

South Worcestershire Councils Water Cycle Study – Phase 1 Scoping Study

Final Report

August 2019

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South Worcestershire Councils

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Revision History

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Contract

This report describes work commissioned by the South Worcestershire Councils (Wychavon District Council, Malvern Hills District Council and Worcester City Council), by an email dated 12th October 2018 from Wychavon District Council. Lucy Finch and Richard Pardoe of JBA Consulting carried out this work.

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Purpose

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Executive summary

In October 2018, JBA Consulting was commissioned by the South Worcestershire Councils (SWCs) to undertake a Water Cycle Study (WCS) to inform the SWCs Development Plan Review and Preferred Options. This study assesses the potential issues relating to future development within South Worcestershire and the impacts on water supply, wastewater collection and wastewater treatment. The Water Cycle Study is required to assess the constraints and requirements on the water infrastructure that will arise from potential growth.

New homes require the provision of clean water, safe disposal of wastewater and protection from flooding. The allocation of large numbers of new homes 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 housing demand, future climate change presents further challenges to pressures on 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: Environment Agency – Water Cycle Study Guidance

This study will assist the SWCs to select and develop sustainable development allocations where there is minimal impact on the environment, water quality, water resources, infrastructure and flood risk. This has been achieved by identifying areas where there may be conflict between any proposed development, the requirements of the environment and by recommending potential solutions to these conflicts.

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

Potential development sites were provided by the SWCs and wastewater treatment works (WwTW) likely to serve growth in the area were identified using the Environment Agency Consents database and Severn Trent data. Each development site/growth scenario 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 and used to

assess the requirements for further study in Phase 2. Where further study is required, a proposed methodology is provided.

The South Worcestershire Issues and Options Consultation defined five options for spatial growth:

Option A – Rail station focussed development

Option B – Continuation of the adopted SWDP Development Strategy (locate new development throughout SW on the periphery of the city, towns and villages linking to the existing network).

Option C – Increasing densities through regeneration – locate growth in existing areas through intensification and regeneration.

Option D – Large urban extensions

Option E – New/expanded settlement/site

The objective of the study is to provide evidence to guide development towards the most sustainable option or combination of options.

It should be remembered that where a development or growth option is scored 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

South Worcestershire is covered by the Strategic Grid Water Resource Zone (WRZ). Growth accounted for within STW's Water Resource Management Plan is broadly in line with the Ministry of Housing Communities and Local Government (MHCLG) household projections for South Worcestershire and in line with the Objectively Assessed Need for South Worcestershire.

The WRMP shows a supply-demand deficit from 2024 if no action is taken, however it goes on to define a number of actions that will address this. Severn Trent Water confirmed that they would have adequate water resources for all the proposed development sites.

Although STW have not relied on new homes being more water-efficient than existing metered homes, the opportunity exists through the planning system to ensure that new homes meet the higher standard of domestic water usage in line with the general principles of sustainable development and supported by the location of the study area in a region of moderate water stress.

On the basis that there is a 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 is recommended as part of a Phase 2 Outline study.

Water supply infrastructure

Severn Trent Water responded to the request for an assessment of water supply infrastructure within South Worcestershire. STW stated that the WRMP considers supply and demand issues for the next 25 years. As development within South Worcestershire occurs, it will be necessary to undertake detailed modelling of the water supply infrastructure to allow for appropriate infrastructure upgrades and local reinforcements. STW does not expect water supply to be a constraint to development within South Worcestershire.

No further analysis of water supply infrastructure is recommended as part of a Phase 2 Outline study.

Wastewater collection infrastructure

STW provide wastewater services to the whole of South Worcestershire. Sewerage Undertakers have a duty under Section 94 of the Water Industry Act 1991 to provide sewerage 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. Early developer engagement with STW is therefore essential to ensure that sewerage capacity can be provided without delaying development.

STW provided a red/amber/green assessment of the sewer network in each scenario, which represent the relative difficulty of providing wastewater infrastructure. Significant infrastructure would be required to serve growth in Option A (rail station) and Option E (new/expanded settlements). Growth on the periphery of existing settlements either as smaller sites (Option B) or large urban extensions (Option D) can accommodate some of the required growth with minimal additional infrastructure depending on location and the capacity of the existing network. Infill development (Option C) requires the least investment in infrastructure.

No single growth option can provide the number of houses required to meet SWC's Objectively Assessed Need (OAN) without additional infrastructure being required. It is therefore likely that a combination of scenarios will be required. Severn Trent Water's preference is for growth to be focused in larger settlements as it is usually more efficient to provide one large infrastructure scheme that several smaller schemes.

If larger developments or clusters of developments such as Option A or Option E were to be adopted, early engagement with STW is recommended to allow time for the strategic infrastructure required to serve these developments to be planned.

Further study of the wastewater network is recommended as part of a Phase 2 study as the SWDP develops and the SWCs have greater certainty over which sites will be brought forward for development.

Wastewater treatment capacity

STW provided assessments of the WwTW serving growth in each scenario based on both hydraulic capacity and headroom in the environmental permit. JBA carried out a flow permit assessment in parallel to this.

The results suggest that of the five growth options, C and D (infill, and large urban extensions) are the easiest to accommodate with the minimal additional infrastructure. Option A and option E concentrate growth in areas where capacity is limited, and so upgrades would be required at WwTW serving that growth. Option B, development on the periphery of existing settlements, distributes growth between 35 WwTW. Where capacity exists at a particular WwTW then growth could be accommodated, however where it is limited and upgrades are required, it may be more efficient to focus growth in fewer locations, and for STW to carry out strategic upgrades to serve a greater number of development sites.

Once the SWCs have confirmed which sites will be developed, and STW have modelled the additional demand, where capacity is not currently available, STW will complete necessary improvements to provide the capacity. They will ensure that their assets have no adverse effect on the environment and that appropriate levels of treatment are provided at each of their sewage treatment works.

Further study of the wastewater treatment capacity is recommended as part of a Phase 2 Outline study as the SWDP develops and the SWCs have greater certainty over which sites will be brought forward for development.

Odour

20 sites are close enough to a WwTW that an odour assessment is recommended as part of the planning process. The cost of this should be met by the developer.

No further assessment of odour is recommended in a Phase 2 WCS. Any future assessment should be carried out as part of the planning process.

Water quality

In general terms Options D and E (large urban extensions and new/expanded settlements) will concentrate growth at just a few WwTW so the increase in effluent flow, and its potential impact could be large. Option B (growth on the periphery of existing settlements) distributes growth across the study area, using many treatment works. This may allow the impact on water quality to be distributed, reducing the likelihood of WFD deterioration, however the total effluent load in the study area would be the same, and upgrading multiple WwTW to prevent deterioration would not be as cost effective as providing a strategic upgrade to a limited number of WwTW.

Water quality modelling, using a catchment-wide approach is required in order to understand the current capacity of the water environment and the impact of each of the five growth options.

Flood risk from additional foul flow

A detailed assessment of flood risk can be found in the South Worcestershire Councils Level 1 Strategic Flood Risk Assessment (SFRA). The impact of increased discharges of treated wastewater effluent flows due to planned growth was quantified and is not predicted to have a significant impact on flood risk in any of the receiving watercourses.

No further assessment is recommended in a Phase 2 WCS.

Environmental constraints

A number of SSSIs exist within South Worcestershire, and there is a possibility of point source pollution (from WwTW) or diffuse pollution (for example from surface runoff from development) to impact these sites. Opportunities exist to mitigate this through implementation of SuDS schemes to manage surface runoff.

The impact of WwTW on water quality should be assessed in a Phase 2 Study.

Overall conclusions

This study indicates that while a certain level of growth can be accommodated with minimal additional infrastructure, significant new infrastructure and upgrades to existing network and wastewater treatment works will be required to accommodate South Worcestershire's OAN. A combination of the five spatial growth options is therefore likely to be required.

It is recommended that water quality modelling is carried out in a Phase 2 Outline study to assess the cumulative impact of growth across the whole study area on the Water Framework Directive classification of the receiving waterbodies in order to ensure that the environmental capacity of the catchment is not a constraint to growth.

Further study of the wastewater network is also recommended once greater certainty over which sites will be brought forward for development.

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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
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
MI/d	Mega (Million) litres per day
MHCLG	Ministry of Housing Communities and Local Government
NH4	Ammonia
NPPF	National Planning Policy Framework
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
RZ	Resource Zone
SA	Sustainability Appraisals
SAC	Special Area of Conservation
SBP	Strategic Business Plan
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
SWDP	South Worcestershire Development Plan
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
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 the SWCs to undertake a Water Cycle Study (WCS) for South Worcestershire. The purpose of the WCS is to form part of a comprehensive and robust evidence base to inform the preparation of the Development Plan Review and Preferred Options, which will set out a vision and framework for development in the area up to 2041 and will be used to inform decisions on the location of future development.

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

Planning Practice Guidance on Water Supply, Wastewater and Water Quality¹ describes a water cycle study as:

"a voluntary study that helps organisations work together to plan for sustainable growth. It uses water and planning evidence and the expertise of partners to understand environmental and infrastructure capacity. It can identify joined up and cost-effective solutions, that are resilient to climate change for the lifetime of the development."

The study provides evidence for Local Plans and sustainability appraisals and is ideally done at an early stage of plan-making. Local authorities (or groups of local authorities) usually lead water cycle studies, as a chief aim is to provide evidence for sound Local Plans, but other partners often include the Environment Agency and water companies."

The Environment Agency's guidance on WCS² recommends a phased approach:

- Phase 1: Scoping study, focussing on formation of a steering group, identifying issues for consideration and the need for an outline study.
- Phase 2: Outline study, to identify environmental constraints, infrastructure constraints, a sustainability assessment and consideration of whether a detailed study is required.
- Phase 3: Detailed study, to identify infrastructure requirements, when they are required, how they will be funded and implemented and an overall assessment of the sustainability of proposed infrastructure.

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.

1 Planning Practice Guidance: Water supply, wastewater and water quality, Department for Communities and Local Government (2014). Accessed online at: <http://planningguidance.planningportal.gov.uk/blog/guidance/> on: 17/01/2019

2 Water Cycle Study Guidance, Environment Agency (2009). Accessed online at: <http://webarchive.nationalarchives.gov.uk/20140328084622/http://cdn.environment-agency.gov.uk/geho0109bpff-e-e.pdf> on: 17/01/2019

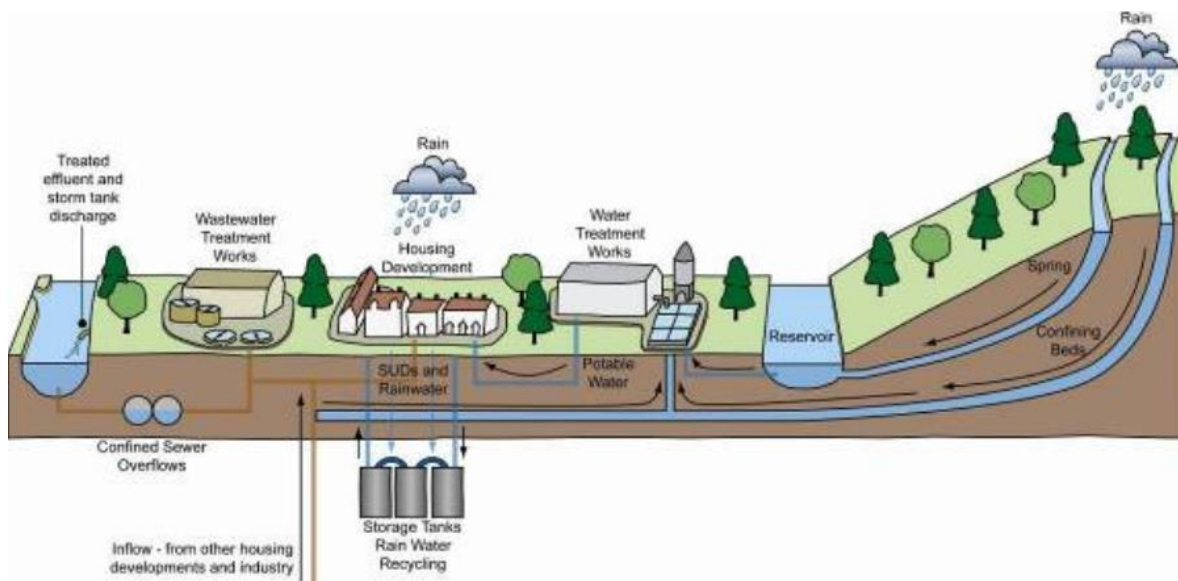


Figure 1.1 The Water Cycle

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 Objectives

As a WCS is not a statutory instrument, Local Planning Authorities are advised to prioritise the different stages of the WCS to integrate with their Local Plan programme. This scoping report is written to support the development of the South Worcestershire Development Plan Review and to identify whether an outline/detailed WCS is required.

The WCS brief from the SWCs stated that the overall objective of the WCS is to understand the environmental and physical constraints of development and identify opportunities for more sustainable planning and improvements that may be required to achieve the required level of development. This should be assessed by considering the following issues:

- Water supply;
- Wastewater and treatment;
- Water quality and the environment;
- Consideration of leachate;
- Demand management; and
- Flood risk.

1.5 Study Area

The SWCs are made up of Malvern Hills District in the west, Wychavon District in the east and Worcester City in the centre. South Worcestershire covers an area of approximately 1,300km² and has a population of approximately 304,800 (2014 mid-year

population estimates). The main urban areas in South Worcestershire are Worcester, Pershore, Evesham, Droitwich Spa, Malvern, Tenbury Wells and Upton upon Severn.

South Worcestershire is located within the River Severn catchment, and contains the River Avon and the River Teme; significant tributaries to the Severn.

Water supply and wastewater services are provided by Severn Trent Water.

1.6 Record of Engagement

1.6.1 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 where there may be cross-boundary issues, with neighbouring local authorities. This section forms a record of engagement for the WCS.

1.6.2 Scoping Study Engagement

The preparation of this WCS was supported by the following engagement:

Inception meeting

Engaged Parties	SWCs Severn Trent Water Environment Agency
Details	Scope of works and data collection requirements reviewed.

Neighbouring authorities

Engaged Parties	Forest of Dean District Council Cotswold District Council Tewkesbury Borough Council Stratford on Avon District Council Wyre Forest District Council Bromsgrove District Council Redditch Borough Council Herefordshire Council Shropshire Council
Details	Request for water cycle studies conducted in their area, and housing growth that would be served by WwTW within or shared with the SWCs. From available mapping and data from STW, it is not thought that there is any shared wastewater infrastructure across the boundary with Shropshire, so they were not contacted for information.

Collaboration with Water Companies

Engaged Parties	Severn Trent Water
Details	Water company assessments of water and wastewater infrastructure and capacity constraints.

2 Future Growth in South Worcestershire

2.1 Development sites in South Worcestershire

Figure 2.1 shows the location of development sites (SHELAA sites) under consideration within South Worcestershire.

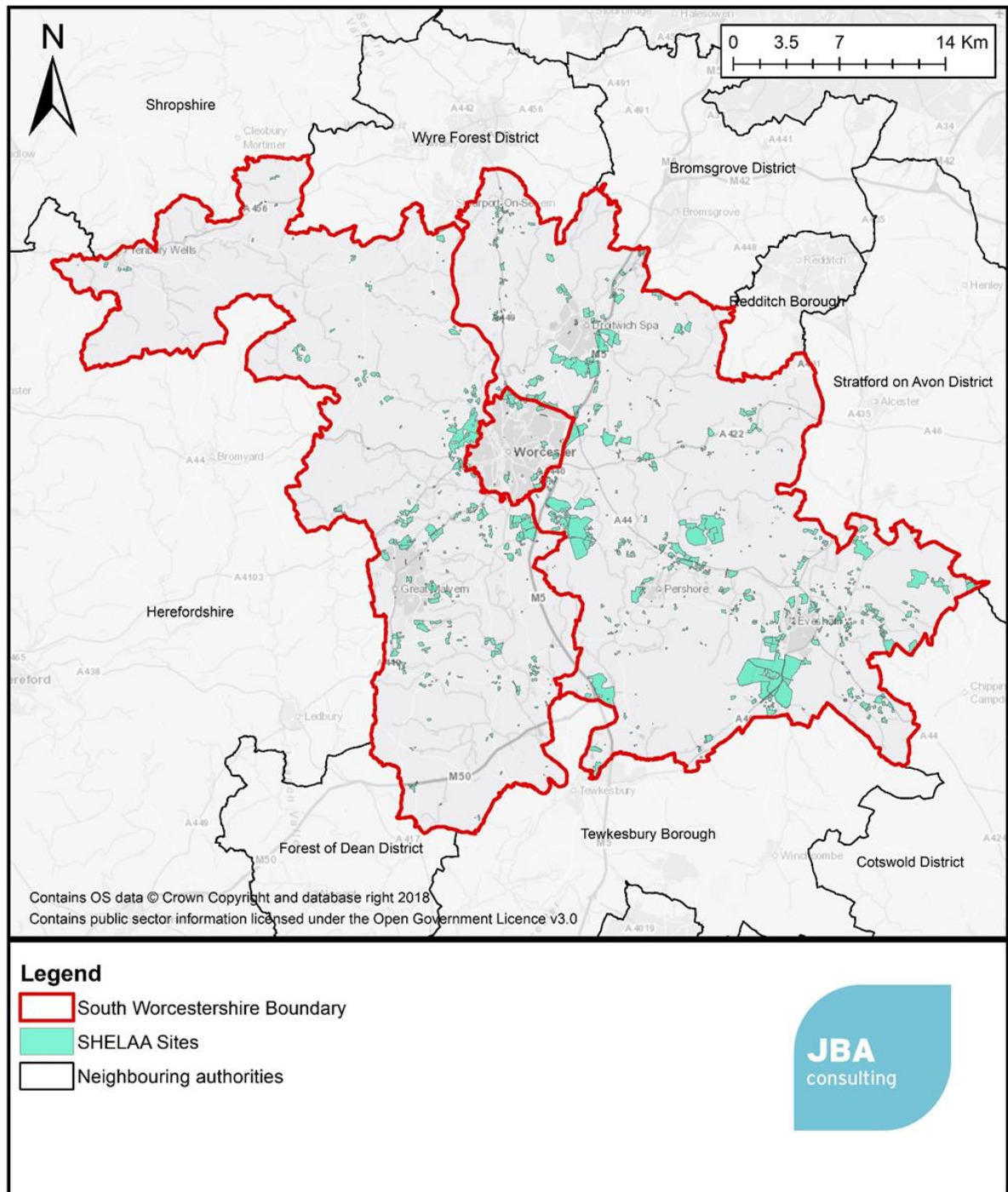


Figure 2.1 Map of the water cycle study area

2.2 Growth in South Worcestershire

The South Worcestershire Development Plan (SWDP) is currently under review and is expected to be published in 2021. The review will provide an updated plan period to the year 2041.

It is anticipated that the SWDP needs to make provision for approximately 14,000 dwellings for the period up to 2041 (Table 2-1).

Table 2-1 Calculation of SWC's Objectively Assessed Need (OAN)

SWDP Housing Requirement 2016-2021 (a)	Annual Requirement (standard methodology) (b)	Local Housing Need 2021-2041 (c)	Housing Need 2016-2021 (a+c)	Completions, Commitments and Undeveloped Allocations (d)	Net Housing Need (a+c - d)
5,913	1,232	24,640	30,553	16,555	13,998

The OAN for employment land is set out in Table 2-2 and shows a deficit of 163 ha across the South Worcestershire area.

Table 2-2 OAN for employment land

Area	Available supply (ha)	Land Demand 2018-2041 (ha)	Surplus/Deficit (ha)
Malvern Hills	44.6	31.6	13
Worcester	19.8	32.1	-12.3
Wychavon	67.5	231.1	-163.6
South Worcestershire	131.9	294.8	-162.9

2.3 South Worcestershire Issues and Options Consultation

The South Worcestershire Issues and Options consultation³ defines five options for spatial growth:

Option (A) - Rail station focussed development

Option (B) - Continuation of the adopted SWDP Development strategy (locate new development throughout SW on the periphery of the city, towns and villages linking to the existing network).

Option (C) - Increasing densities through regeneration - locate growth in existing areas through intensification and regeneration.

Option (D) - Large urban extension

Option (E) - New/expanded settlement/site

The water cycle study will assess the sustainability of each option from the perspective of water resources, the water and wastewater infrastructure, and the capacity of the water environment. Where development trajectory is unknown, it will be assumed to be spread evenly across the Local Plan period.

The objective of this study is to provide evidence to guide development towards the most sustainable option or combination of options.

³ Issues and Options Consultation, South Worcestershire Councils (2018). Accessed online at: <http://www.swdevelopmentplan.org/wp-content/uploads/2018/11/SWDPR-IO-Nov18-RFS.pdf> on: 22/11/2018

2.4 Option A – Rail station focussed development

2.4.1 Definition

The county of Worcestershire is crossed by two nationally important rail lines, the North Cotswold (London Paddington to Worcester, Great Malvern and Hereford) and the Bristol to Birmingham line. Local services operate to Birmingham along the Kidderminster, Bromsgrove and Redditch routes.

This option would see all significant new development located within two miles of an existing, enhanced or proposed rail station. There are nine stations within the study area, and one new station due to open in 2019 (Worcestershire Parkway).

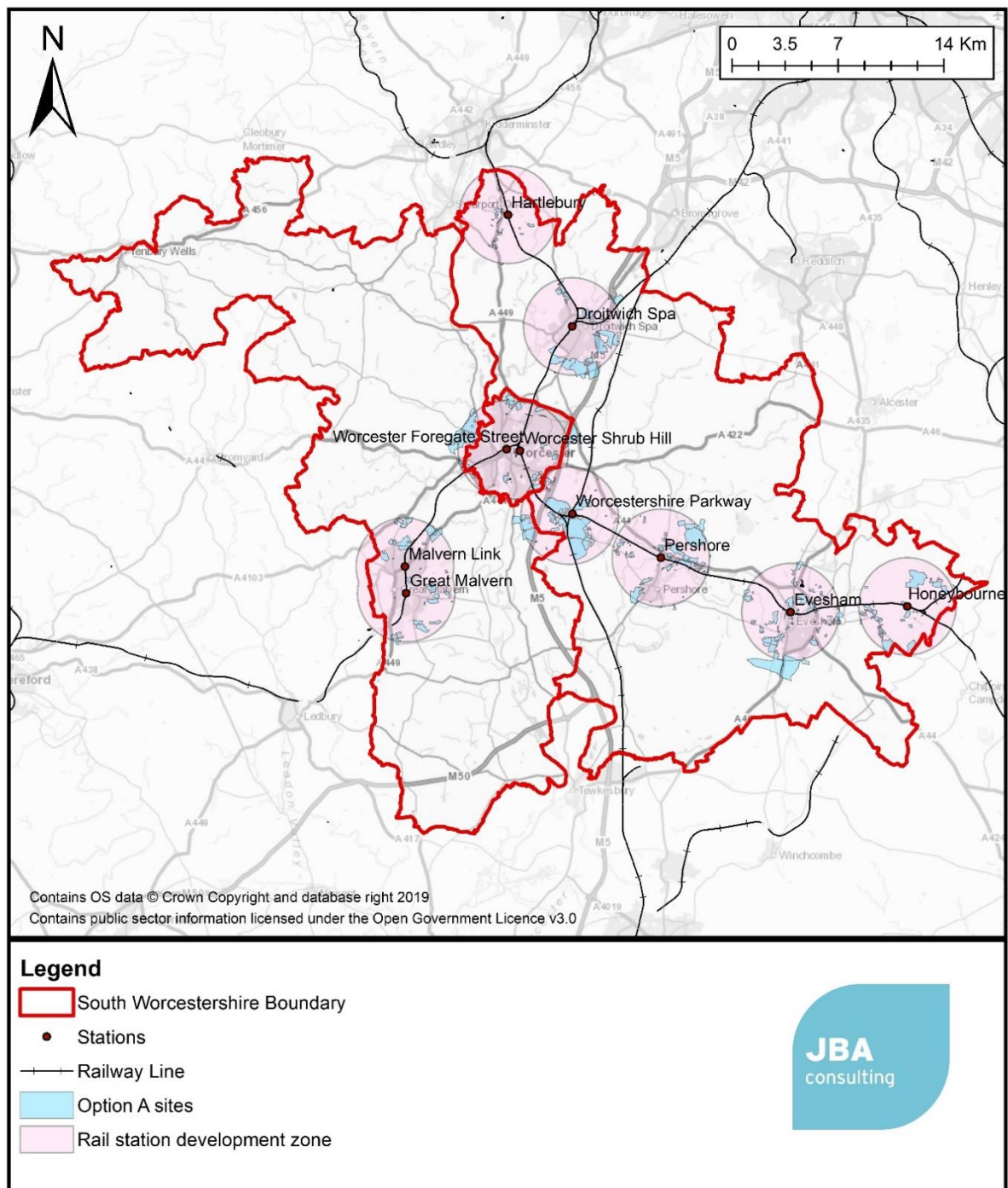


Figure 2.2 Option A – Rail station focussed development

2.4.2 Methodology

- A two-mile buffer was placed around these stations and form "rail station development zones". Where there are overlapping zones, for example in Malvern and in Worcester, they will be combined.

The sum of the areas of each development site within each rail station development zone was compared with the total area of all the development sites within all zones, and a proportion of the OAN allocated to each rail station development zone accordingly. This is shown in

- Table 2-3.
- The employment land need (162.9 ha) was allocated in the same manner.
- Severn Trent Water were asked for the following information:
 - Comments on how each station zone will be supplied with clean water,
 - Any known network constraints,
 - RAG assessment for each zone,
 - An overall assessment of the viability of supplying water to development centred around rail stations,
 - Allocation of each zone to a WwTW,
 - Comments on how each zone will be served with wastewater,
 - RAG assessment for each zone,
 - An overall assessment of the viability of providing wastewater services to development centred around rail stations.

Table 2-3 Growth forecast by rail station

Rail station development zone	WwTW	Housing units in scenario	Employment Land in scenario (m ²)
Droitwich	Droitwich	2,238	156,258
Evesham	Evesham	2,600	181,499
Hartlebury	Kidderminster	196	13,695
Honeybourne	Blackminster	1,218	58,056
Malvern	Malvern	1,398	97,647
Pershore	Pershore	1,622	113,205
Worcester	Worcester	2,147	149,901
Worcestershire Parkway	Worcester	2,581	180,165
Total		14,000	977,400

2.4.3 Windfall

Windfall sites are sites that have not been specifically identified in the Local Plan. They normally comprise previously developed sites that have unexpectedly become available. Windfall estimates provided by the SWCs were 363 sites for the period 2018 to 2023. This windfall allowance was extrapolated over the local plan period (2018 to 2041) and proportions allocated to WwTWs based on the distribution of growth from the allocations in Option A as shown in Table 2-4, on the assumption that windfall is more likely in areas which are already growing more quickly.

Table 2-4 Option A - allocation of windfall by WwTW

WwTW	Housing units per year
Blackminster	6
Droitwich	11
Evesham	14
Kidderminster	1
Malvern	7
Pershore	8
Worcester	25

2.5 Option B – Continuation of the adopted SWDP Development Strategy

2.5.1 Definition

The current strategy set out in the adopted SWDP is to locate new development on the periphery of the city and on the edge of the larger (category 1-3) towns and villages. Growth in this strategy therefore includes all sites within 0.5km of existing urban areas Figure 2.3.

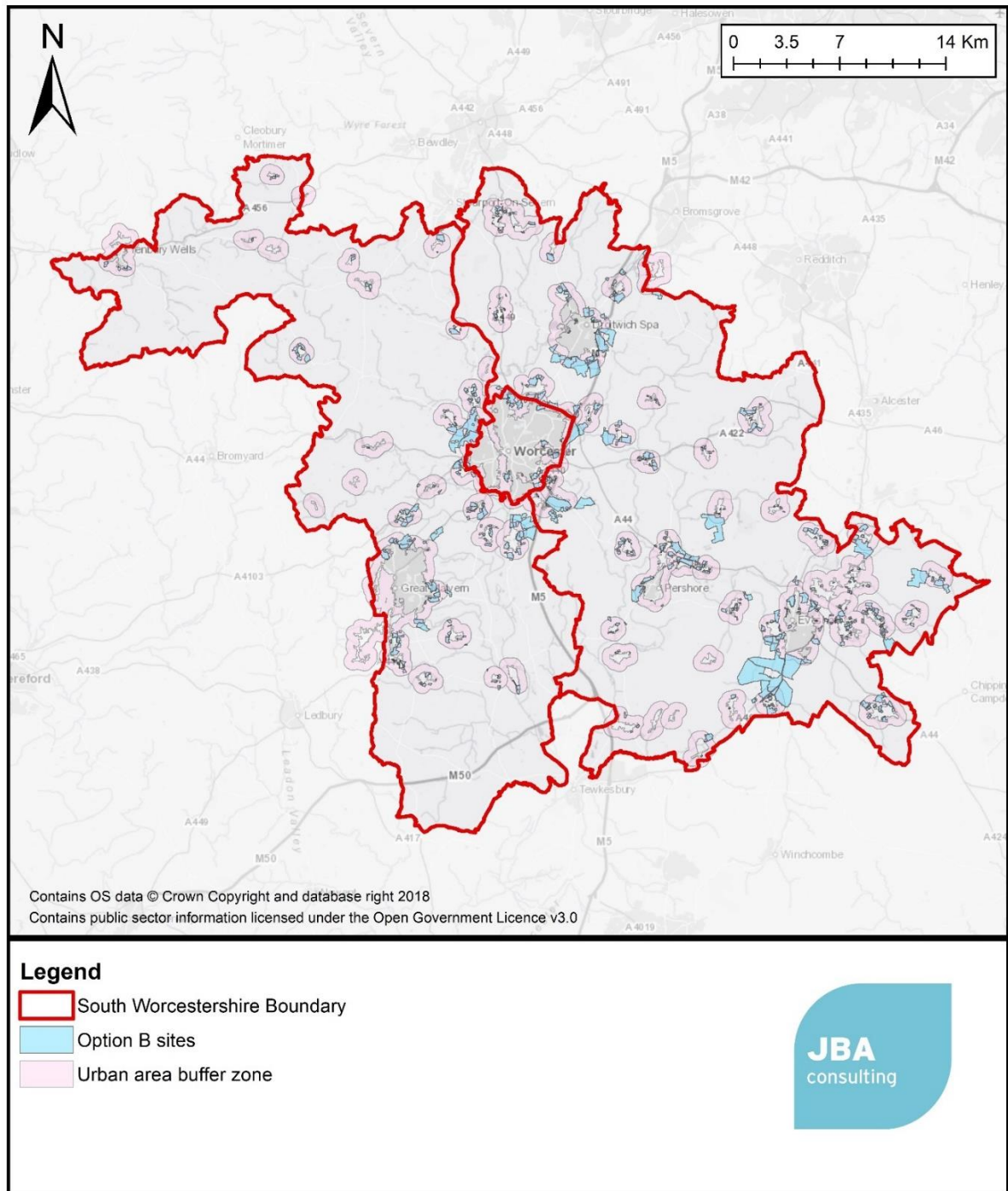


Figure 2.3 Option B – Continuation of the adopted SWDP development strategy

2.5.2 Methodology

- The SWCs provided the settlement hierarchy which was used to decide which settlements growth would be focused at in this scenario.
- Cities, towns, and category 1, 2 and 3 villages were included in this scenario. Where villages were included in the hierarchy but were not part of the "built up area" layer, a polygon representing the settlement was drawn in ArcMap.
- The "built-up area" layer (Office of National Statistics - Builtup_Areas_December_2011_Boundaries_v2) was used to define existing boundary of settlements.
- A buffer at the appropriate distance was then used to define the "periphery" of settlements.
- All sites that lay within this buffer were then assumed to be developed.
- The capacity of sites within this layer will be calculated using a housing density of 30 dwellings/hectare and a developable area of 60%⁴.
- Employment land was not considered in this scenario as considering each site as 100% residential produces a higher water demand and is therefore the "worst case".
- This total number of houses in this scenario far exceeds the OAN for the study area. It is noted that not every settlement would be adopted, and not all sites within a settlement would come forward. The growth forecast therefore represents a "worst case" scenario for each settlement.
- Severn Trent Water were asked for the following information:
 - Comments on how each settlement will be supplied with clean water,
 - Any known network constraints,
 - RAG assessment for each settlement and guidance on which settlements would be preferred,
 - An overall assessment of the viability of supplying water to development centred around existing settlements,
 - Advice on which WwTW(s) would serve each settlement,
 - Comments on network and WwTW capacity for each settlement,
 - RAG assessment for each settlement,
 - An overall assessment of the viability of providing wastewater services to development centred around existing settlements.

Table 2-5 Growth on the periphery of each settlement

Settlement	Housing units in scenario	Settlement	Housing units in scenario
Abberley Common	135	Hanley Swan BUA	492
Ashton under Hill BUA	127	Hartlebury BUA	771
Astley	462	Harvington BUA	637
Badsey BUA	1,273	Himbleton	104

⁴ SWDP 5 assumes 40% of the site is allocated to "green infrastructure". This leaves developable area of 60% which assumes the density figure already allows for roads and footways. SuDS schemes play areas etc are absorbed within the GI figure.

Settlement	Housing units in scenario	Settlement	Housing units in scenario
Bayton	128	Holt Heath	348
Beckford	442	Honeybourne BUA	466
Bishampton BUA	2,674	Inkberrow BUA	1,137
Bransford	106	Kempsey BUA	4,366
Bredon BUA	136	Leigh Sinton BUA	1,196
Bretforton BUA	2,372	Lindridge BUA	33
Broadwas BUA	22	Lower Broadheath BUA	2,136
Broadway BUA	1,590	Lower Moor BUA	337
Callow End BUA	523	Offenham/South Littleton BUA	690
Church Lench BUA	68	Ombersley BUA	308
Cleeve Prior BUA	2,183	Pebworth BUA	2,572
Clifton upon Teme BUA	761	Pershore BUA	1,975
Crothorne BUA	621	Powick	1,011
Crowle (Wychavon) BUA	2,526	Sedgeberrow BUA	11,418
Cutnall Green BUA	327	Stoke Prior BUA	624
Defford BUA	224	Tenbury Wells BUA	349
Drakes Broughton BUA	806	Tibberton (Wychavon) BUA	1,294
Droitwich BUA	11,250	Tunnel Hill	142
Eckington BUA	61	Upton Snodsbury BUA	881
Evesham BUA	12,336	Upton upon Severn BUA	382
Fernhill Heath BUA	2,672	Welland BUA	263
Flyford Flavell BUA	123	Whittington	1,315
Great Malvern BUA	7,099	Worcester BUA	9,154
Great Witley BUA	261	Wychbold BUA	978
Hallow BUA	4,068	Wyre Piddle BUA	2,302
		Total	103,056

2.5.3 Windfall

Windfall sites are sites that have not been specifically identified in the Local Plan. They normally comprise previously developed sites that have unexpectedly become available. Windfall estimates provided by the SWCs were 363 sites for the period 2018 to 2023. This windfall allowance was extrapolated over the local plan period (2018 to 2041) and proportions allocated to WwTWs based on the distribution of growth from the allocations in Option B as shown in Table 2-6.

Table 2-6 Option B - allocation of windfall by WwTW

WwTW	Total housing units over Local Plan period	WwTW	Total housing units over Local Plan period
Ashton under Hill	2	Honeybourne	8
Beckford	7	Inkberrow	18
Bidford on Avon	35	Kempsey	71
Blackminster	70	Kidderminster	20
Bredon	2	Malvern	115
Broadway	26	Ombersley	5
Church Lench	1	Pershore	131
Clifton upon Teme	12	Powick	46
Crothorne Heath	10	Quay Lane	8
Crowle Worcester	41	Stoke Prior	10
Defford Village	4	Stratford Milcote	42
Droitwich	188	Tenbury	6
Eckington	1	Upton upon Severn	9
Evesham	386	Upton Snodsbury	14
Flyford Flavell	2	Welland	4
Great Whitley	6	Worcester	336
Harvington	10	Wychbold	16
Holt Heath	6		

2.6 Option C – Increasing densities through regeneration

2.6.1 Definition

This scenario includes growth within existing settlements through in-fill and urban regeneration. The total number of dwellings could be limited in this scenario and unlikely to meet the OAN.

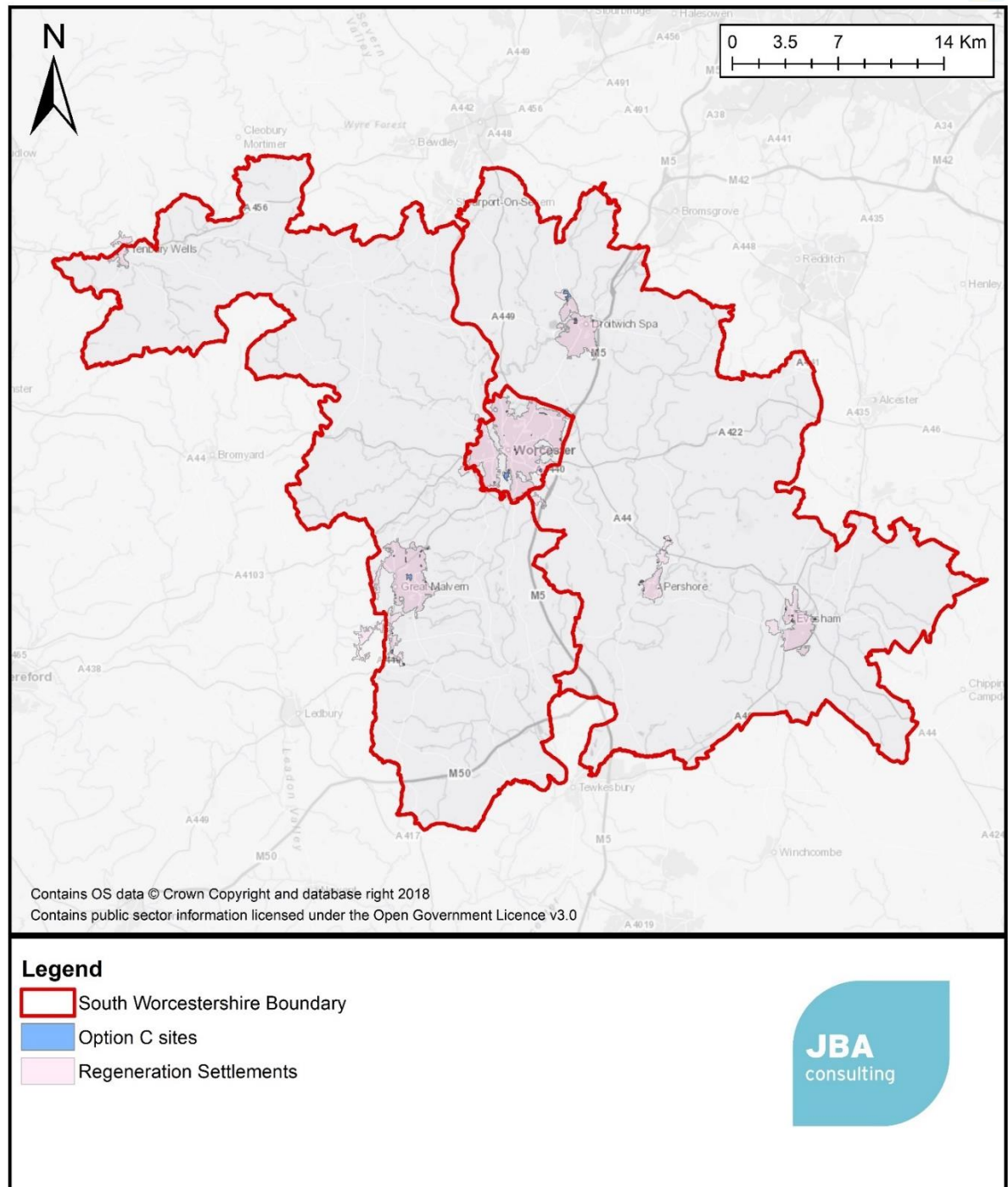


Figure 2.4 Option C – Increasing densities through regeneration

2.7 Methodology

- Development sites that fell within the existing urban extent of the six largest towns were included in this scenario.
- A developable area of 60% of the gross site area was used, and a housing density of 40 houses/hectare was applied.
- Severn Trent Water supplied information on sewer flooding which was used to infer where there is limited capacity in the existing wastewater network.
- Severn Trent Water were asked for the following information:
 - Comments on how each settlement will be supplied with clean water,
 - Any known network constraints,
 - RAG assessment for each settlement and guidance on which settlements would be preferred,
 - An overall assessment of the viability of supplying water to development based on increasing densities through regeneration,
 - Advice on which WwTW(s) would serve each settlement,
 - Comments on network and WwTW capacity for each settlement,
 - RAG assessment for each settlement,
 - An overall assessment of the viability of providing wastewater services to development based on increasing densities through regeneration.

Table 2-7 Regeneration growth

Settlement	Housing units in scenario
Droitwich	433
Evesham	96
Malvern	450
Pershore	96
Tenbury	12
Worcester	700
Total	1,787

2.7.1 Windfall

Windfall sites are sites that have not been specifically identified in the Local Plan. They normally comprise previously developed sites that have unexpectedly become available. Windfall estimates provided by the SWCs were 363 sites for the period 2018 to 2023. This windfall allowance was extrapolated over the local plan period (2018 to 2041) and proportions allocated to WwTWs based on the distribution of growth from the potential site in Option C as shown in Table 2-8.

Table 2-8 Option C - allocation of windfall by WwTW

WwTW	Housing units per year	Total housing units over Local Plan period
Droitwich	18	404
Evesham	4	90
Malvern	18	421
Pershore	4	90
Tenbury	1	11
Worcester	28	654

2.8 Option D – Large urban extensions

2.8.1 Definition

Three large urban extensions have been submitted by landowners:

- West of Worcester
- South of Droitwich
- North of Great Malvern

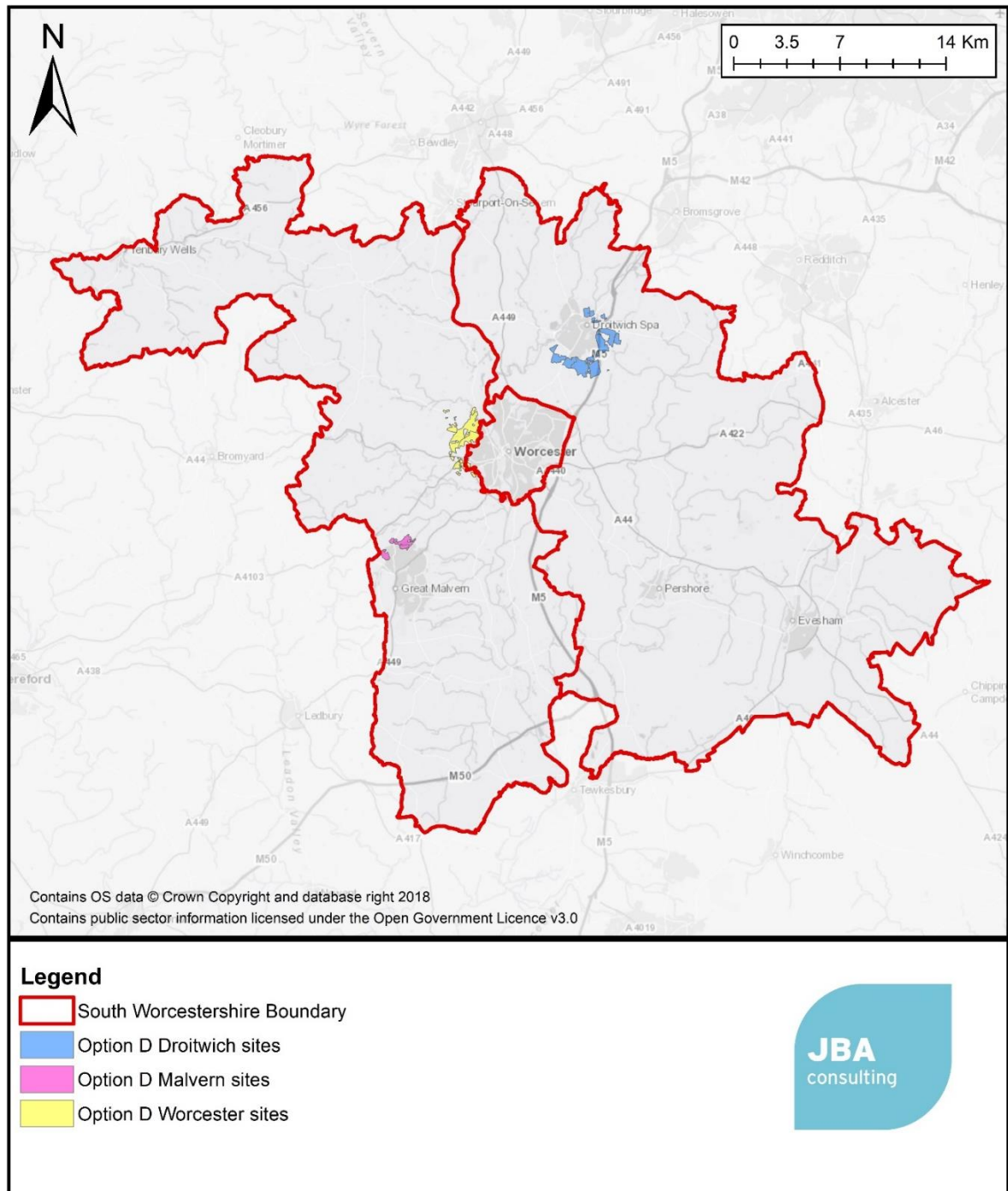


Figure 2.5 Option D – Large urban extensions

2.8.2 Methodology

- An indicative boundary for the three urban extensions was defined, and any sites that fell within this boundary were included in the scenario.
- A developable area of 60% was used with a housing density of 40 houses/hectare.
- Employment land was not considered in this scenario as considering each site as residential produces a higher water demand and is therefore the “worst case”.
- The total number of houses in this scenario exceeds the OAN for the study area. However, it is recognised that not every urban extension may be used, and not every site adopted. The housing units in Table 2-9 represent the maximum water demand for each urban extension.
- Severn Trent Water were asked for the following information:
 - Comments on how each urban extension will be supplied with clean water,
 - Any known network constraints,
 - RAG assessment for each settlement and guidance on which settlements would be preferred,
 - An overall assessment of the viability of supplying water to development based on increasing densities through regeneration,
 - Advice on which WwTW(s) would serve each urban extension,
 - Comments on network and WwTW capacity for each urban extension,
 - RAG assessment for each urban extension,
 - An overall assessment of the viability of providing wastewater services to development based on urban extensions.

Table 2-9 Housing capacity in urban extensions

Settlement	Housing units in scenario
South of Droitwich	13,718
North of Great Malvern	3,861
West of Worcester	9,110
Total	26,689

2.8.3 Windfall

Windfall sites are sites that have not been specifically identified in the Local Plan. They normally comprise previously developed sites that have unexpectedly become available. Windfall estimates provided by the SWCs were 363 sites for the period 2018 to 2023. This windfall allowance was extrapolated over the local plan period (2018 to 2041) and proportions allocated to WwTWs based on the distribution of growth from the potential sites in Option D as shown in Table 2-10.

Table 2-10 Option D - allocation of windfall by WwTW

WwTW	Housing units per year	Total housing units over Local Plan period
Droitwich	39	887
Malvern	10	233
Worcester	24	550

2.9 Option E – New/expanded settlement/site

2.9.1 Definition

Three large areas of land that could potentially provide new/extended settlements have been submitted by landowners:

- Rushwick
- Worcestershire Parkway
- Throckmorton

Each of these settlements is likely to require a minimum of 5,000 units to ensure sustainability. Maps showing their potential location were provided by the SWCs.

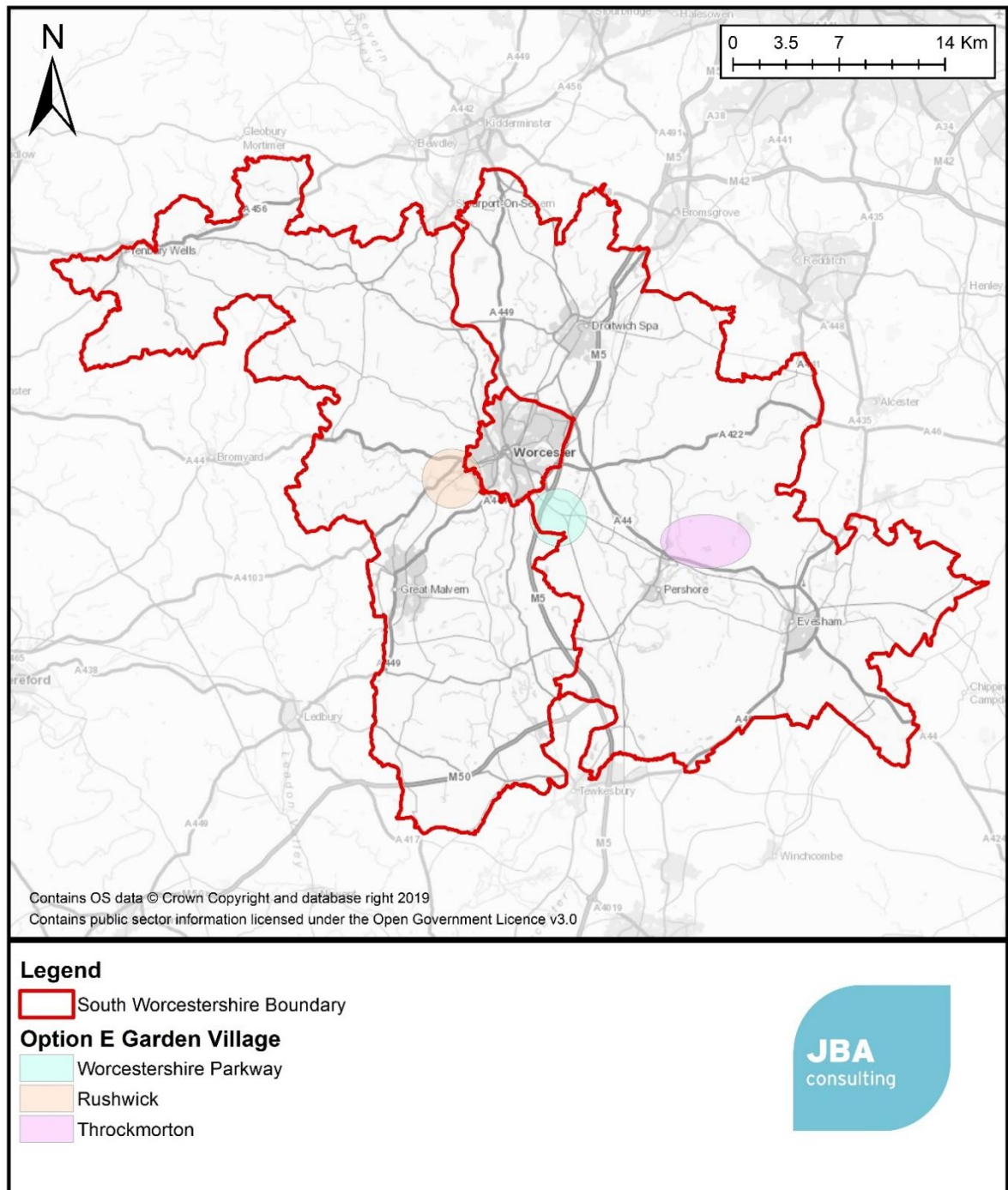


Figure 2.6 Option E – New/expanded settlement/site

2.9.2 Methodology

- An assumption of 5,000 homes and 2,000 employees will be used in each of the new settlement locations in order to calculate the water demand.
- Severn Trent Water were asked for the following information:
 - Comments on how each urban extension will be supplied with clean water,
 - Any known network constraints,
 - RAG assessment for each settlement and guidance on which settlements would be preferred,
 - An overall assessment of the viability of supplying water to development based on increasing densities through regeneration,
 - Advice on which WwTW(s) would serve each urban extension,
 - Comments on network and WwTW capacity for each urban extension,
 - RAG assessment for each urban extension,
 - An overall assessment of the viability of providing wastewater services to development based on urban extensions.

Table 2-11 Housing and employment by new/expanded settlement/site

Settlement	Housing units in scenario	Net number of employees
Rushwick	5,000	2,000
Throckmorton	5,000	2,000
Worcestershire Parkway	5,000	2,000
Total	15,000	6,000

2.9.3 Windfall

Windfall sites are sites that have not been specifically identified in the Local Plan. They normally comprise previously developed sites that have unexpectedly become available. Windfall estimates provided by the SWCs were 363 sites for the period 2018 to 2023. This windfall allowance was extrapolated over the local plan period (2018 to 2041) and proportions allocated to WwTWs based on the distribution of growth from the allocations in Option E as shown in Table 2-12.

Table 2-12 Option E - allocation of windfall by WwTW

WwTW	Housing units per year	Total housing units over Local Plan period
Pershore	24	557
Worcester	48	1113

2.10 Growth outside South Worcestershire

Where growth within a neighbouring Local Planning Authority (LPA) area may be served by infrastructure within or shared with South Worcestershire, the LPA were contacted as part of a duty to cooperate request to provide information on:

- Any Water Cycle Study completed in the authority's area.
- The latest growth forecast (housing and employment) for the district.
- Details of future growth within the catchments of WwTW which serve part of their council area and South Worcestershire.

2.10.1 Shropshire Council

Shropshire Council completed a Water Cycle Study in 2014⁵ as part of their Site Allocations and Management of Development Plan. At the time of writing this WCS, Shropshire Council are undertaking a Local Plan review and will be commissioning a new WCS to support this. Table 2-12 summarises planned growth in Shropshire for the period 2016-2036 and Table 2-14 summarises the planned growth in Burford which is served by Tenbury WwTW, located in South Worcestershire.

Table 2-13 Growth in Shropshire

Housing (units)			Employment (ha)		
Expected housing growth 2016-2036	Committed	Net requirement	Expected employment growth 2016-2036	Committed	Net requirement
28,750	18,500	10,250	300	223	77

Table 2-14 Summary of growth in Shropshire served by infrastructure within or shared with South Worcestershire

WwTW	Housing (units)				Employment
	Preferred dwelling guideline 2016-2036	Completed in 2016-2017	Committed as of 31st March 2017	Remaining to be allocated and/or windfall allowance	Committed or Allocated (reg. 18 or reg. 19)
Tenbury (WRW) – serving Burford	100	1	3	96	0*

**No employment land is proposed for allocation in Burford, however Local Plan policies will allow flexibility for appropriate employment uses to be delivered*

2.10.2 Tewkesbury Borough Council

Growth information was not provided by Tewkesbury Borough Council; however, the Local Plan was consulted, and the Council are at preferred options stage with sites being well defined. There were no sites located around the village of Snowhill, which would be served by Broadway WwTW which could also serve growth in South Worcestershire.

⁵ Water cycle evidence for Shropshire Local Plan, Halcrow Group Ltd, Shropshire Council (2014). Accessed online at: <https://www.shropshire.gov.uk/media/8314/ev19b-shropshire-wcs-review-final-report-july-2014.pdf> on: 21/01/2019

2.10.3 Stratford on Avon District Council

Various Water Cycle Studies⁶ were commissioned by Stratford on Avon District Council as part of the evidence base for its Core Strategy (2011-2031). The Core Strategy provides for an additional 14,600 dwellings and 12,100 FTE jobs in the District during the period. Bidford on Avon and Stratford Milcote WwTWs are likely to serve growth within South Worcestershire. Table 2-15 summarises the growth in Stratford on Avon District by Bidford on Avon and Stratford Milcote WwTWs.

Table 2-15 Summary of growth in Stratford on Avon District served by infrastructure within or shared with South Worcestershire

WwTW	Housing (units)		Employment (area or employees)		Notes (e.g. any additional information such as the trajectory, the type of employment space etc).
	Committed	Allocated (reg. 18 or reg. 19)	Committed	Allocated (reg. 18 or reg. 19)	
Bidford on Avon (WRW)	466	0	2,000 m ²	0	Anticipated that most of this development will take place within the next 5 years
Stratford Milcote (WRW)	1,390	1,000	Small-scale commitments that are not monitored	Stratford upon Avon 84,550m ² Atherstone on Stour 50,000m ²	Varying timescales with all planned to be completed by 2031

2.10.4 Wyre Forest District Council

The latest Water Cycle Study for Wyre Forest District Council was produced by JBA Consulting in 2017⁷, and an addendum produced in 2018⁸ to accommodate further sites identified as part of the Local Plan consultation process. Kidderminster Oldington WwTW serves significant parts of South Worcestershire and Wyre Forest District. JBA used the growth data for Wyre Forest that was supplied/calculated during the WCS update and this is summarised in Table 2-16.

6 Water and Flood Risk Technical Evidence, Stratford on Avon District Council. Accessed online at: <https://www.stratford.gov.uk/planning-regeneration/water-and-flood-risk.cfm> on 21/01/2019

7 Wyre Forest District Council Water Cycle Study, JBA Consulting (2017). Accessed online at: <http://www.wyreforestdc.gov.uk/media/2973599/2017-Wyre-Forest-Water-Cycle-Study-v50-with-Appendices-120517-.pdf> on 21/01/2019

8 Wyre Forest District Council Water Cycle Study Addendum, JBA Consulting (2018). Accessed online at: <http://www.wyreforestdc.gov.uk/media/3997002/2018s0809-Wyre-Forest-WCS-Addendum-v3.pdf> on 21/01/2019

Table 2-16 summary of growth in Wyre Forest District served by infrastructure within or shared with South Worcestershire

WwTW	Housing (units)	Employment (ha)	Notes (e.g. any additional information such as the trajectory, the type of employment space etc).
	Potential housing number 2015-2035	Potential employment space (ha) 2015-2035	
Kidderminster Oldington (WRW)	5,657	11.05	Employment land class – Mixed B

2.10.5 Cotswold District Council

The latest Water Cycle Study for Cotswold District Council was completed by JBA Consulting in 2015⁹. The housing trajectory for Cotswold District is summarised in Table 2-17 and remaining employment land requirement for the Local Plan period is shown in Table 2-18. The District's Local Plan (2011-2031) sets out a requirement for at least 24.4ha of employment land for the period 2016-2031. Honeybourne WwTW in South Worcestershire serves four parishes in Cotswold District and housing and employment trajectory is included in Table 2-19 below. Cotswold District Council stated that they have a large amount of windfall developments across the District, some of which are likely to be delivered in the four parishes served by Honeybourne WwTW. All committed employment development is expected to be delivered in the next five years.

Table 2-17 Cotswold District Housing Trajectory (2018-2031)

18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
850	490	478	433	456	543	426	340	348	371	381	385	387

Table 2-18 Cotswold District employment land requirement up to 2031

Type	Emp. land forecast (ha) 2016-2031	Net emp. land gained/lost (ha) 2017-2018	Net emp. land gained/lost (ha) 2016-2018	Net committed emp. land (ha) at 1st April 2018	Net proposed emp. land allocations (ha) at 1st April 2018	Cumulative completed, committed and allocated emp. land at 1st April 2018
B1	16.60	0.66	1.93	14.70	9.13	25.76
B2	-2.10	0.34	0.93	6.36	0.88	8.17
B8	9.90	2.69	4.52	4.72	0.88	10.12
Total req.	24.40	3.69	7.38	25.78	10.89	44.05

9 Cotswold District Council Water Cycle Study, JBA Consulting (2015). Accessed online at: <https://www.cotswold.gov.uk/media/1624949/6203-Water-Cycle-Study-%E2%80%93-Aug-2015.pdf> on: 21/09/2019

Table 2-19 Summary of growth in Cotswold District served by infrastructure within or shared with South Worcestershire

WwTW	Parish	Housing (units)		Employment (area or employees)		Notes (e.g. any additional information such as the trajectory, the type of employment space etc).
		Committed	Allocated in Local Plan (2011-2031)	Committed	Allocated in Local Plan (2011-2031)	
Honey-bourne (WRW)	Aston-sub-Edge	0	0	None	0	
	Mickleton	93	0	346m ² to be gained 1510m ² to be lost	0	
	Weston-sub-Edge	3	0	0	0	
	Willersey	88	54	61m ² to be gained 138m ² to be lost	WIL_E1C: No floorspace specified in Local Plan but the site is 1.97ha of B1, B2 and/or B8	WIL_E1C is expected to be delivered in the next 6-10 years

2.10.6 Bromsgrove District Council

MWH completed a combined Water Cycle Study for Bromsgrove District Council and Redditch Borough Council in 2012¹⁰. The WCS outlines the allocation of proposed development to 2026 to WwTW catchments in Bromsgrove District. The WwTW serving growth in both Bromsgrove District and South Worcestershire is summarised in Table 2-20.

Table 2-20 Summary of growth in Bromsgrove District served by infrastructure within or shared with South Worcestershire

WwTW	Housing (units)	Employment (ha)
	Potential housing number 2010-2026	Potential employment space (ha) 2010-2026
Stoke Prior (WRW)	9	1.8

10 Redditch Borough Council and Bromsgrove District Council Outline Water Cycle Study, MWH (2012). Accessed online at <https://www.bromsgrove.gov.uk/media/1077240/Final-Report-25-May-2012.pdf> on 21/01/2019

2.10.7 Other Neighbouring Authorities

Growth within Forest of Dean District Council, Herefordshire Council and Redditch Borough Council is not likely to be served by WwTW within South Worcestershire, and wastewater infrastructure within these local authority areas is unlikely to be shared with South Worcestershire. For this reason, they were not contacted for information during this study.

2.11 Employment Land

2.11.1 Economic Needs Assessment

The SWCs form the South Worcestershire Functional Economic Market Area (FEMA). The Economic Needs Assessment¹¹ for this area was updated in September 2018 as part of the South Worcestershire Development Plan Review and reviews employment land supply and demand from 2016 to 2041.

Two different growth scenarios for objectively assessed need for employment land were analysed in the EDNA, historic land and floorspace take-up forecast and an employment-based forecast (based on an Experian econometric model). The study recommended that the outputs from the historic land and floorspace take-up model were adopted for South Worcestershire for the forecast period. The net employment floorspace projections are summarised in Table 2-21. Results are also shown for the forecast with a buffer equivalent to a five-year take-up of land, included to incorporate flexibility in the forecast to provide for unexpected requirements.

Table 2-21 Net employment floorspace projections 2016-2041 by B-Class use

Scenario	Projection of Floorspace requirement (2016-2041), sqm**			Projection of Land requirement (2016-2041), ha**			Total
	B1*	B2	B8	B1*	B2	B8	
Excluding five-year buffer	172,800	415,200	449,900	22.1	106.4	115.4	243.9
Including five-year buffer	209,700	502,000	543,000	26.9	128.7	139.2	294.8

Source: BE Group, 2018

* Assumed to be two-storey

** Excluded recorded completions in 2016/17

11 South Worcestershire Economic Development Needs Assessment BE Group and Mickledore (2018). Accessed online at: <http://www.swdevelopmentplan.org/wp-content/uploads/2018/10/South-Worcestershire-EDNA-Final-Report-with-appendices.pdf> on: 21/01/2019

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3 Legislative and Policy Framework

3.1 Introduction

The following sections introduce several national, regional and local policies that must be considered by the LPAs, 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)¹² was 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 2019¹³, 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 149:

"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 170 (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. This has not yet been updated to take account of the 2018 or 2019 updates of the NPPF, however MHCLG have stated that this will, where necessary, be updated in due course. Of relevance to this study;

- Flood Risk and Coastal Change¹⁴

12 National Planning Policy Framework, Department for Communities and Local Government (2012)

13 National Planning Policy Framework, Ministry of Housing, Communities and Local Government (2019). Accessed online at: <https://www.gov.uk/government/publications/national-planning-policy-framework--2> on: 27/02/2019

14 Planning Practice Guidance: Flood Risk and Coastal Change, Department for Communities and Local Government

- Water Supply, Wastewater and Water Quality¹⁵.
- Housing - Optional Technical Standards¹⁶.

3.2.2 Planning Practice Guidance: Flood Risk and Coastal Change

Diagram 1 in the Planning Practice Guidance sets out how flood risk should be considered in the preparation of Local Plans (Figure 3.1). These requirements are addressed principally in the Council's Strategic Flood Risk Assessment.

3.2.3 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 3.2.

(2014). Accessed online at: <http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/> on: 21/01/2019.

15 Planning Practice Guidance: Water supply, wastewater and water quality, Department for Communities and Local Government (2014). Accessed online at: <https://www.gov.uk/guidance/water-supply-wastewater-and-water-quality> on: 23/01/2019

16 Planning Practice Guidance: Housing - Optional Technical Standards, Department for Communities and Local Government (2014). Accessed online at: <https://www.gov.uk/guidance/housing-optional-technical-standards> on: 23/01/2019

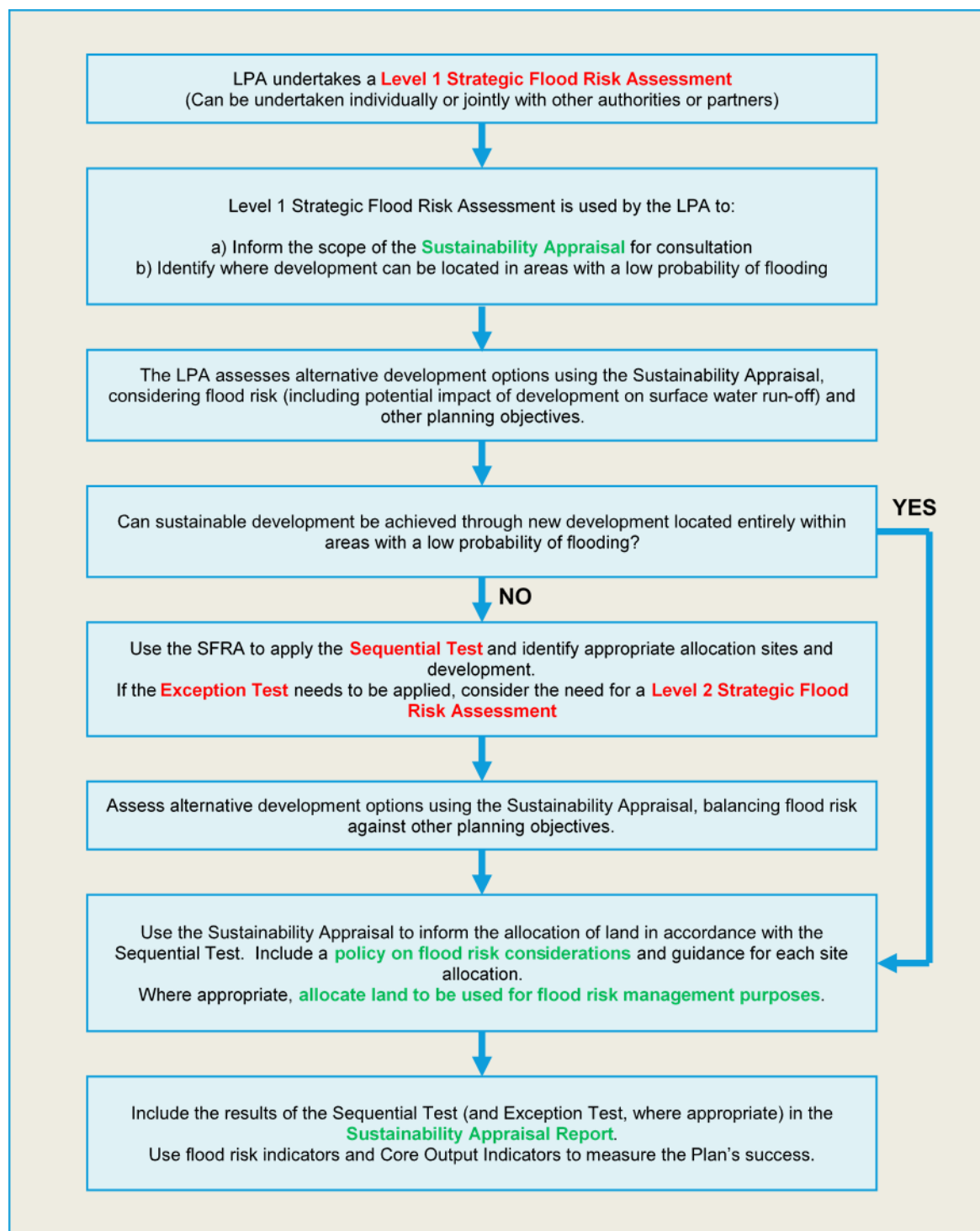


Figure 3.1 Flood Risk and the Preparation of Local Plans¹⁷

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 of foul drainage discharging into a public sewer. Phasing of development and infrastructure. 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.
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. Expectations relating to sustainable drainage systems.	➔	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 adequate infrastructure to deal with wastewater.
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 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 seeking opportunities to improve water bodies.	➔	No specific guidance (should be considered in applications).

Figure 3.2 PPG: Water supply, wastewater and water quality considerations for plan-making and planning applications

3.2.4 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 study¹⁸ 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.

3.2.5 Building Regulations

The Building Regulations (2010) Part G¹⁹ 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.

3.2.6 BREEAM

The Building Research Establishment Environmental Assessment Methodology (BREEAM) is an internationally recognised method for assessing, rating and certifying the sustainability of buildings. BREEAM can be used to assess the environmental performance of any type of building: new and existing. Standard BREEAM schemes exist for assessment of common domestic and non-domestic building types and less common building types can be assessed by developing bespoke criteria.

Using independent, licensed assessors, BREEAM 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. Buildings are rated and certified on a scale of ‘Pass’, ‘Good’, ‘Very Good’, ‘Excellent’ and ‘Outstanding’.

BREEAM has expanded from its original focus on individual new buildings at the construction stage to encompass the whole life cycle of buildings from planning to in-use and refurbishment. The standard is regularly revised to improve sustainability, respond to industry feedback and support sustainability strategies and commitments. BREEAM standard can be applied to virtually any building and location, with versions for new buildings, existing buildings, refurbishment projects and large developments.

The Councils have the opportunity to seek BREEAM status for all new, residential and non-residential buildings. Whilst BREEAM contains the flexibility to achieve this in a number of ways, a “Very Good” rating for water resources would typically relate to a 40% improvement over baseline building water consumption²⁰. As a minimum, a 12.5% improvement must be demonstrated to obtain BREEAM status. Guidance is provided on how to calculate this. Table 3-1 shows the BREEAM credits available for percentage improvement over baseline building water consumption in precipitation zone 1, which covers the whole of the UK.

18 Housing Standards Review: Cost Impacts, Department for Communities and Local Government (2014). Accessed online at:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/353387/021c_Cost_Report_11th_Sept_2014_FINAL.pdf on: 23/01/2019

19 The Building Regulations (2010) Part G - Sanitation, hot water safety and water efficiency, 2015 edition with 2016 amendments. HM Government (2016). Accessed online at:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/504207/BR_PDF_AD_G_2015_with_2016_amendments.pdf on: 23/01/2019

20 BREEAM International New Construction 2016: Technical Manual SD233 2.0, BREEAM (2016). Accessed online at: <https://www.breeam.com/discover/technical-standards/newconstruction/> on: 09/03/2018

Table 3-1 BREEAM credits for improvement over baseline water consumption

BREEAM Credits	Percentage improvement over baseline water consumption
1	12.5%
2	25%
3	40%
4	50%
5	55%
Exemplary	65%

3.2.7 Sustainable Drainage Systems (SuDS)

From April 2015, Local Planning Authorities (LPA) have been given the responsibility for ensuring through the planning system that sustainable drainage is implemented on developments of 10 or more homes or other forms of major development. 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 statement²¹ setting out government 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 are in place for ongoing maintenance over the lifetime of the development.” This requirement is also now incorporated in the 2019 update of the NPPF (paragraph 165). 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 systems²². 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.
- Worcestershire County Council are the 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 “Worcestershire County Council SuDS guide” was published in April 2018²³ and contains guidance for the design and application of SuDS in Worcestershire.
- An updated version of the CIRIA SuDS Manual²⁴ 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

21 Sustainable drainage systems: Written statement - HCWS161, UK Government (2014). Accessed online at: <http://www.parliament.uk/business/publications/written-questions-answers-statements/written-statement/Commons/2014-12-18/HCWS161/> on: 23/0/2019

22 Sustainable Drainage Systems: Non-statutory technical standards for sustainable drainage systems, Defra (2015).

23 Worcestershire SuDS guide, Worcestershire County Council (2018). Accessed online at: http://www.worcestershire.gov.uk/download/downloads/id/10361/worcestershire_suds_design_and_evaluation_guide.pdf on: 13/12/2018

24 The SuDS Manual (C753), CIRIA (2015).

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)²⁵, which contains detailed guidance on all aspects of SuDS construction, with specific information on each SuDS component available as a downloadable chapter.
- Severn Trent Connect (STC, part of Severn Trent Water) do not currently have a SuDS adoption manual. In its Addendum to Sewers for Adoption 7th Edition²⁶, STC states that it "will consider the adoption of SuDS as long as the systems are designed and constructed in accordance with the CIRIA SuDS Manual (C753)" and also outlines the SuDS techniques that are adoptable by STC.
- The water industry is currently developing Sewers for Adoption version 8, the guide to the standards that sewers must meet if they are to be adoptable by water and sewerage companies in England. This is expected to include a significant expansion of what can be considered to be an adoptable surface water sewer, to include some forms of SuDS. If implemented, this could lead to many more SuDS systems being adopted by Severn Trent Water during the plan period²⁷. A pre-implementation version released in April 2018 included this in section C3.

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. South Worcestershire is covered by the River Severn CFMP²⁸.

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. The Worcestershire SWMP²⁹ was produced in July 2018. At the time of preparing this WCS, Worcestershire County Council are in the process of creating a Flood Risk Management Plan for Droitwich, which considers flooding from all sources, not primarily surface water.

25 Guidance on the Construction of SuDS (C768), CIRIA (2017), Accessed online at: <https://www.ciria.org/ItemDetail?iProductcode=C768&Category=BOOK> on: 10/12/2018

26 Addendum to Sewers for Adoption 7th Edition, Severn Trent Connect. Accessed online at: <https://www.severntrentconnect.com/media/1567/severn-trent-connect-addendum-to-sewers-for-adoption-7th-final.pdf> on: 22/01/2019

27 Water UK (2017) Sewers for Adoption 8: Revised Principles Paper

28 River Severn Catchment Flood Management Plan, Environment Agency (2009). Accessed online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/289103/River_Severn_Catchment_Management_Plan.pdf on: 13/12/2018

29 Worcestershire Surface Water Management Plan (2018). Accessed online at: http://www.worcestershire.gov.uk/download/downloads/id/10123/worcestershire_surface_water_management_plan.pdf on: 18/01/2019

3.3.3 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 enough water continues to be available for growth and that the supply systems are flexible enough to adapt to climate change.

The Severn Trent WRMP covers South Worcestershire and is reviewed in section 4.

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"*³⁰.

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 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.

3.4.2 Local Plan and Local Strategy

The SWCs are currently working on a Development Plan Review for 2021. This will include the overall development strategy for South Worcestershire, site allocations and development management policies and replaces the SWCs planning policies currently set out in the Adopted South Worcestershire Development Plan (2016).

³⁰ Localism Act 2011: Section 110, UK Government (2011). Accessed online at: <http://www.legislation.gov.uk/ukpga/2011/20/section/110> on: 23/01/2019
2018s1367 South Worcestershire WCS Final Report v1.0.docx

3.5 Infrastructure Delivery Plan

The purpose of an Infrastructure Delivery Plan (IDP) is to evaluate various services to determine if there is sufficient infrastructure to support the future levels of housing and employment in the area. The IDP presents sources of funding to assist in the delivery of infrastructure to help upgrade facilities, promote economic growth to ultimately increase the quality of life. The plan aims to sustainably develop towns and districts whilst maintaining a high-quality environment. The provision of infrastructure to support new housing in South Worcestershire is essential, this includes roads, schools, water and sewerage provision. The implications of this has resulted in the SWCs commissioning an updated IDP that is currently underway.

3.6 Environmental Policy

3.6.1 Urban Wastewater Treatment Directive (UWWTD)

The UWWTD³¹ 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'.

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. The WFD estimated that 95% of water bodies were at risk of failing to meet "good status".

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. South Worcestershire falls into the Severn River Basin District (RBD)³². Under the WFD the RBMPs, which were originally published in December 2009 were reviewed and updated in December 2015. A primary

31 UWWTD. Accessed online at: <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:31991L0271>
On: 23/01/2019.

32 Severn River Basin District River Basin Management Plan: 2015, Environment Agency (2015). Accessed at:
<https://www.gov.uk/government/publications/severn-river-basin-district-river-basin-management-plan>
on: 13/12/2018

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 Severn River Basin Management Plan. 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:

- To prevent deterioration of the status of surface waters and groundwater;
- to achieve objectives and standards for protected areas;
- to aim to 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;
- to reverse any significant and sustained upward trends in pollutant concentrations in groundwater;
- the cessation of discharges/emissions of priority hazardous substances into surface waters; and
- 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 as implemented in the Environment Agency's River Basin Management Plans. It is of primary importance when assessing the impact of additional wastewater flows on local river quality.

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); and
- 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; and
- 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)

- To 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; and
- prevent further such pollution.

Nutrient Sensitive Areas (Urban Waste Water Treatment Directive)

- To 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 protection³³ 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.

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. Following the referendum decision of June 2016 that the United Kingdom would leave the EU, the UK Government announced that it would introduce the "European Union (Withdrawal) Bill" to repeal the European Communities Act 1972 and to transpose European Union law into domestic law "wherever practical". This Bill received Royal Assent on 26 June 2018. A White Paper published in March 2017³⁴ states the following objectives for the Bill:

- Repeal of European Communities Act (ECA) 1972
- Conversion of EU law into UK law
- Conversion of directly applicable EU laws into UK law
- Preservation of secondary legislation made under the ECA

EU regulations - as they applied in the UK the moment before the country leaves the EU - will be converted into domestic law by the Bill and will continue to apply until legislators in the UK decide otherwise.

It is therefore assumed for the purposes of this study that European Union derived environmental legislation, most significantly the Water Framework Directive, will continue to be a key driver for environmental planning 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 Water Industry Policy

3.7.1 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 essentially 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 - these are 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).

33 The Environment Agency's approach to groundwater protection, Environment Agency (2018). Accessed online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/598778/LIT_7660.pdf on: 29/10/2018

34 "Our Approach to the Great Repeal Bill", UK Government (2017) Accessed online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/604516/Great_repeal_bill_white_paper_accessible.pdf on: 30/01/2019

- 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.

3.7.2 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 company's 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 6 (AMP6) which runs from 2015 to 2020.

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.

3.7.3 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) framework³⁵ sets out how the industry intends to approach this, 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, in Strategic Planning Groups (SPGs) organised broadly along river basin district catchments.

As the DWMP process is only just commencing, it is too early to inform this study. In the future, however, DWMPs will provide more transparent and consistent information

35 A framework for the production of Drainage and Wastewater Management Plans, UK Water Industry Research (2018). Accessed online at: <http://www.water.org.uk/wp-content/uploads/2018/12/Water-UK-DWMP-Framework-Report-Main-Document.pdf> on: 07/01/2019.

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.

3.7.4 Developer Contributions and Utility Companies

Developments with planning permission have a right to connect to the public water and sewerage systems, although this doesn't preclude the requirement to ensure capacity exists to serve a development.

Developers may either 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 action to secure 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.

3.7.5 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 connections³⁶. These rules apply to all companies in England and will commence on 1st April 2018. The two relevant water companies for the study area have now published their charging arrangements which can be found in the footnotes³⁷. The key changes include:

- 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 paid 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.
- Some suppliers offer charging incentives to encourage environmentally sustainable development:

36 Charging rules for new connection services (English undertakers), OfWAT (2017). Accessed online at: <https://www.ofwat.gov.uk/publication/charging-rules-new-connection-services-english-undertakers/> on: 23/01/2019

37 New Connections Charging, Severn Trent Water (2018). Accessed online at: https://www.stwater.co.uk/content/dam/stw/stw_buildinganddeveloping/STWChargingArrangementDocument-brandv0.230012018A.pdf 24/01/2019

- Severn Trent Water³⁸ will provide 100% discount on the water infrastructure charge whereby builds are demonstrated to be below 110 litres per person per day. They also provide incentives for sewerage infrastructure charge. Whereby there is no surface water connection, 100% discount is applied. Alternatively, whereby a surface water connection is available via a sustainable drainage system, the charge is reduced by 75%.

3.7.6 Sewers for Adoptions Version 8

Sewers for Adoption (SfA) provides detailed guidance for developers, designers and constructors on how to design and build foul and surface water sewerage systems to a standard such that they will subsequently be adopted by water companies, under Section 104 of the Water Industry Act. This is the method by which most new sewerage is designed, constructed and becomes a public sewer.

The standard, up to and including version 7, has 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.

Water UK, the industry body representing water and sewerage companies in the UK, has led the development of version 8 (SfA 8), which was released as a pre-implementation version in August 2018³⁹. This recognises the roles of the various Risk Management Authorities with responsibilities for surface water management, and the expectation within NPPF that SuDS be implemented, as a first preference, for all developments. It therefore widens the definition of what can be defined as adoptable sewers, to include components which:

- drain buildings and yards appurtenant to buildings,
- have a channel,
- convey water to a sewer, surface water body or groundwater, and
- have an effective point of discharge with a lawful authority to discharge.

This definition will allow for the adoption of components including swales, rills, bioretention systems, ponds, wetlands, basins, tanks, infiltration trenches and soakaways as adoptable sewers. The CIRIA SuDS Manual is widely referenced as the key source of design guidance. Watercourses and components which drain only highway surfaces are excluded for adoption under SfA 8.

The responsibility for the final approval of SfA 8 lies with the industry regulator OfWAT, and it is anticipated that it will come into effect in mid-2019. This will, therefore, during the life of the Local Plan, provide developers with a nationally consistent route for having many SuDS components adopted by the relevant water company.

38 Infrastructure Charges Discount Scheme, Severn Trent Water (2018). Accessed online at: <https://www.stwater.co.uk/building-and-developing/regulations-and-forms/application-forms-and-guidance/infrastructure-charges/> 24/01/2019

39 Water UK (2018) Sewers for Adoption Eighth Edition. August 2018. Accessed online at: <https://www.water.org.uk/publication/sewers-for-adoption/> on: 05/02/2019

4 Water Resources and Water Supply

4.1 Introduction

4.1.1 Surface Waters

Figure 4.1 shows the main watercourses within the study area, which lies within the River Severn catchment. The River Severn enters South Worcestershire in the north from Stourport and flows south through the study area, through Worcester City and into Gloucestershire at Tewkesbury. The main tributaries of the River Severn in South Worcestershire include the River Salwarpe, Laughern Brook, River Teme and the Bushley Brook. The River Avon flows into the east of South Worcestershire from Stratford on Avon District near Cleeve Prior. The Avon flows west passing through Evesham and Pershore before travelling south-west and leaving South Worcestershire into Tewkesbury and joining the River Severn. The main tributaries of the River Avon in South Worcestershire include the Badsey Brook, River Isbourne, Merry Brook, Piddle Brook and the Bow Brook.

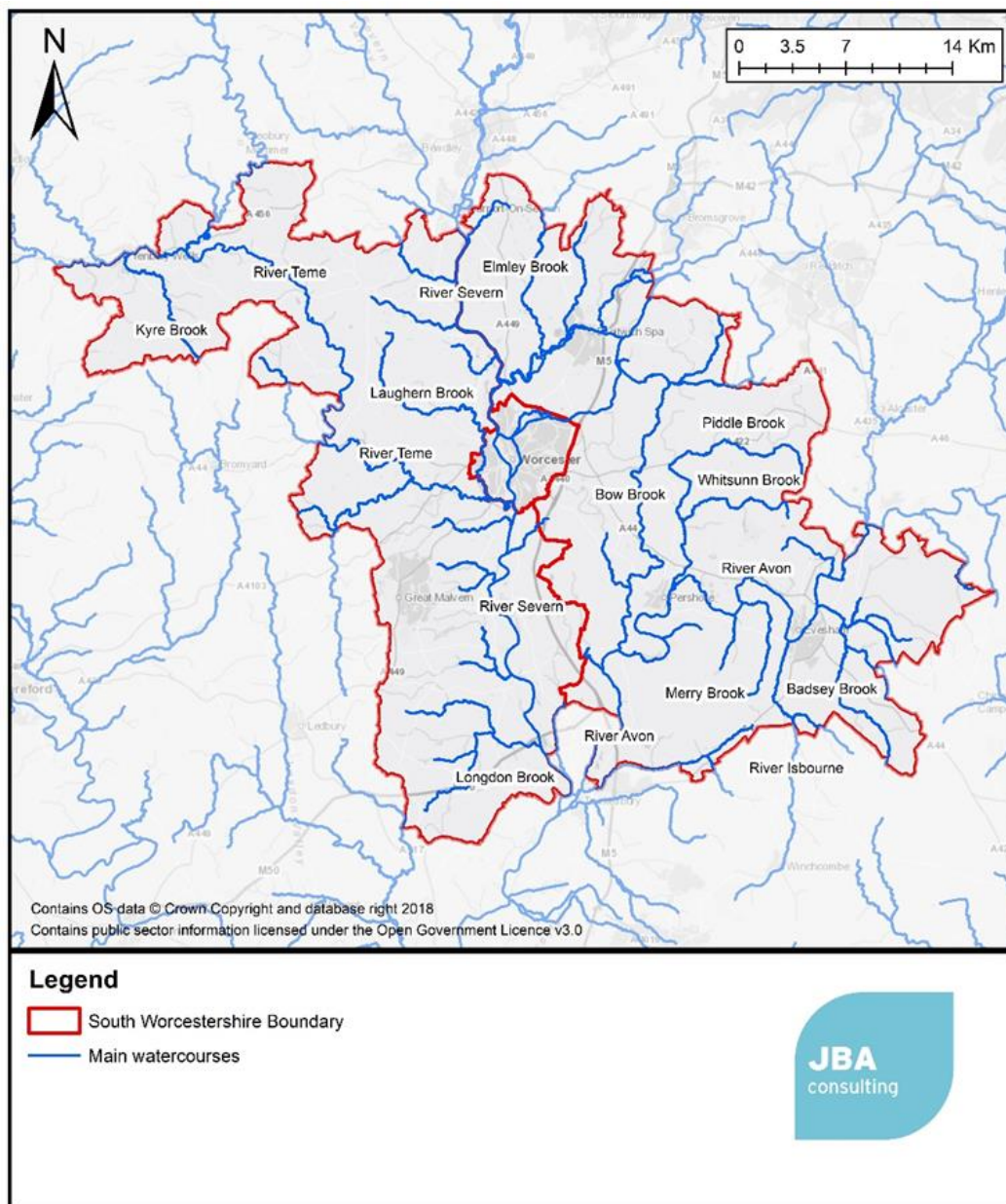
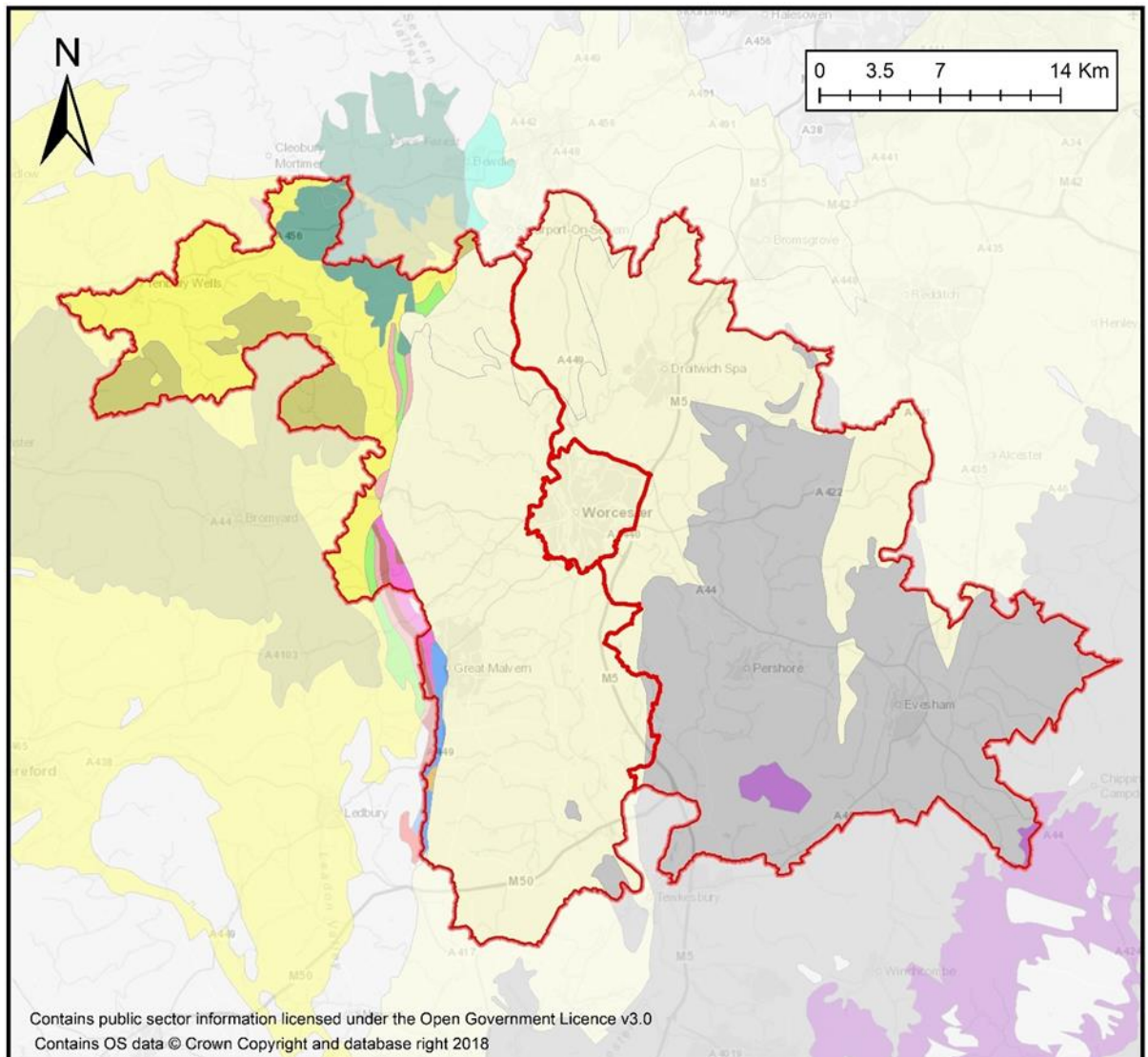


Figure 4.1 Significant watercourses within South Worcestershire

4.1.2 Geology

The geology of the catchment can be an important influencing factor in the way that water runs off the ground surface. This is primarily due to variations in the permeability of the surface material and bedrock stratigraphy. Figure 4.2 shows the bedrock geology of the South Worcestershire study area. The majority of the study area is made up of undifferentiated Triassic mudstones, siltstones and sandstones, which run through the centre of South Worcestershire. The east is mainly underlain by Lias Group mudstone, siltstone limestone and sandstone. The north west of South Worcestershire is underlain by a number of bedrocks, including Lower Devonian mudstone, siltstone and sandstones and Pridoli mudstone, siltstone and sandstones, with narrow bands of undifferentiated Ludlow rocks, undifferentiated Silurian rocks, undifferentiated Wenlock rocks and undifferentiated Llandovery rocks.



Legend

 South Worcestershire Boundary

Bedrock Geology

- INFERIOR OOLITE GROUP - LIMESTONE, SANDSTONE, SILTSTONE AND MUDSTONE
- LIAS GROUP - MUDSTONE, SILTSTONE, SANDSTONE AND LIMESTONE
- LLANDOVERY ROCKS (UNDIFFERENTIATED) - MUDSTONE, SILTSTONE AND SANDSTONE
- LOWER DEVONIAN ROCKS (UNDIFFERENTIATED) - MUDSTONE, SILTSTONE AND SANDSTONE
- LUDLOW ROCKS (UNDIFFERENTIATED) - MUDSTONE, SILTSTONE AND SANDSTONE
- PERMIAN ROCKS (UNDIFFERENTIATED) - SANDSTONE AND CONGLOMERATE, INTERBEDDED
- PRIDOLI ROCKS (UNDIFFERENTIATED) - MUDSTONE, SILTSTONE AND SANDSTONE
- SILURIAN ROCKS (UNDIFFERENTIATED) - LIMESTONE, MUDSTONE AND CALCAREOUS MUDSTONE
- TREMADOC ROCKS (UNDIFFERENTIATED) - MUDSTONE, SILTSTONE AND SANDSTONE
- TRIASSIC ROCKS (UNDIFFERENTIATED) - SANDSTONE AND CONGLOMERATE, INTERBEDDED
- UNNAMED EXTRUSIVE ROCKS, NEOPROTEROZOIC - MAFIC LAVA AND MAFIC TUFF
- UNNAMED IGNEOUS INTRUSION, NEOPROTEROZOIC - FELSIC ROCK
- WARWICKSHIRE GROUP - SILTSTONE AND SANDSTONE WITH SUBORDINATE MUDSTONE
- WENLOCK ROCKS (UNDIFFERENTIATED) - MUDSTONE, SILTSTONE AND SANDSTONE

Figure 4.2 Bedrock geology of South Worcestershire

Figure 4.3 shows superficial (at the surface) deposits of clay, silt and sand along the course of the River Teme, and along the course of the River Sever and River Avon within wider areas of sand and gravel. Isolated deposits of Diamicton (clay with flints) can be found in the east of the study area.

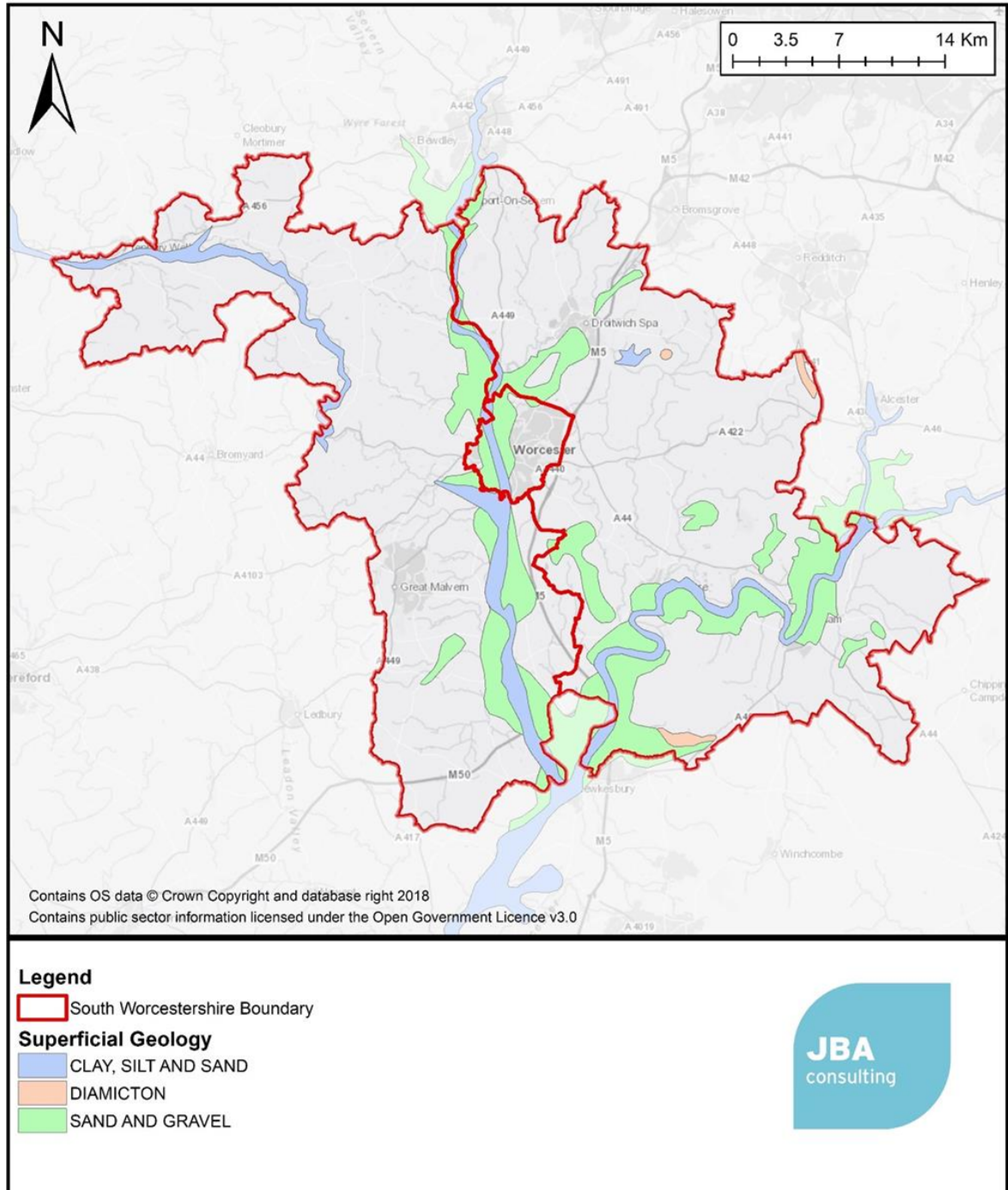


Figure 4.3 Superficial (at surface) geology of South Worcestershire

4.2 Availability of Water Resources

4.2.1 Abstraction Licencing Strategy

The Environment Agency (EA), working through their Catchment Abstraction Management Strategy (CAMS) process, prepare an Abstraction Licensing Strategy (ALS) for each sub-catchment within a river basin. This licensing strategy sets out how water resources are managed in different areas of England and contributes to implementing the Water Framework Directive (WFD). The ALS report provides information on the resources available and what conditions might apply to new licences. The licences require abstractions to stop or reduce when a flow or water level falls below a specific threshold, as a restriction to protect the environment and manage the balance between supply and demand for water users. The CAMS process is published in a series of ALSs for each river basin.

All new licences, and some existing licenses, are time limited. This allows time for a periodic review of the specific area as circumstances may have changed since the licences were initially granted. These are generally given for a twelve-year duration, but shorter license durations may also be granted. This is usually based on the resource assessment and environmental sustainability. In some cases, future plans or changes may mean that the EA will grant a shorter time limited licence, so it can be re-assessed following the change. If a licence is only required for a short time period, it can be granted either as a temporary licence or with a short time limit. If a licence is considered to pose a risk to the environment it may be granted with a short time limit while monitoring is carried out. The licences are then replaced with a changed licence, revoked or renewed near to the expiry date.

The ALS are important in terms of the Water Resource Management Plan (WRMP) as this helps to determine the current and future pressures on water resources and how the supply and demand will be managed by the relevant water companies⁴⁰. South Worcestershire is covered by six ALS areas: Severn Corridor, Severn Vale, Warwickshire Avon, Worcestershire Middle Severn, Teme and Wye as shown in Figure 4.4 below.

40 Environment Agency (2018) Managing Water Abstraction. Accessed Online at: <https://www.gov.uk/government/collections/water-abstraction-licensing-strategies-cams-process> on: 11/12/2018
2018s1367 South Worcestershire WCS Final Report v1.0.docx

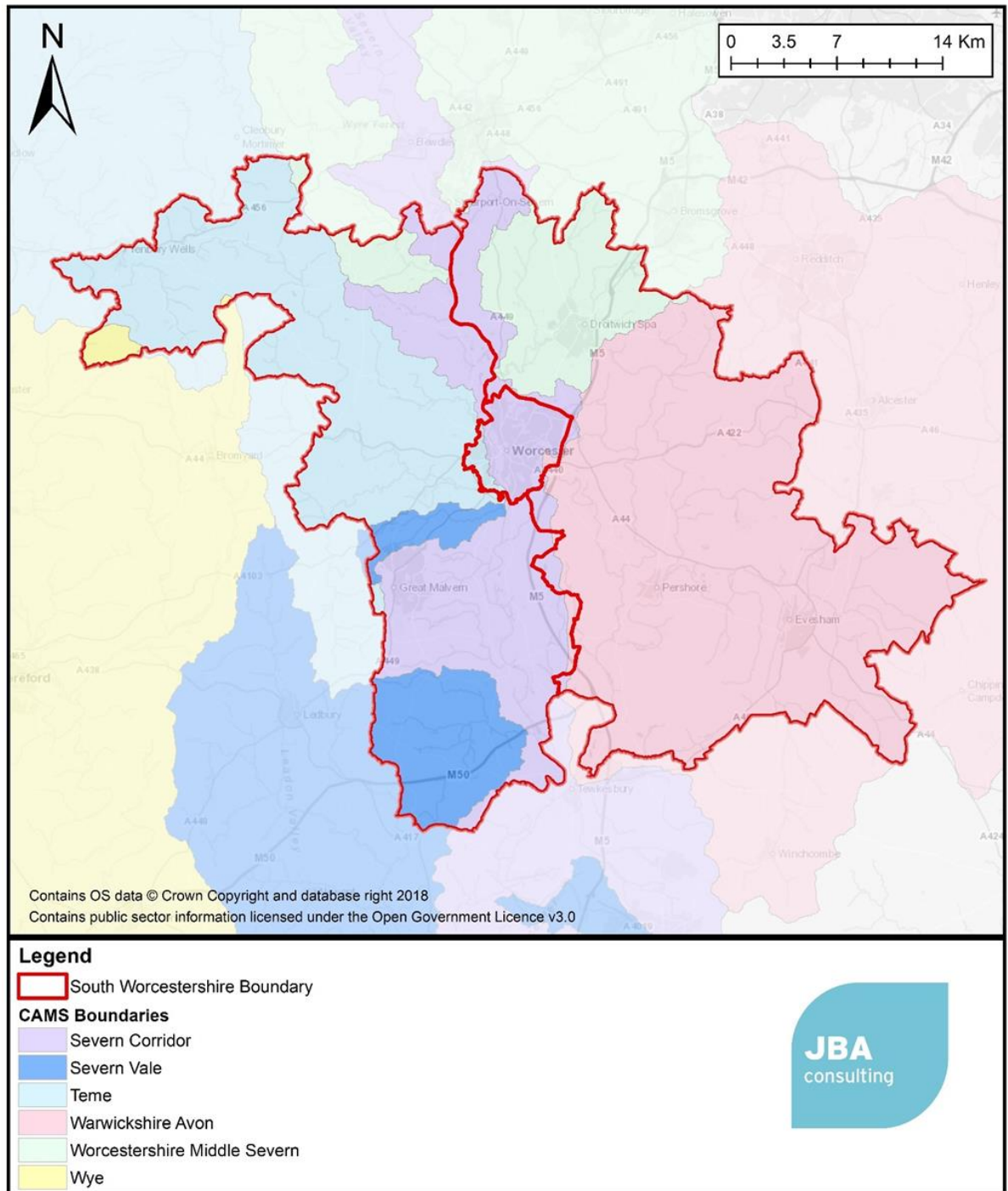


Figure 4.4 CAMS Boundaries covering South Worcestershire

4.2.2 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 6 years) in relation to the Environmental Flow Indicator (EFI). Results are displayed using different water resource availability colours, further explained in Table 4-1. 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.

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 4-1 Implications of Surface Water Resource Availability Colours

Water Resource Availability Colour	Implications for Licensing
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.
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.
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.
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.
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.

4.2.3 Warwickshire Avon ALS

The Warwickshire Avon ALS⁴¹, extends the length of the River Avon, from its source in Naseby, Northamptonshire, to its confluences with the River Severn at Tewkesbury in Gloucestershire.

The majority of the ALS, including the majority of the ALS covering the study area, has moderately reliable water resources, with water being available for abstraction at least 50% of the time.

Surface water flows are assessed by Assessment Points (APs), which are significant points on the river, i.e. where two major rivers join or at a gauging station. There are 14 APs within the Warwickshire Avon ALS, 5 of which fall within South Worcestershire: AP9, AP10, AP11, AP12 and AP13. Currently there is water available for further licensing at each of these APs subject to restrictions at the relevant gauging stations and a HOF of 1800MI/d at Deerhurst gauging station on the River Severn.

The groundwater availability in the Warwickshire Avon ALS region is guided by the surface water assessment unless specific information on principal aquifers exists or local issues that need protecting overrule it.

Consumptive groundwater licences which do not have a direct impact upon main river flows may be permitted but may be subject to restrictions such as prescribed groundwater levels. Restrictions will be determined on a case-by-case basis, dependent upon the nature and scale of any abstraction.

Resource availability for AP9, AP10, AP11, AP12 and AP13 are presented in Table 4-2 below.

Table 4-2 Warwickshire Avon ALS resource availability

AP	Name	ALS	Local Resource Availability	HOF Q (1)	Days p.a. (2)	HOF (MI/d) (3)	Gauging station at AP?
9	Offenham (Badsey Brook)	Warwickshire Avon	Water available for further licensing	15.5MI/d at Offenham gauging station	248	2.8	Yes
10	Evesham (River Avon)	Warwickshire Avon	Water available for further licensing	409MI/d at Evesham gauging station	318	32.6	Yes
11	Hinton (River Isbourne)	Warwickshire Avon	Water available for further licensing	38MI/d at Hinton gauging station	164	4.8	Yes
12	Wyre Piddle (Piddle Brook)	Warwickshire Avon	Water available for further licensing	11MI/d at Wyre Piddle gauging station	277	1.6	Yes
13	Besford Bridge (Bow Brook)	Warwickshire Avon	Water available for further licensing	16MI/d at Besford Bridge	281	1.6	Yes

41 Warwickshire Avon catchment abstraction licensing strategy, Environment Agency (2013). Accessed online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291400/LIT_2604_7a244e.pdf on: 11/12/2018

AP	Name	ALS	Local Resource Availability	HOF Q (1)	Days p.a. (2)	HOF (MI/d) (3)	Gauging station at AP?
				gauging station			

(1) Hands off Flow restriction

(2) Number of days per annum abstraction may be available

(3) Approximate volume available at restriction (MI/D)

At AP 9 to 13, there is water available for licensing, subject to a handsoff flow as stated in the above table. This means that for new licences:

- All new consumptive or partially consumptive licences will be issued with the given HOF.
- Water is only available during periods of medium to high flows due to the HOF condition.

4.2.4 Severn Corridor ALS

The Severn Corridor ALS⁴², covers from the upper reaches of the River Severn and its upland tributaries in Wales and parts of Shropshire until its confluence with the River Perry north-west of Shrewsbury. From here the Severn Corridor catchment focusses on the River Severn itself and its smaller tributaries down to the Severn Estuary. The main water demand pressure in the Severn Corridor ALS is from agriculture.

The entirety of the Severn Corridor has reliable water resources, with water being available for abstraction at least 70% of the time.

There are 13 APs within the Severn Corridor ALS, one of which fall within South Worcestershire: AP11. Currently there is restricted water available for licensing at this AP.

The groundwater availability in the Severn Corridor ALS region is guided by the surface water assessment unless specific information on principal aquifers exists or local issues that need protecting overrule it.

Consumptive groundwater licences which do not have a direct impact upon main river flows may be permitted but may be subject to restrictions such as prescribed groundwater levels. Restrictions will be determined on a case-by-case basis, dependent upon the nature and scale of any abstraction.

Resource availability for AP11 is presented in Table 4-3 below.

42 Severn Corridor catchment abstraction licensing strategy, Environment Agency (2013). Accessed online at:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291406/LIT_7848_c0b50e.pdf on: 11/12/2018

Table 4-3 Severn Corridor ALS resource availability

AP	Name	ALS	Local Resource Availability	HOF Q (1)	Days p.a. (2)	HOF (MI/d) (3)	Gauging station at AP?
11	River Severn at Saxons Lode	Severn Corridor	Restricted water available for licensing	1800MI/d at Deerhurst gauging station	328	275	Yes

(1) Hands off Flow restriction

(2) Number of days per annum abstraction may be available

(3) Approximate volume available at restriction (MI/D)

At AP11, there is water available for licensing subject to HOF of 1800MI/d at Deerhurst gauging station. This means that for new licenses:

- There is no water available for unconstrained abstraction i.e. abstraction with no HOF condition.
- All new consumptive or partially consumptive licences will be issued with this HOF.
- Water is only available during periods of medium to high flows due to the HOF condition.

4.2.5 Teme ALS

The Teme ALS⁴³ covers the north-west of South Worcestershire, along the River Teme and its tributaries from where the Teme enter South Worcestershire at Tenbury on Wells to the confluence of the Teme and the River Severn to the west of Worcester City. The main demand for water within the Teme catchment comes from public water supply and agriculture.

The entirety of the Teme ALS has reliable water resources, with water being available for abstraction at least 70% of the time.

There are 15 APs within the Teme ALS, 8 of which fall within South Worcestershire: AP3, AP4, AP5, AP11, AP12, AP13, AP14 and AP15. Currently there is restricted water available for licensing at these APs.

The groundwater availability in the Teme ALS region is guided by the surface water assessment unless specific information on principal aquifers exists or local issues that need protecting overrule it.

Consumptive groundwater licences which do not have a direct impact upon main river flows may be permitted but may be subject to restrictions such as prescribed groundwater levels. Restrictions will be determined on a case-by-case basis, dependent upon the nature and scale of any abstraction.

Resource availability for AP3, AP4, AP5, AP11, AP12, AP13, AP14 and AP15 is presented in Table 4-4 below.

43 Teme Abstraction Licencing Strategy, Environment Agency (2013). Accessed online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291396/LIT_785_0_7f5c56.pdf on: 11/12/2018

Table 4-4 Teme ALS resource availability

AP	Name	ALS	Local Resource Availability	HOF Q (1)	Days p.a. (2)	HOF (MI/d) (3)	Gauging station at AP?
3	River Teme at Tenbury	Teme	Restricted water available for licensing	240MI/d	292	29MI/d available upstream of Tenbury and 33 MI/d available downstream of Tenbury	Yes
4	River Teme at Knightsford	Teme	Restricted water available for licensing	226MI/d at Tenbury gauging station	310	29MI/d available upstream of Tenbury and 33 MI/d available downstream of Tenbury	Yes
5	River Teme at Worcester	Teme	Restricted water available for licensing	226MI/d at Tenbury gauging station	310	29MI/d available upstream of Tenbury and 33 MI/d available downstream of Tenbury	No
11	Ledwyche Brook	Teme	Restricted water available for licensing	240MI/d at Tenbury gauging station	292	29MI/d available upstream of Tenbury and 33 MI/d available downstream of Tenbury	No
12	River Rea	Teme	Restricted water available for licensing	226MI/d at Tenbury gauging station	310	29MI/d available upstream of Tenbury and 33 MI/d available downstream of Tenbury	Yes
13	Sapey Brook	Teme	Restricted water available for licensing	226MI/d at Tenbury gauging station	310	29MI/d available upstream of Tenbury and 33 MI/d available downstream of Tenbury	No
14	Leigh Brook	Teme	Restricted water available for licensing	226MI/d at Tenbury gauging station	310	29MI/d available upstream of Tenbury and 33 MI/d available	No

AP	Name	ALS	Local Resource Availability	HOF Q (1)	Days p.a. (2)	HOF (MI/d) (3)	Gauging station at AP?
						downstream of Tenbury	
15	Laughern Brook	Teme	Restricted water available for licensing	226MI/d at Tenbury gauging station	310	29MI/d available upstream of Tenbury and 33 MI/d available downstream of Tenbury	No

(1) Hands off Flow restriction

(2) Number of days per annum abstraction may be available

(3) Approximate volume available at restriction (MI/D)

At AP3-15, there is water available for licensing subject to HOF of 226MI/d at Tenbury gauging station. This means that for new licenses:

- There is no water available for unconstrained abstraction i.e. abstraction with no HOF condition.
- All new consumptive or partially consumptive licences will be issued with this HOF.
- Water is only available during periods of medium to high flows due to the HOF condition.

4.2.6 Worcestershire Middle Severn ALS

The Worcestershire Middle Severn ALS⁴⁴ covers part of the north-east of South Worcestershire, including the River Salwarpe, Elmley Brook and Elmbridge Brook to the north-east of Worcester City. In addition, a small part of the ALS falls within the north of South Worcestershire along the Dick Brook. The main water resource issue in the Worcestershire Middle Severn ALS is the historic over-abstraction of groundwater for public supply and the associated environmental impact as well as the high demand for water to irrigate agricultural land.

The majority of the Worcestershire Middle Severn ALS has very unreliable water resources, with water being available for abstraction less than 30% of the time, however the reach of the ALS which extends into north-east of South Worcestershire has water available for abstraction at least 30% of the time.

There are 10 APs within the Worcestershire Middle Severn ALS, 2 of which fall within South Worcestershire: AP9 and AP10. Currently there is restricted water available for licensing at these APs.

The groundwater availability in the Worcestershire Middle Severn ALS region is guided by the surface water assessment unless specific information on principal aquifers exists or local issues that need protecting overrule it.

Consumptive groundwater licences which do not have a direct impact upon main river flows may be permitted but may be subject to restrictions such as prescribed groundwater levels. Restrictions will be determined on a case-by-case basis, dependent upon the nature and scale of any abstraction.

44 Worcestershire Middle Severn Abstraction Licensing Strategy, Environment Agency (2013). Accessed online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/305450/lit_5356_35376b.pdf on: 11/12/2018

Resource availability for AP9 and AP10 is presented in Table 4-5 below.

Table 4-5 Worcestershire Middle Severn ALS resource availability

AP	Name	ALS	Local Resource Availability	HOF Q (1)	Days p.a. (2)	HOF (MI/d) (3)	Gauging station at AP?
9	Hadley Brook at Wards Bridge	Worcestershire Middle Severn	Restricted water available for licensing	70MI/d at Harford Hill on the River Salwarpe	183	3.7	Yes
10	River Salwarpe at Harford Hill	Worcestershire Middle Severn	Restricted water available for licensing	70MI/d	183	3.7	Yes

(1) Hands off Flow restriction

(2) Number of days per annum abstraction may be available

(3) Approximate volume available at restriction (MI/D)

At AP9 and AP10, there is restricted water available for licensing subject to HOF of 70MI/d at Harford Fill on the River Salwarpe. This means that for new licenses:

- There is no water available for unconstrained abstraction i.e. abstraction with no HOF condition.
- All new consumptive or partially consumptive licences will be issued with this HOF.
- Water is only available during periods of medium to high flows due to the HOF condition.

4.2.7 Severn Vale ALS

The Severn Vale ALS⁴⁵ covers part of the south-west of South Worcestershire, including the Longdon Brook, Bushley Brook, China Brook and Mill Brook to the River Severn. In addition, north of Malvern along the Carey's Brook to the River Severn is also part of the Severn Vale ALS. The main demand for water within the Severn Vale catchment is from agriculture and to a lesser extent, public water supply.

The parts of the Severn Vale ALS which fall within South Worcestershire have water resources available for abstraction at least 70% of the time.

There are 15 APs within the Severn Vale ALS, 2 of which fall within South Worcestershire: AP1 and AP2. Currently there is restricted water available for licensing at these APs.

The groundwater availability in the Severn Vale ALS region is guided by the surface water assessment unless specific information on principal aquifers exists or local issues that need protecting overrule it.

Consumptive groundwater licences which do not have a direct impact upon main river flows may be permitted but may be subject to restrictions such as prescribed groundwater levels. Restrictions will be determined on a case-by-case basis, dependent upon the nature and scale of any abstraction.

Resource availability for AP9 and AP10 is presented in Table 4-6 below.

45 Severn Vale Abstraction Licencing Strategy, Environment Agency (2013). Accessed online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291759/LIT_325_4_9f2621.pdf on: 11/12/2018

Table 4-6 Severn Vale ALS resource availability

AP	Name	ALS	Local Resource Availability	HOF Q (1)	Days p.a. (2)	HOF (MI/d) (3)	Gauging station at AP?
1	Careys Brook	Severn Vale	Restricted water available for licensing	1800MI/d at Deerhurst gauging station	328	0.2	No
2	Bushley Brook	Severn Vale	Restricted water available for licensing	1800MI/d at Deerhurst gauging station	328	0.6	No

(1) Hands off Flow restriction

(2) Number of days per annum abstraction may be available

(3) Approximate volume available at restriction (MI/D)

At AP1 and AP2, there is restricted water available for licensing subject to HOF of 1800MI/d at Deerhurst gauging station. This means that for new licenses:

- There is no water available for unconstrained abstraction i.e. abstraction with no HOF condition.
- All new consumptive or partially consumptive licences will be issued with this HOF.
- Water is only available during periods of medium to high flows due to the HOF condition.

4.2.8 Wye ALS

The Wye ALS⁴⁶ covers two small areas in the north-east of South Worcestershire, along the Cheaton Brook near Grafton and Bockleton and a small area around Broad Heath. The main source of supply for abstraction in the Wye ALS is surface water, with the main demands being public water supply and agriculture.

There are 32 APs within the Wye ALS, none of which fall within South Worcestershire. The nearest APs to South Worcestershire are AP11, AP12, AP13 and AP14. Currently there is restricted water available for licensing at these APs.

Resource availability for AP11, AP12, AP13 and AP14 is presented in Table 4-7 below.

Table 4-7 Wye ALS resource availability

AP	Name	ALS	Local Resource Availability	HOF Q (1)	Days p.a. (2)	Gauging station at AP?
11	Lugg upstream of Arrow	Wye	Restricted water available for licensing	168MI/d at Butts Bridge gauging station	270	No
12	Arrow upstream of Lugg	Wye	Restricted water available for licensing	53MI/d at Titley gauging station	270	No

46 Wye Abstraction Licencing Strategy, Environment Agency (2016). Accessed online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/531555/LIT_104_85.pdf on: 12/12/2018

AP	Name	ALS	Local Resource Availability	HOF Q (1)	Days p.a. (2)	Gauging station at AP?
13	Lugg upstream of Pinsley Brook	Wye	Restricted water available for licensing	168MI/d at Butts Bridge gauging station	270	No
14	Pinsley Brook upstream of Lugg	Wye	Restricted water available for licensing	Local equivalent 1900MI/d at Redbrook gauging station	270	No

(1) Hands off Flow restriction

(2) Number of days per annum abstraction may be available

(3) Approximate volume available at restriction (MI/D)

At AP11 to AP14, there is restricted water available for licensing subject to the HOFs quoted in Table 4-7 for their respective gauges. This means that for new licenses:

- There is no water available for unconstrained abstraction i.e. abstraction with no HOF condition.
- All new consumptive or partially consumptive licences will be issued with this HOF.
- Water is only available during periods of medium to high flows due to the HOF condition.

4.3 Recommendations for better management practices

The main options for this identified in the ALS are to adopt water efficiency and demand management techniques. Methods include:

- Testing the level of water efficiency before granting an abstraction licence;
- Promoting efficient use of water;
- Taking actions to limit the demand;
- Reducing leakage; and
- Embedding policies for low-water consumption design in new buildings into spatial plans.

This would ultimately cut the growth in abstraction and limit the impacts on flow and the ecology.

4.3.1 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 Environment Agency and Natural Resources Wales assessment⁴⁷ the Severn Trent supply region is classed as an area of “moderate” water stress.

4.4 Water Resource Assessment: Water Resource Management Plans

4.4.1 Introduction

When new development within a Local Planning Authority is being planned, it is important to ensure that there are sufficient water resources in the area to cover the increase in demand without risk of shortages in the future or during periods of high demand, and without causing a negative impact on the waterbodies from which water is abstracted.

The aim of this assessment was to compare the future additional demand as a result of development proposed within the emerging Local Plan, with the demand allowed for by Severn Trent Water in their Water Resource Management Plans.

The water resources assessment has been carried out utilising two approaches; initially by reviewing the Water Resource Management Plans (WRMPs) of Severn Trent Water and secondly by providing the water company with a growth estimate allowing them to assess the impact of planned growth on their water resource zone.

4.4.2 Methodology

Severn Trent Water Resource Management Plan (WRMP)⁴⁸, covering the period 2020 to 2080 were reviewed and attention was mainly focussed upon:

- The available water resources and future pressures which may impact upon the supply element of the supply/demand balance.
- The allowance within those plans for housing and population growth and its impact upon the demand side of the supply/demand balance.

The spatial boundaries for each water company’s water resource zones were used to overlay the local authority boundaries. The Ministry for Housing, Communities and Local Government (MHCLG) 2016-based estimates of household growth up to 2041⁴⁹ were collated for the local authorities which lie within each WRZ. The percentage of the current population of each local authority within the WRZ was estimated from the OS Code Point dataset and the WRZ boundary. The assessment has used MHCLG figures, because they are available for all LPAs within the water resource zone, and over a consistent timescale and methodology. The resulting total number of households in the base year within the WRZ is comparable with the figures quoted in the WRMPs.

The results were assessed using a red/amber/green traffic light definition to score the water resource zone:

Adopted WRMP has planned for the increase in demand, or sufficient time to address supply demand issues in the next WRMP.	Insufficient evidence in adopted WRMP to confirm that the planned increase in demand can be met.	Adopted WRMP does not take into consideration the planned increase in demand. Additional water resources may be required.
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47 Water Stressed Areas - Final Classification, Environment Agency and Natural Resources Wales (2013). Accessed online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244333/water-stressed-classification-2013.pdf on: 12/12/2018

48 Draft Water Resource Management Plan 2019, Severn Trent Water (2018). Accessed online at: <https://www.severntrent.com/about-us/future-plans/water-resource-management/wrmp-19-documents/on:28/11/2018>

49 2014-Based Household Projections for England, Office for National Statistics (2018). Accessed online at: <https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/datasets/householdprojectionsforengland> on: 31/10/2018

4.4.3 Severn Trent Water

Severn Trent Water is responsible for supplying South Worcestershire with water. For the purposes of water resources planning, the supply area is divided into 15 Water Resources Zones (WRZs) which vary greatly in scale and have unique water resource concerns. The entirety of South Worcestershire and all of the proposed development sites are located within the Strategic Grid WRZ, the largest WRZ which supplies the majority of Severn Trent Water customers. Figure 4.5 shows the location of South Worcestershire within the Strategic Grid WRZ.

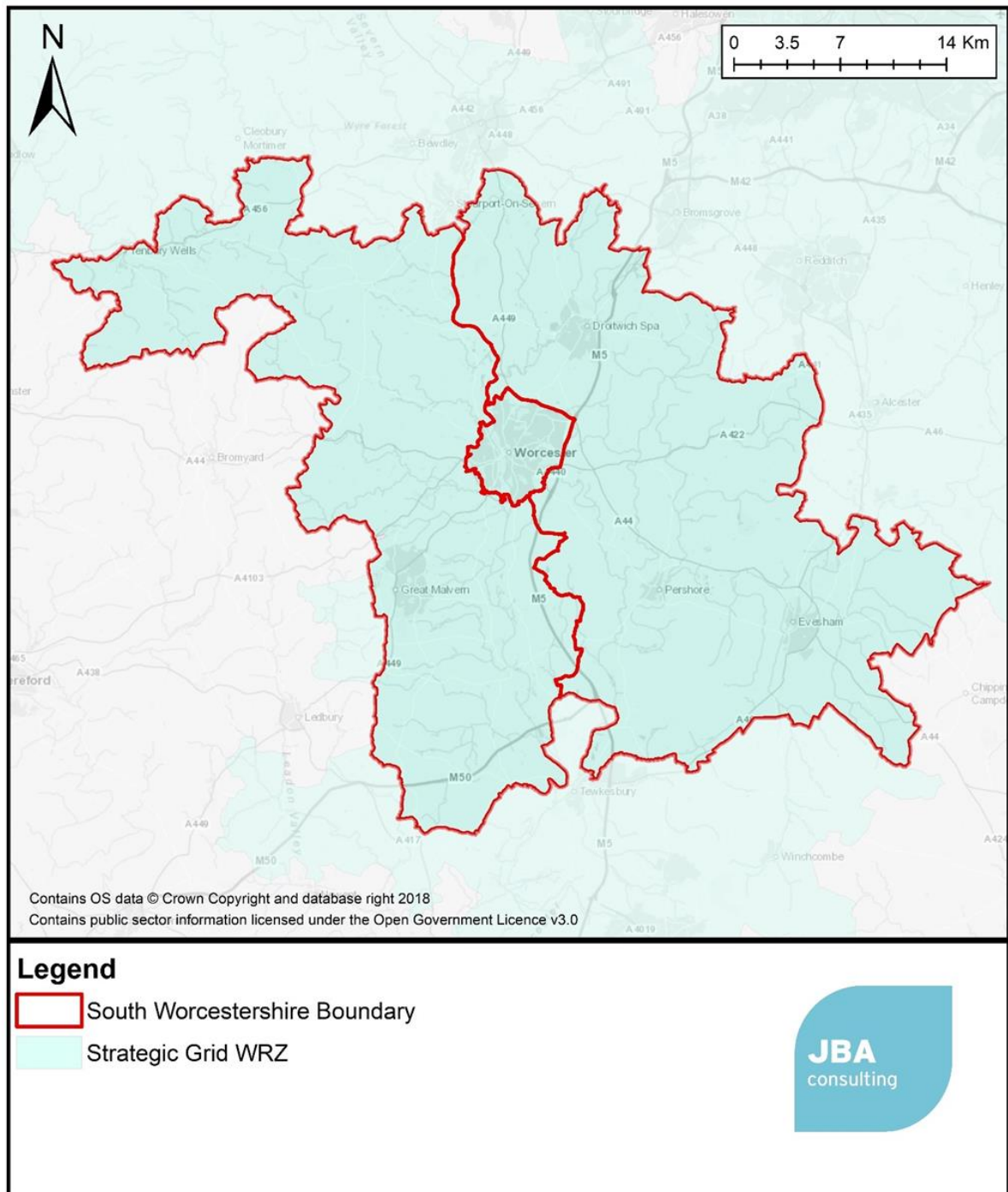


Figure 4.5 South Worcestershire within STW's Strategic Grid WRZ

Severn Trent's dWRMP forecasts a significant deficit between supply and demand for water, with a focus to prevent the risk of future environmental deterioration, meaning that alternative ways of meeting customer demand need to be found as current water sources become unreliable. The water company aims to do this by:

- Using demand management measures to reduce the amount of water that is needed to put into the supply by:
 - Educating customers to use less water;
 - Reducing network leakage;
 - Reducing consumption by increasing the coverage of water meters.
- Making the best of sustainable sources of supply by:
 - Reducing abstraction from sources that have a negative environmental impact;
 - Ensuring future water abstractions do not pose a risk of environmental deterioration (a requirement of the Water Framework Directive);
 - Improving resilience and flexibility of the supply system;
 - Increasing or optimising outputs for existing sustainable sources;
 - Improving habitats and ecological resilience to low flows using catchment restoration techniques;
 - Protecting drinking water supply sources from risk of pollution using catchment management measures;
 - Optimising national use of resources.

Across all of their WRZs, Severn Trent aim to improve long term supply capability by replacing output from unsustainable sources of abstraction. This includes reducing the pressures upon groundwater abstraction ensuring that there is no future increase associated with this source. Consequently, Severn Trent are focusing their supply upon surface water abstraction and existing reservoir storage. Also, it is proposed that the strategic water distribution links will be enhanced to allow increased flexibility around the system to move water to locations that require it most.

Across the water supply area, 34% of supply is provided by groundwater, with the majority (approximately 88%) being derived from Sherwood Sandstone or sandstone aquifers in the Midlands region. The sandstone aquifers have substantial storage and are typically not sensitive to short term changes in precipitation.

Vulnerability assessments upon the WRZs across the supply area identified those most sensitive to the impacts of climate change. The results showed that the largest WRZs (the Strategic Grid and Nottingham) are both vulnerable to potential changes in temperature and rainfall. However, 'high' vulnerability was applied to all WRZs to maintain consistency.

STW's key points for the Strategic Grid WRZ

The largest challenge faced by the Strategic Grid is the supply/demand deficit forecast across the WRZ by 2045, where the maximum potential deficit over this time period is 239.71 ML/d in 2034-2035. Table 4-8 summarises the Strategic Grid strategy up to 2045.

Table 4-8 Summary of Strategic Grid Water Management Strategy 2019-2045

Delivery Period	Scheme Description	Assumed Benefit
AMP6 2015-2020	Reduce leakage to 272.1 MI/d	272.1 MI/d
AMP7 2020-2025	Reduce leakage to 213.9 MI/d	213.9 MI/d
	Birmingham Groundwater Scheme boreholes conversion to potable supply	15 MI/d
	Site C water treatment works enhancements	9 MI/d
	Site I water treatment work enhancements	2 MI/d
	Site E water treatment works expansion and transfer main supported by raw augmentation of the River Trent	35 MI/d
	Site F water treatment works expansion	
	Site B water treatment works enhancements	10 MI/d
		3.6 MI/d
AMP8 2025-2030	Reduce leakage to 213.9 MI/d	213.0 MI/d
	River Soar to support Site B water treatment works	17 MI/d
	East Midlands third party raw water storage asset including new water treatment works	45 MI/d
	Carsington Reservoir support to Site Q water treatment enhancements	30 MI/d
	Draycote Reservoir capacity increase with transfer main from Site C water treatment works to Coventry	9 MI/d
	Site R water treatment works to Baslow pipeline capacity increase	20 MI/d
	Stanford Reservoir capacity increase	2.5 MI/d
	Thornton Reservoir to support Site B water treatment works	12 MI/d
	Whitacre Reservoir capacity increase	2.5 MI/d
	Ladyflatte boreholes recommissioning	2.7 MI/d

Delivery Period	Scheme Description	Assumed Benefit
	Lower Shustoke capacity increase	2.5 MI/d
	Maximise deployment from Diddlebury water treatment works to nearby borehole	0.9 MI/d
AMP9 2030-2035	Reduce leakage to 212.95 MI/d	212.95 MI/d
AMP10 2035-2040	Reduce leakage to 199.0 MI/d	199.0 MI/d
AMP11 2040-2045	Reduce leakage to 199.0 MI/d (assumption is leakage would otherwise increase in line with demand over this time period)	199.0 MI/d

4.4.4 Population and household growth

For the base year 2016/17, the number of properties within the supply area were based on STW's billing system TARGET. Property records were then linked to WRZs using their postcodes. These figures were used to forecast property numbers for each year to 2045. Forecasts for population growth and therefore housing yields are based on the 2014 population projections from the Office for National Statistics (ONS). The household growth estimates used in the 2019 WRMP⁵⁰ for the Strategic Grid area are shown in Table 4-9. For comparison with the MHCLG household projections in Table 4-10, only estimates up to 2039 are shown.

Table 4-9 STW WRMP Household Growth Estimates for the Strategic Grid WRZ

Component	2020-2025	2025-2030	2030-2035	2035-2039	Total
Strategic Grid New Build Properties	112,210	90,120	93,900	95,900	392,130

The Strategic Grid WRZ is comprised of 26 full local authorities and 13 local authorities that are located on the periphery of the WRZ and are therefore partially covered. To provide a comparison using the latest household projections for each relevant local authority, the Ministry of Housing Communities and Local Government's (MHCLG's) 2016-based live tables estimates for household growth, published in December 2018 were collated for the Strategic Grid supply area. For those districts partially covered, the percentage of the current population of each local authority within the WRZ was applied. Table 4-10 shows the MHCLG housing projections for the local authorities within the Strategic Grid.

Table 4-10 MHCLG 2016-Based Household Projections in the STW Strategic Grid WRZ

Local Planning Authority	Est. % pop. in WRZ	LPA total / WRZ total	2015-2020	2020-2025	2025-2030	2030-2035	2035-2039	Total
South Worc.	100%	LPA	5,655	5,051	4,680	4,232	3,110	22,728
Derby	100%	LPA	2,745	2,619	3,084	3,210	2,496	14,154
Leicester	100%	LPA	2,688	4,253	5,326	5,256	3,730	21,253
Amber Valley	100%	LPA	1,889	1,762	1,513	1,310	996	7,470
Chesterfield	100%	LPA	1,071	901	827	755	593	4,147
Derbyshire Dales	100%	LPA	874	816	640	486	343	3,159
Erewash	100%	LPA	1,851	1,484	1,365	1,447	1,209	7,356
North East Derbyshire	100%	LPA	1,286	1,005	806	671	536	4,304
Blaby	100%	LPA	2,160	1,750	1,602	1,533	1,212	8,257
Charnwood	100%	LPA	3,790	3,739	3,871	3,523	2,530	17,453
Harborough	100%	LPA	2,275	2,082	1,930	1,776	1,317	9,380
Hinckley and Bosworth	100%	LPA	2,794	2,334	2,075	1,881	1,373	10,457
Melton	100%	LPA	514	471	420	423	316	2,144
Oadby and Wigston	100%	LPA	-140	273	480	533	459	1,605
Nuneaton and Bedworth	100%	LPA	1,883	1,640	1,605	1,585	1,325	8,038
Rugby	100%	LPA	1,825	1,776	1,636	1,643	1,331	8,211
Stratford-On-Avon	100%	LPA	1,729	1594	1385	1193	925	6826
Warwick	100%	LPA	1,333	1,356	1,436	1,483	1,196	6,804
Coventry	100%	LPA	12,188	9,837	9,711	9,418	7,314	48,468
Solihull	100%	LPA	2,941	2,716	2,731	2,854	2,307	13,549
Redditch	100%	LPA	478	619	528	364	211	2,200
Wyre Forest	100%	LPA	1,427	1,128	893	780	645	4,873
Cheltenham	100%	LPA	925	1,175	1,397	1,513	1,164	6,174
Gloucester	100%	LPA	2,305	2,436	2,431	2,391	1,851	11,414
Bolsover	47%	LPA	1348	1,166	1,016	908	758	5,196
		WRZ	634	548	478	427	356	2,442
High Peak	48%	LPA	1,342	1,052	855	700	493	4,442
		WRZ	644	505	410	336	237	2,132

Local Planning Authority	Est. % pop. in WRZ	LPA total / WRZ total	2015-2020	2020-2025	2025-2030	2030-2035	2035-2039	Total
South Derbyshire	69%	LPA	2,688	2,392	2,055	1,807	1,311	10,253
		WRZ	1,855	1,650	1,418	1,247	905	7,075
North West Leic.	99%	LPA	2,494	2,239	1,992	1,785	1,353	9,863
		WRZ	2,469	2,217	1,972	1,767	1,339	9,764
Rushcliffe	9%	LPA	1,721	1,932	1,915	1,734	1,276	9,823
		WRZ	155	174	172	156	115	772
Shropshire	15%	LPA	5,576	5,083	4,351	3,692	2,677	21,379
		WRZ	836	762	653	554	402	3,207
North Warks.	93%	LPA	861	774	692	656	550	3,533
		WRZ	801	720	644	610	512	3,286
Birmingham	90%	LPA	13,192	15,098	16,651	17,347	13,736	76,024
		WRZ	11,873	13,588	14,986	15,612	12,362	68,422
Dudley	25%	LPA	2,892	2,333	2,104	2,403	2,248	11,980
		WRZ	723	583	526	601	562	2,995
Bromsgrove	98%	LPA	1,716	1,495	1,427	1,368	1,067	7,073
		WRZ	1,682	1,465	1,398	1,341	1,046	6,932
Forest of Dean	7%	LPA	1,589	1,540	1,424	1,292	920	6,765
		WRZ	111	108	100	90	64	474
Stroud	52%	LPA	2,019	2,377	2,290	2,031	1,482	10,199
		WRZ	1,050	1,236	1,191	1,056	771	5,303
Tewkesbury	96%	LPA	2,395	2,194	2,023	1,845	1,366	9,823
		WRZ	2,299	2,106	1,942	1,771	1,311	9,430
TOTAL							372,657	

The comparison shows that Severn Trent Water forecast a housing yield of 392,130 between 2015 and 2039 in the Strategic Grid WRZ. The latest MHCLG household growth estimates forecast a value of 372,657. This is 5% less than the housing yield used in the 2019 dWRMP and this difference may be a result of the method for calculating the proportion of the population where it is split across the WRZ boundary.

A breakdown of the South Worcestershire MHCLG housing projections into Local Authority are shown in Table 4-11.

Table 4-11 MHCLG 2016-based household projections for SW in the STW Strategic Grid WRZ

Local Planning Authority	Est. % pop. within WRZ	2015-2020	2020-2025	2025-2030	2030-2035	2035-2039	Total
Wychavon	100%	2,716	2,575	2,304	2,013	1,458	11,066
Malvern Hills	100%	1,266	1,251	1,209	1,056	731	5,513
Worcester City	100%	1,673	1,225	1,167	1,163	921	6,149
TOTAL South Worcestershire	100%	5,655	5,051	4,680	4,232	3,110	22,728

4.4.5 Summary

All settlements and sites within South Worcestershire are supplied by Severn Trent Water and are located within the Strategic Grid WRZ. Severn Trent Water's dWRMP highlights the significant deficit between supply and demand forecast and emphasises the need to reduce this potential deficit and prevent the risk of future environmental deterioration.

The growth forecast planned for in the dWRMP is broadly in line with that expected if the level of growth forecast by the MHCLG is realised. This is also in line with the Objectively Assessed Need within South Worcestershire.

Although Severn Trent Water has not relied on new homes being more water-efficient than existing metered homes, the opportunity, through the planning system, to ensure that new homes do meet the higher standard of domestic water usage, at no additional cost to the developer, would be in line with general principals of sustainable development, and reducing energy consumed in the treatment and supply of water.

4.5 Severn Trent Water's Assessment

Severn Trent gave a RAG score of "green" to all growth scenarios. They provided the following comment for all scenarios:

"Based on the assumption of 30,553 dwellings between 2016-2041, a lower estimate of housing growth was included in the WRMP. However, additional headroom is added to take into account uncertainty in the growth data. An additional 350 properties per year on top of what was planned for will be unlikely to cause issues in the water resource zone."

This confirms that although the level of growth that would occur if South Worcestershire delivers its housing need is higher than that accounted for in the WRMP, there is sufficient water resources to accommodate all of South Worcestershire's housing need.

4.6 Conclusions

The WRMP shows a supply-demand deficit from 2024 if no action is taken. It goes on to define a number of actions that will address this. Severn Trent Water commented that they would have adequate water resource for all proposed development sites.

On the basis that there is a 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 is recommended as part of a Phase 2 Outline study.

4.7 Recommendations

The recommendations for water resources are provided in Table 4-12 below.

Table 4-12 Recommendations for water resources for South Worcestershire

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.	SWCs	Ongoing
Use planning policy to require the 110l/person/day water consumption target permitted by National Planning Policy Guidance in water-stressed areas.	SWCs	In emerging SWDP

Action	Responsibility	Timescale
Water companies should advise the SWCs of any strategic water resource infrastructure developments within the Authority, where these may require safeguarding of land to prevent other types of development occurring. However, at present, no major potential schemes have been identified within the South Worcestershire boundary.	STW, SWCs	In emerging SWDP

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 homes⁵¹. This is particularly feasible within property owned or managed by the local authorities, such as social housing.

5.2 Methodology

Severn Trent Water were provided with a complete list of sites and the potential/equivalent housing numbers for each scenario. Using this information, STW were asked to comment on the impact of the proposed growth on water supply infrastructure in South Worcestershire.

5.3 Results

The following response was received from Severn Trent Water:

“Severn Trent Water’s Water Resource Management Plan already considers the supply and demand issues for the next 25 years. However, the water supply network is a highly pressurised system and detailed modelling is required to determine whether additional demand will require capacity upgrades. As development occurs within South Worcestershire, Severn Trent Water modelling teams can then undertake detailed modelling but because infrastructural improvements and local reinforcements can usually be undertaken within 18 months to 2 years, water capacity is not expected to be a constraint to development.”

5.4 Conclusions

Severn Trent Water responded to the request to assess the impacts of development on water supply infrastructure. STW confirmed that water supply is not expected to be a constraint to development. Early developer engagement is required to ensure that, as development occurs within the study area, detailed modelling of water supply

51 Water Efficiency Retrofitting: A Best Practice Guide, Waterwise (2009). Accessed online at: http://www.waterwise.org.uk/wp-content/uploads/2018/01/Waterwise-2009_Water-efficiency-Retrofitting_Best-practice.pdf on: 29/10/2018
2018s1367 South Worcestershire WCS Final Report v1.0.docx

infrastructure will allow any upgrades to be completed without restricting the timing, location or scale of the planned development.

No further analysis of water supply infrastructure is recommended as part of a Phase 2 Outline study.

5.5 Recommendations

Table 5-1 Recommendations for water supply infrastructure

Action	Responsibility	Timescale
Once a preferred options list of sites is developed, undertake network modelling to ensure adequate provision of water supply is feasible	STW SWCs	As part of the planning process
SWCs and Developers should engage early with STW to ensure infrastructure is in place prior to occupation.	SWCs 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 SU 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. At present, STW do not adopt SuDS, although this position is likely to change following the implementation of Sewers for Adoption version 8 (see section 3.7.6 for details).

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 consented 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 SuDS to groundwater, watercourses or surface water sewers. In some areas of South Worcestershire, 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 or Watercourse, before utilising sewers, as supported by paragraph 80 of the NPPG. Surface water should also not be permitted to connect to a foul sewer.

6.2 Sewerage System Capacity Assessment

New residential developments 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 with an outline of the five scenarios, including a list of the sites and forecast housing numbers or employment floor space included in each scenario. Using this information, they were asked to assess each site/growth area using the range of datasets they hold.

The following red/amber/green traffic light definition was used to score each site/growth area:

Capacity available to serve the proposed growth	Infrastructure and/or treatment work upgrades are required to serve proposed growth, but no significant constraints to the provision of this infrastructure have been identified	Infrastructure and/or treatment upgrades will be required to serve proposed growth. Major constraints have been identified.
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Comments were also received on each site or scenario.

A red RAG score given by STW 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.

A red assessment does not reflect a “showstopper” and STW have a statutory duty to serve new development under the Water Industry Act 1991 – but they show 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 Data collection

The following datasets were to assess the sewerage system capacity:

- Locations of promoted sites in GIS format (provided by SWCs)
- Site tracker spreadsheet (see Appendix A)
- Wastewater catchments (provided by Severn Trent Water)

6.5 Results

6.5.1 Severn Trent Water DWMP

Whilst publication of Drainage and Wastewater Management Plans (DWMPs) is not scheduled until 2022/23, STW have published a draft of their initial findings as they start the process⁵². This has been reviewed to report information of relevance to the sewer network in this WCS.

The Worcester Bromwich Road catchment is the largest in the study area and covers most of Worcester City and the surrounding areas, serving a population of approximately 110,973. Due to the proximity to the River Severn there are known high infiltration risks, especially when the river is at high levels which causes increased flows to the works. There are also fluvial interactions which have an adverse interaction with the sewerage system in the Hylton Road area and Diglis. Resilience works are currently being evaluated with the potential for partnership working with the River Severn flooding groups. There are two CSOs that have a high frequency of spilling listed in the National Environment Programme (NEP) for Storm Overflow Assessment Framework (SOAF) investigation.

6.5.2 Foul sewer network assessment

Table 6-1 to Table 6-5 summarise the RAG assessments of the foul sewer network for STW. A complete list of assessments and comments on a site-by-site basis can be found in site tracker spreadsheets in Appendix A.

Sewerage Undertakers have a duty under Section 94 of the Water Industry Act 1991 to provide sewerage 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. Early developer engagement with water companies is therefore essential to ensure that sewerage capacity can be provided without delaying development.

The results of STW's RAG assessment are shown in Table 6-1 to Table 6-5, and where appropriate, graphically in Figure 6.1 to Figure 6.3. STW's comments regarding the foul sewerage network capacity for each site option can be found in the site tracker spreadsheet in Appendix A.

Option A – Rail station centred growth

Table 6-1 Option A results

Rail station	Overall RAG assessment	Total number of potential houses
Droitwich	Red	2,238
Evesham		2,600
Hartlebury		196
Honeybourne		1,218
Malvern		1,398
Pershore		1,622
Worcester		2,147
Worcestershire Parkway		2,581

52 A9: Drainage and Wastewater Management Plan 2018, Severn Trent Water (2018). Accessed online at: https://www.stwater.co.uk/content/dam/stw/about_us/pr19-documents/sve_appendix_a9_drainage_and_wastewater_management_plan.pdf on: 27/02/2019

A red assessment was given by STW to each of the rail station development zones. This reflects the large number of houses in a limited area that does not currently have the wastewater infrastructure to accommodate the additional flows.

Further modelling would be required by STW in order to differentiate between the ten station zones. Smaller developments could be accommodated in each of the zones more easily.

Option B – Development on the periphery of settlements

Table 6-2 Option B results

Number of settlements in each category		
Red	Amber	Green
38	16	3
Number of potential houses in each category		
Red	Amber	Green
98,722	3,962	339

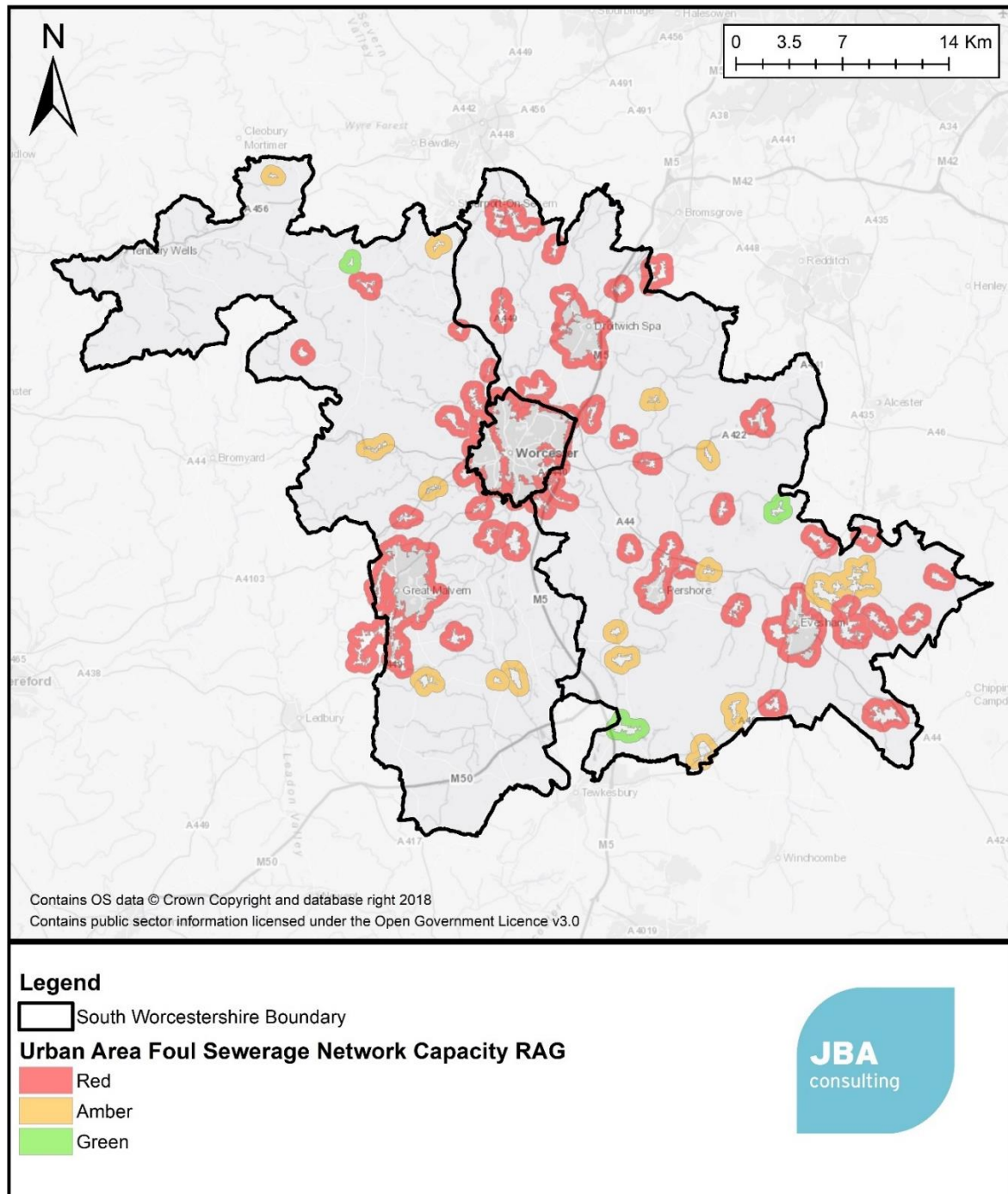


Figure 6.1 Option B results

Option B focuses development on the periphery of existing settlements, and this scenario includes all sites identified that lie within a buffer zone around the existing cities, towns and category 1 to 3 settlements.

In many of the smaller settlements, the adoption of all of the identified sites would result in a very large increase, in some cases doubling, in the population of the existing settlement. The sewer infrastructure in these settlements is likely to have grown organically with the settlement and will not have the capacity to accommodate the additions flows. Extensive infrastructure is likely to be required to overcome these constraints and for this reason these settlements have been given a red score.

Limited growth could be accommodated in these catchments, and further discussion with STW would be required in order to estimate the headroom in the sewer network in each settlement.

In the larger settlements, such as Worcester, this scenario produces multiple sites all around the edge of the city. This means that multiple upgrades will be required distributed all around the edge in order to accommodate these sites. STW's preference would be for larger developments focused in fewer areas (for example Option D – Urban extensions), as infrastructure upgrades could be provided in a more efficient manner.

Option C – Infill development/regeneration

In this option growth occurs within the major settlements in the study area as regeneration projects and infill development.

Table 6-3 Option C results

Regeneration area	Number of sites in each category		
	Red	Amber	Green
Droitwich	0	0	4
Evesham	0	0	7
Malvern	0	1	13
Tenbury	0	0	1
Worcester	0	0	17
	Number of potential houses in each category		
	Red	Amber	Green
Total	0	205	1582

STW advised that in general infill schemes are easier to accommodate as they are in area where there is existing infrastructure, are generally smaller, and may be change in use so do not represent a large increase in demand. For this reason, the majority of the sites in this scenario have been given a green assessment, and the one amber assessment is due to known sewer flooding issues downstream of the site.

With this type of development there may also be an opportunity for betterment where surface water can be managed to through SuDS where it was previously discharging to a surface water or combined sewer.

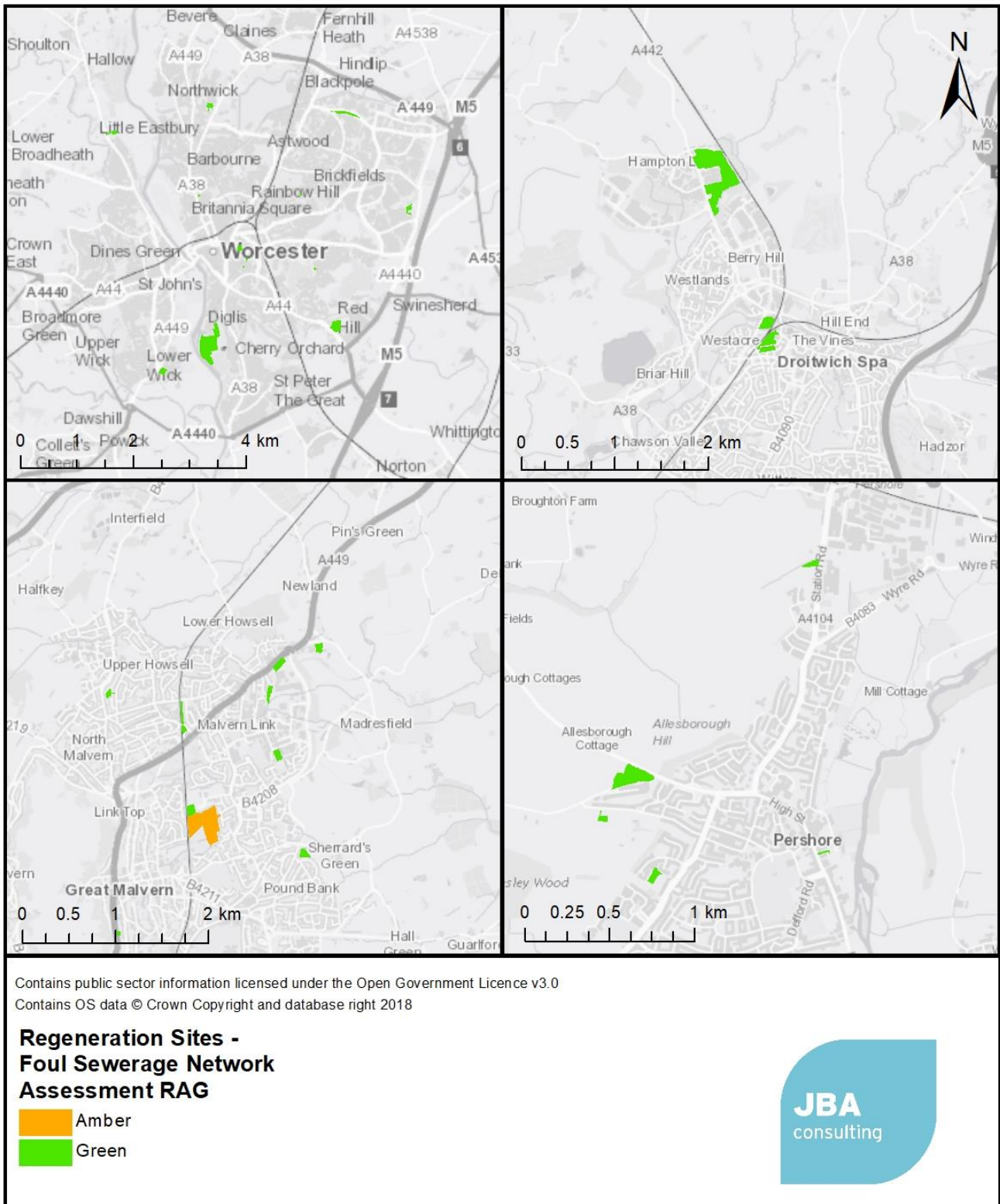


Figure 6.2 Option C results

Option D – Large Urban Extensions

This scenario contains large potential developments on the periphery of three settlements in the study area, Droitwich, Malvern and Worcester.

Red assessments were given by STW to 16 of the development sites across the three settlements reflecting the size of the developments and the lack of existing infrastructure to accommodate the additional flow.

35 of the sites (providing 1,748 houses) could be accommodated in this scenario with minimal additional infrastructure.

In general, STW prefer this type of development to that offered in Option B, as it is more efficient to provide new water infrastructure to a development of this type than to multiple smaller sites distributed throughout the study area.

There are significant developments already allocated in West Worcester, South East Worcester and North Malvern, and wastewater schemes have been planned to serve them. Once there is a greater clarity on which of the new urban extensions may be accommodated in the updated SWDP, it may be possible to modify these existing schemes to accommodate the additional growth. Early engagement between the Councils and STW is required in order to make sure that the infrastructure for the existing allocations is sufficient to accommodate future growth from urban extensions.

Table 6-4 Option D results

Urban extension area	Number of sites in each category		
	Red	Amber	Green
South of Droitwich	8	8	14
North of Malvern	2	6	4
West of Worcester	6	9	17
	Number of potential houses in each category		
	Red	Amber	Green
	18,523	6,418	1,748

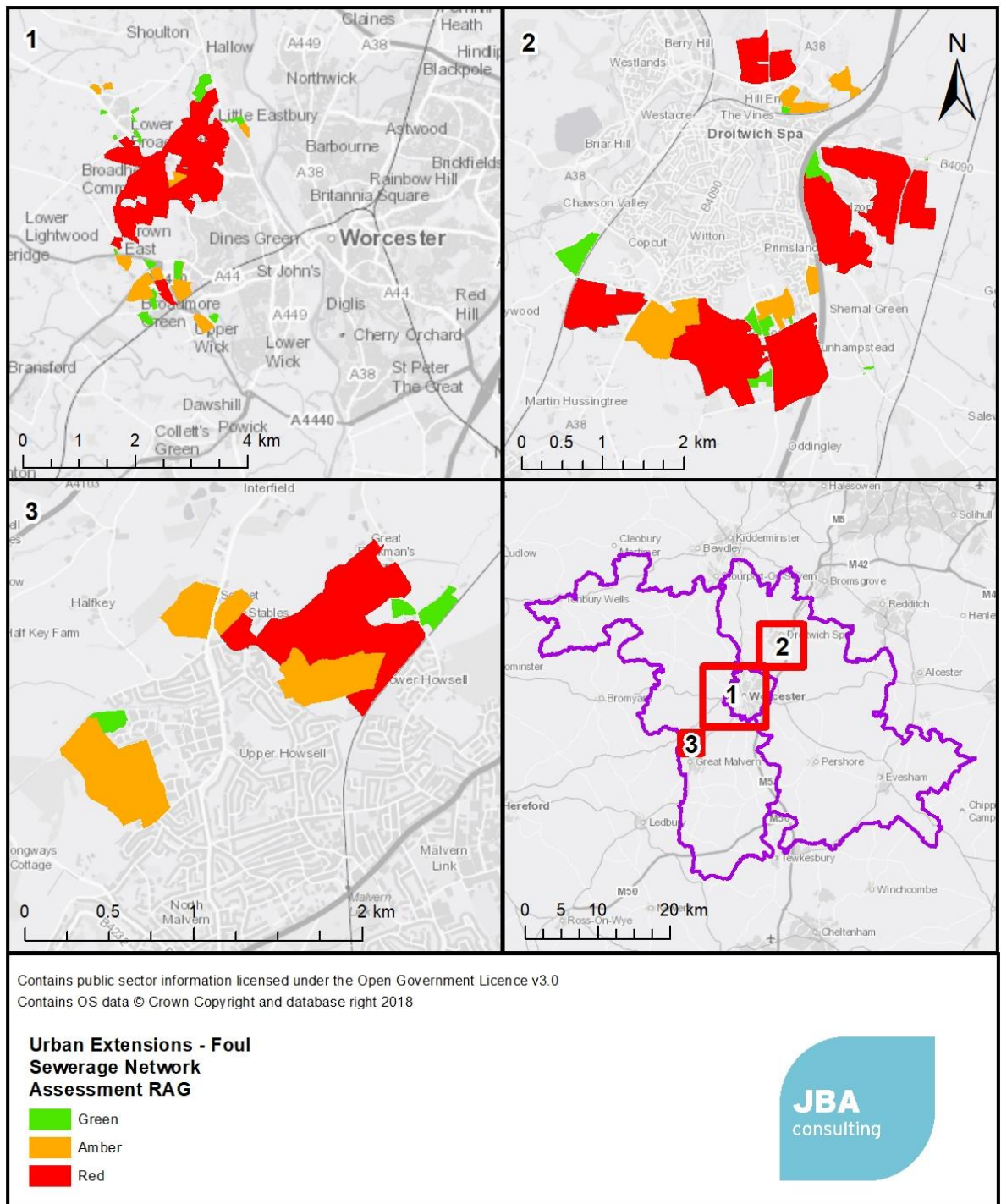


Figure 6.3 Option D results

Option E – New/expanded settlements/sites

This scenario contained three new/expanded settlements/sites, each of 5,000 houses. A red assessment has been given to each of the new settlements reflecting the size of the development, and the need for significant new infrastructure including new trunk mains to connect into the existing network.

Table 6-5 Option E results

New settlement	Overall RAG assessment	Number of potential houses
Rushwick	Red	5,000
Throckmorton		5,000
Worcestershire Parkway		5,000

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 CSO operation. Early engagement with 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 design SuDS.

The results in section 6.5.2 show the relative difficulty in providing wastewater infrastructure in each of the five scenarios. Significant new infrastructure would have to be provided in order to serve growth centred around rail stations (Option A) and new/expanded settlements/sites (Option E). Growth on the periphery of existing settlements, either as smaller sites (Option B) or large urban extensions (Option D) can accommodate some of the required growth with minimal additional infrastructure depending on the location of the site and the capacity of the existing network. Infill development (Option C) requires the least investment as they are generally on brownfield sites, or areas with existing infrastructure.

No single scenario can provide the number of houses required to meet the SWC's OAN without some additional infrastructure being required. It is therefore likely that a combination of scenarios will be required.

Severn Trent Water's preference is for growth to be focused in larger settlements as it is usually more efficient to provide one large infrastructure scheme than several smaller schemes.

If larger developments, or clusters of developments such as Option A or Option E were to be adopted, early engagement with STW is recommended to allow time for the strategic infrastructure required to serve these developments to be planned.

Further study of the wastewater network is recommended as part of a Phase 2 Outline as the SWDP develops and the SWCs have greater certainty over which sites will be brought forward for development.

6.7 Recommendations

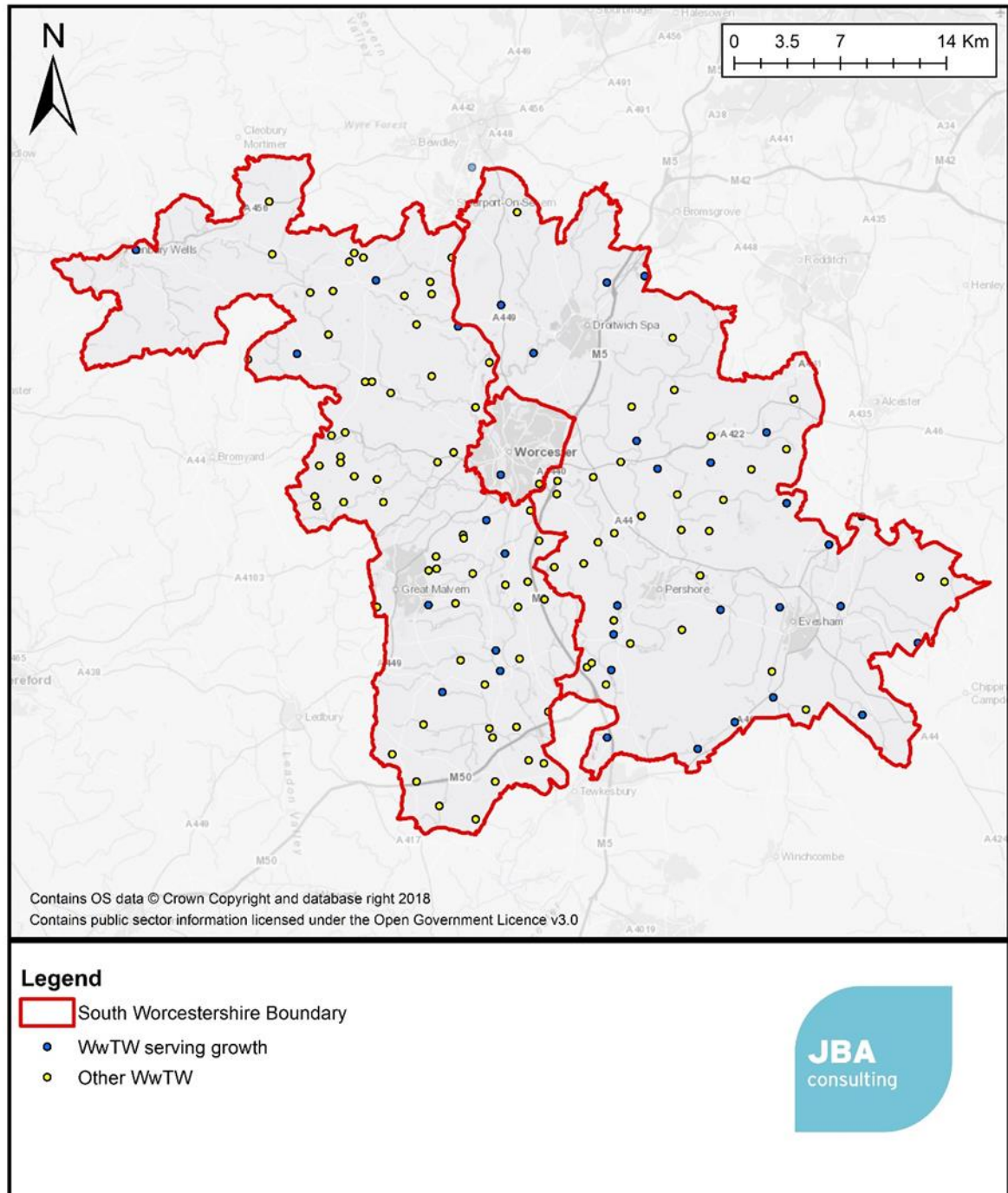
Table 6-6 Recommendations from wastewater network assessment

Action	Responsibility	Timescale
Early engagement between the SWCs and STW is required to ensure that where strategic infrastructure is required, it can be planned in by STW.	SWCs STW	Ongoing
Take into account wastewater infrastructure constraints in phasing development in partnership with the sewerage undertaker	SWCs STW	Ongoing
Developers will be expected to work with the sewerage undertaker closely and early in the planning promotion process to develop an outline Drainage Strategy for sites. The Outline 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.	STW and Developers	Ongoing
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 surface water sewers seen as the last option. New connections for surface water to foul sewers will be resisted by the LLFA.	Developers LLFA	Ongoing
Opportunities for betterment on brown field sites (particularly in Option C) should be sought.	SWCs	In SWDP

7 Wastewater Treatment

7.1 Wastewater Treatment Works in South Worcestershire

There are 128 WwTWs within South Worcestershire that are operated by Severn Trent Water. 35 of these are likely to serve growth within South Worcestershire based on the five growth scenarios. In addition, there are three WwTW in neighbouring authority areas that are likely to serve growth from within South Worcestershire. The WwTWs in South Worcestershire are shown in Figure 7.1 below.



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 Wastewater Treatment Works (WwTW) should be the only discharge (1). With rainfall, the storm tanks fill and eventually start discharging to the watercourse (2) and 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.

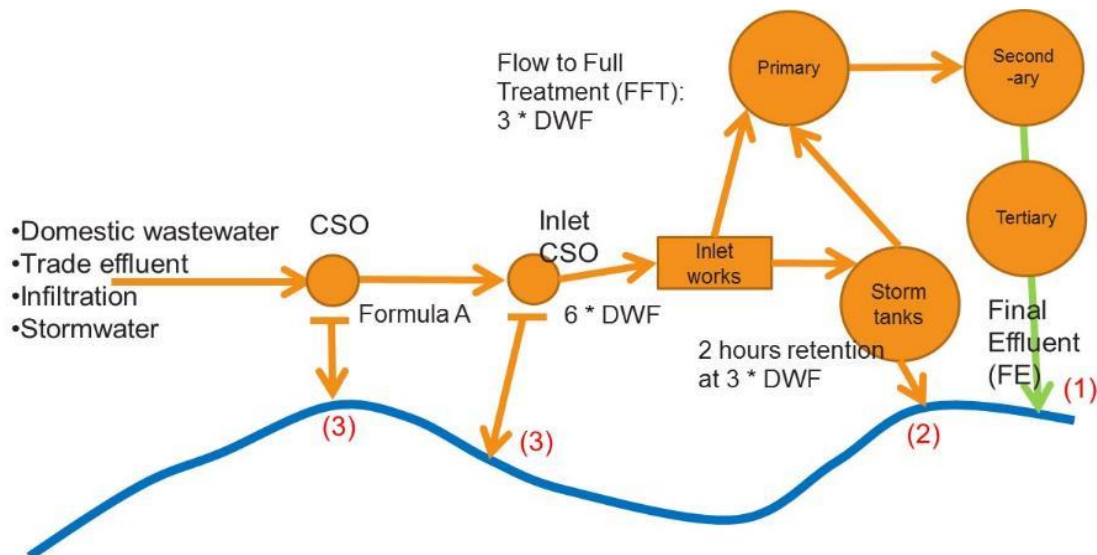


Figure 7.2 Overview of typical combined sewerage system and WwTW discharges

Environmental permits are used alongside water quality limits as a means of controlling the pollutant load discharged from a water recycling centre to a receiving watercourse. Sewage flow rates must be monitored for all WwTWs where the permitted discharge rate is greater than 50 m³/day in dry weather.

Permitted discharges are based on 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 also consent for maximum concentrations of pollutants, in most cases Suspended Solids (SS), Biochemical Oxygen Demand (BOD) and Ammonia (NH₄). 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 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

Severn Trent were provided with the proposed growth scenarios and the potential housing numbers for each scenario/site (See Appendix A). STW were then invited to provide an assessment of the receiving WwTW and provide any additional comments about the impacts of the development.

The STW assessment consists of two factors, the hydraulic capacity of the WwTW (consented flow vs current flow) and the capacity of the WwTW to treat a given load. The assessment may also reflect upgrades already planned at WwTW.

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

Capacity available to serve the proposed growth	Infrastructure and/or treatment upgrades will be required to serve proposed growth, but no significant constraints to the provision of this infrastructure have been identified	Infrastructure and/or treatment upgrades will be required to serve proposed growth. Major constraints have been identified.
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A parallel 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 calculated as the 80-percentile exceedance flow for 2016-2018. The flow data was cleaned to remove zero values and low outlier values which would bring the measured DWF down.
- Growth scenarios, potential development sites and existing commitments were assigned to a WwTW using the sewerage drainage area boundaries.
- For each scenario/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.

Table 7-1 Values used in water demand calculations

Water Company	Water Resource Zone	Occupancy rate (persons per dwelling)	Per capita consumption (m3/person/day)
Severn Trent Water	Strategic Grid	2.2	0.121

7.4 Results

Table 7-2 and Figure 7.3 to Figure 7.7 below show a summary of the results of STW's RAG assessment of each WwTW for each growth scenario. JBA's assessment of WwTW capacity is contained in Appendix B and is referred to in the "Does DWF flow exceed permitted flow" column in Table 7-2.

Table 7-2 Summary of results

WwTW	Growth option	STW comments	Does DWF flow exceed permitted flow?
Ashton under Hill	B	Small number of dwellings, minimal impact on hydraulic capacity.	Yes
Beckford	B	Estimated spare hydraulic capacity of 0 dwellings. Significant headroom available in terms of quality performance. Investment likely 2020-2025 to address hydraulic capacity issues	Yes
Bidford on Avon	B	Estimated spare hydraulic capacity of 0 dwellings. Minimal headroom available in terms of quality performance. Investment likely 2020-2025 to address hydraulic capacity issues.	Yes, approximately 2022
Blackminster	A, B	Estimated spare hydraulic capacity of 0 dwellings. Significant headroom available in terms of quality performance. Improvement planned 2020-2025 to meet new Phosphorous permit, with capacity improvements in line with existing development plans	Yes
Bredon	B	Estimated spare hydraulic capacity of 0 dwellings. Significant headroom available in terms of quality performance. Hydraulic capacity limited by surface water connections in catchment	Yes, approximately 2025
Broadway	B	Estimated spare hydraulic capacity of 52 dwellings. Limited headroom available in terms of quality performance. Improvement planned 2020-2025 to meet new Phosphorous permit, with capacity improvements in line with existing development plans	Yes
Church Lench	B	Estimated spare hydraulic capacity of 20 dwellings. Significant headroom available in terms of quality performance. Improvement planned 2020-2025 to meet new Phosphorous permit.	No
Clifton upon Teme	B	Estimated spare hydraulic capacity of 21 dwellings. Significant headroom available in terms of quality performance.	Yes, approximately 2028
Crophorne Heath	B	Estimated spare hydraulic capacity of 0 dwellings. Limited headroom available in terms of quality performance.	Yes
Crowle (Worcester)	B	Estimated spare hydraulic capacity of 0 dwellings. Minimal headroom available in terms of quality performance.	Yes

WwTW	Growth option	STW comments	Does DWF flow exceed permitted flow?
Defford Village	B	Estimated spare hydraulic capacity of 17 dwellings. Limited headroom available in terms of quality performance. Improvement planned 2020-2025 to meet new Phosphorous permit.	No
Droitwich-Ladywood	A, B, C, D	Estimated spare hydraulic capacity of 0 dwellings. Significant headroom available in terms of quality performance. Investment likely 2020-2025 to address hydraulic capacity issues.	Yes
Eckington Works	B	Estimated spare hydraulic capacity of 51 dwellings. Limited headroom available in terms of quality performance.	No
Evesham Works	A, B	Estimated spare hydraulic capacity of 1083 dwellings. Significant headroom available in terms of quality performance. There is some spare capacity at this WwTW, however improvements would be required to allow capacity for greater than 2000 dwellings.	Yes, approximately 2025 (A) Yes, approximately 2020 (B)
	C	Estimated spare hydraulic capacity of 1083 dwellings. Significant headroom available in terms of quality performance.	No
Flyford Flavell	B	Estimated spare hydraulic capacity of 0 dwellings. Limited headroom available in terms of quality performance.	Yes, approximately 2020
Great Witley	B	Estimated spare hydraulic capacity of 0 dwellings. Limited headroom available in terms of quality performance.	Yes
Harvington Works	B	Estimated spare hydraulic capacity 0 dwellings. Limited headroom available in terms of quality performance.	Yes, approximately 2033
Holt Heath	B	Estimated spare hydraulic capacity of 16 dwellings. Significant headroom available in terms of quality performance.	Yes, approximately 2027
Honeybourne	B	Estimated spare hydraulic capacity of 188 dwellings. Significant headroom available in terms of quality performance. Upgrades due in 2020-2025 period.	No
Inkberrow	B	Estimated spare hydraulic capacity of 66 dwellings. Limited headroom available in terms of quality performance. Improvement planned 2020-2025 to meet new Phosphorous permit.	Yes, approximately 2023
Kempsey Works	B	Estimated spare hydraulic capacity of 138 dwellings. Significant headroom available in terms of quality performance. There is very limited existing capacity at the WwTW and significant improvement would be required to allow capacity for 4000 new dwellings. There is potential that this development could drain to Worcester - Bromwich Road.	Yes, approximately 2025

WwTW	Growth option	STW comments	Does DWF flow exceed permitted flow?
Kidderminster Oldington	A, B	Estimated spare hydraulic capacity of 4688 dwellings. Significant headroom available in terms of quality performance. Capacity needs to be considered in conjunction with Wyre Forest plans.	No
Malvern	A, B, C	Estimated spare hydraulic capacity of 1505 dwellings. Limited headroom available in terms of quality performance. Improvement planned 2020-2025 to meet new Phosphorous permit	No
	D	Estimated spare hydraulic capacity of 1505 dwellings. Limited headroom available in terms of quality performance. Improvement planned 2020-2025 to meet new Phosphorous permit	No
Ombersley	B	Estimated spare hydraulic capacity of 45 dwellings. Limited headroom available in terms of quality performance.	Yes
Persshore	A, B, E	Estimated spare hydraulic capacity of 242 dwellings. Limited headroom available in terms of quality performance. There is limited existing capacity to this WwTW and significant improvement would be required to allow capacity for greater than 1000 dwellings.	No (A) Yes, approximately 2033 (B) Yes approximately 2038 (E)
	C	Estimated spare hydraulic capacity of 242 dwellings. Limited headroom available in terms of quality performance. There is limited existing capacity to this WwTW and significant improvement would be required to allow capacity for greater than 1000 dwellings.	No
Powick	B	Estimated spare hydraulic capacity of 0 dwellings. Limited headroom available in terms of quality performance. Improvement planned 2020-2025 to meet new Phosphorous permit. Spare capacity takes into account existing development plans south of Worcester.	Yes, approximately 2023
Quay Lane	B	Estimated spare hydraulic capacity of 45 dwellings. Limited headroom available in terms of quality performance.	Yes, approximately 2040
Stoke Prior	B	Estimated spare hydraulic capacity of 154 dwellings. Significant headroom available in terms of quality performance. Improvement planned 2020-2025 to meet new Phosphorous permit	No
Stratford Milcote	B	Pebworth Village WwTW has been closed down and flows transferred to Stratford Milcote. Estimated spare hydraulic capacity 9721 dwellings. Limited headroom available in terms of quality performance. Development needs to be considered in conjunction with Stratford upon Avon plans.	No

WwTW	Growth option	STW comments	Does DWF flow exceed permitted flow?
Tenbury	B, C	Estimated spare hydraulic capacity of 495 dwellings. Significant headroom available in terms of quality performance. >75% of load is from a single trade effluent source.	
Upton upon Severn	B	Estimated spare hydraulic capacity of 121 dwellings. Limited headroom available in terms of quality performance.	No
Upton Snodsbury	B	Estimated spare hydraulic capacity of 13 dwellings. Significant headroom available in terms of quality performance.	Yes, approximately 2020
Welland	B	Estimated spare hydraulic capacity of 48 dwellings. Significant headroom available in terms of quality performance. Improvement planned 2020-2025 to meet new Phosphorous permit.	Yes, approximately 2035
Worcester Bromwich Road	A, B (Fernhill Heath, Hallow, Lower Broadheath, Worcester), E	Estimated spare hydraulic capacity of 4875 dwellings. Significant headroom available in terms of quality performance. Upgrades due in 2020-2025 period to account for existing planned growth to Worcester. Additional capacity improvements may be required to account for 2000-6000 additional dwellings.	No (A) Yes, approximately 2036 (B) Yes, approximately 2038 (E)
	B (Broadwas, Tibberton, Whittington), C, D	Estimated spare hydraulic capacity of 4875 dwellings. Significant headroom available in terms of quality performance. Upgrades due in 2020-2025 period to account for existing planned growth to Worcester.	Yes, approximately 2036 (B), No (C), No (D)
Wychbold	B	Estimated spare hydraulic capacity of 53 dwellings. Significant headroom available in terms of quality performance	Yes, approximately 2022

Option A – Growth at rail stations

Figure 7.3 shows the wastewater catchments serving rail station development zones with their corresponding RAG assessment applied. Seven WwTW are expected to serve the 9 rail station zones. The capacity of each of these WwTW in scenario A is shown in Appendix B.

Kidderminster Oldington WwTW which would serve development around Hartlebury Station has sufficient headroom to accommodate growth in scenario A, and so would not be a constraint to growth in this area. This WwTW will also serve growth in Wyre Forest which has been taken into account in JBA's headroom assessment.

Pershore WwTW has limited headroom in both hydraulic capacity and quality performance and STW advise that significant performance improvements are required in order to accommodate growth in scenario A. For this reason, it has been given a "red" assessment.

The other five WwTW have been given "amber" assessments reflecting limited capacity or quality concerns. In these cases, a reduced level of growth may be accommodated.

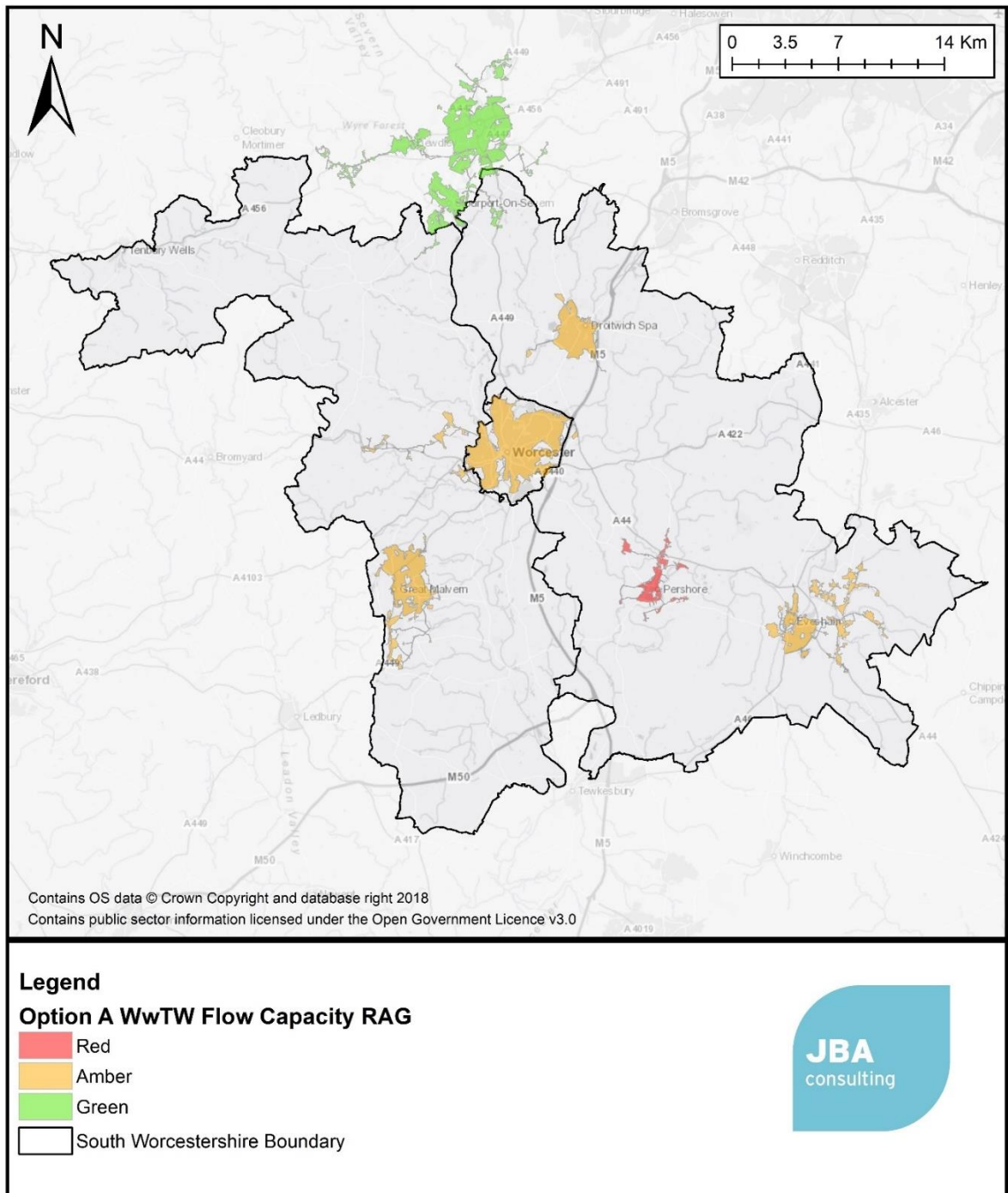


Figure 7.3 Option A results

Option B – Growth on the periphery of existing settlements

Figure 7.4 below shows the wastewater catchments serving growth in option B with the corresponding RAG score applied. 35 WwTW are expected to serve growth in this scenario. The capacity of each of these WwTW is shown in Appendix B.

In this scenario six of the WwTW (serving nine settlements) have been given a green assessment by STW where there is sufficient hydraulic capacity and no quality concerns. Four WwTW serving eight settlements have been given a “red” score by STW reflecting significant upgrades required to overcome capacity or quality concerns.

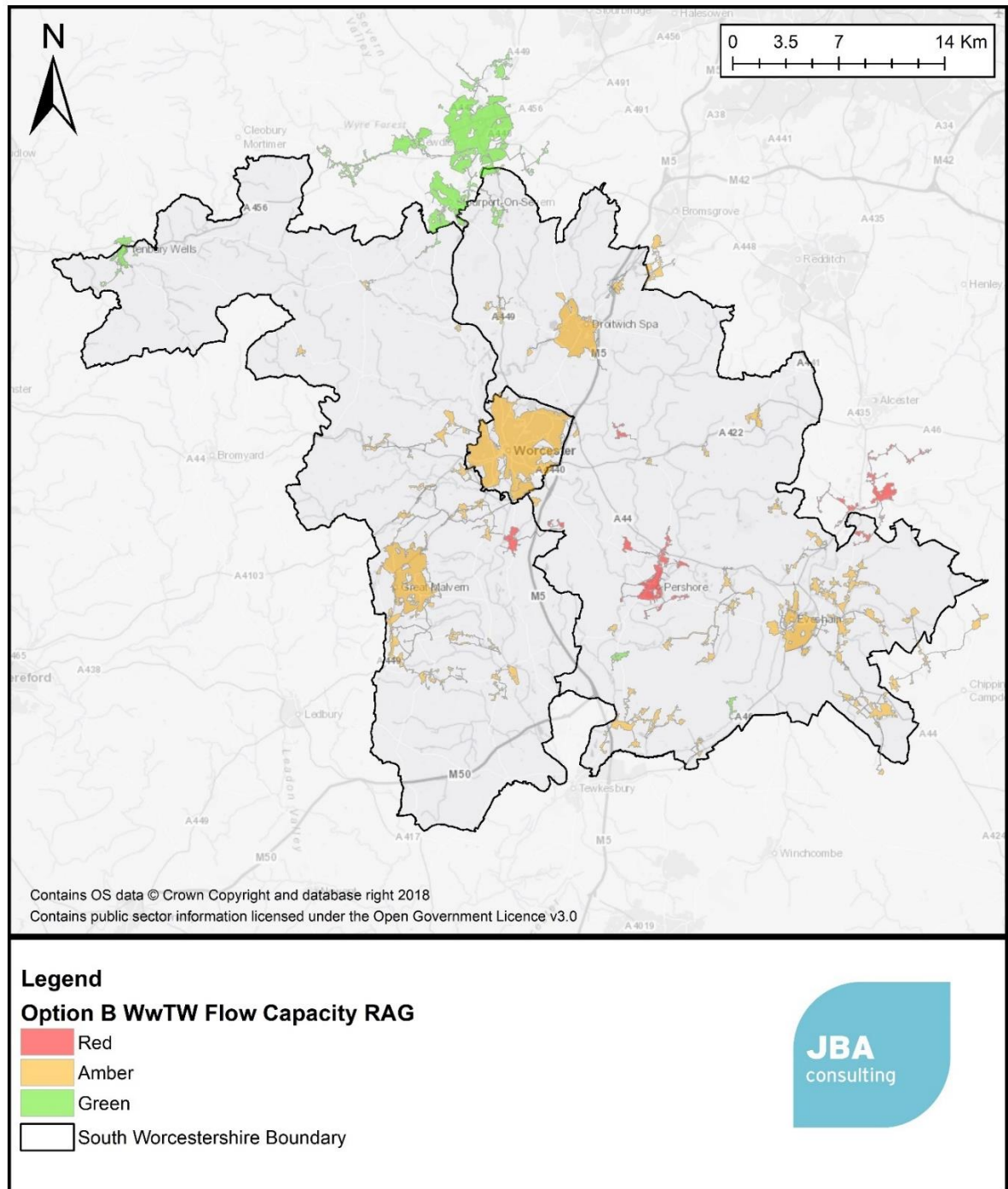


Figure 7.4 Option B results

Option C – Infill/regeneration

Figure 7.5 below shows the wastewater catchments serving growth in option C with the corresponding RAG score applied. Six WwTW are expected to serve growth in this scenario. The capacity of each of these WwTW is shown in Appendix B.

In this scenario three of the WwTW (serving 24 development sites in Tenbury, Evesham and Worcester) have been given a green assessment by STW where there is sufficient hydraulic capacity and no quality concerns. The remaining three WwTW serving 25 development sites within Pershore and Malvern were given an “amber” score by STW reflecting either limited hydraulic capacity or quality concerns in those catchments, and the need for upgrades at these WwTW.

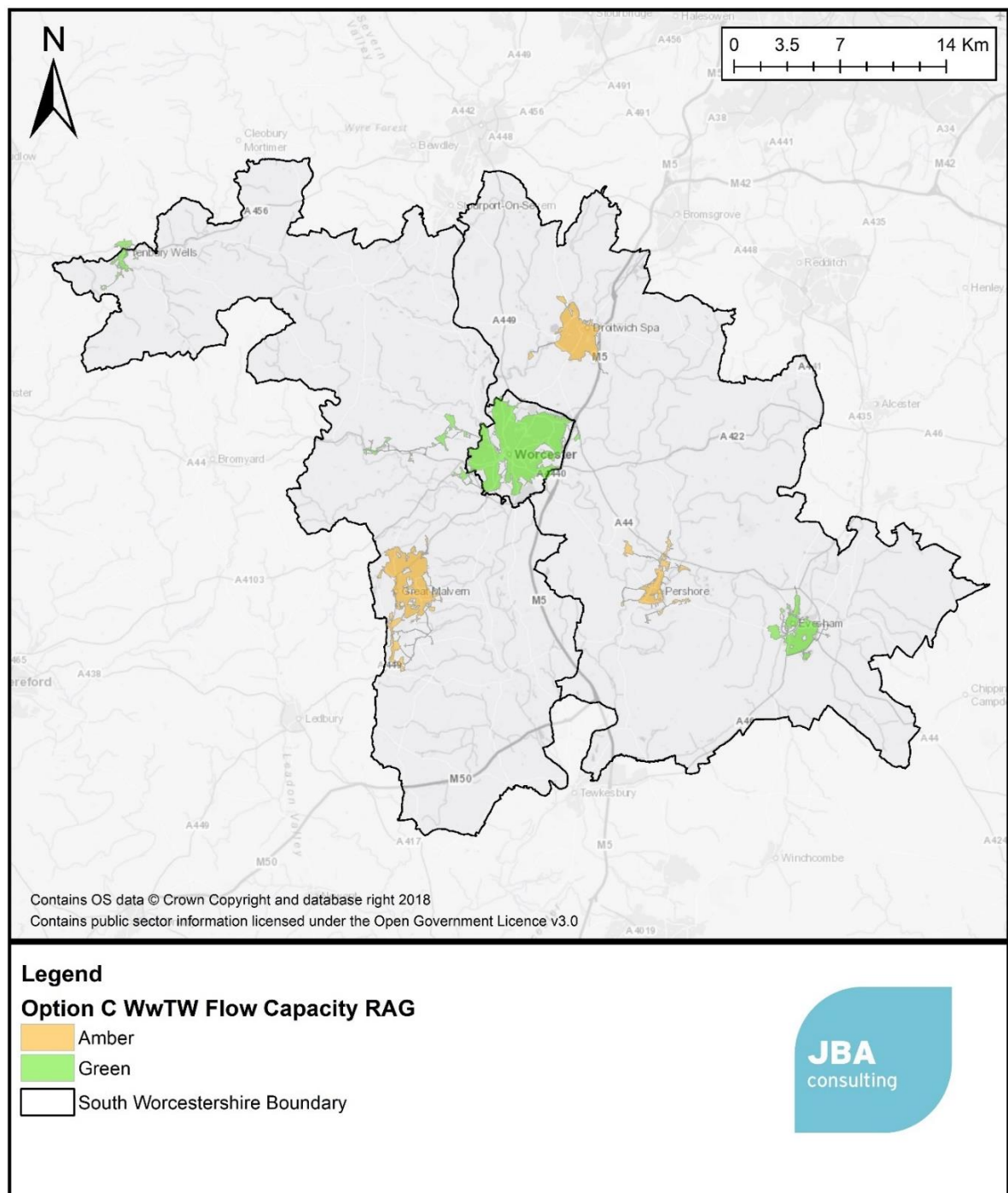


Figure 7.5 Option C results

Option D – Large urban extensions

Figure 7.6 below shows the wastewater catchments serving growth in option D with the corresponding RAG score applied. Three WwTW are expected to serve growth in this scenario. The capacity of each of these WwTW is shown in Appendix B.

In this scenario Droitwich-Ladywood WwTW, serving 33 development sites around Droitwich has been given an “amber” assessment by STW reflecting the lack of hydraulic capacity at this works. Investment in this works is expected in 2020-25 to increase capacity, however if significant growth is planned in this catchment, early liaison with STW is required to make sure that the planned upgrades at this works can accommodate all the planned growth in the future.

The remaining 39 sites in this scenario are served by Worcester-Bromwich Road and Malvern WwTWs, which have been given a “green” assessment by STW in this scenario.

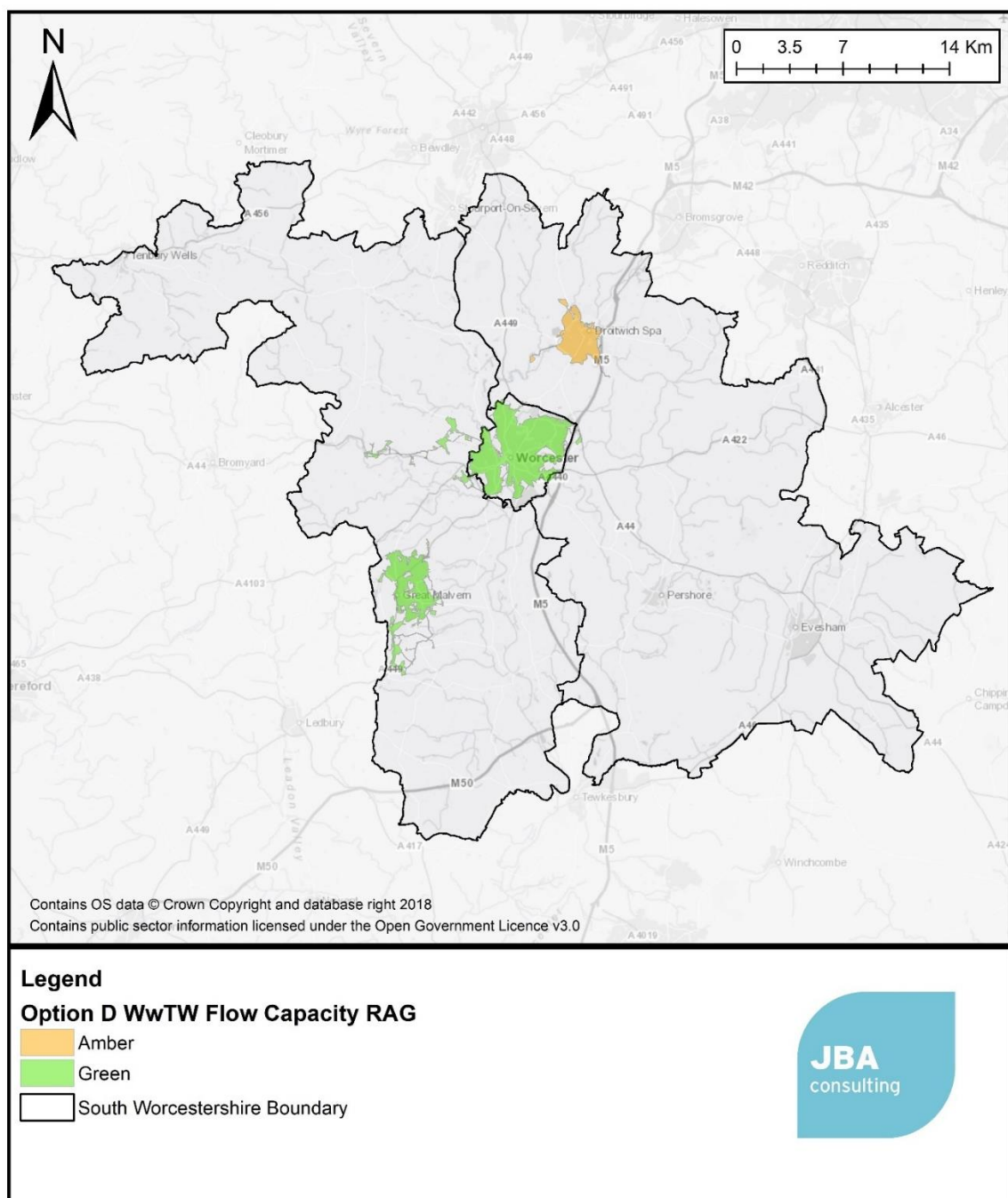
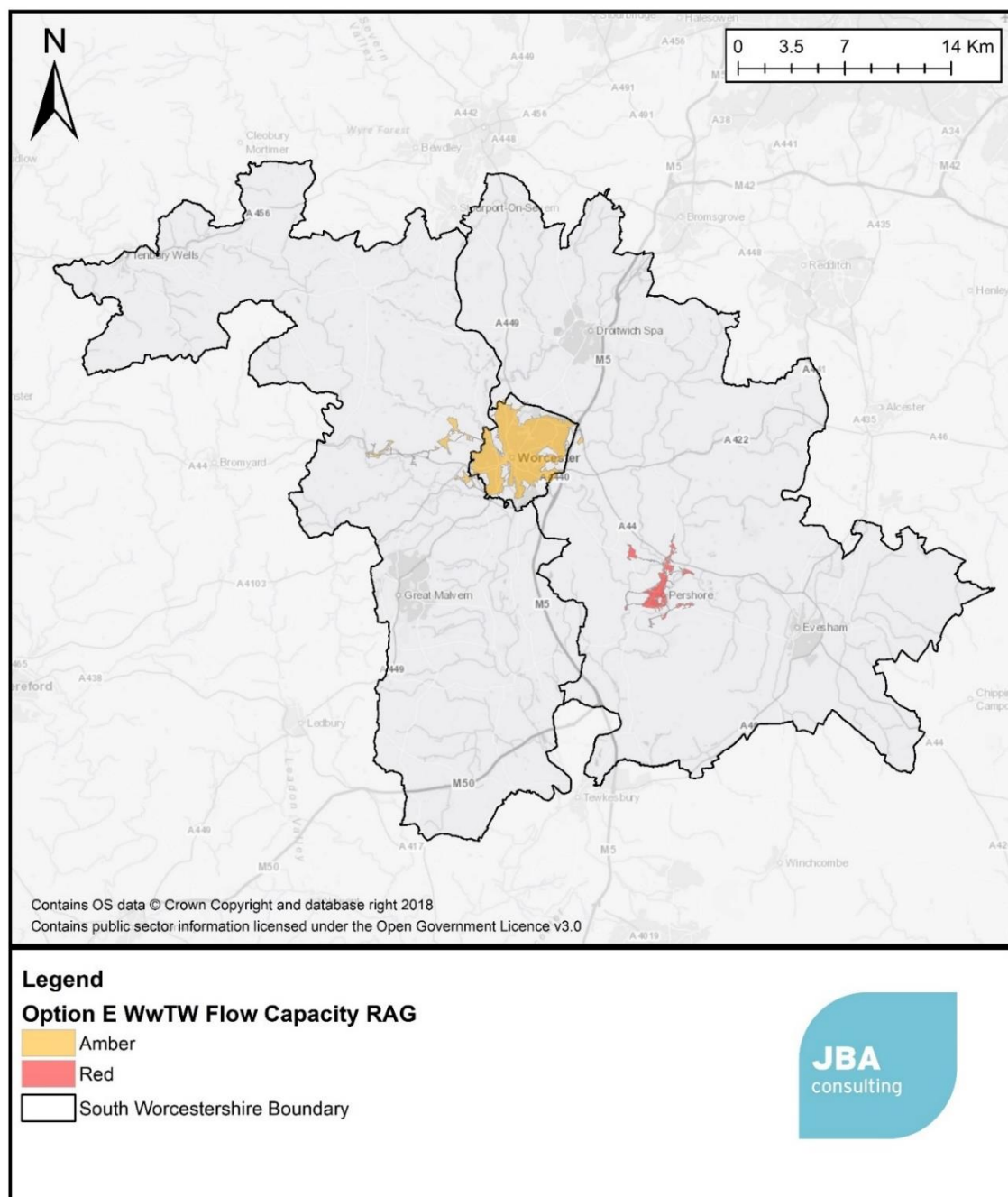


Figure 7.6 Option D results

Option E – New/expanded settlements/sites

Figure 7.7 below shows the wastewater catchments serving the potential new/expanded settlements/sites in option E with the corresponding RAG score applied. Rushwick and Worcestershire Parkway new/expanded settlement proposals would be served by Worcester-Bromwich Road WwTW, and the Throckmorton new/expanded settlement proposal would be served by Pershore WwTW. The capacity of each of these WwTW is shown in Appendix B.

Pershore has been given a “red” assessment by STW as there is limited hydraulic capacity and limited headroom in quality performance. Worcester-Bromwich Road WwTW has been given an “amber” assessment by STW as upgrades would be required to serve settlements of this size. Upgrades are currently planned in the period 2020-25 to serve existing growth. Early liaison with STW is required if this option was to be adopted to make sure that this option was accommodated as part of existing upgrades.



7.5 Conclusions

STW provided assessments of the WwTW serving growth in each scenario based on both hydraulic capacity and headroom in the environmental permit. JBA carried out a flow permit assessment in parallel to this.

Where a red assessment is given it does not indicate that growth cannot take place in that area, just that additional infrastructure will be required in order to accommodate it.

The results suggest that of the five growth Options, C and D (infill, and large urban extensions) are the easiest to accommodate with the minimal additional infrastructure. Option A and Option E concentrate growth in areas where capacity is limited, and so upgrades would be required at WwTW serving that growth. Option B, development on the periphery of existing settlements, distributes growth between 35 WwTW. Where capacity exists at a particular WwTW then growth could be accommodated, however where capacity is limited, and upgrades are required, it may be more efficient to focus growth in fewer locations, and for STW to carry out strategic upgrades to serve a greater number of development sites.

Upgrades are currently planned at a number of WwTW, and early engagement with STW is required to ensure that opportunities to accommodate this growth within exiting upgrade schemes can be realised.

Once the SWCs have confirmed which sites will be developed, and STW have modelled the additional demand, where capacity is not currently available, STW will complete necessary improvements to provide the capacity. They will ensure that their assets have no adverse effect on the environment and that appropriate levels of treatment are provided at each of their sewage treatment works.

Further study of the wastewater treatment capacity is recommended as part of a Phase 2 Outline study as the SWDP develops and the SWCs have greater certainty over which sites will be brought forward for development.

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.	SWCs STW	Ongoing
Provide Annual Monitoring Reports to STW detailing projected housing growth in each of the Local Authorities.	SWCs	Ongoing
STW to assess growth demands as part of their wastewater asset planning activities and feedback to the Councils if concerns arise.	STW SWCs	Ongoing

8 Odour Assessment

8.1 Introduction

Where new developments encroach upon 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.

8.2 Methodology

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 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 approximate population served by each WwTW has been used to assign a "trigger" distance. Where the distance between the site and the WwTW is greater than the trigger distance, an odour assessment is needed.

Another important aspect is the location of the site in respect to the WwTW. Historic wind direction records for sites around South Worcestershire indicate that the prevailing wind is from south (Birmingham airport) to south southwest (Staverton, Gloucestershire) recorded at METAR weather stations⁵³.

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

Site is unlikely to be impacted by odour from WwTW	Site location is such that an odour impact assessment is recommended	Site is in an area with confirmed WwTW odour issues
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8.3 Data Collection

The datasets used to assess the impact of odour from a WwTW were:

- Site location in GIS format (provided by SWCs)
- WwTW locations (from "Consented discharges to controlled waters with conditions" database)
- Site tracker spreadsheet (see Appendix A)

8.4 Results

There are 20 potential development sites that may require an odour assessment. A full list of sites is contained in Table 8-1, and shown graphically Figure 8.1.

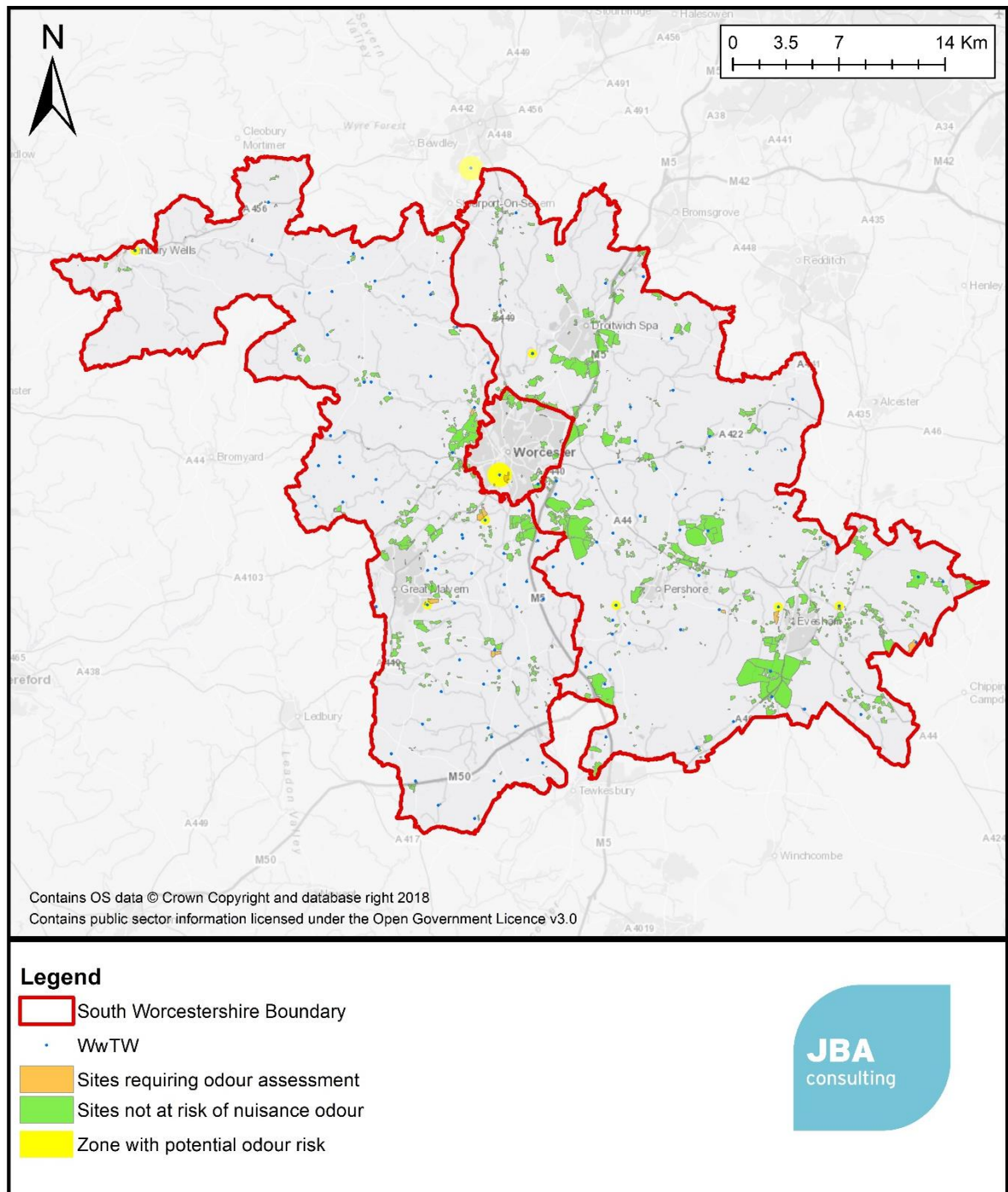


Figure 8.1 Sites and buffer zones surrounding each WwTW

Table 8-1 Sites with potential risk of nuisance odour

WwTW	Site Ref.	Distance from WwTW (m)	Direction to WwTW	Encroaches closer than existing urban area (Y/N)
Blackminster	CFS0385	13	NNW	Y
	CFS0478	48	NNW	Y
Cropthorne Heath	CFS0746	96	W	Y
Evesham Works	CFS0679	247	NNW	Y
Hallow	CFS0344	4	ENE	N
Harvington	CFS0796	36	SE	Y
Honeybourne	CFS0924	13	ESE	Y
	CFS0925	13	ESE	Y
Kempsey	CFS0777	0	N	Y
Malvern	CFS0353	116	E	Y
	CFS0905	178	SW	Y
Powick	CFS0397	182	SSE	N
	CFS0508	206	SSE	N
Quay Lane	CFS0156	26	NE	N
	CFS0157	2	W	N
Worcester Bromwich Road	CFS0572	508	W	N
	CFS0573	455	WNW	N
	CFS0809	675	NNE	N
	CFS0933	316	WNW	N
	CFS1076	581	WNW	N

8.5 Conclusions

20 sites are identified as being at risk of nuisance odour and given a RAG rating of amber. An odour assessment is recommended as part of the planning process, paid for by developers. The remaining sites have been given a rating of green.

No further assessment of odour is recommended as part of a Phase 2 WCS. Any future assessment should be carried out as part of the planning process.

8.6 Recommendations

Table 8-2 Recommendations from the odour section

Action	Responsibility	Timescale
Consider odour risk in the sites identified to be potentially at risk from nuisance odour	SWCs	Ongoing
Carry out an odour assessment for 'amber' assessed sites.	Site Developers	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 instructions⁵⁴ (now withdrawn) set out a hierarchy for how the no-deterioration requirements of the WFD should be implemented on inland waters. 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”⁵⁵ 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.
- **Could the development alone prevent the receiving watercourse from reaching Good Ecological Status (GES) or Potential?** Is GES possible with current technology or is GES technically possible after development with any potential WwTW upgrades.

9.2 Methodology

A qualitative assessment was conducted using available data on WFD Cycle 2 status for the receiving watercourse, forecast growth for each WwTW and existing water quality assessments conducted on each WwTW where available.

⁵⁴ Water Quality Planning: no deterioration and the Water Framework Directive, Environment Agency (2012). Accessed online at: http://www.fwr.org/WQreg/Appendices/No_deterioration_and_the_WFD_50_12.pdf on: 29/10/2018

⁵⁵ PRESS RELEASE No 74/15, European Court of Justice (2015). Accessed online at: <https://curia.europa.eu/jcms/upload/docs/application/pdf/2015-07/cp150074en.pdf> on: 23/01/2019

9.3 Results

9.3.1 Overview

Figure 9.1 shows the Cycle 2 Water Framework Directive overall waterbody classifications for watercourse in the study area, and the location of the 35 WwTW that are likely to be serving growth. The majority of the waterbodies have a moderate or poor ecological status, and in all of the waterbodies that contain a WwTW serving growth, sewage discharge was cited as one of the “reasons for not achieving good status”. The ecological status of each waterbody, with the respective determinand status is contained in Table 9-1. The exception to this is the River Teme (River Onny to River Severn) which is currently achieving good ecological status. Also contributing to the good status not being achieved are diffuse sources of phosphate from agriculture (Livestock and poor nutrient management), and in some cases from urban and transport sources. The RBMP for the River Severn⁵⁶ estimates that pollution from wastewater affects 29% of water bodies within this river basin district.

⁵⁶ Severn river basin district River basin management plan (LIT 10315), Environment Agency (2015). Accessed online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/718336/Severn_RBD_Part_1_river_basin_management_plan.pdf on: 03/04/2019

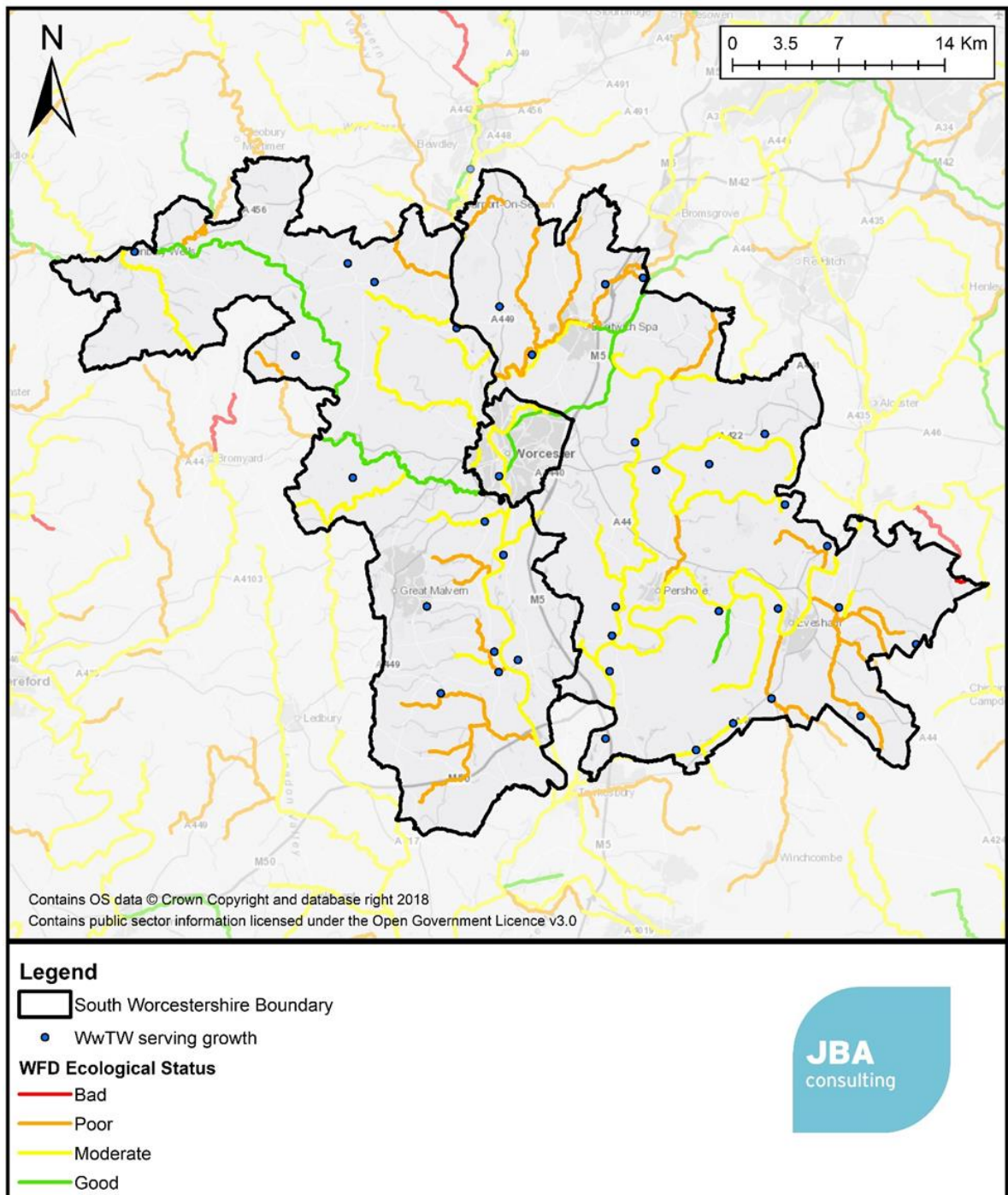


Figure 9.1 WFD status of waterbodies in South Worcestershire

Table 9-1 Summary of WFD Ecological Status by waterbody

WFD Waterbody Name	Ecological Class (cycle 2 2016)	Sanitary Determinand Class (Cycle 2 2016)			Reasons for not achieving good status	WwTW discharging in this waterbody	Permitted DWF (MI/d)	Growth Scenario (Y/N)				
		NH ₄	BOD	P				A	B	C	D	E
Carrant Bk - source to conf R Avon	MODERATE	HIGH		POOR	P (PS) - Sewage discharge (continuous) P (D) - Livestock and Poor nutrient management	Ashton-u-hill	0.145		Y			
						Beckford	0.22		Y			
Avon - Tramway Br Stratford to Workan Br Evesham	MODERATE	GOOD	HIGH	POOR	P (PS) - Sewage discharge (continuous) P (D) - Livestock, and urban and transport.	Bidford on Avon	1.87		Y			
						Stratford Milcote	13.11		Y			
Avon conf Workman Br, Evesham to conf R Severn	MODERATE	HIGH	HIGH	POOR	P (PS) - Sewage discharge (continuous) P (D) - Livestock	Bredon	1.084		Y			
						Cropton Heath	0.63		Y			
						Evesham Works	5.797	Y	Y	Y		
						Eckington Works	0.26		Y			
Broadway - Badsey Bk - source to conf R. Avon	MODERATE	HIGH	HIGH	POOR	P (PS) - Sewage discharge (continuous) P (D) - Livestock and Poor pesticide management	Broadway	1.03		Y			
						Blackminster	2.756	Y	Y			
Whitsunn Bk - source to conf Piddle BK	MODERATE	HIGH		POOR	P (PS) - Sewage discharge (continuous)	Church Lench	0.147		Y			
Sapey Bk - source to conf R Teme	POOR	HIGH		MODERATE	P (PS) - Sewage discharge (continuous) P (D) - Poor nutrient management	Clifton upon Teme	0.173		Y			
	MODERATE	HIGH	HIGH	POOR		Crowle Worcester	0.16		Y			

WFD Waterbody Name	Ecological Class (cycle 2 2016)	Sanitary Determinand Class (Cycle 2 2016)			Reasons for not achieving good status	WwTW discharging in this waterbody	Permitted DWF (MI/d)	Growth Scenario (Y/N)				
		NH ₄	BOD	P				A	B	C	D	E
Bow Bk - Shell to conf R Avon					P (PS) - Sewage discharge (continuous) P (D) - Livestock and Poor nutrient management	Defford Village	0.124		Y			
						Pershore	3.838	Y	Y	Y		Y
Salwarpe - conf Elmbridge to conf R Severn	POOR	HIGH	HIGH	POOR	P (PS) - Sewage discharge (continuous) P (D) - Livestock, Poor nutrient management and urban and transport.	Droitwich-Ladywood	7.183	Y	Y	Y	Y	
Piddle Bk - source to conf Whitsun Bk	MODERATE	HIGH		POOR	P (PS) - Sewage discharge (continuous) P (D) - livestock and poor nutrient management	Flyford Flavell	0.054		Y			
						Inkberrow	0.359		Y			
						Upton Snodsbury	0.077		Y			
Dick Bk - source to conf R Severn	POOR	HIGH	HIGH	GOOD	Invasive non-native species	Great Whitley	0.045		Y			
Harvington Bk - source to conf R Avon	POOR	HIGH		GOOD	Macrophytes and Phytobenthos - Sewage discharge (continuous)	Harvington Works	0.434		Y			
Bretforton Bk - source to conf Broadway-Badsey Bk	POOR	HIGH		POOR	P (PS) - Sewage discharge (continuous)	Honeybourne	1.646		Y			
Severn - conf R Stour to conf R Teme	MODERATE	HIGH	HIGH	MODERATE	P (PS) - Sewage discharge (continuous)	Holt Heath	0.084		Y			
						Kidderminster Oldington	26.504	Y	Y			
						Worcester-Bromwich Road	33	Y	Y	Y	Y	

WFD Waterbody Name	Ecological Class (cycle 2 2016)	Sanitary Determinand Class (Cycle 2 2016)			Reasons for not achieving good status	WwTW discharging in this waterbody	Permitted DWF (MI/d)	Growth Scenario (Y/N)				
		NH ₄	BOD	P				A	B	C	D	E
Severn - conf R Teme to conf R Avon	MODERATE	HIGH	HIGH	MODERATE	P (PS) - Sewage discharge (cont.) P (D) - Livestock	Kempsey works	1.09		Y			
						Malvern	13.4	Y	Y	Y	Y	
						Quay Lane	0.291		Y			
						Upton upon Severn	1.18		Y			
Hadley Bk - source to conf R Salwarpe	POOR	HIGH		POOR	P (PS) - Sewage discharge (cont.) P (D) - Livestock, Poor nutrient management and urban & transport.	Ombersley	0.1		Y			
Careys Bk - source to conf R Severn	MODERATE	HIGH		MODERATE	P (PS) - Private sewage treatment P (D) - Livestock	Powick	2.838		Y			
Salwarpe - source to conf Elmbridge Bk	MODERATE	HIGH	HIGH	BAD	P (PS) - Sewage discharge (cont.) and private sewage treatment P (D) - Livestock, Poor nutrient management and urban and transport.	Stoke Prior	1.2		Y			
						Wychbold	0.458		Y			
Teme - conf R Onny to conf R Severn	GOOD	HIGH	HIGH	GOOD	N/A	Tenbury	1.245		Y	Y		
Bushley Longdon Bk - source to conf R Severn	POOR	HIGH		POOR	P (PS) - Sewage discharge (cont.) and private sewage treatment P (D) - Livestock, Poor nutrient management and urban and transport.	Welland	0.303		Y			Y

P = Phosphate (PS) = Point source (D) = Diffuse

9.3.2 Other WwTWs within South Worcestershire

There are 138 WwTWs within South Worcestershire, and many more upstream within the River Severn RBD. All of these have a cumulative impact on water quality in the river basin. For the purpose of this study, WwTW within the study area, but not expected to receive growth are assumed to maintain the same effluent flow and quality during the Local Plan period and have not been assessed.

9.4 Priority substances

As well as the general chemical and physicochemical 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 wastewater treatment works 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 the WCS 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.
- 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 sections 11.3.3 and 11.3.4.
- 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 seem more appropriate to be managing 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 the Water Cycle Study.

9.5 Distribution of growth

The five different growth scenarios produce different challenges to water quality in the study area. The impact of growth will depend on the current water quality (as indicated in the WFD status of the waterbody), the quantity of new houses within the wastewater catchment, the performance of each WwTW and its capacity to be upgraded to provide a higher level of treatment.

In general terms Options D and E (large urban extensions and new/expanded settlements) will concentrate growth at just a few WwTW so the increase in effluent flow, and its potential impact could be large. Option B (growth on the periphery of existing settlements) distributes growth across the study area, using many treatment works. This may allow the impact on water quality to be distributed, reducing the likelihood of WFD deterioration, however the total effluent load in the study area would be the same, and upgrading multiple WwTW to prevent deterioration would not be as cost effective as providing a strategic upgrade to a limited number of WwTW.

Water quality modelling, using a catchment-wide approach is required in order to understand the current capacity of the water environment and the impact of each of the five growth options.

9.6 Conclusions

The increased wastewater discharges at the WwTWs serving growth in South Worcestershire have the potential to impact downstream water quality in the receiving watercourses.

Further assessment of the impact upon water quality should be undertaken, for the above WwTW, as part of a Phase 2 Outline Water Cycle Study. In particular, consideration should be paid to those which already have a 'poor' or 'bad' status and are forecast for increased growth.

9.7 Proposed methodology for Phase 2

Water Quality is a cross-boundary issue, and the impacts of growth can be cumulative where wastewater treatment works receiving growth from several local authorities, discharge to a river system. The Environment Agency advised that, where several treatment works discharge into the same river system, it is their preference that the impacts are assessed using catchment scale modelling. The EA provided two SIMCAT models covering the River Severn River Basin District, one for ammonia and BOD and one for phosphate. These were calibrated to a 2010 baseline and no updates to this model are currently planned by the EA. An updated base model will need to be prepared as part of a Phase 2 study.

The existing model will be updated to include:

- Latest river flow data from the National River Flow Archive for waterbodies within the study area;
- WwTW expected to serve growth within the study area will be updated using data supplied by STW;
- WQ data at selected sampling points in the model will be updated using data obtained from the EA Water Quality Data Archive.

Manual calibration of the model will be carried out to ensure a fit to observed data. It is not anticipated that this will result in significant changes to the model.

The model will then be re-run using estimated future flows for the WwTW expected to serve growth.

Spot checks will be performed on the major WwTWs using the EA's RQP (single site) assessment tool.

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 extra flow reaching a specific WwTW:

- Calculate the increase in DWF attributable to planned growth;
- Identify the point of discharge of these WwTWs;
- At each outfall point, use the FEH CD-ROM v3.0 or FEH Webservice to extract the catchment descriptors;
- 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 score was applied to score the associated risk as follows:

Additional flow $\leq 5\%$ of Q30. Low risk that increased discharges will increase fluvial flood risk	Additional flow $\geq 5\%$ of Q30. Moderate risk that increased discharges will increase fluvial flood risk	Additional flow $\geq 5\%$ of Q100. High risk that increased discharges will increase fluvial flood risk
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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 v3.0⁵⁷
- Catchment descriptors from FEH Web Service⁵⁸

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.

57 FEH CD-ROM v3.0 © NERC (CEH). © Crown copyright. © AA. 2009. All rights reserved.

58 FEH Web Service © and database right NERC (CEH) 2015. All rights reserved Accessed online at: <https://fehweb.ceh.ac.uk/> Catchment descriptors extracted on: 21/01/2019

10.3 Results

Table 10-1 to Table 10-5 reports the additional flow from each WwTW as a percentage of the Q30 and Q100 peak flow (using the lowest from either the ReFH or FEH Stat method to be the most conservative). Note that where the ReFH peak flow is stated as n/a, the catchment was unsuitable for using the ReFH method. The results show 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 - Option A

WwTW	ReFH Q30 m ³ /s	ReFH Q100 m ³ /s	FEH Stat Q30 m ³ /s	FEH Stat Q100 m ³ /s	Add. Average DWF MI/d	Add. Flow m ³ /s	Flow increase % Q30	Flow increase % Q100
Blackminster	40.4	51.5	30.9	36.9	0.6	0.006	0.02%	0.02%
Droitwich-Ladywood	43.2	53.8	44.1	58.8	1.1	0.012	0.03%	0.02%
Evesham Works	n/a	n/a	325.3	385.7	1.4	0.016	0.01%	0.00%
Kidderminster Oldington	n/a	n/a	60.3	81.3	1.8	0.021	0.03%	0.03%
Malvern	n/a	n/a	2.2	3.0	1.0	0.012	0.54%	0.40%
Pershore	42.4	52.4	50.6	63.8	0.8	0.010	0.02%	0.02%
Worcester-Bromwich Road	n/a	n/a	898.3	1097.8	6.6	0.076	0.0%	0.01%

Table 10-2 Summary of DWF increase a % of Q30 and Q100 peak flows - Option B

WwTW	ReFH Q30 m ³ /s	ReFH Q100 m ³ /s	FEH Stat Q30 m ³ /s	FEH Stat Q100 m ³ /s	Add. Average DWF MI/d	Add. Flow m ³ /s	Flow increase % Q30	Flow increase % Q100
Ashton-u-hill	6.3	8.3	4.6	6.0	0.00	0.000	0.01%	0.01%
Beckford	26.5	34.3	19.1	23.8	0.1	0.001	0.01%	0.01%
Bidford on Avon	407.7	501.4	298.5	354.3	0.7	0.008	0.00%	0.00%
Blackminster	40.4	51.5	30.9	36.9	1.1	0.013	0.04%	0.03%
Bredon	1.2	1.6	0.8	1.0	0.0	0.000	0.06%	0.05%
Broadway	0.5	0.67	0.3	0.4	0.4	0.005	1.81%	1.36%
Church Lench	1.6	2.1	0.8	1.1	0.0	0.000	0.02%	0.02%
Clifton upon Teme	0.4	0.5	0.3	0.3	0.2	0.002	0.94%	0.72%
Crophorne Heath	424.1	519.4	328.7	390.0	0.2	0.002	0.00%	0.00%
Crowle Worcester	31.5	39.4	31.3	37.9	0.7	0.007	0.02%	0.02%
Defford Village	41.3	50.9	50.8	64.1	0.1	0.001	0.00%	0.00%
Droitwich-Ladywood	43.2	53.8	44.1	58.8	3.0	0.035	0.08%	0.07%
Eckington Works	n/a	n/a	0.5	0.7	0.0	0.000	0.05%	0.04%

WwTW	ReFH Q30 m ³ /s	ReFH Q100 m ³ /s	FEH Stat Q30 m ³ /s	FEH Stat Q100 m ³ /s	Add. Average DWF Ml/d	Add. Flow m ³ /s	Flow increase % Q30	Flow increase % Q100
Evesham Works	n/a	n/a	325.3	385.7	6.3	0.073	0.02%	0.02%
Flyford Flavell	15.8	20.0	14.8	18.3	0.0	0.000	0.00%	0.00%
Great Witley	n/a	n/a	0.3	0.3	0.1	0.001	0.48%	0.36%
Harvington Works	3.4	4.4	2.6	3.5	0.2	0.002	0.07%	0.06%
Holt Heath	n/a	n/a	881.0	1076.6	0.1	0.001	0.00%	0.00%
Honeybourne	4.6	5.9	4.2	5.6	0.2	0.001	0.06%	0.05%
Inkberrow	1.7	2.2	1.4	1.8	0.3	0.003	0.25%	0.19%
Kempsey works	n/a	n/a	1068.4	1295.7	1.1	0.013	0.00%	0.00%
Kidderminster Oldington	n/a	n/a	60.3	81.3	2.0	0.023	0.04%	0.03%
Malvern	n/a	n/a	2.2	3.0	2.2	0.026	1.15%	0.85%
Ombersley	n/a	n/a	0.3	0.4	0.1	0.001	0.35%	0.26%
Pershore	42.4	52.4	50.6	63.8	2.2	0.025	0.06%	0.05%
Powick	8.5	10.8	9.6	12.8	1.4	0.016	0.19%	0.15%
Quay Lane	n/a	n/a	1069.0	1296.5	0.1	0.002	0.00%	0.00%
Stoke Prior	3.9	5.0	4.1	5.5	0.2	0.002	0.06%	0.05%
Stratford Milcote	n/a	n/a	244.2	293.5	0.7	0.008	0.00%	0.00%
Tenbury	n/a	n/a	202.1	244.5	0.2	0.002	0.00%	0.00%
Upton upon Severn	n/a	n/a	1074.8	1303.4	0.1	0.002	0.00%	0.00%
Upton Snodsbury	1.6	2.1	1.3	1.7	0.2	0.003	0.21%	0.16%
Welland	5.2	6.7	4.4	5.8	0.1	0.001	0.02%	0.02%
Worcester-Bromwich Road	n/a	n/a	898.3	1097.8	9.8	0.113	0.01%	0.01%
Wychbold	11.8	15.2	11.8	14.8	0.3	0.003	0.02%	0.02%

Table 10-3 Summary of DWF increase as a % of Q30 and Q100 peak flow - Option C

WwTW	ReFH Q30 m ³ /s	ReFH Q100 m ³ /s	FEH Stat Q30 m ³ /s	FEH Stat Q100 m ³ /s	Add. Average DWF Ml/d	Add. Flow m ³ /s	Flow increase % Q30	Flow increase % Q100
Droitwich-Ladywood	43.2	53.8	44.1	58.8	0.3	0.003	0.01%	0.01%
Evesham Works	n/a	n/a	325.3	385.7	0.3	0.003	0.00%	0.00%
Malvern	n/a	n/a	2.2	3.0	0.6	0.007	0.33%	0.24%
Pershore	42.4	52.4	50.6	63.8	0.2	0.002	0.00%	0.00%
Tenbury	n/a	n/a	202.1	244.5	0.1	0.001	0.00%	0.00%

Worcester-Bromwich Road	n/a	n/a	898.3	1097.8	4.8	0.056	0.01%	0.01%
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Table 10-4 Summary of DWF increase a % of Q30 and Q100 peak flow - Option D

WwTW	ReFH Q30 m ³ /s	ReFH Q100 m ³ /s	FEH Stat Q30 m ³ /s	FEH Stat Q100 m ³ /s	Add. Average DWF Ml/d	Add. Flow m ³ /s	Flow increase % Q30	Flow increase % Q100
Droitwich-Ladywood	43.2	53.8	44.1	58.8	4.0	0.046	0.11%	0.09%
Malvern	n/a	n/a	2.2	3.0	1.4	0.017	0.75%	0.55%
Worcester-Bromwich Road	n/a	n/a	898.3	1097.8	6.9	0.080	0.01%	0.01%

Table 10-5 Summary of DWF increase as a % of Q30 and Q100 peak flow - Option E

WwTW	ReFH Q30 m ³ /s	ReFH Q100 m ³ /s	FEH Stat Q30 m ³ /s	FEH Stat Q100 m ³ /s	Add. Average DWF Ml/d	Add. Flow m ³ /s	Flow increase % Q30	Flow increase % Q100
Pershore	42.4	52.4	50.6	63.8	1.7	0.020	0.05%	0.04%
Worcester-Bromwich Road	n/a	n/a	898.3	1097.8	7.7	0.089	0.01%	0.01%

10.4 Conclusions

- A detailed assessment of flood risk can be found within the South Worcestershire Level 1 Strategic Flood Risk Assessment (at the time of writing this was in the process of being updated).
- The impact of increased effluent flows is not predicted to have a significant impact upon flood risk in any of the receiving watercourses in any of the growth scenarios.

Increases in discharges of treated wastewater effluent as a result of growth are not expected to significantly increase flood risk. No further assessment is recommended in a Phase 2 WCS.

10.5 Recommendations

Table 10-6 Recommendations from 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 Opportunities and Constraints

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.

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.

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

After or during heavy rainfall, the first flush of water carrying accumulated dust and dirt is often highly polluted. Development has the potential to increase the diffuse pollution by providing additional sources from roads and housing estates.

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.

11.2 Sites with Environmental Designation

11.2.1 Sites protected by European designations

The Habitats Regulations Assessment process is designed to ensure that consideration is given within planning policy to sites protected by European Directives, namely Special Areas of Conservation (SAC) or Special Protection Areas (SPA). There are no SPAs in South Worcestershire, however the Bredon Hill and Lyppard Grange Ponds SACs fall within the South Worcestershire boundary, and Dixon Wood SAC lies approximately 2.5km south of the study area. These three SACs are also designated as SSSIs.

There is no hydrological pathway from WwTW or development sites to these SACs, so impact at these sites will not be assessed further in the WCS.

11.2.2 Sites of Special Scientific Interest

SSSIs are not subject to the HRA process, but are protected under the Wildlife and Countryside Act, and the impact of development on these sites must also be considered. There are several SSSIs within the study area boundary, as well as many outside which could be affected by the effects of development upstream. 83 SSSIs lie in or within 2km of South Worcestershire and are shown in Figure 11.1 below.

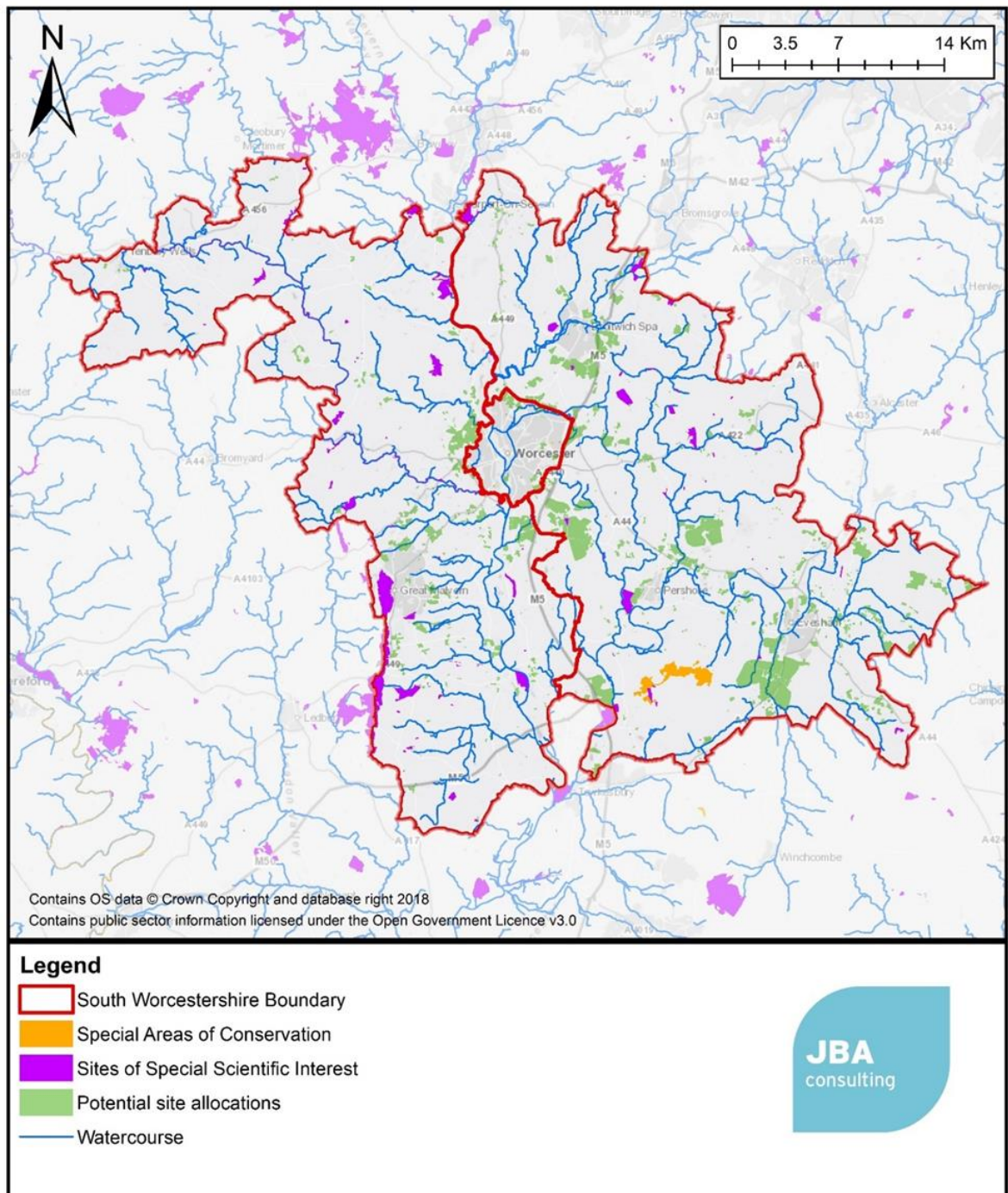


Figure 11.1 Sites with environmental designations

11.3 Point source pollution

The main sources of point source water pollution in South Worcestershire are the WwTWs. The effect of additional wastewater flows on water quality is assessed in section 9, and a summary of their potential impact following a source-pathway-receptor approach is presented in Table 11-1. The SSSIs within 20km of each WwTW have been assessed. In many cases, deterioration in water quality from additional wastewater flow could be prevented by treatment at technically achievable limit (TAL), but this needs to be verified through a water quality assessment.

Table 11-1 WwTW serving growth in South Worcestershire relative to sites with environmental designations

Source	Pathway	Receptor	Distance downstream (km)	Potential Impact
Ashton under Hill WwTW	Carrant Brook, River Avon	Severn Ham, Tewkesbury SSSI (SO885325) Old River Severn, Upper Lode SSSI (SO88030)	12	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
Beckford WwTW	Carrant Brook, River Avon	Severn Ham, Tewkesbury SSSI (SO885325) Old River Severn, Upper Lode SSSI (SO88030)	5	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
	Carrant Brook, River Avon and River Severn	Wainlode Cliff SSSI (SO845257) Ashleworth Ham SSSI (SO832262)	15	
Bishampton WwTW	Whitsunn Brook, Piddle Brook and River Avon	Tiddesley Wood SSSI (SO929452)	12	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
Bredon WwTW	River Avon	Severn Ham, Tewkesbury SSSI (SO885325) Old River Severn, Upper Lode SSSI (SO88030)	10	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
Church Lench WwTW	Whitsunn Brook, Piddle Brook and River Avon	Tiddesley Wood SSSI (SO929452)	19	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
Clifton on Teme WwTW	Sapey Brook	River Teme SSSI (SO507745)	8	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
	Sapey Brook and River Teme	Osebury Rock SSSI (SO737555) Lord's Wood Meadows SSSI (SO732552)	9	
Crothorne Heath WwTW	River Avon	Tiddesley Wood SSSI (SO929452)	7	Water quality deterioration possible. WQ Assessment

Source	Pathway	Receptor	Distance downstream (km)	Potential Impact
		Rectory Farm Meadows SSSI (SO921382) Upham Meadow and Summer Leasow SSSI (SO915375)	20	required as part of Phase 2 Study
Crowle Worcester WwTW	Bow Brook	Tiddesley Wood SSSI (SO929452)	14	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
Defford Village WwTW	Bow Brook and River Avon	Rectory Farm Meadows SSSI (SO921382) Upham Meadow and Summer Leasow SSSI (SO915375)	5.5	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
		Severn Ham, Tewkesbury SSSI (SO885325) Old River Severn, Upper Lode SSSI (SO88030)	12.5	
Droitwich Ladywood WwTW	River Salwarpe and River Severn	Grimley Brick Pits SSSI (SO838616)	5	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
		Northwick Marsh SSSI (SO835579)	7.5	
Eckington Works WwTW	River Avon	Rectory Farm Meadows SSSI (SO921382) Upham Meadow and Summer Leasow SSSI (SO915375)	2	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
		Severn Ham, Tewkesbury SSSI (SO885325) Old River Severn, Upper Lode SSSI (SO88030)	9	
	River Avon and River Severn	Wainlode Cliff SSSI (SO845257)	19	

Source	Pathway	Receptor	Distance downstream (km)	Potential Impact
		Ashleworth Ham SSSI (SO832262)		
Evesham Works WwTW	River Avon	Tiddesley Wood SSSI (SO929452)	17	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
		Rectory Farm Meadows SSSI (SO921382) Upham Meadow and Summer Leasow SSSI (SO915375)	30	
Flyford Flavell WwTW	Piddle Brook	Grafton Wood SSSI (SO973560)	0.8	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
	Piddle Brook and River Severn	Tiddesley Wood SSSI (SO929452)	18	
Great Witley WwTW	Tributary of the Dick Brook and Dick Brook	Shrawley Wood SSSI (SO808659)	5	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
	Tributary of the Dick Brook, Dick Brook and River Severn	Grimley Brick Pits SSSI (SO838616)	13	
		Northwick Marsh SSSI (SO835579)	17	
Hallow WwTW	Laughern Brook	River Teme SSSI (SO507745)	6	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
Holt Heath WwTW	River Severn	Grimley Brick Pits SSSI (SO838616)	2	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
		Northwick Marsh SSSI (SO835579)	6	
Inkberrow WwTW	Tributary of Piddle Brook and Piddle Brook	Long Meadow, Thorn SSSI (SP015552)	1	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
		Grafton Wood SSSI (SO973560)	6	
Kempsey Works WwTW	River Severn	Upton Ham SSSI (SO859400)	10	Water quality deterioration possible. WQ Assessment

Source	Pathway	Receptor	Distance downstream (km)	Potential Impact
		Severn Ham, Tewkesbury SSSI (SO885325) Old River Severn, Upper Lode SSSI (SO88030)	20	required as part of Phase 2 Study
Kidderminster Oldington WwTW	River Stour	Wilden Marsh and Meadows SSSI (SO827738) River Stour Flood Plain SSSI (SO824730)	0	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
		Hartlebury Common and Hillditch Coppice SSSI (SO823707)	3	
	River Stour and River Severn	Shrawley Wood SSSI (SO808659)	10	
		Grimley Brick Pits SSSI (SO838616)	17	
		Northwick Marsh SSSI (SO835579)	21	
Lower Moor WwTW	River Avon	Tiddesley Wood SSSI (SO929452)	7	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
		Rectory Farm Meadows SSSI (SO921382) Upham Meadow and Summer Leasow SSSI (SO915375)	20	
Malvern WwTW	Tributary of Pool Brook, Pool Brook and River Avon	Upton Ham SSSI (SO859400)	11	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
		Severn Ham, Tewkesbury SSSI (SO885325) Old River Severn, Upper Lode SSSI (SO88030)	20	
Ombersley WwTW	Hadley Brook, River Salwarpe, River Severn	Grimley Brick Pits SSSI (SO838616)	9	Water quality deterioration possible. WQ Assessment

Source	Pathway	Receptor	Distance downstream (km)	Potential Impact
		Northwick Marsh SSSI (SO835579)	11	required as part of Phase 2 Study
Persore WwTW	Bow Brook	Tiddesley Wood SSSI (SO929452)	0	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
	Bow Brook and River Avon	Rectory Farm Meadows SSSI (SO921382)	9	
		Upham Meadow and Summer Leasow SSSI (SO915375)		
		Severn Ham, Tewkesbury SSSI (SO885325)	16	
		Old River Severn, Upper Lode SSSI (SO88030)		
Powick WwTW	Careys Brook and River Severn	Upton Ham SSSI (SO859400)	14	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
Quay Lane WwTW	River Severn	Upton Ham SSSI (SO859400)	1.5	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
		Severn Ham, Tewkesbury SSSI (SO885325)	12	
		Old River Severn, Upper Lode SSSI (SO88030)		
Stoke Prior WwTW	Hen Brook	Upton Warren Pools SSSI (SO935671)	0	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
	Hen Brook, River Salwarpe and River Severn	Grimley Brick Pits SSSI (SO838616)	19	
		Northwick Marsh SSSI (SO835579)	21	
Tenbury WwTW	River Teme	River Teme SSSI (SO507745)	0	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study

Source	Pathway	Receptor	Distance downstream (km)	Potential Impact
Upton upon Severn Works WwTW	River Severn	Upton Ham SSSI (SO859400)	0.5	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
		Severn Ham, Tewkesbury SSSI (SO885325)	10	
		Old River Severn, Upper Lode SSSI (SO88030)		
		Wainlode Cliff SSSI (SO845257)	20	
		Ashleworth Ham SSSI (SO832262)		
Upton Snodsbury WwTW	Tributary of the Piddle Brook	Naunton Court Meadows SSSI (SO954524)	1.5	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
	Tributary of the Piddle Brook, Piddle Brook and River Avon	Tiddesley Wood SSSI (SO929452)	13	
Welland WwTW	Marlbank Brook and China Brook	Malthouse Farm Meadows SSSI (SO805389)	0	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
	Marlbank Brook, China Brook, Mill Brook, Bushley Brook and River Severn	Severn Ham, Tewkesbury SSSI (SO885325) Old River Severn, Upper Lode SSSI (SO88030)	13	
Worcester Bromwich Road WwTW	River Severn	Upton Ham SSSI (SO859400)	17	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
Wychbold WwTW	River Salwarpe and River Severn	Grimley Brick Pits SSSI (SO838616)	16	Water quality deterioration possible. WQ Assessment required as part of Phase 2 Study
		Northwick Marsh SSSI (SO835579)	18	

11.3.1 Diffuse sources of water pollution

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. Sites within South Worcestershire that could be considered as sources of additional runoff, and receptors in the form of sites with environmental designations for Growth Option A (railway sites), Option D (urban extensions) and Option E (new/expanded settlements) are summarised in Table 11-2 to Table 11-4 below. As the number of sites in the Call for Sites process is large, a high-level overview of the SSSIs falling within or near the development areas for each of the Options A, D and E was undertaken. 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. A probable impact score of low, medium or high was applied to each SSSI to provide an indication of the likely impact prior to any mitigation being applied. It should be noted that this is a desk-based assessment to highlight risk and should not replace the appropriate level assessment on a site by site basis. Other development sites not identified in the table, may still contribute to a cumulative impact within the catchment and so management of water quality of surface runoff from these sites should still be considered.

Table 11-2 Potential sources of diffuse pollution and receptors - Option A rail station growth

Source	Pathway	Receptor	Distance (km)	Potential Impact
Development surrounding Pershore rail station	Surface water pathway to SSSI identified using RoFSW map	Tiddesley Wood SSSI (SO929452)	SSSI is on south-western edge of two-mile buffer around Pershore rail station and is adjacent to a few potential sites	This SSSI is ash-maple woodland which has been developed on heavy basic soils. As the wood is on high ground in relation to potential development sites nearby it is unlikely to receive any surface runoff. Probable impact – LOW
Development surrounding Worcestershire Parkway rail station	Surface water pathway to SSSI identified using RoFSW map	Cooksholme Meadows SSSI (SO889505)	SSSI is in centre of two-mile buffer around Worcestershire Parkway rail station and is adjacent to a number of potential sites	This SSSI consists of an unusually large block of unimproved grassland. Two of the meadows are traditionally managed for hay and the other consists of damp grazing pasture. The soils are neutral, derived from the underlying Keuper Marl. For both the damper pastures and meadows, regular and careful maintenance of surface drainage including ditches and drains can be essential to prevent adverse changes in the plant species composition of the sward. Deepening of surface drainage should be avoided. Impact possible – the inclusion of SuDS and appropriate

Source	Pathway	Receptor	Distance (km)	Potential Impact
				management of runoff should limit pollution risk.
Development surrounding Worcester rail stations	Surface water pathway to SSSI identified using RoFSW map	Northwick Marsh SSSI (SO835579)	SSSI is on northern edges of two-mile buffer around Worcester rail stations.	This SSSI is an open area of species-rich marsh occupying disused brickpits on the River Severn floodplain and has retained an open marsh community as a result of cattle grazing. Part of the site holds standing water for most of the year, whilst part is extensively inundated by floodwater during winter and spring. Careful maintenance of existing ditches and drains is usually acceptable practice, but abandonment or deepening of ditches can be harmful. Impact possible – the inclusion of SuDS and appropriate management of runoff should limit pollution risk.
	n/a	Lyppard Grange Ponds SSSI (SO879556)	SSSI on east of two-mile buffer around Worcester rail stations	This SSSI is made up of two field ponds, supporting a large breeding colony of great crested newts in the grounds of the former Lyppard Grange Farm. There are no surface water flow paths from potential sites to this SSSI. Probable impact – LOW
Development surrounding Malvern rail stations	Surface water pathway to SSSI identified using RoFSW map	Grange Meadow SSSI (SO85481)	SSSI is towards east of two-mile buffer around Malvern rail stations.	This SSSI is of special interest due to the occurrence of ancient, semi-natural and floristically diverse lowland grassland. Regular and careful maintenance of surface drainage including ditches and drains can be necessary to prevent adverse changes in the plant species composition of the sward. Deepening of surface drainage should be avoided. Impact possible – the inclusion of SuDS and appropriate

Source	Pathway	Receptor	Distance (km)	Potential Impact
				management of runoff should limit pollution risk.
		Malvern Common SSSI (SO786442)	SSSI is located towards south of two-mile buffer around Malvern rail stations.	This SSSI is of special interest for its nationally important species-rich neutral grassland and rush-pasture. The SSSI is not located on a surface water flow path from any of the sites identified in the Call for Sites. Probable impact – LOW
		Ailleshurst Coppice (SO773502)	SSSI located towards north of two-mile buffer around Malvern rail stations	This SSSI is an area of relict stream-side coppice woodland. While the SSSI lies within surface water flow paths, there is no potential development sites upstream of this SSSI. Probable impact – LOW
	n/a	Malvern Hills SSSI (SO761386)	SSSI is towards west of two-mile buffer around Malvern rail stations.	The Malvern Hills lies on higher ground, with no proposed sites having surface water flow paths towards this SSSI. Probable impact – LOW
Development surrounding Evesham rail station	n/a	n/a	n/a	No SSSIs lie within the two-mile buffer around Evesham rail station and any sites within this buffer to not have any surface water flow paths towards any other SSSIs. Probable impact – LOW
Development surrounding Honeybourne rail station	n/a	n/a	n/a	No SSSIs lie within the two-mile buffer around Honeybourne rail station and any sites within this buffer to not have any surface water flow paths towards any other SSSIs. Probable impact – LOW

Table 11-3 Potential sources of diffuse pollution and receptors - Option D Urban Extensions

Source	Pathway	Receptor	Distance (km)	Potential Impact
West of Worcester City urban extension	Surface water pathway to SSSI identified using RoFSW map	River Teme SSSI (SO507745)	SSSI located to the south of proposed development sites to the west of Worcester City.	The River Teme drains a hilly, predominantly rural catchment of Devonian and Silurian rocks. The channel is of special interest as a representative, near-natural and biologically rich river type associated with sandstones and mudstones. The maintenance of good water and sediment quality are essential to maintaining a healthy river system. River management should minimise pollution both from point and diffuse sources, including discharges of domestic and trade effluent, and runoff from urban land. Impact possible – the inclusion of SuDS and appropriate management of runoff should limit pollution risk.
Droitwich Spa urban extension	Surface water pathway to SSSI identified using RoFSW map	Oakley Pool SSSI (SO892606)	Lies adjacent to two sites south of Droitwich Spa	This SSSI consists of a pool surrounded by reed swamp, fen and grassland and is a valuable breeding site for a number of birds. The protection of appropriate water quality is important for maintaining aquatic habitats and the range of species associated with them. Increases in the amounts of nutrients within the waterbody as a result of pollution from direct discharges and diffuse sources can lead to loss of aquatic life in favour of algae and impact vertebrate species which are both important food sources for a range of wetland birds. Impact possible – the inclusion of SuDS and appropriate management of runoff

Source	Pathway	Receptor	Distance (km)	Potential Impact
				should limit pollution risk.
		Lower Saleway Farm Meadows (SO924602)	Lies to south-east of Droitwich Spa	This SSSI consists of a large sloping field and a smaller parcel in the floodplain of the Dean Brook. It is of special interest as a large, botanically diverse, semi-natural lowland grassland. Regular and careful maintenance of surface drainage including ditches and drains can be necessary to prevent adverse changes in the plant species composition of the sward. Impact possible – the inclusion of SuDS and appropriate management of runoff should limit pollution risk.
		Dean Brook Valley Pastures (SSSI SO944605)	Lies to south-east of Droitwich Spa	This SSSI consists of two larger pastures overlying a medieval ridge and furrow system, of special interest due to the diversity of the semi-natural grassland sward. Regular and careful maintenance of surface drainage including ditches and drains can be necessary to prevent adverse changes in the plant species composition of the sward. Impact possible – the inclusion of SuDS and appropriate management of runoff should limit pollution risk.
Malvern urban extension	Surface water pathway to SSSI identified using RoFSW map	Grange Meadow SSSI (SO85481)	SSSI is towards east of Malvern	This SSSI is of special interest due to the occurrence of ancient, semi-natural and floristically diverse lowland grassland. Regular and careful maintenance of surface drainage including ditches and drains can be necessary to prevent adverse changes in the

Source	Pathway	Receptor	Distance (km)	Potential Impact
				plant species composition of the sward. Deepening of surface drainage should be avoided. Impact possible – the inclusion of SuDS and appropriate management of runoff should limit pollution risk.

Table 11-4 Potential sources of diffuse pollution and receptors - Option E new/expanded settlement/sites

Source	Pathway	Receptor	Distance (km)	Potential Impact
Rushwick expanded settlement	Surface water pathway to SSSI identified using RoFSW map	River Teme SSSI (SO507745)	SSSI runs through the centre of the proposed expanded settlement	The River Teme drains a hilly, predominantly rural catchment of Devonian and Silurian rocks. The channel is of special interest as a representative, near-natural and biologically rich river type associated with sandstones and mudstones. The maintenance of good water and sediment quality are essential to maintaining a healthy river system. River management should minimise pollution both from point and diffuse sources, including discharges of domestic and trade effluent, and runoff from urban land. Impact possible – the inclusion of SuDS and appropriate management of runoff should limit pollution risk.
Worcestershire Parkway new settlement	Surface water pathway to SSSI identified using RoFSW map	Cooksholme Meadows SSSI (SO889505)	SSSI is in centre of Worcestershire Parkway new settlement and is adjacent to several potential sites	This SSSI consists of an unusually large block of unimproved grassland. Two of the meadows are traditionally managed for hay and the other consists of damp grazing pasture. The soils are neutral, derived from the underlying Keuper Marl. For both the damper pastures and meadows, regular and careful maintenance of surface drainage including ditches and drains can be essential to prevent adverse changes in the plant species composition of the sward. Deepening of surface drainage should be avoided. Impact possible – the inclusion of SuDS and appropriate management of

Source	Pathway	Receptor	Distance (km)	Potential Impact
				runoff should limit pollution risk.
Throckmorton new/expanded settlement	Surface water pathway to SSSI identified using RoFSW map	Tiddesley Wood SSSI (SO929452)	SSSI is on south-western edge of two-mile buffer around Pershore rail station and is adjacent to a few potential sites	This SSSI is ash-maple woodland which has been developed on heavy basic soils. As the wood is on high ground in relation to potential development sites nearby it is unlikely to receive any surface runoff. Probable impact – LOW

11.3.2 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 be objectionable 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 paper⁵⁹ 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.

Sewage and trade effluent

Discharge of treated sewage of 2m³ 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

⁵⁹ The Environment Agency’s approach to groundwater protection, Environment Agency (2018). Accessed online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/692989/Environment-Agency-approach-to-groundwater-protection.pdf on: 23/01/2019
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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 standards⁶⁰ for sustainable drainage systems – these should be used in conjunction with the NPPF and PPG;
- and use a SuDS management treatment train (see sections 11.3.3 to 11.3.5).

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

Source Protection Zones in South Worcestershire

The Source Protection Zones (SPZs) that are present in the study are shown in Figure 11.2. They cover small areas to the north of Worcester City, and in the west of South Worcestershire to the west of Malvern.

60 Sustainable Drainage Systems: non-statutory technical standards, Department for Environment, Food & Rural Affairs (2015). Accessed online at: <https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards> on: 23/01/2019
2018s1367 South Worcestershire WCS Final Report v1.0.docx

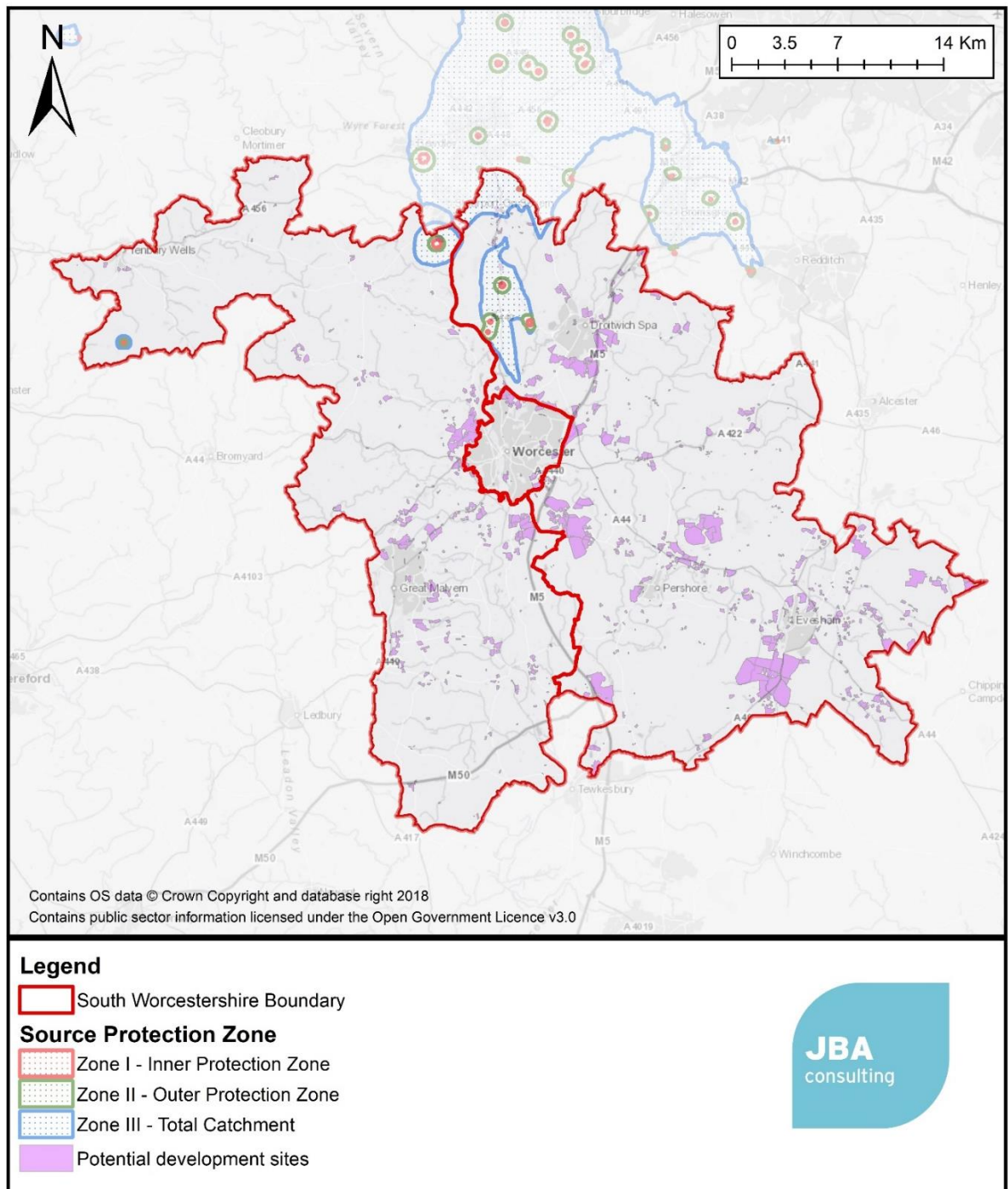


Figure 11.2 Source protection zones in the study area

Table 11-5 Development sites within Source Protection Zones

Source Protection Zone	Sites	Management advice/EA position statement
Zone 1 – Inner Protection Zone	CFS0387, CFS0976	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	CFS0094, CFS0222, CFS0225, CFS0228, CFS0231, CFS0387, CFS0972, CFS0973, CFS0974, CFS0975, CFS0976, CFS1028, CFS1069	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.
Zone 3 – Total Catchment	CFS0132, CFS0133, CFS0134, CFS0173, CFS0174, CFS0222, CFS0223, CFS0224, CFS0225, CFS0226, CFS0227, CFS0228, CFS0229, CFS0230, CFS0231, CFS0232, CFS0237, CFS0334, CFS0335, CFS0357, CFS0371, CFS0387, CFS0420, CFS0488, CFS0497, CFS0513, CFS0591, CFS0592, CFS0726, CFS0729,	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.

	CFS0740, CFS0741, CFS0753, CFS0792, CFS0805, CFS0842, CFS0867, CFS0871, CFS0904, CFS0928, CFS0971, CFS0972, CFS0973, CFS0974, CFS0975, CFS0976, CFS1069, CFS1071	
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11.3.3 Surface Water Drainage and SuDS

Since April 2015⁶¹, 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 (SuDS).

Worcestershire County 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 and improve water quality by treating urban runoff. SuDS can also deliver multiple benefits, through creating habitats for wildlife and green spaces for the community.

National standards on the management of surface water are outlined within the Defra Non-statutory Standards for Sustainable Drainage Systems⁶², with local guidance specified by Worcestershire County Council⁶³. The CIRIA C753 SuDS Manual⁶⁴ and Guidance for the Construction of SuDS⁶⁵ provide the industry best practice guidance for design and management of SuDS.

11.3.4 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,

61 Department for Communities and Local Government (2014) House of Commons: Written Statement (HCWS161) Written Statement made by: The Secretary of State for Communities and Local Government (Mr Eric Pickles) on 18 Dec 2014. Available at:

<https://www.parliament.uk/documents/commons-vote-office/December%202014/18%20December/6.%20DCLG-sustainable-drainage-systems.pdf> on: 23/01/2019

62 Sustainable Drainage Systems, Non-statutory technical standards for sustainable drainage systems, DEFRA (2015) Accessed online at:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf on: 17/12/2018

63 Worcestershire SuDS Design and Evaluation Guide, Worcestershire County Council (2018). Accessed online at:

http://www.worcestershire.gov.uk/download/downloads/id/10361/worcestershire_suds_design_and_evaluation_guide.pdf on: 17/12/2018

64 CIRIA Report C753 The SuDS Manual, CIRIA (2015). Accessed online at:

<https://www.ciria.org/ItemDetail?iProductCode=C753&Category=BOOK&WebsiteKey=3f18c87a-d62b-4eca-8ef4-9b09309c1c91> on: 17/12/2018

65 Guidance on the Construction of SuDS (C768), CIRIA (2017), Accessed online at:

<https://www.ciria.org/ItemDetail?iProductCode=C768&Category=BOOK> on: 17/12/2018

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 Figure 11.3 below.

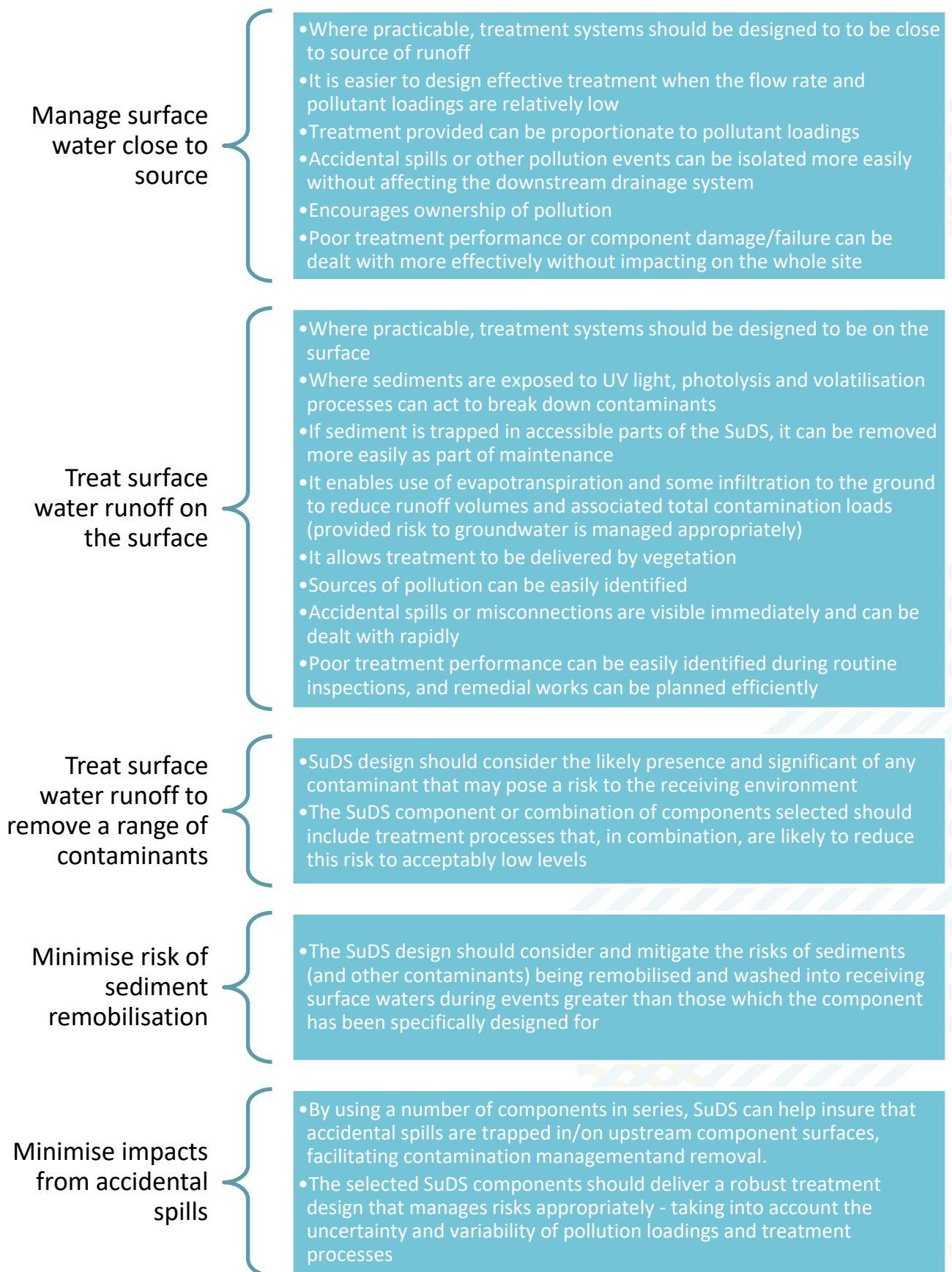


Figure 11.3 Considerations for SuDS design for water quality

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.

Early consideration of SuDS within master planning will typically allow a more effective scheme to be designed.

11.3.5 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 wastewater treatment works.

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, particularly in the south east. 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 as a resource for local environmental education programmes and working groups and directly influence the sense of community in an area.

11.4 Conclusions

- A number of SSSIs exist within South Worcestershire that should be carefully considered in future plan making.
- The most significant point sources of pollution in the study area are the WwTW which serve growth.
- There is potential for additional discharge from WwTW to impact sites with environmental designations (see Section 9). A water quality impact assessment is required in the Phase 2 WCS to understand this further.
- Development sites within South Worcestershire could be sources of diffuse pollution from surface runoff.
- Several of the proposed development sites could have a direct surface water pathway to a SSSI.
- 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.
- SuDS for a single site could be demonstrated to have limited impact, but it is the cumulative impact of all development across the catchment (combined with the potential effects of climate change) that should be taken into account. For this reason, SuDS should be considered on sites that do not have a direct pathway to a SSSI.

No further assessment of environmental constraints and opportunities is recommended in a Phase 2 WCS.

11.5 Recommendations

Table 11-6 Recommendations from environmental constraints and opportunities section

Action	Responsibility	Timescale
The Local Plan should include policies that require development sites, where a pathway exists for surface water to a site with an environmental designation, to adopt SuDS to manage water quality of surface runoff.	SWCs	Ongoing
The local plan should include policies that encourage development sites, where no obvious pathway exists to a site with an environmental designation, to consider the adoption of SuDS to manage the cumulative impact of development within the catchment (unless it is not reasonably practicable to do so).	SWCs	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.	SWCs 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 into existing surface water and combined sewer networks. Prevent connections into the foul network, as this is a significant cause of sewer flooding.	SWCs Developers	Ongoing

12 Climate change impact assessment

12.1 Approach

A qualitative 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 SWCs area wide basis; the available climate models are generally insufficiently refined to draw different conclusions for different parts of South Worcestershire or doing so would require a degree of detail beyond the scope of this study.

Table 12-1 Climate change pressures scoring matrix

		Impact of pressure		
		Low	Medium	High
Have climate change pressures been considered in the assessment?	Yes - quantitative consideration			
	Some consideration but qualitative only			
	Not considered			

12.2 Severn Trent Water infrastructure

Severn Trent Water have published a risk assessment⁶⁶ for both water resources, wastewater treatment and wastewater sewerage networks that identifies the level of threat from climate change in key service areas. In the case of WwTW, the highest perceived risks are in asset performance and pollution incidents, both of which can be attributed to an increased risk of flooding. In the case of the wastewater network, sewer flooding, resulting from increased rainfall intensity overwhelming the sewer network is added to the risks of impacts on asset performance and pollution incidents.

Consideration of the impact of climate change on water resources is included in Severn Trent Water's WRMP, with the main risk being the increased likelihood of severe drought events. Allowance is made within the baseline supply forecast by adjusting the "Water Available for Use". Each WRZ is classified as "low", "medium" or "high" vulnerability, which is then used to determine the level of detail for climate change modelling. The Strategic Grid WRZ is classified as "high vulnerability".

66 Severn Trent Water's Climate Change Adaptation Report 2015-2020, Severn Trent Water (2015). Accessed online at: https://www.stwater.co.uk/content/dam/stw/about_us/documents/Full-Climate-change-adaptation-report-2015-2020.pdf on: 18/01/19
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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 (Phases 1 and 2)?	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).	
Water supply infrastructure	Medium - some increased demand in hot weather	Yes - quantitative assessment within the WRMP.	
Wastewater Collection	High - Intense summer rainfall and higher winter rainfall increases flood risk	Yes – qualitative assessment in climate change adaptation reports by Severn Trent Water. This has not been considered in site by site assessments.	
Wastewater treatment	Medium - Increased winter flows and more extreme weather events reduces flow headroom	Yes – qualitative assessment in the Severn Trent Water climate change adaptation reports. This has not been considered in site by site assessments.	
WwTW odour	Medium – higher temperatures will exacerbate existing odour control issues.	Severn Trent Water have not considered odour in their climate adaptation plan.	
Water quality	Nutrients: High Sanitary determinands: Medium to High	Qualitative assessments have been included in the climate change adaptation policy papers from Severn Trent Water. Water quality impact modelling in Phase 2 should include sensitivity to reductions in river flow.	
Flooding from increased WwTW discharge	Low	No - not considered	

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 by Severn Trent Water. Consideration of changes in water and wastewater demand should be considered when carrying out detailed site assessments in the future.

The impact of reduced river flows due to climate change on water quality should be included in the water quality assessment in Phase 2.

Action	Responsibility	Timescale
When undertaking detailed assessments of environmental or asset capacity, consider how the latest climate change guidance can be included.	EA, STW, SWCs	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.	SWCs and Developers	As required
Water quality modelling in Phase 2 should include sensitivity testing to a reduction in river flow.	JBA Consulting	In Phase 2

*"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 Summary and overall conclusions

13.1 Summary by growth option

Table 13-1 and Table 13-2 summarise the potential number of houses in each option and the advantages and disadvantages of each. The totals are based on all of the sites identified in the call for sites process, and these sites may be suitable or unsuitable for reasons outside the scope of this report. Where a "red" assessment has been given based on wastewater infrastructure it highlights a lack of capacity in the current system or the scale of new infrastructure required. It does not indicate that a site is unsuitable for development.

Table 13-1 Housing numbers based on wastewater RAG assessment

Topic Area	Green	Amber	Red
A – Rail stations	0	0	14,000
B – Periphery of settlements	0	3,732	99,059
C – Infill/ regeneration	809	979	0
D – Large urban extensions	924	7,224	18,524
E – New/ expanded settlements	0	0	15,000
Total	1,733	11,935	146,583

Note: Total reduced to account for sites in multiple scenarios

Green = both network and WwTW capacity green

Amber = At least one amber assessment for network or WwTW capacity

Red = At least one red assessment for network or WwTW capacity

Table 13-2 Summary advantages and disadvantages of growth options

Option	Advantages	Disadvantages	Considerations
A – Rail stations	- Water quality impact is distributed across catchment. - Some focusing of growth limits number of infrastructure schemes required	- Significant new infrastructure required in some of the locations - To deliver OAN with just this option would require development in most if not all zones	Can growth in vicinity of Worcester be tied in with schemes supporting existing urban extensions?
B – Periphery of settlements	Water quality impact is distributed across the catchment	Multiple infrastructure schemes/WwTW upgrades likely to be required	Settlements served by network/WwTW with capacity could be adopted first providing some housing from this option with minimal investment.
C – Infill/ regeneration	- Uses existing network. - There may be opportunities for betterment by	Limited delivery of housing from this option	Potential for additional sites being added to this scenario in the future.

	incorporating SuDS and allowing greater separation of surface and foul water		
D – Large urban extensions	• Growth focused reducing need for multiple schemes • Can connect into existing network (although network reinforcement will be required)	• Water quality impact may be focussed at only a few locations.	If this option is to be adopted – early engagement with STW may allow existing wastewater schemes to be modified to accommodate this.
E – New/expanded settlements	• Opportunity for maximising benefits of SuDS schemes through master planning. • New infrastructure can be provided with minimal impact on existing homes and businesses	• Largest new infrastructure requirement	Strategic view required with STW in order to provide infrastructure

13.2 Summary of phase 1 scoping study

The South Worcestershire Councils have a need to provide approximately 14,000 new homes over the Local Plan period and are exploring five different options to deliver this need. The aim of this water cycle study is to provide the evidence to inform the selection of one or a combination of these options, taking into account the constraints in the water environment and in water and wastewater infrastructure.

The conclusions from each topic area are summarised in Table 13-3, alongside the recommendations for further study in a Phase 2 WCS where appropriate in Table 13-4.

1,733 houses can be provided with minimal additional infrastructure by building around existing settlements where the sewer network and WwTWs have capacity, and by using infill development sites. To deliver the full OAN over the plan period sites will need to be adopted that have been rated amber or red in their network or WwTW assessment by STW. In these cases, additional infrastructure will need to be provided by STW and early engagement between the South Worcestershire Councils, STW and developers is required to ensure the correct infrastructure is in place prior to occupation, and that it is provided in a cost-effective manner.

STW have stated their preference for growth to be focused rather than distributed so wastewater schemes can be provided more efficiently.

A number have WwTW have limited headroom in their environmental permit, additional growth would require upgrades to WwTW performance. The impact of multiple WwTW using headroom in their permit is required to ensure that the overall WFD classification of that reach, does not deteriorate. A catchment level approach to modelling the impact of growth of water quality should therefore be undertaken as part of a Phase 2 Outline Study.

Table 13-3 Summary of conclusions and requirements for Phase 2 study

Assessment	Conclusion	Requirement for Phase 2 Study
Water resources	The WRMP shows a supply-demand deficit from 2024 if no action is taken. It goes on to define a number of actions that will address this. Severn Trent Water commented that they would have adequate water resource for all proposed development sites	On the basis that there is a 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 is recommended as part of a Phase 2 Outline study.
Water supply infrastructure	- Severn Trent Water responded to the request to assess the impacts of development on water supply infrastructure. STW confirmed that water supply is not expected to be a constraint to development - Early developer engagement is required to ensure that, as development occurs within the study area, detailed modelling of water supply infrastructure will allow any upgrades to be completed without restricting the timing, location or scale of the planned development	No further analysis of water supply infrastructure is recommended as part of a Phase 2 Outline study.
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 CSO operation - No single scenario can provide the number of houses required to meet SWCs OAN without some additional infrastructure being required - STW's preference is for growth to be focused in larger settlements as it is usually more efficient to provide one large infrastructure scheme than several smaller schemes - If larger development, or clusters of development such as Option A or Option E were adopted, early engagement with STW is recommended to allow time for the strategic infrastructure required to serve the development to be planned - Early engagement with Severn Trent Water is required, and further modelling of the network may be required at the planning application stage.	Further study of the wastewater network is recommended as part of a Phase 2 Outline as the SWDP develops and the SWCs have greater certainty over which sites will be brought forward for development.
Wastewater Treatment	STW provided assessments of the WwTW serving growth in each	Further study of the wastewater treatment

Assessment	Conclusion	Requirement for Phase 2 Study
Works Flow Permit assessment	scenario based on hydraulic capacity and headroom in the environmental permit. JBA performed a flow permit assessment in parallel to this - Where a "red" assessment is given, it does not indicate that growth cannot take place in that area, just that significant infrastructure would be required to support it - Options C and D are the easiest of the five options to accommodate with minimal additional infrastructure - Options A and E would require significant upgrades to existing WwTW due to high growth in one location - Option B distributes growth throughout the study area and will require many smaller WwTWs to be upgraded	capacity is recommended as part of a Phase 2 Outline study as the SWDP develops and the SWCs have greater certainty over which sites will be brought forward for development.
Water quality impact assessment	- The increased wastewater discharges at the WwTWs serving growth in South Worcestershire have the potential to impact downstream water quality in the receiving watercourses - Catchment level modelling is required in order to assess the cumulative impact of growth on the overall WFD status across the study area	Further assessment of the impact upon water quality should be undertaken, for the WwTW serving growth as part of a Phase 2 Outline Water Cycle Study. In particular, consideration should be paid to those discharging to watercourses which already have a 'poor' or 'bad' status and are forecast for increased growth.
Odour Assessment	20 sites are identified as being at risk of nuisance odour. An odour assessment is recommended as part of the planning process, paid for by developers	No further assessment of odour is recommended as part of a Phase 2 Outline study. Any future assessment should be carried out as part of the planning process.
Flood risk from additional WwTW flow	The impact of increased effluent flows is not predicted to have a significant impact upon flood risk in any of the receiving watercourses in any of the growth scenarios	Increases in discharges of treated wastewater effluent as a result of growth are not expected to significantly increase flood risk. No further assessment is recommended in a Phase 2 WCS.
Environmental Constraints and Opportunities	- There are numerous SSSIs within South Worcestershire which should be carefully considered in future plan-making - WwTWs serving growth within South Worcestershire are the most significant point sources of pollution in the study area	Water Quality modelling should be undertaken as part of Phase 2 Outline Study. No further assessment of Environmental Constraints is recommended as part of a Phase 2 study.

Assessment	Conclusion	Requirement for Phase 2 Study
	- There is potential for additional discharge from WwTW to impact sites with environmental designations (see Section 11.2). A water quality impact assessment is recommended in a Phase 2 water cycle study to understand this further - Development sites within South Worcestershire could be sources of diffuse pollution from surface runoff - Several of the proposed development sites could have a direct surface water pathway to a SSSI - 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 - SuDS for a single site could be demonstrated to have limited impact, but it is the cumulative impact of all development across the catchment (combined with the potential effects of climate change) that should be taken into account. For this reason, SuDS should be considered on sites that do not have a direct pathway to a SSSI	

13.3 Recommendations

Table 13-4 below summarises the recommendations from each section of the report.

Table 13-4 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. Take the latest growth forecasts into account in the emerging 2019 WRMP.	STW	Ongoing
	Provide yearly profiles of projected housing growth to water companies to inform the WRMP.	SWCs	Annually
	Use planning policy to require the 110l/person/day water consumption target permitted by National Planning Practice Guidance ⁶⁷ in water-stressed areas and use the BREEAM standard to require percentage improvement over baseline building water consumption of at least 12.5%.	SWCs	In emerging SWDP
	Water companies should advise the SWCs of any strategic water resource infrastructure developments within the Authority, where these may require safeguarding of land to prevent other type of development occurring. However, at present, no major potential schemes have been identified within the South Worcestershire boundary.	STW, SWCs	In emerging SWDP
Water supply	Once a preferred options list of sites is developed, undertake network modelling to ensure adequate provision of water supply is feasible	STW SWCs	As part of the planning process
	SWCs and Developers should engage early with STW to ensure infrastructure is in place prior to occupation.	SWCs STW Developers	Ongoing
Wastewater collection	Early engagement between the SWCs and STW is required to ensure that where strategic infrastructure is required, it can be planned in by STW.	SWCs STW	Ongoing
	Take into account wastewater infrastructure constraints in phasing	SWCs STW	Ongoing

Aspect	Action	Responsibility	Timescale
	development in partnership with the sewerage undertaker		
	Developers will be expected to work with the sewerage undertaker closely and early in the planning promotion process to develop an outline Drainage Strategy for sites. The Outline 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.	STW and Developers	Ongoing
	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 surface water sewers seen as the last option. New connections for surface water to foul sewers will be resisted by the LLFA.	Developers LLFA	Ongoing
	Opportunities for betterment on brown field sites (particularly in Option C) should be sought.	SWCs	In SWDP
Wastewater treatment	Consider the available WwTW capacity when phasing development going to the same WwTW.	SWCs STW	Ongoing
	Provide Annual Monitoring Reports to STW detailing projected housing growth in each of the Local Authorities.	SWCs	Ongoing
	STW to assess growth demands as part of their wastewater asset planning activities and feedback to the Councils if concerns arise.	STW SWCs	Ongoing
Odour	Consider odour risk in the sites identified to be potentially at risk from nuisance odour	SWCs	Ongoing
	Carry out an odour assessment for sites at risk	Site Developers	Ongoing
Flood Risk Management	Proposals to increase discharges to a watercourse may also require a flood risk activities environmental	STW	During design of

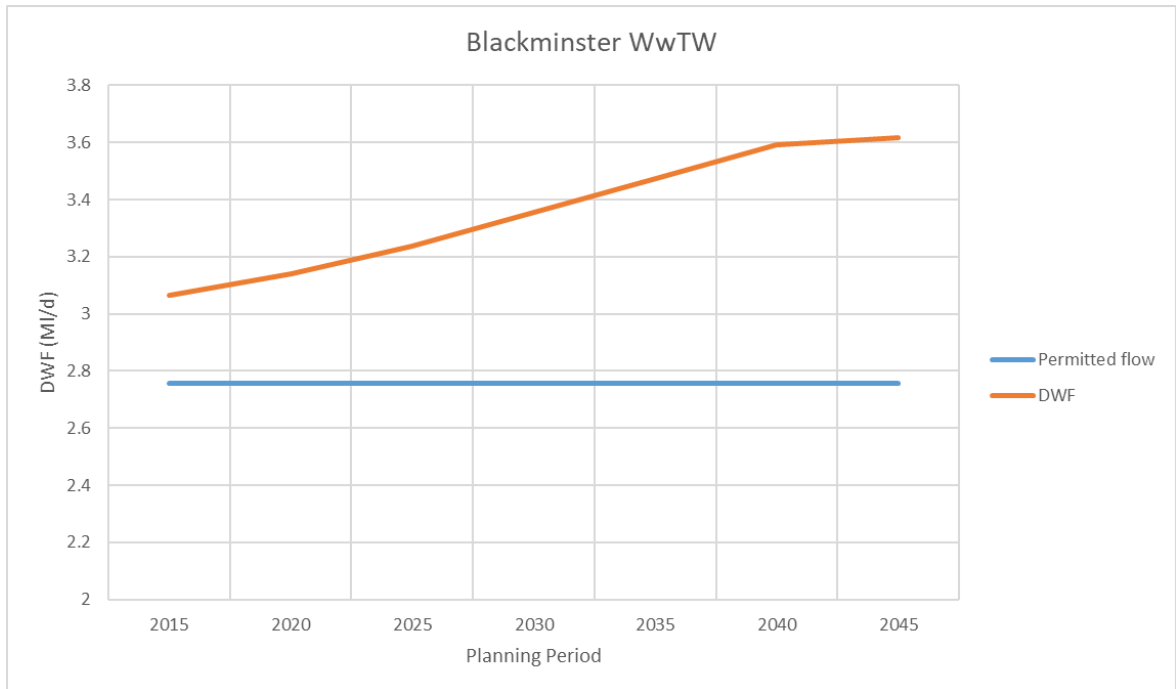
Aspect	Action	Responsibility	Timescale
	permit from the EA (in the case of discharges to Main River), or a land drainage consent from the Lead Local Flood Authority (in the case of discharges to an Ordinary Watercourse).		WwTW upgrades
Environment	The Local Plan should include policies that require development sites, where a pathway exists for surface water to a site with an environmental designation, to adopt SuDS to manage water quality of surface runoff.	SWCs	Ongoing
	The local plan should include policies that encourage development sites, where no obvious pathway exists to a site with an environmental designation, to consider the adoption of SuDS to manage the cumulative impact of development within the catchment (unless it is not reasonably practicable to do so).	SWCs	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.	SWCs 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 into existing surface water and combined sewer networks. Prevent connections into the foul network, as this is a significant cause of sewer flooding.	SWCs Developers	Ongoing

Appendices

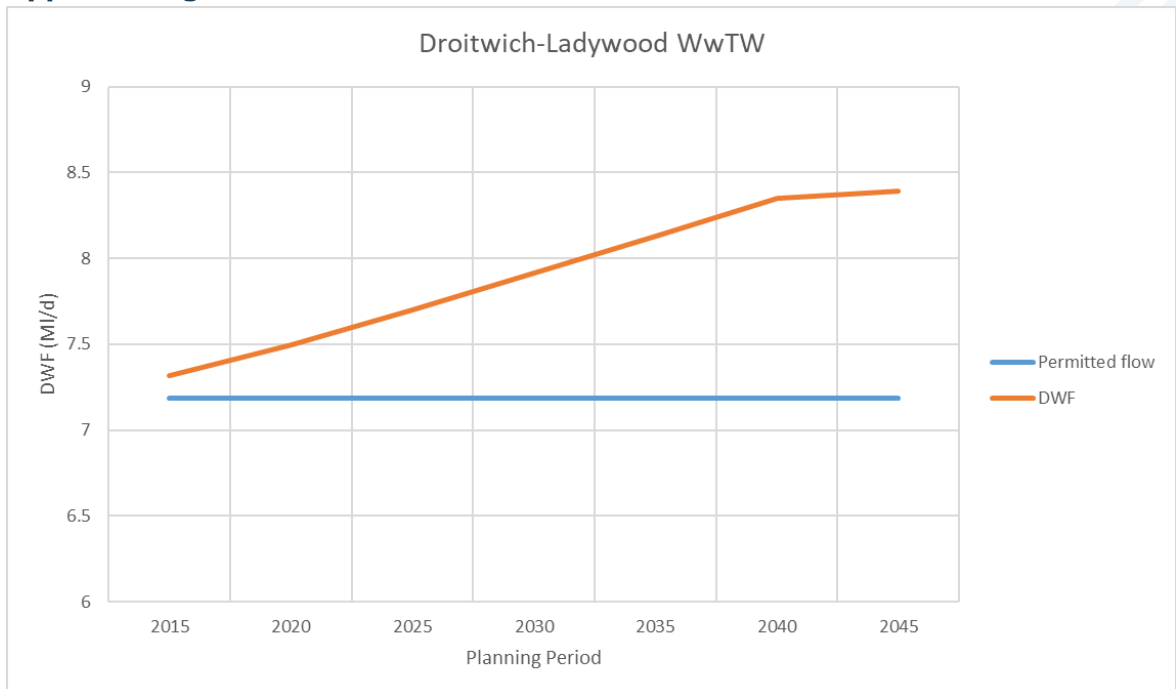
A Site Tracker Spreadsheets

B WwTW Flow capacity assessments

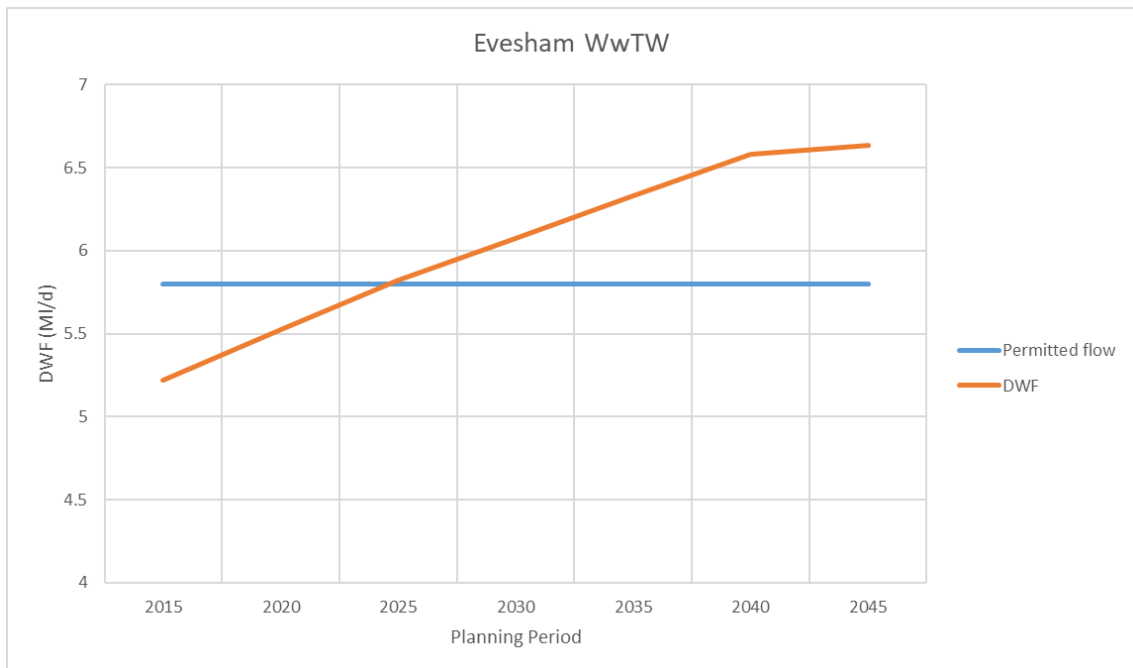
B.1 Option A – Rail station focussed growth



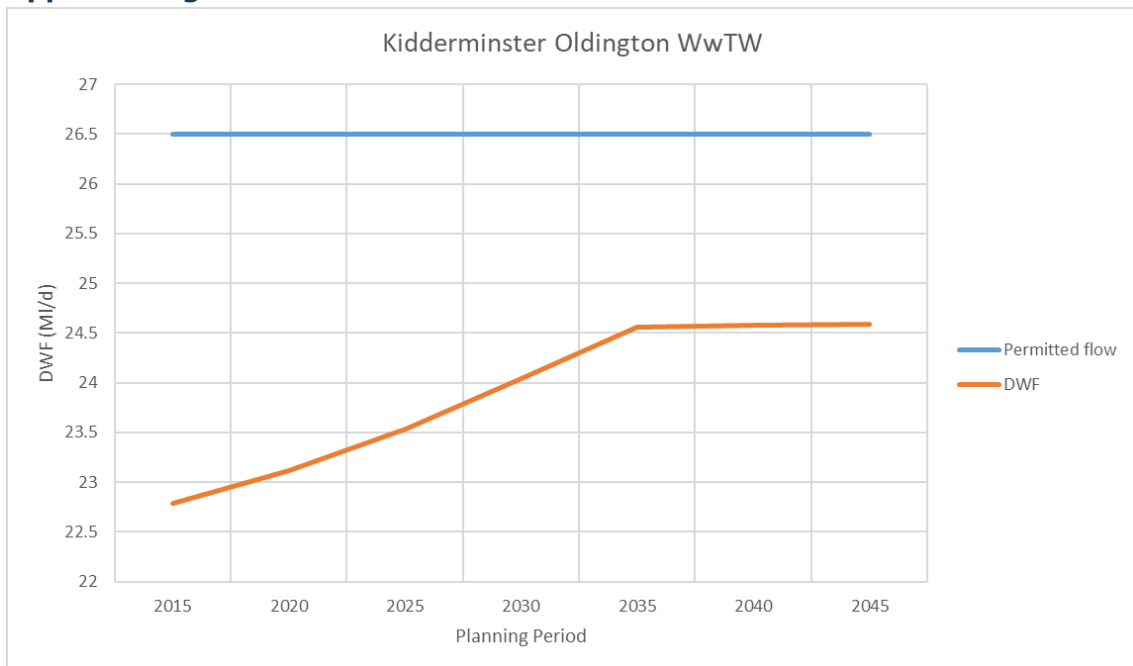
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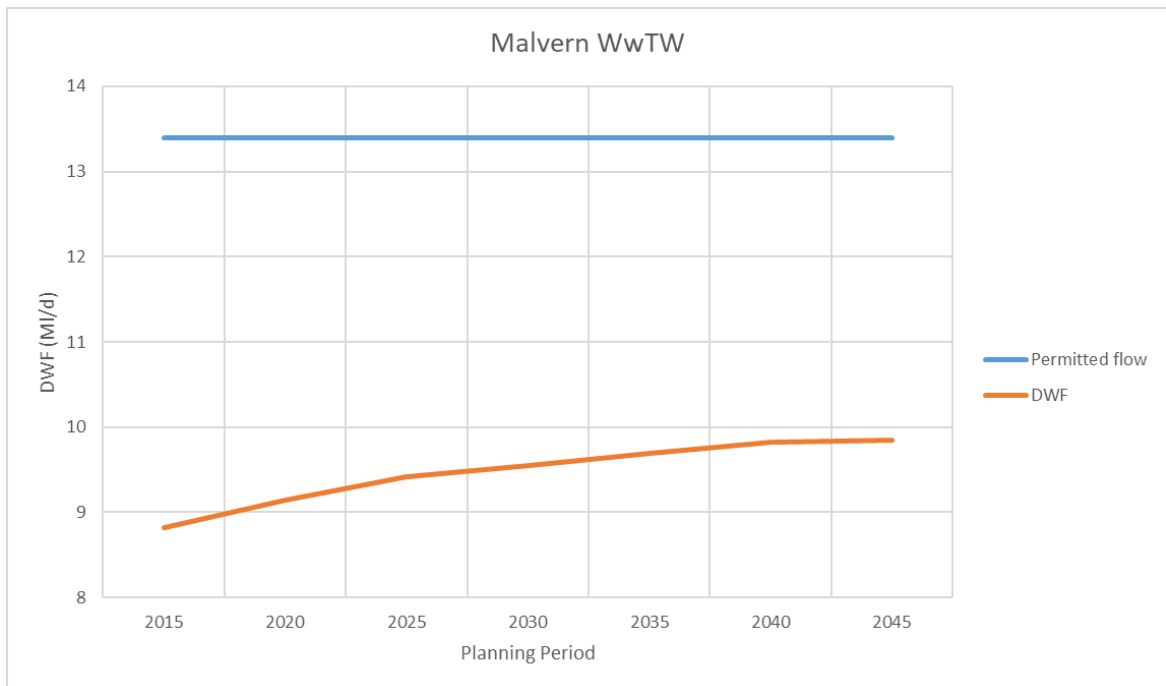
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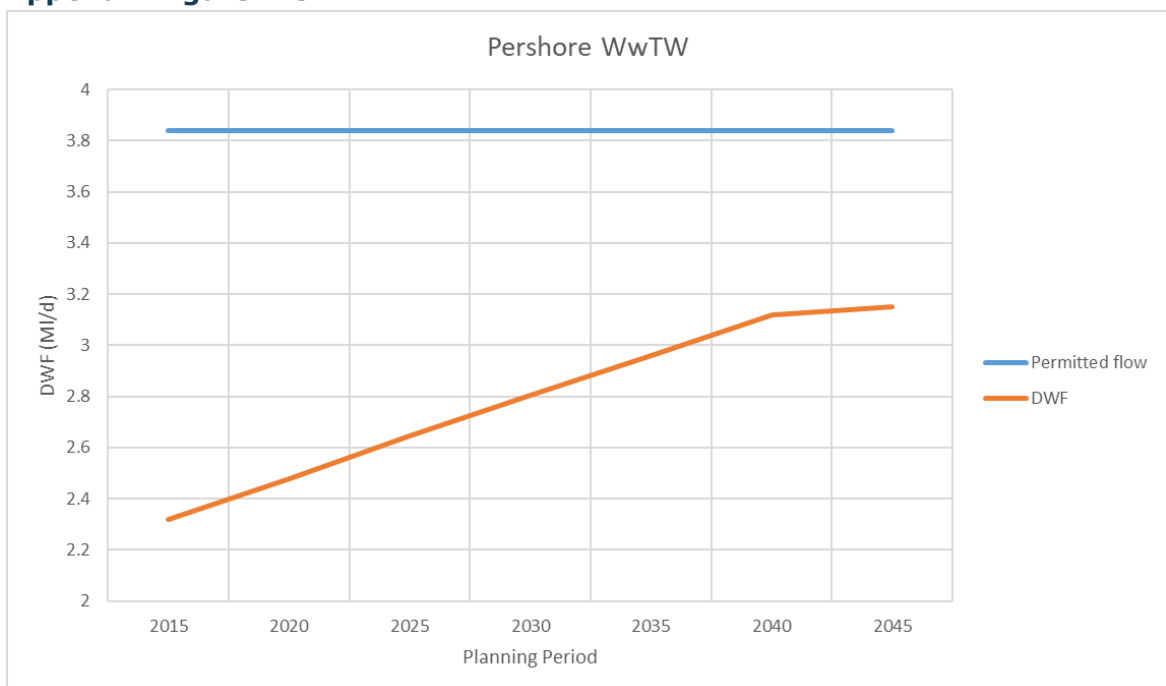
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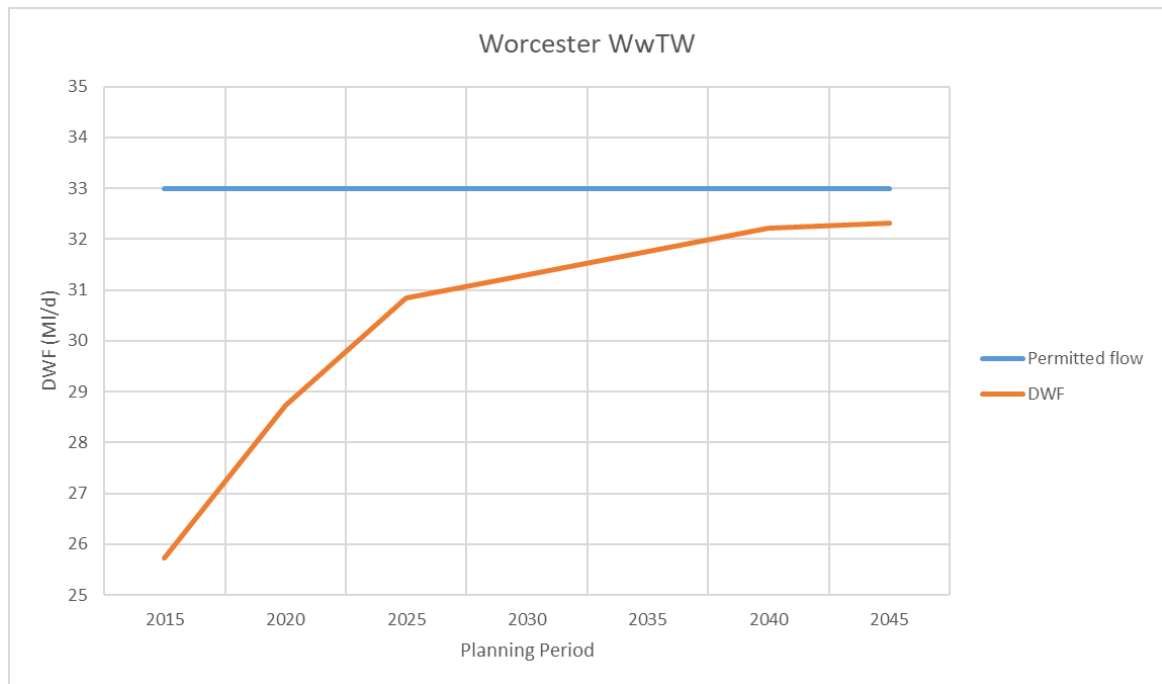
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Appendix Figure B-5

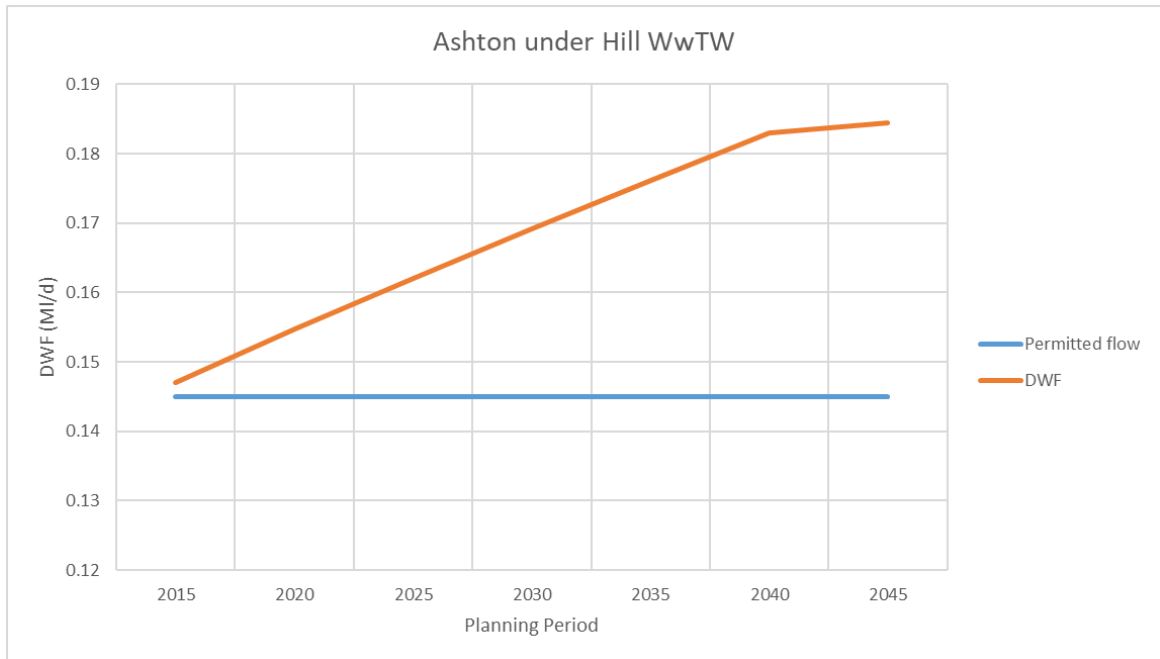


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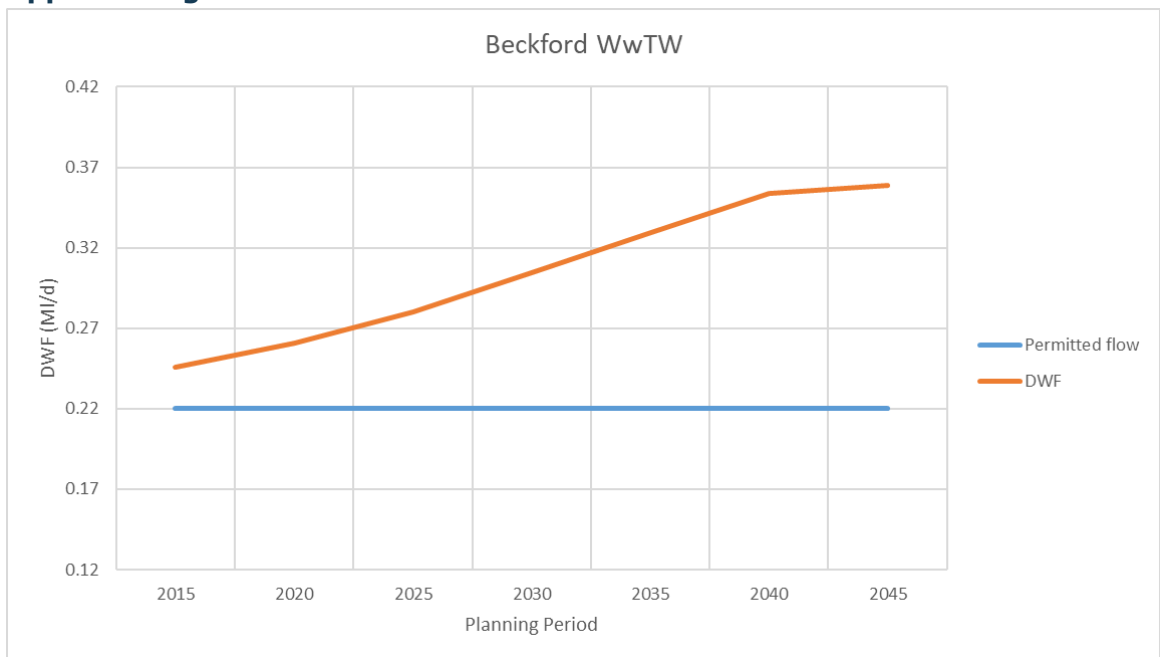


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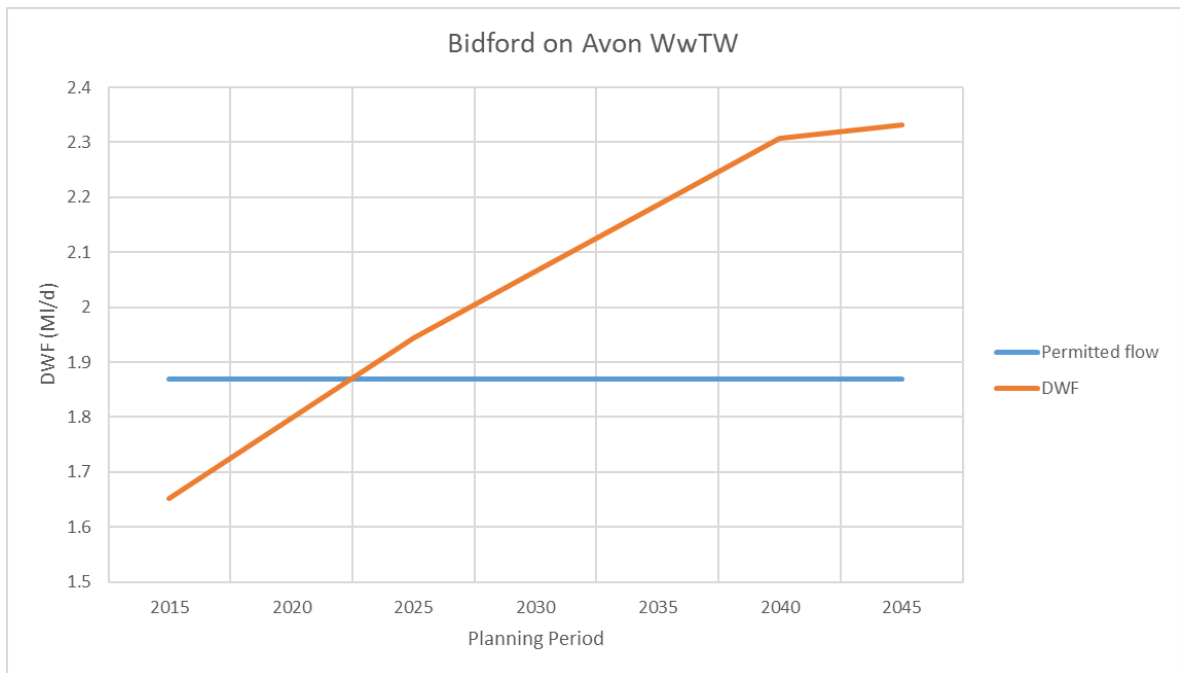
B.2 Option B – Development on the periphery of existing settlements



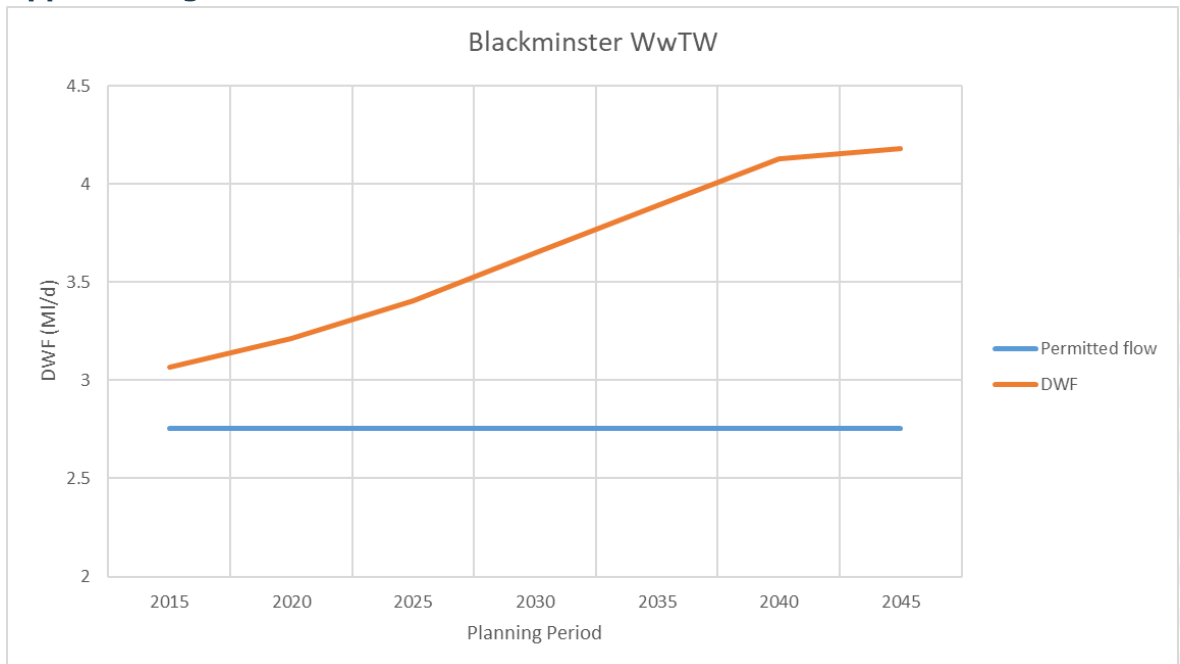
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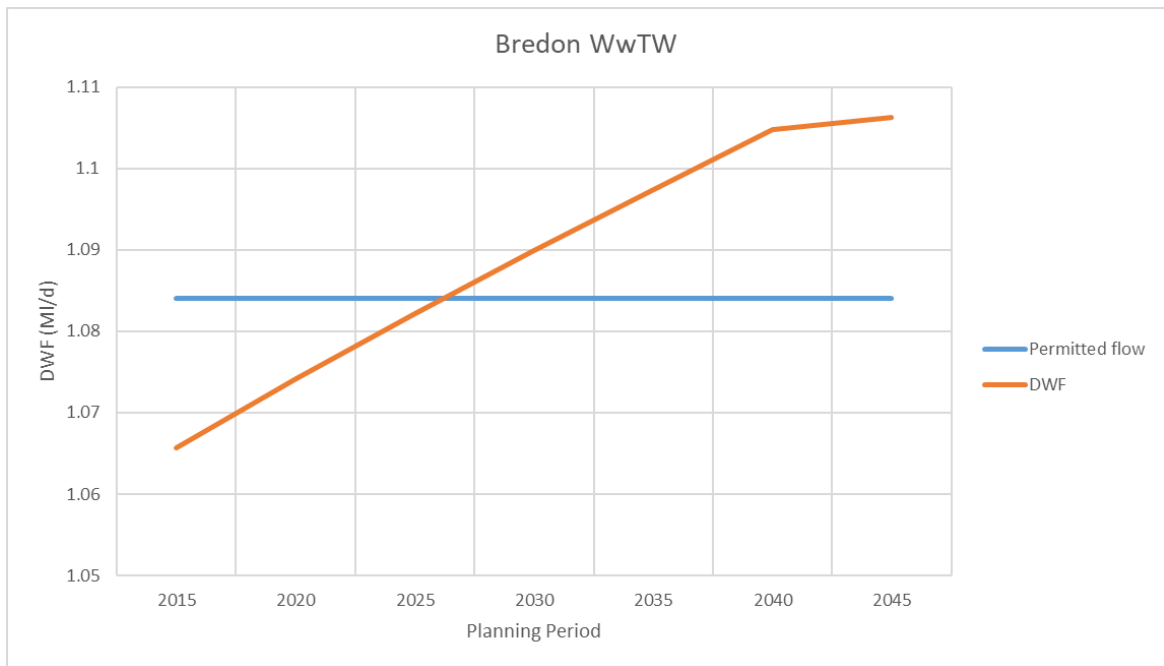
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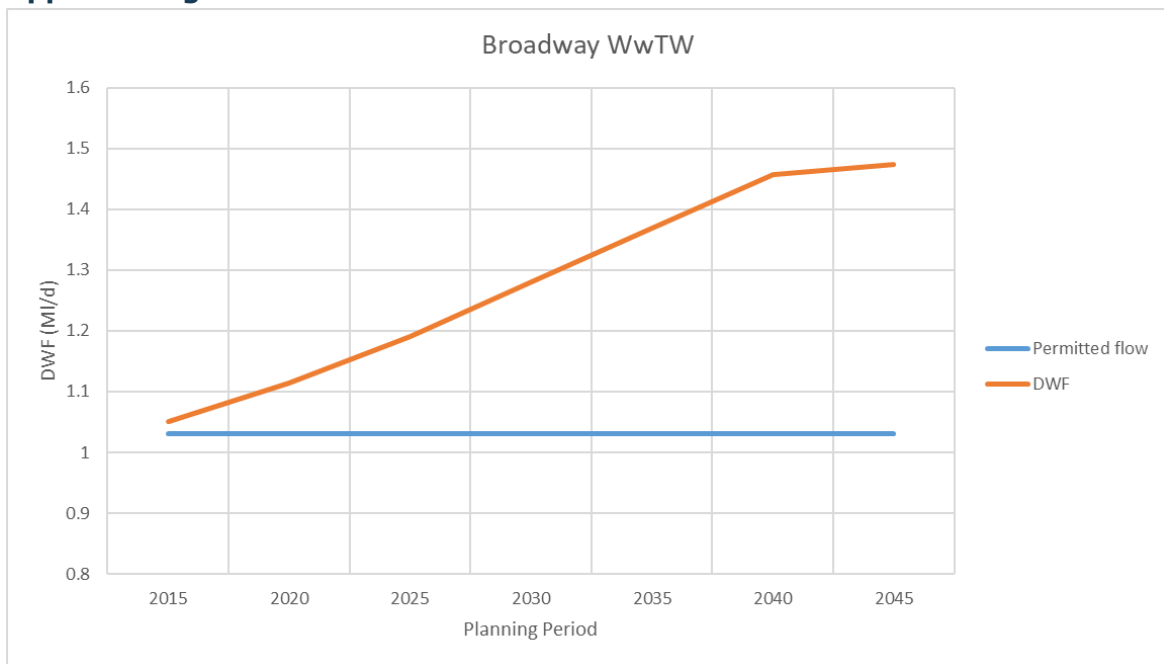
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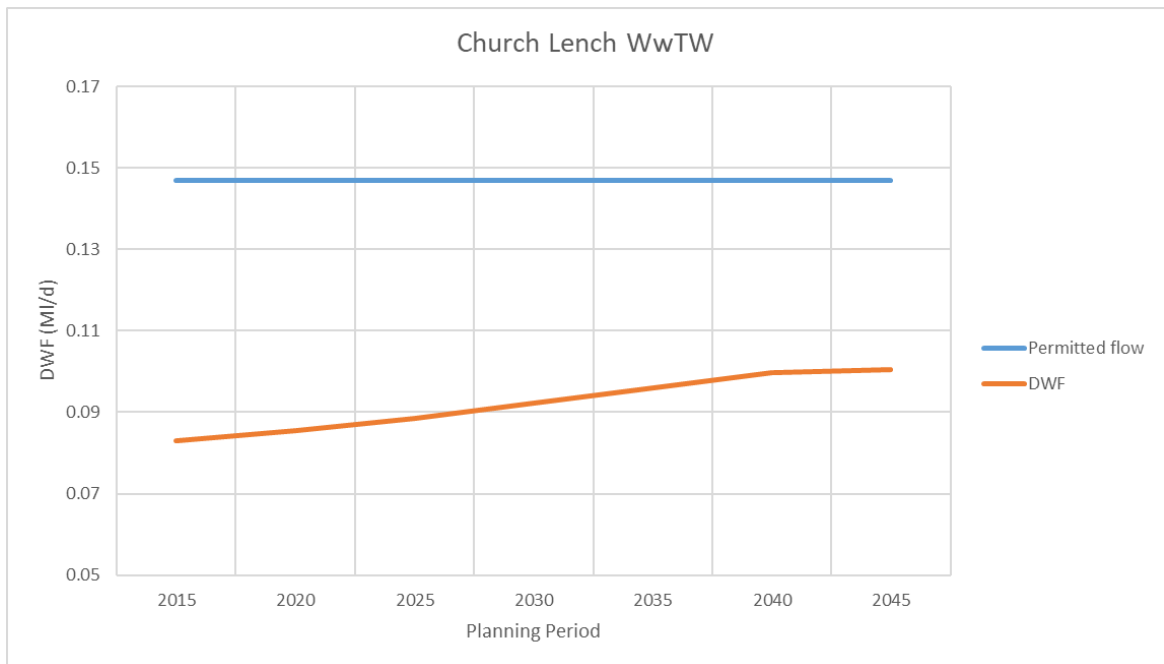
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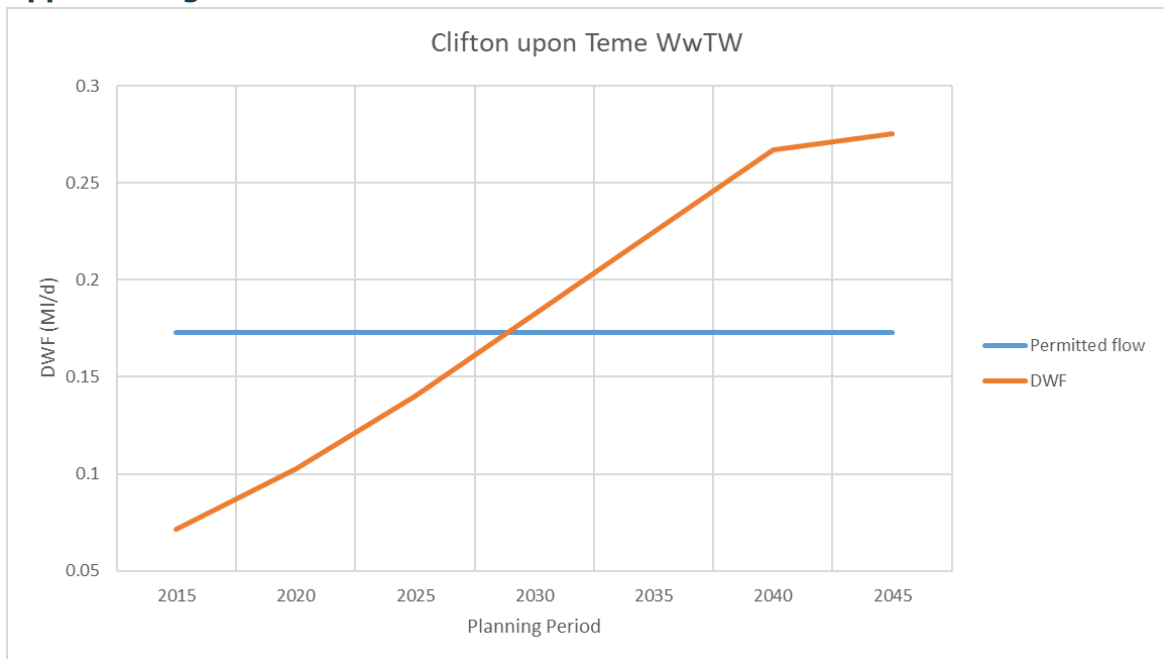
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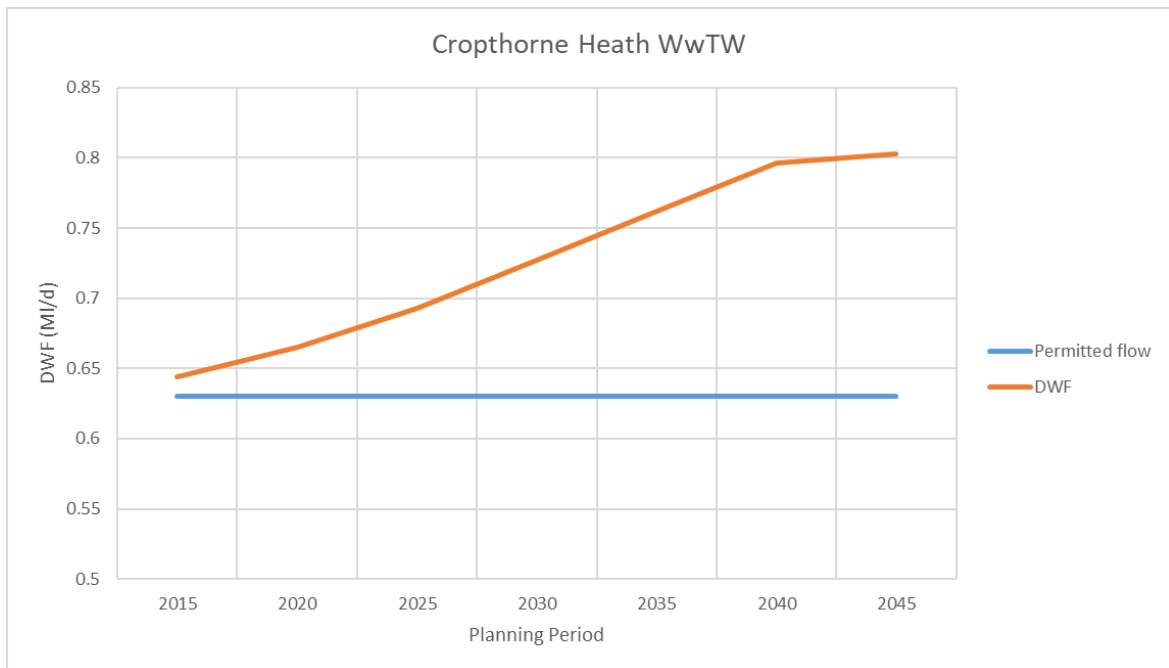
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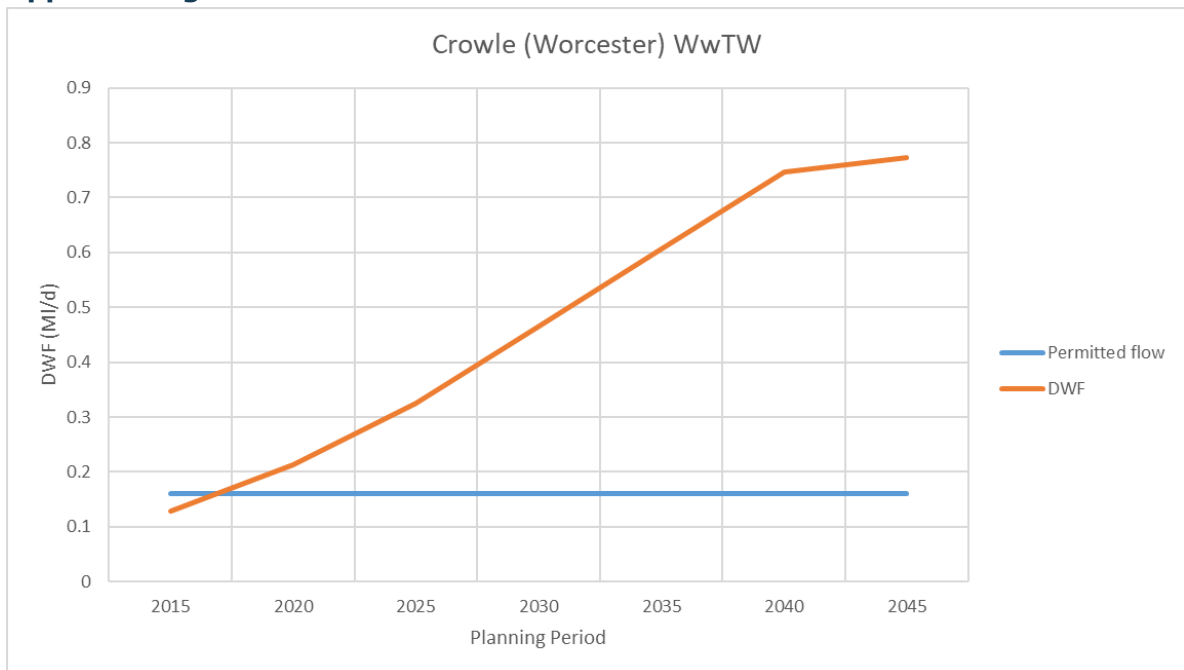
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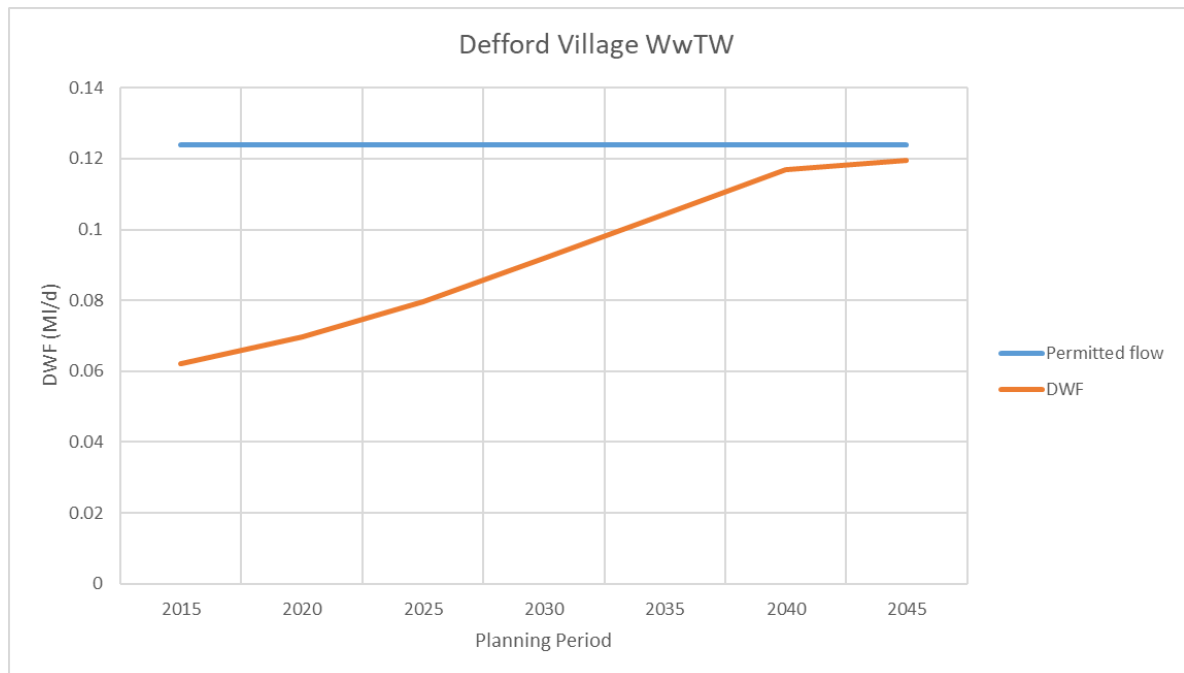
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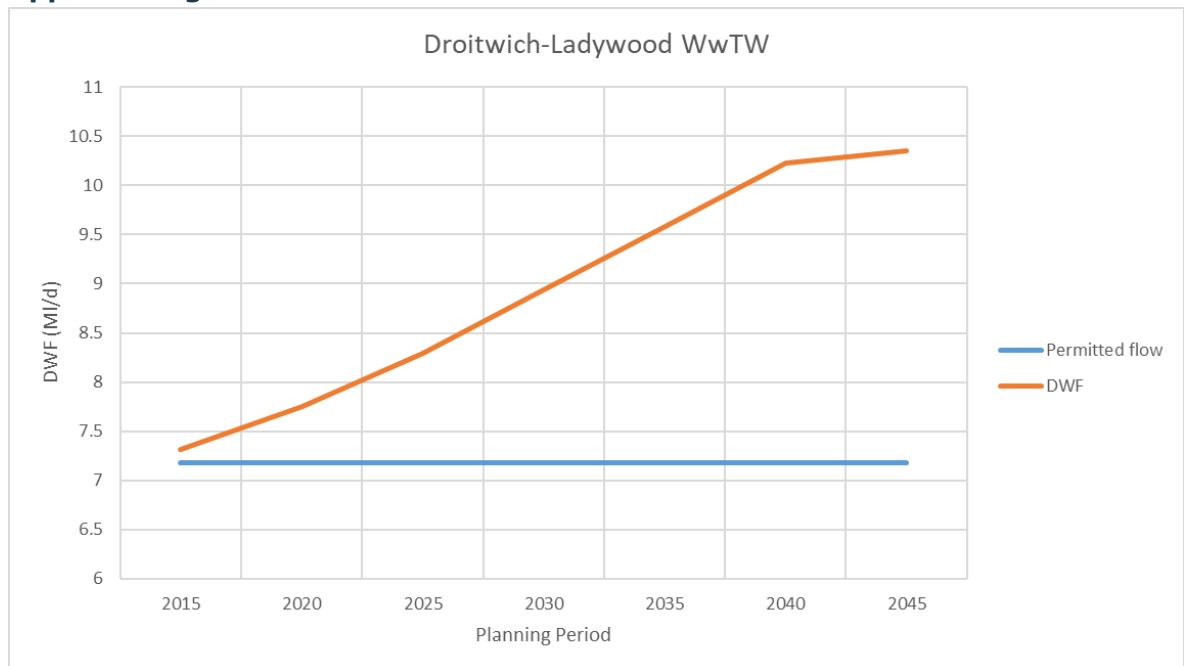
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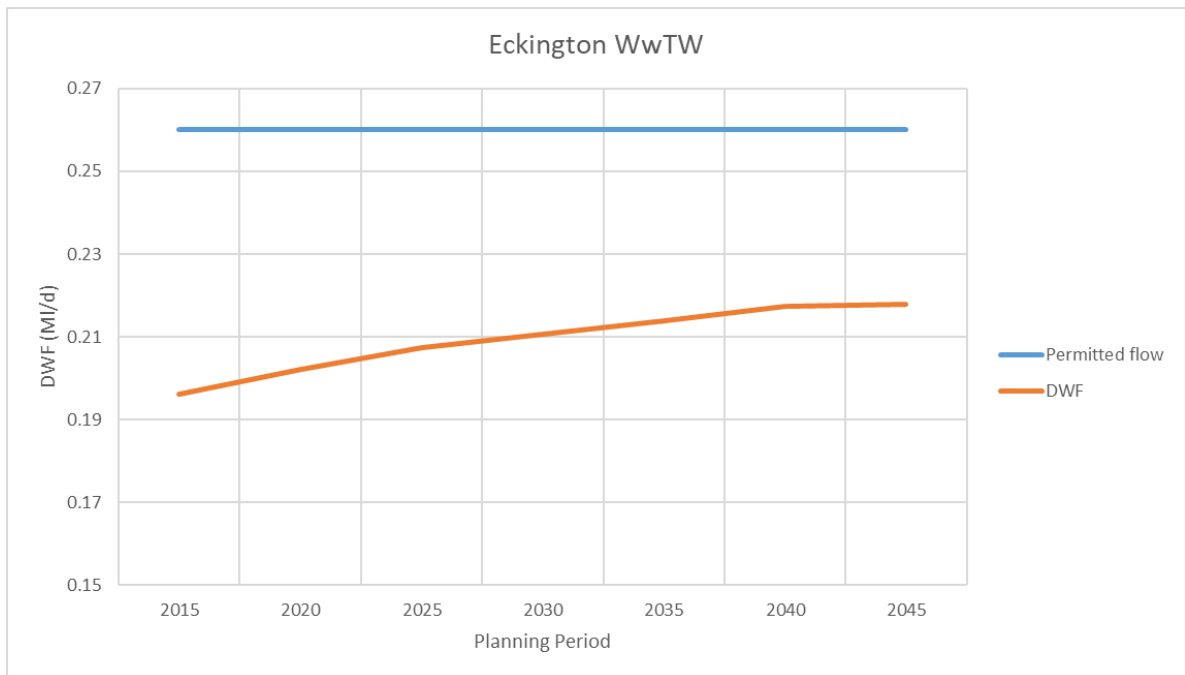
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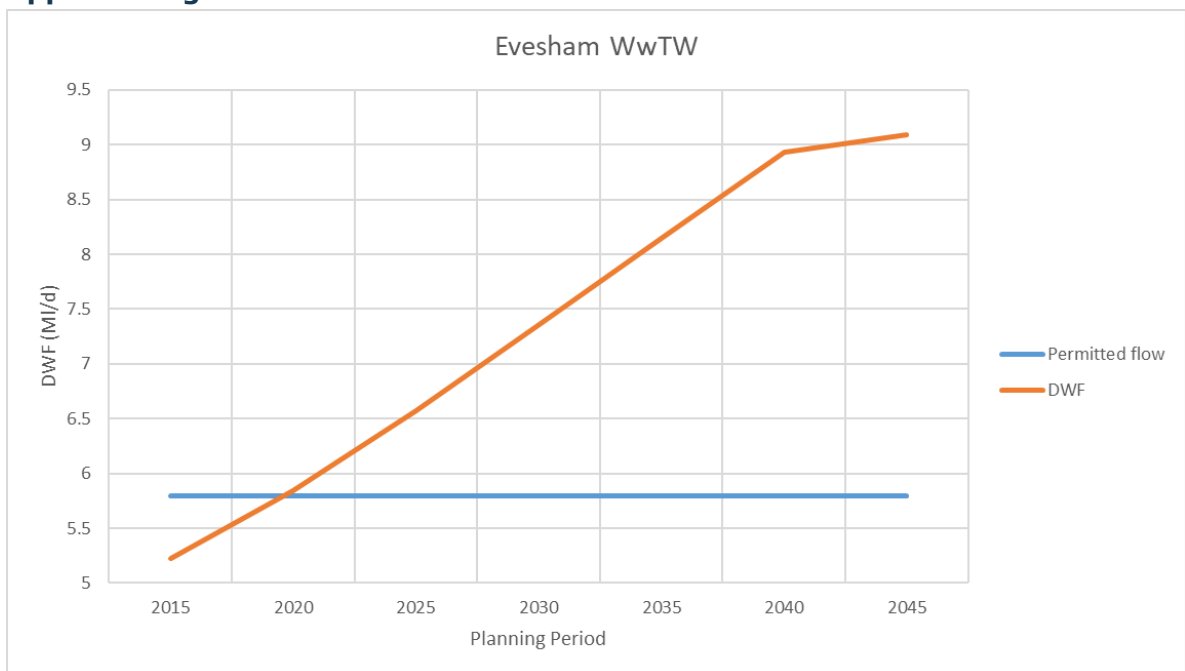
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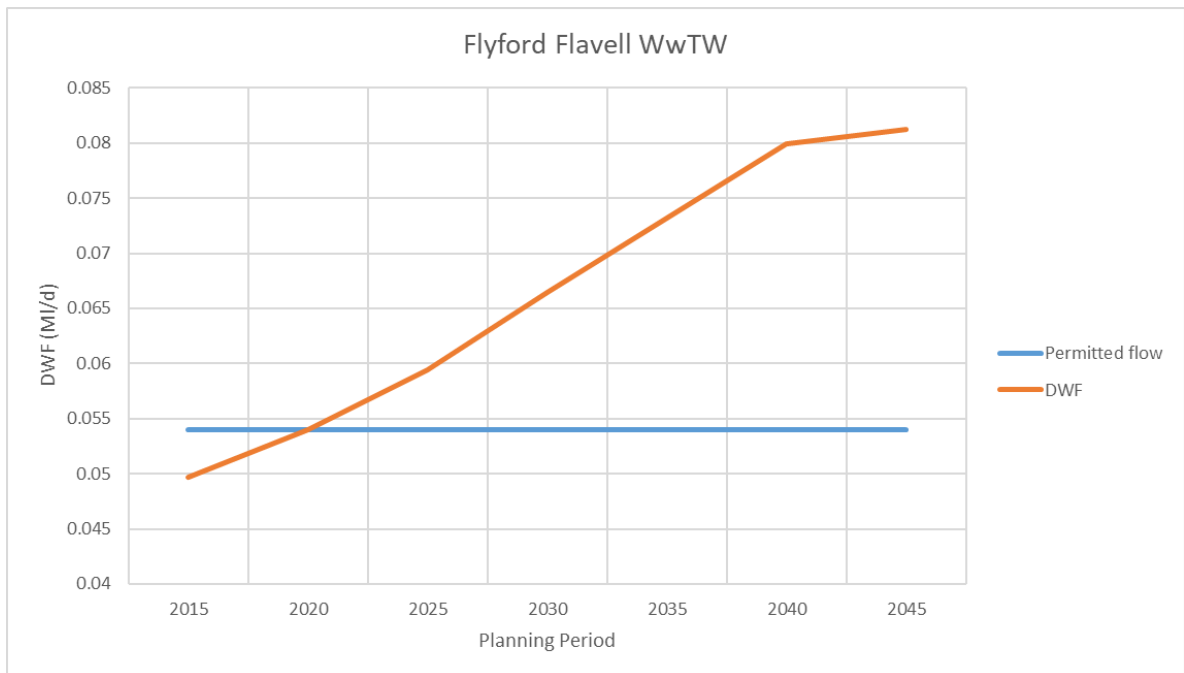
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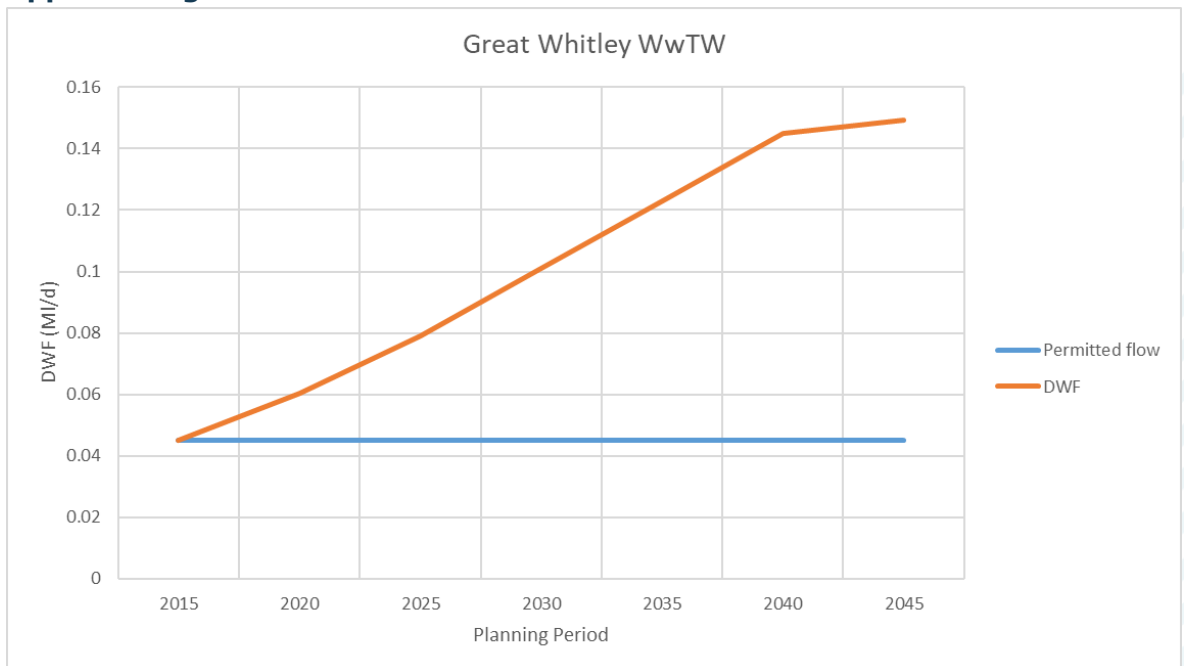
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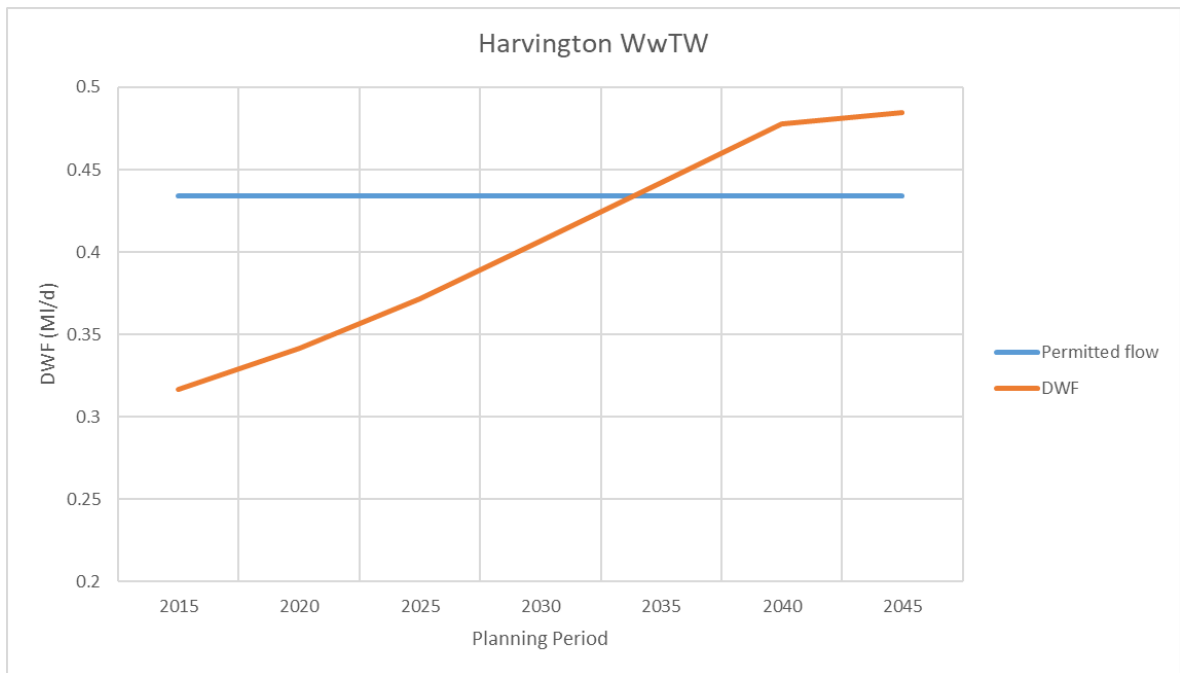
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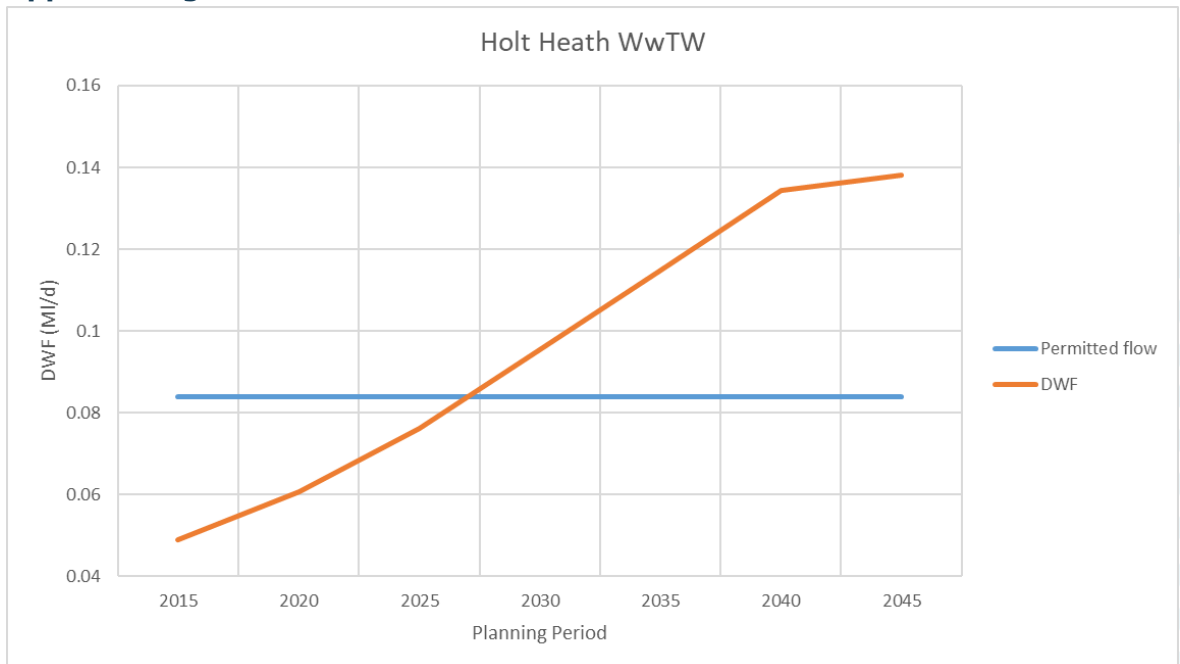
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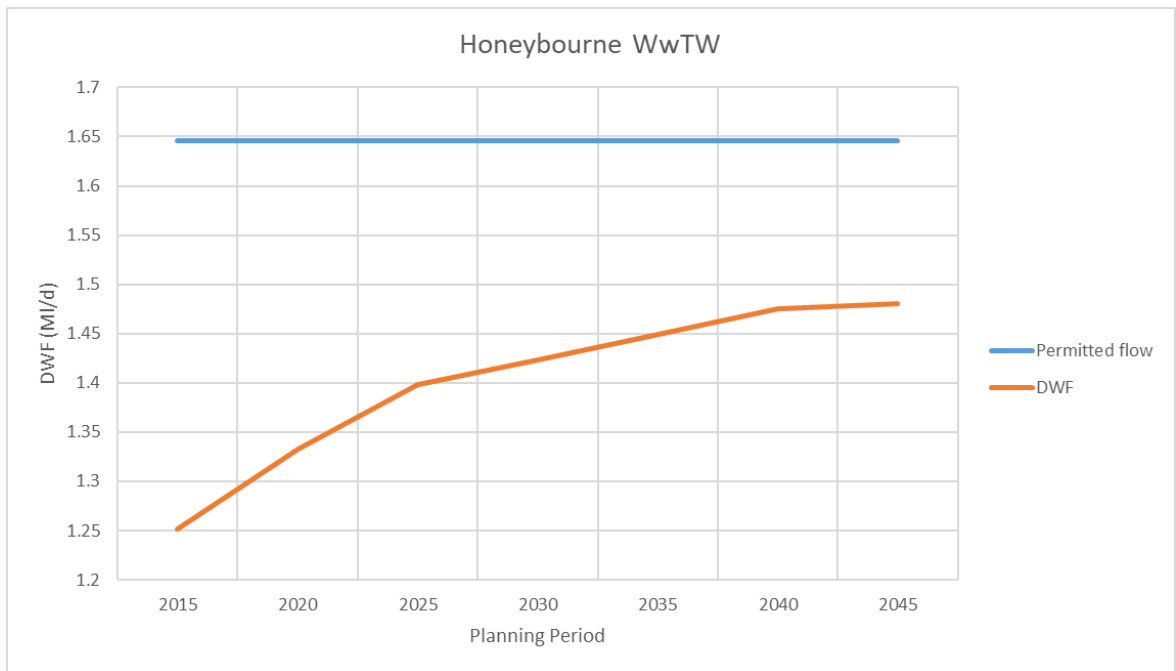
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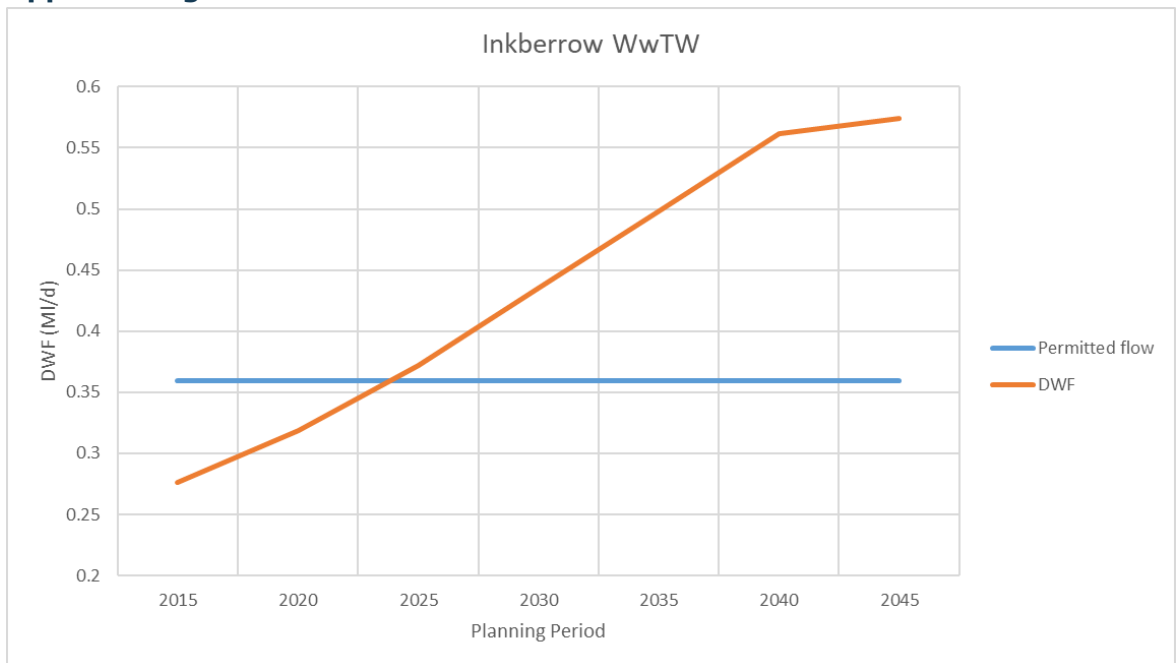
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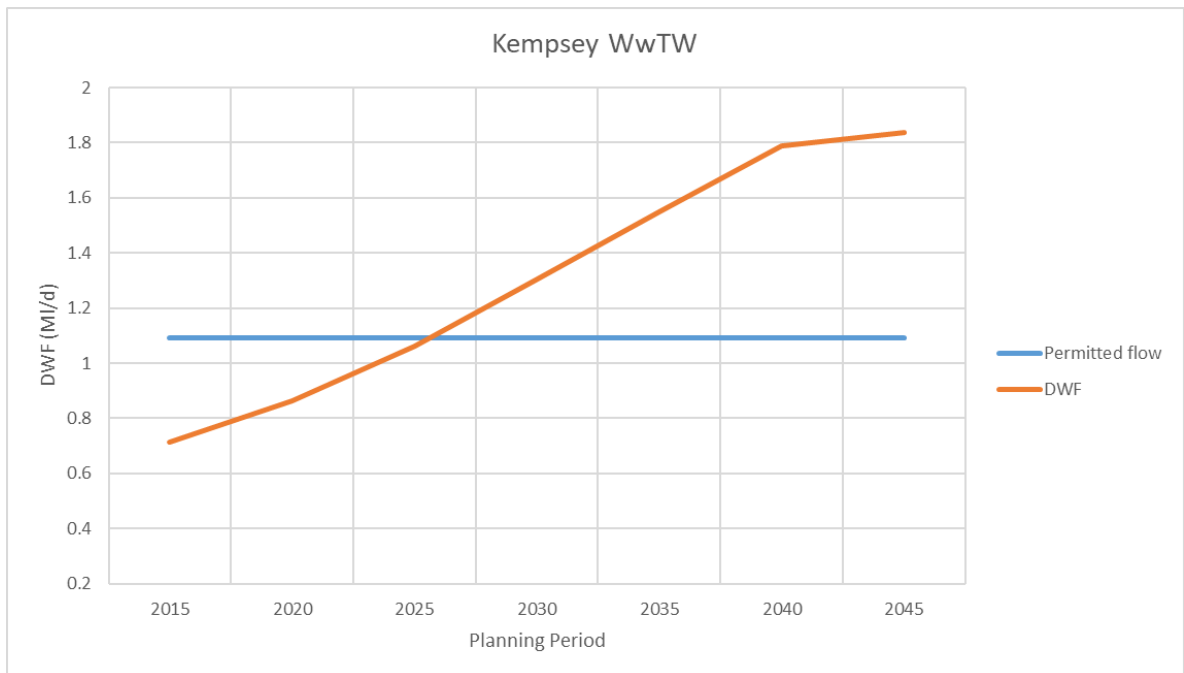
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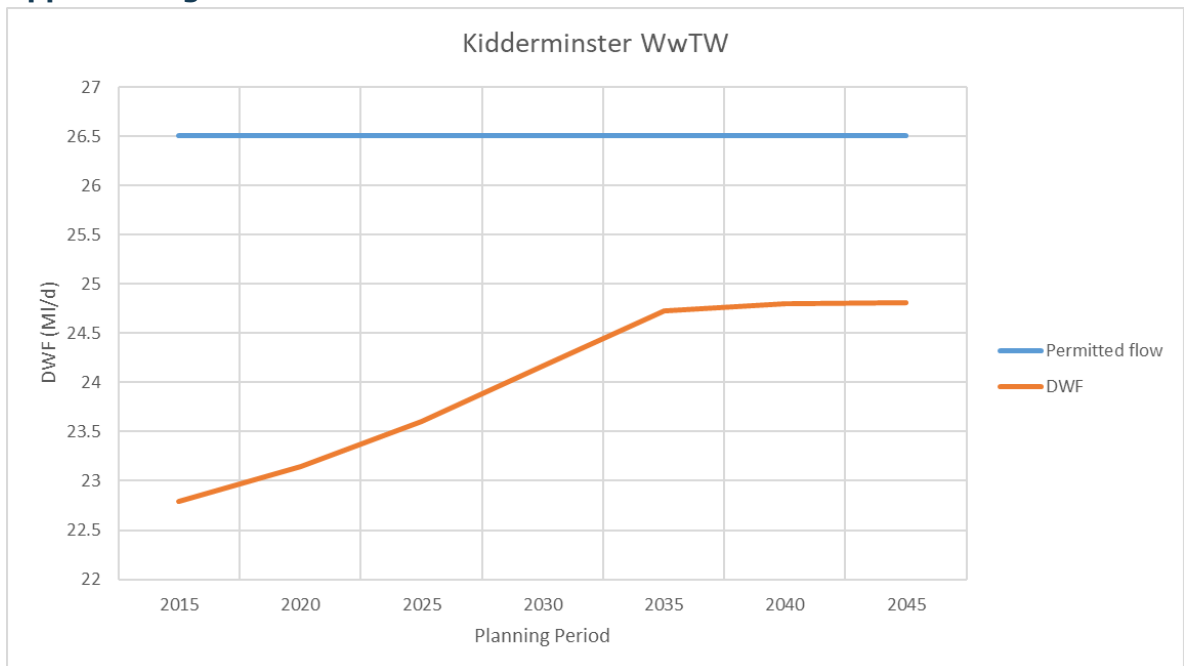
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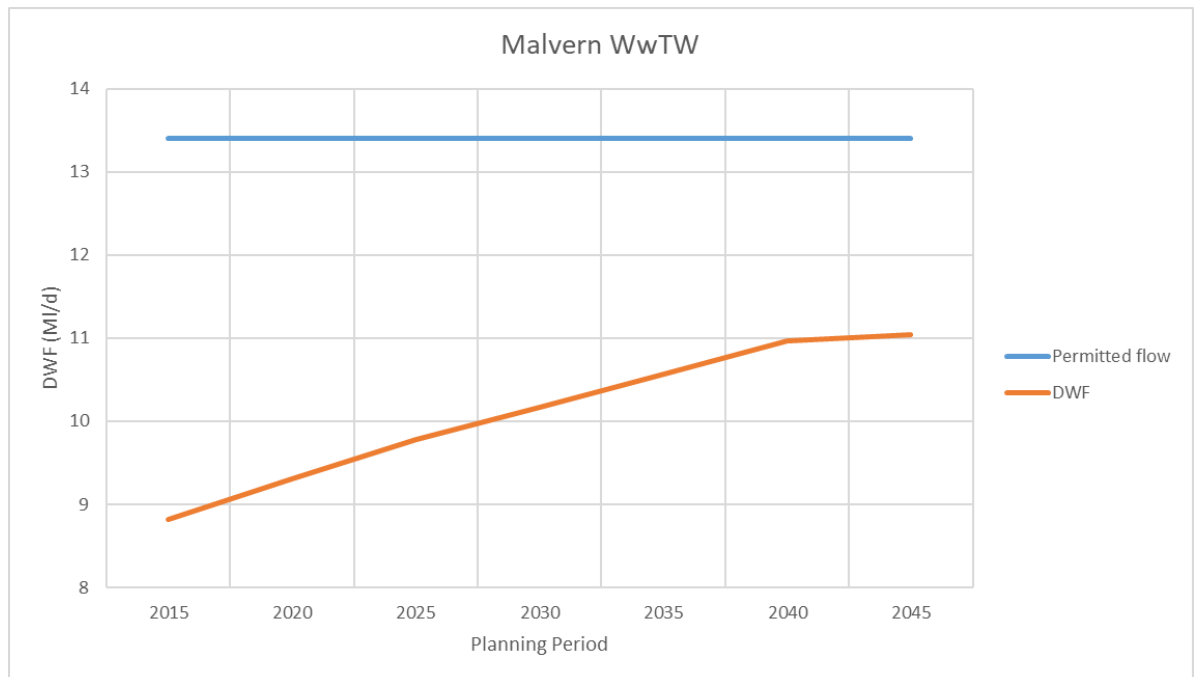
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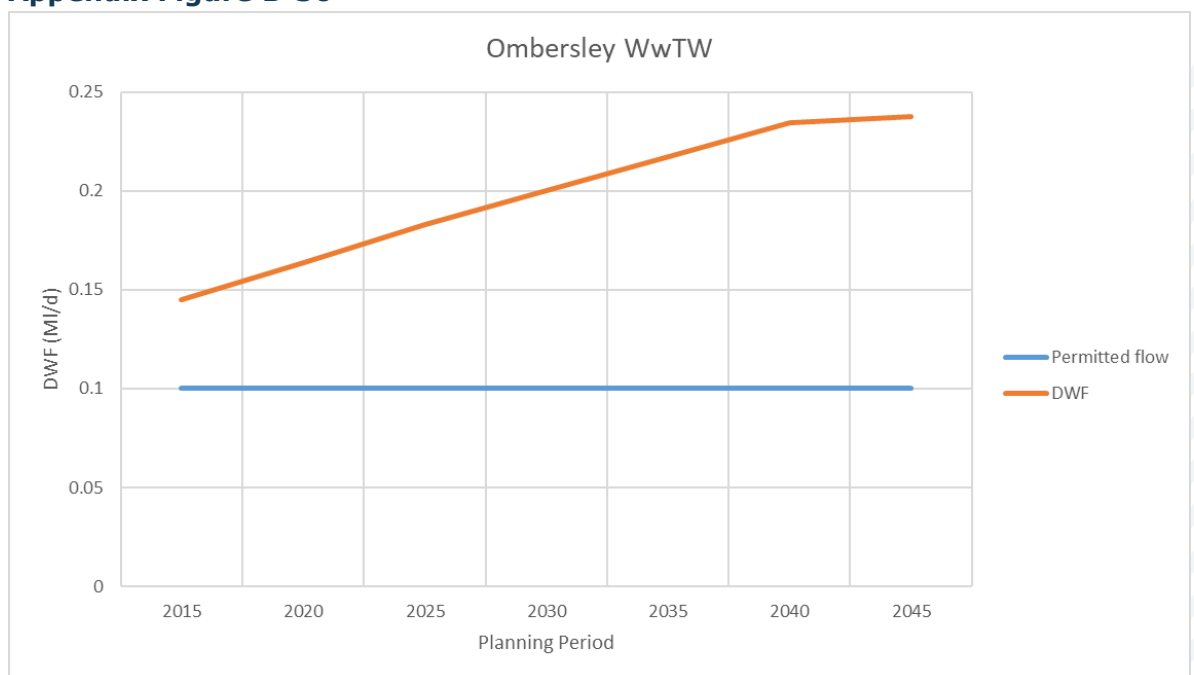
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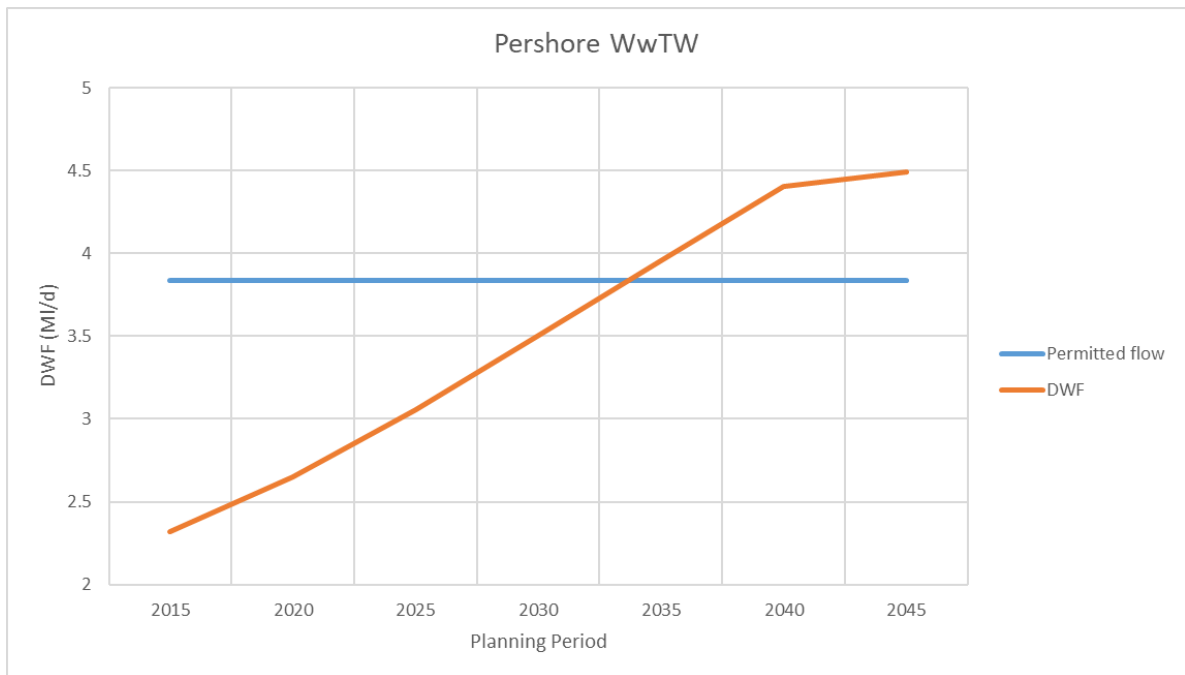
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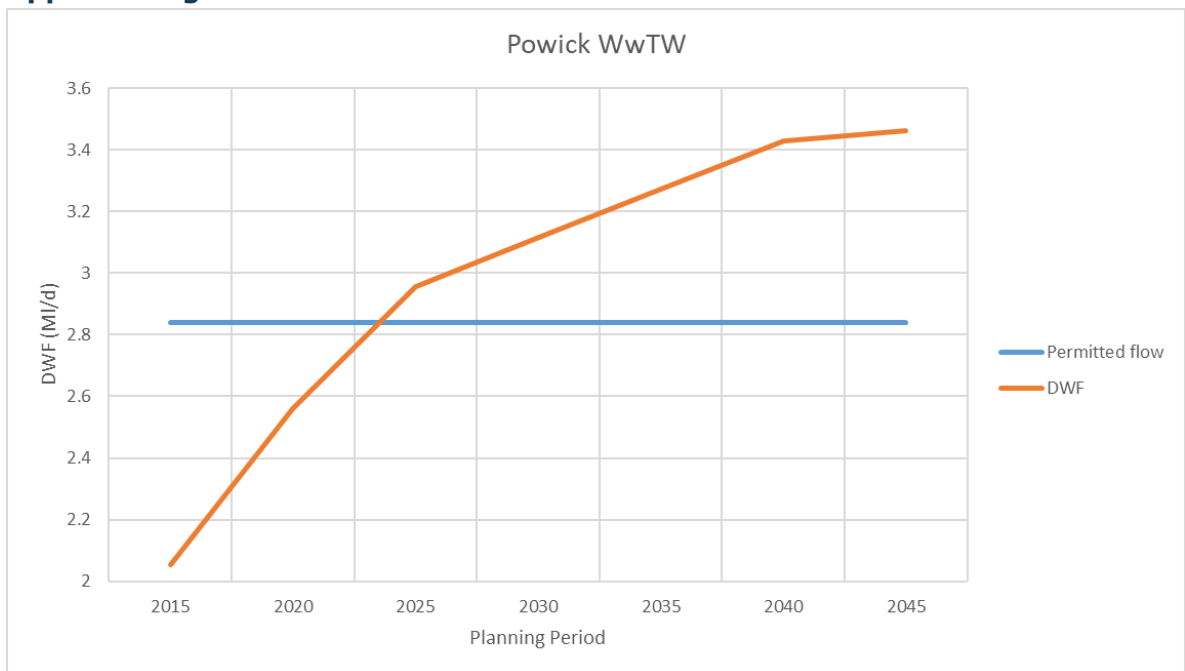
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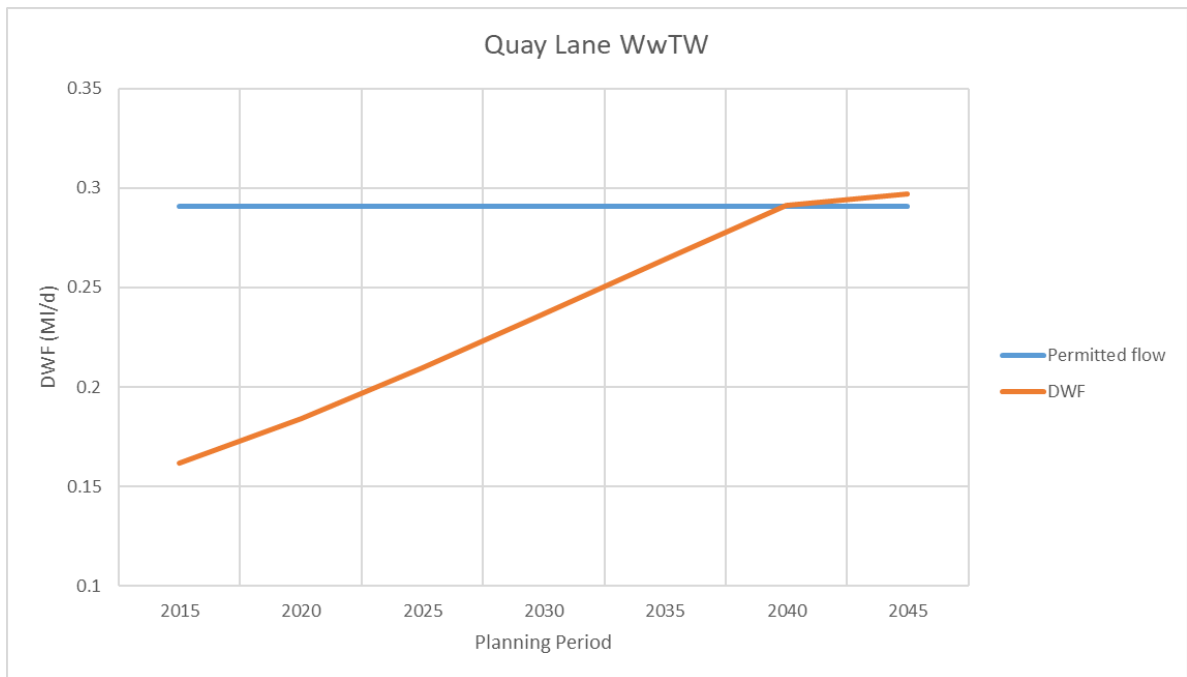
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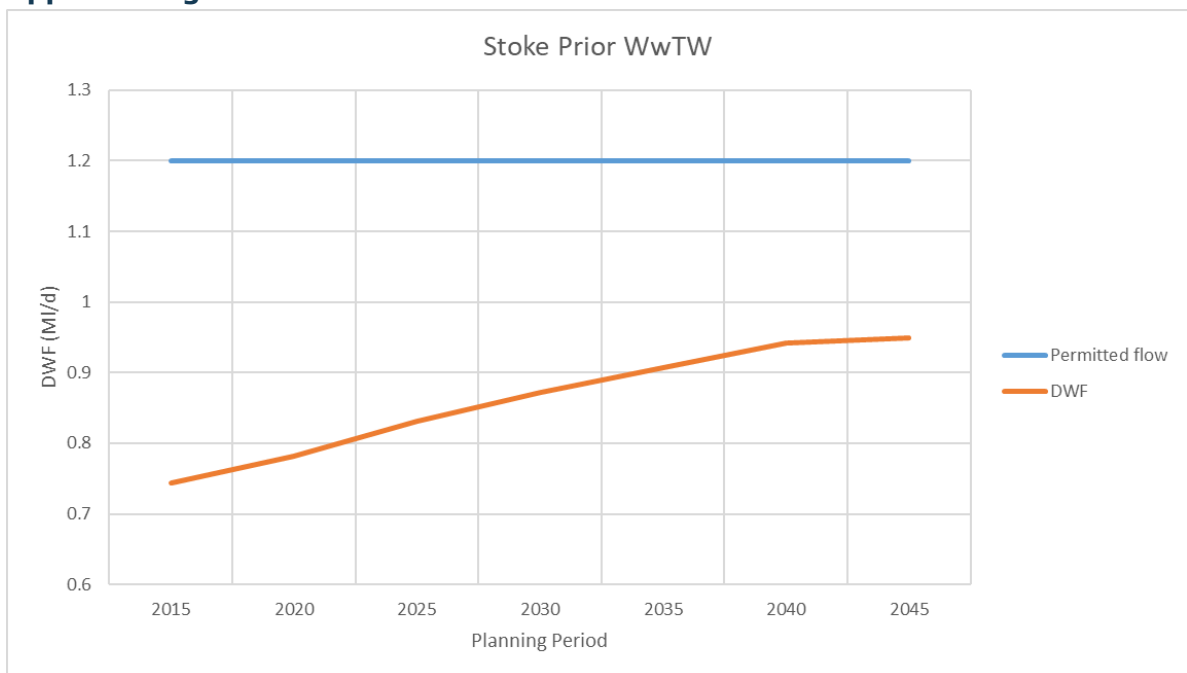
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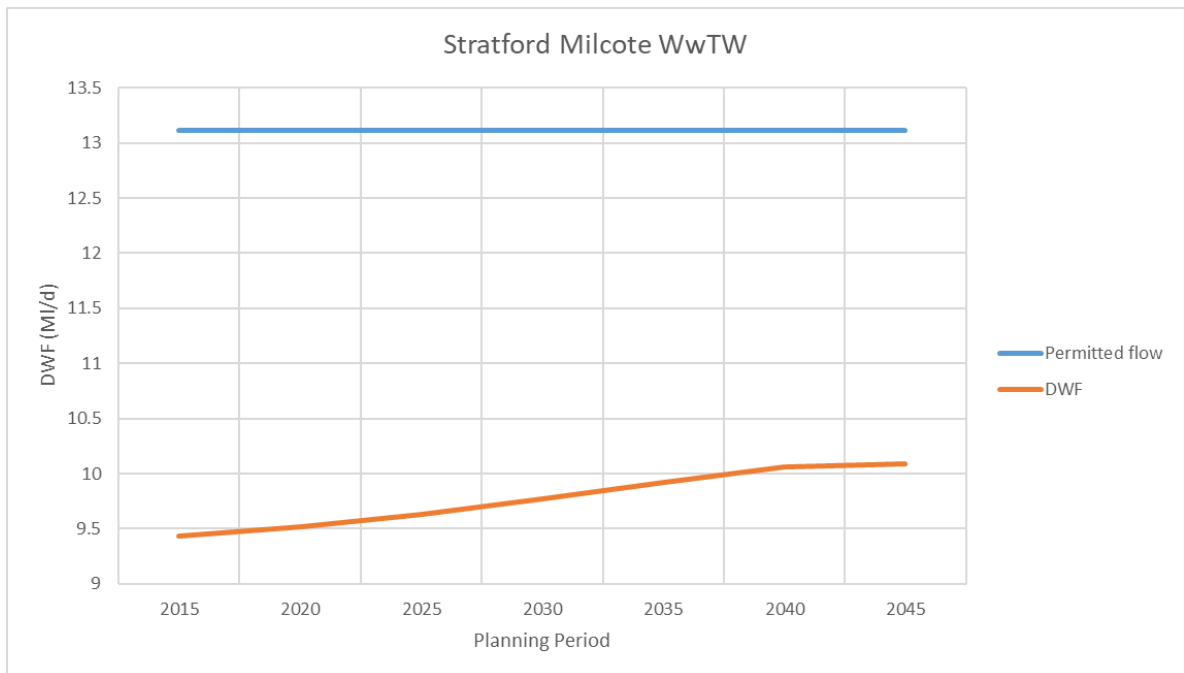
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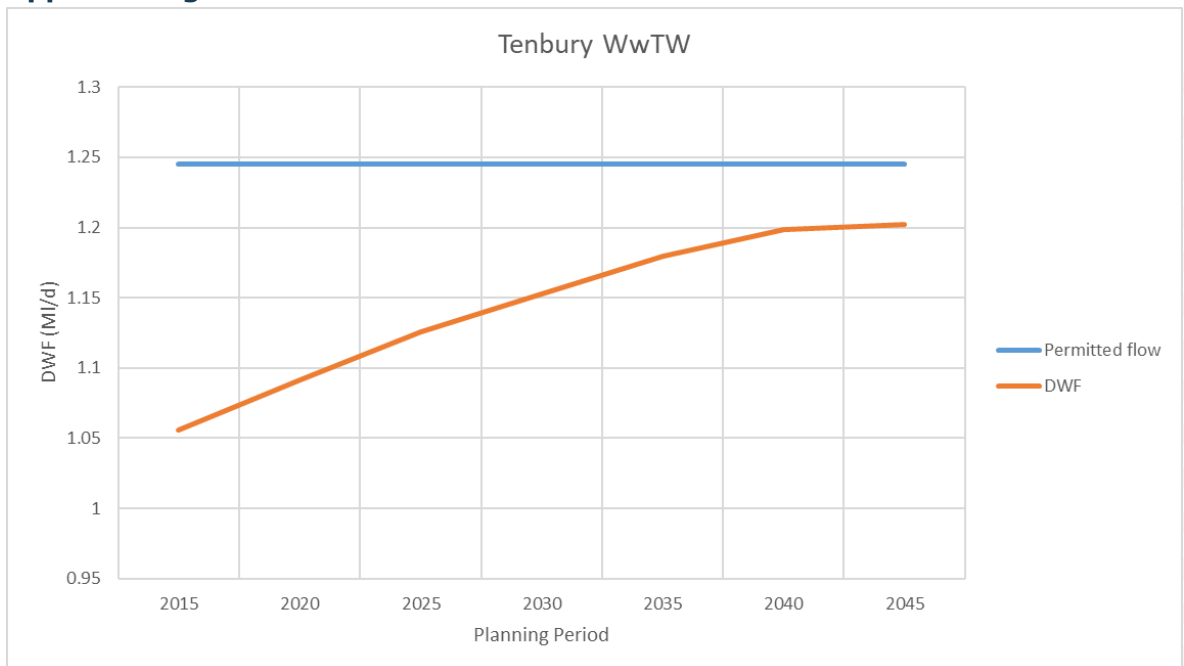
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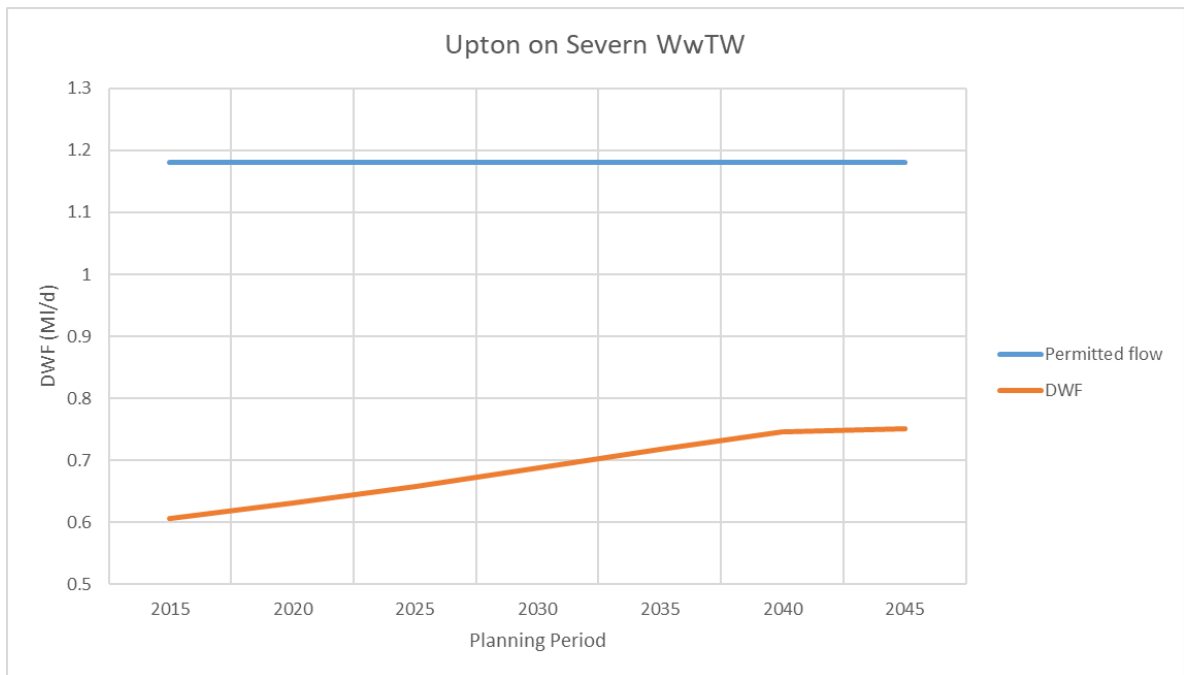
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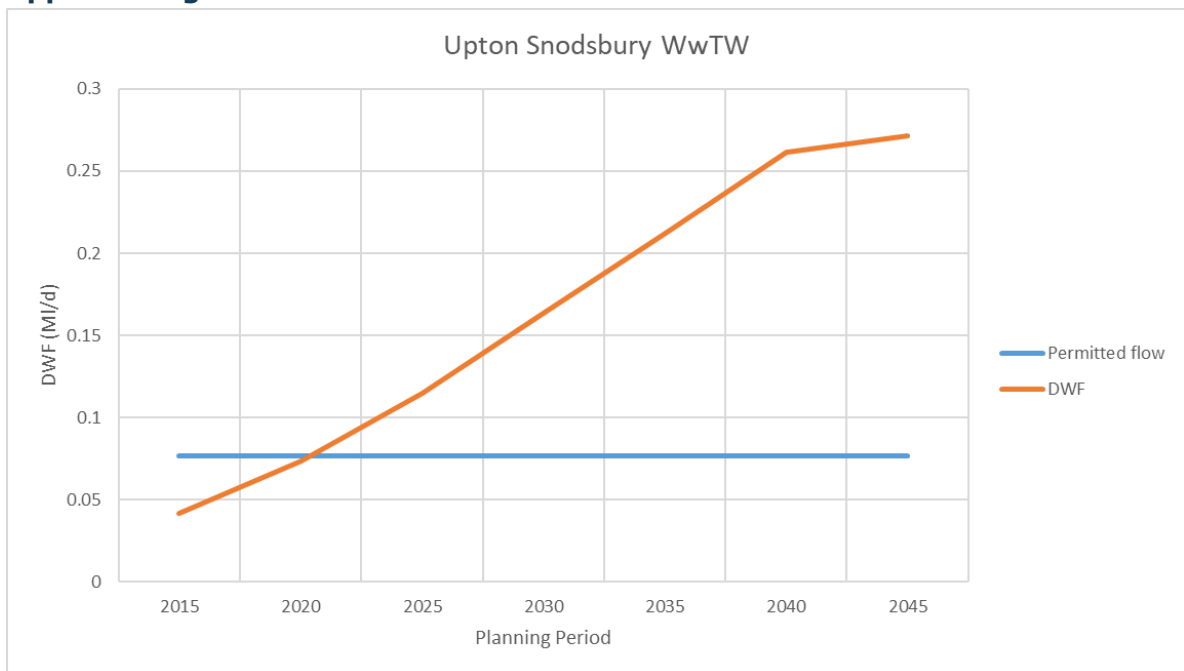
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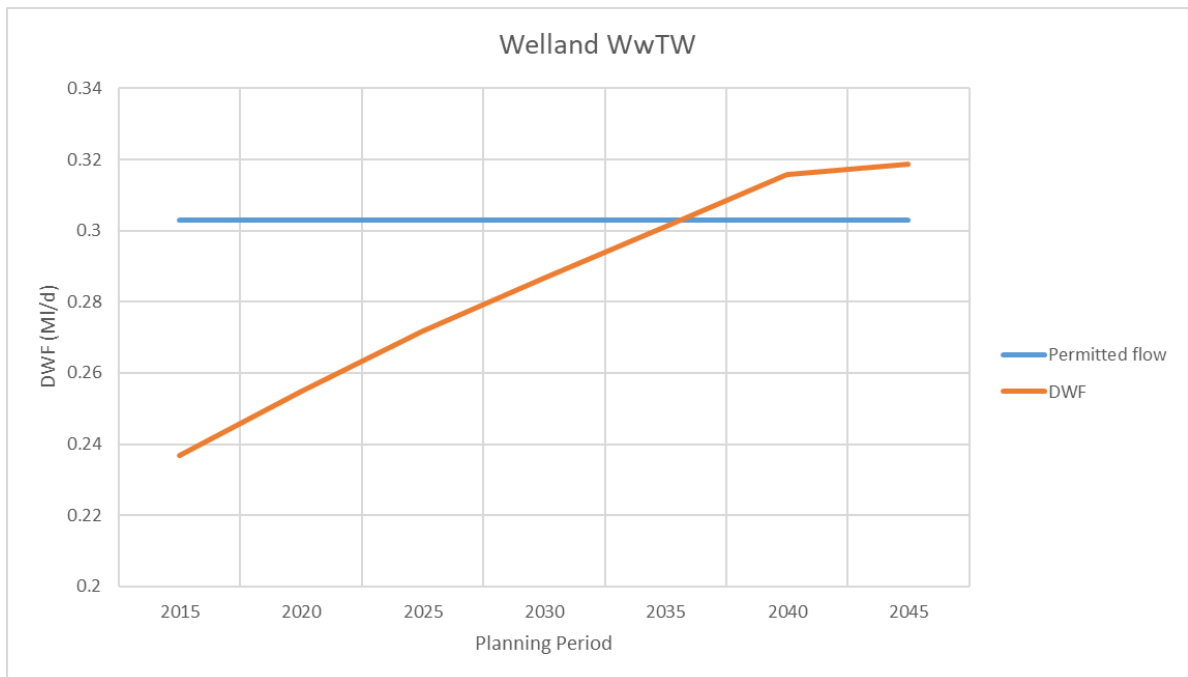
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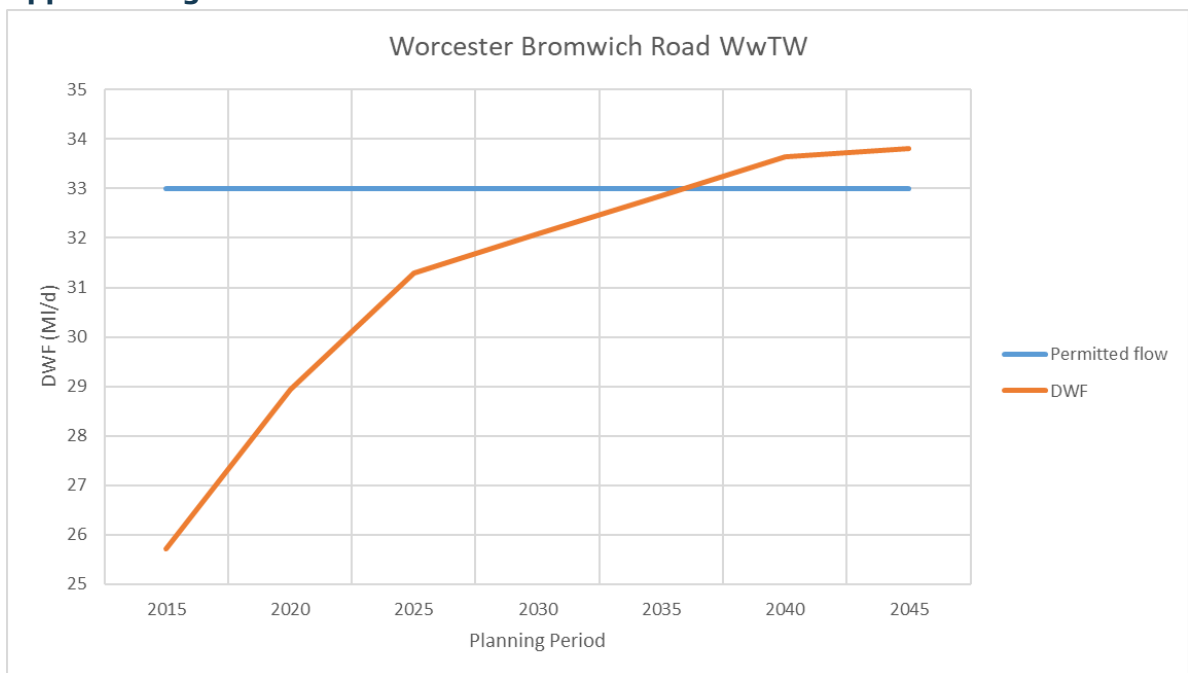
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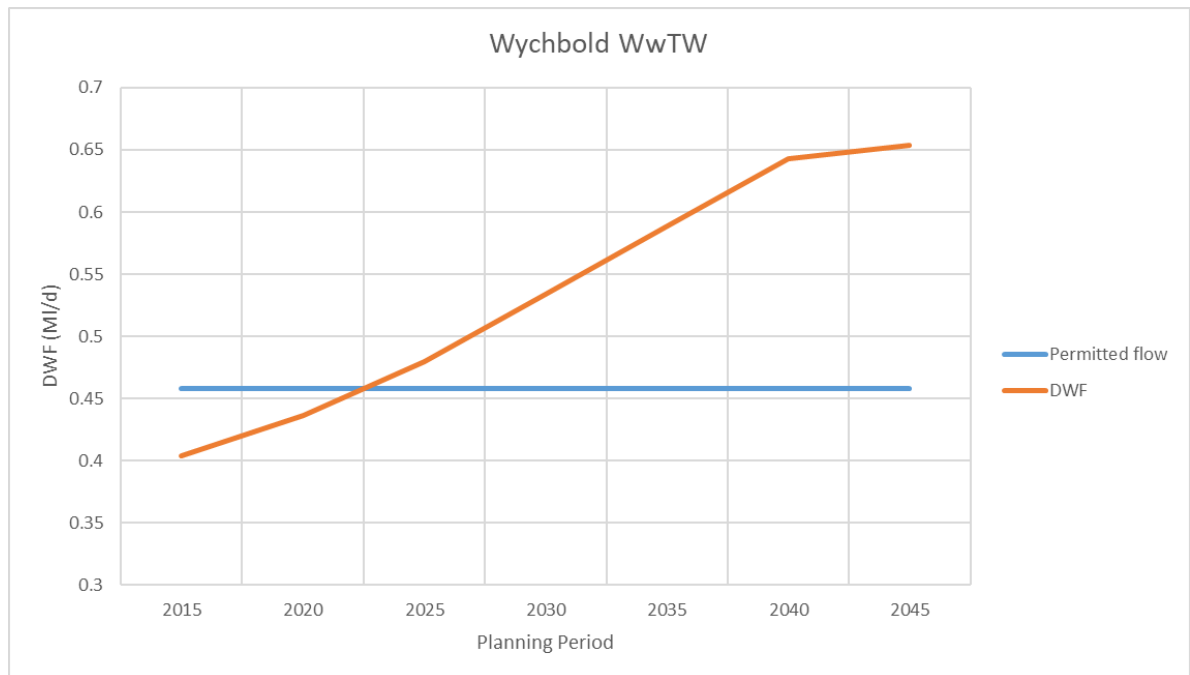
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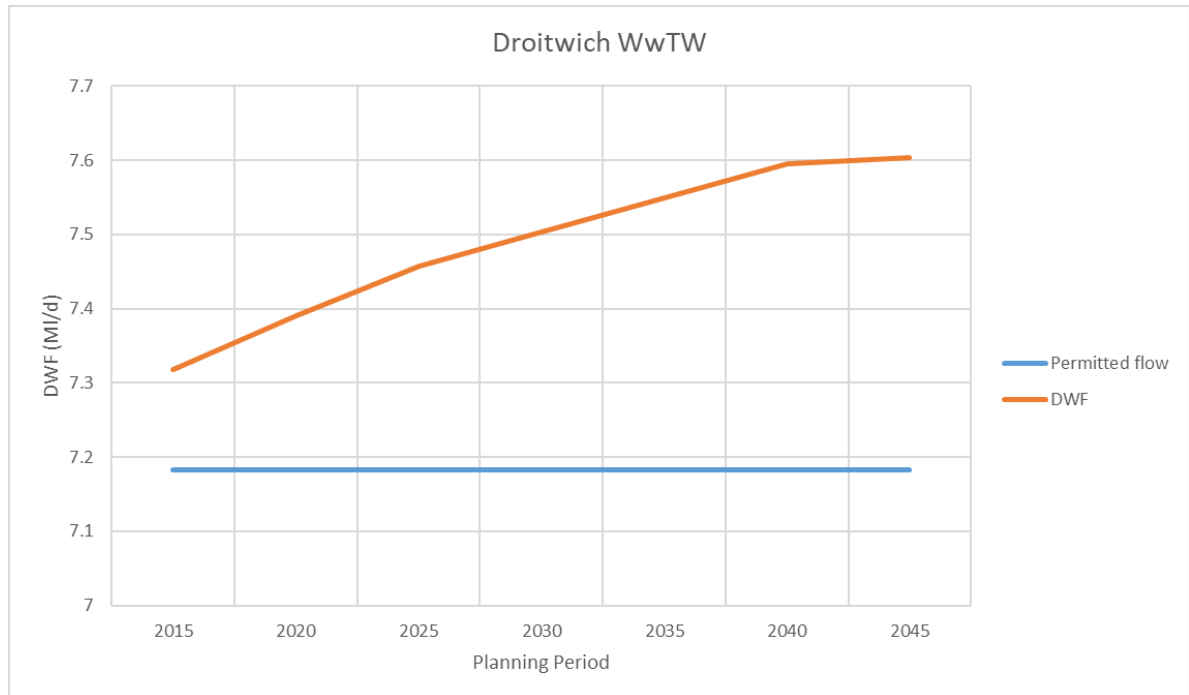


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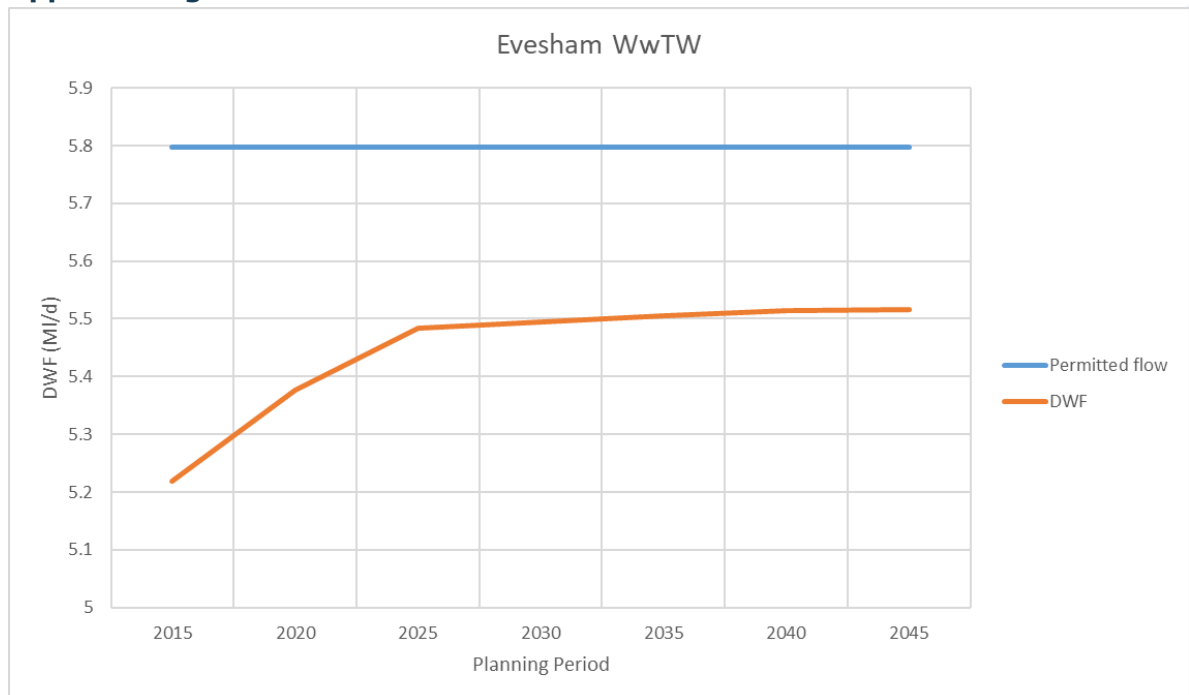


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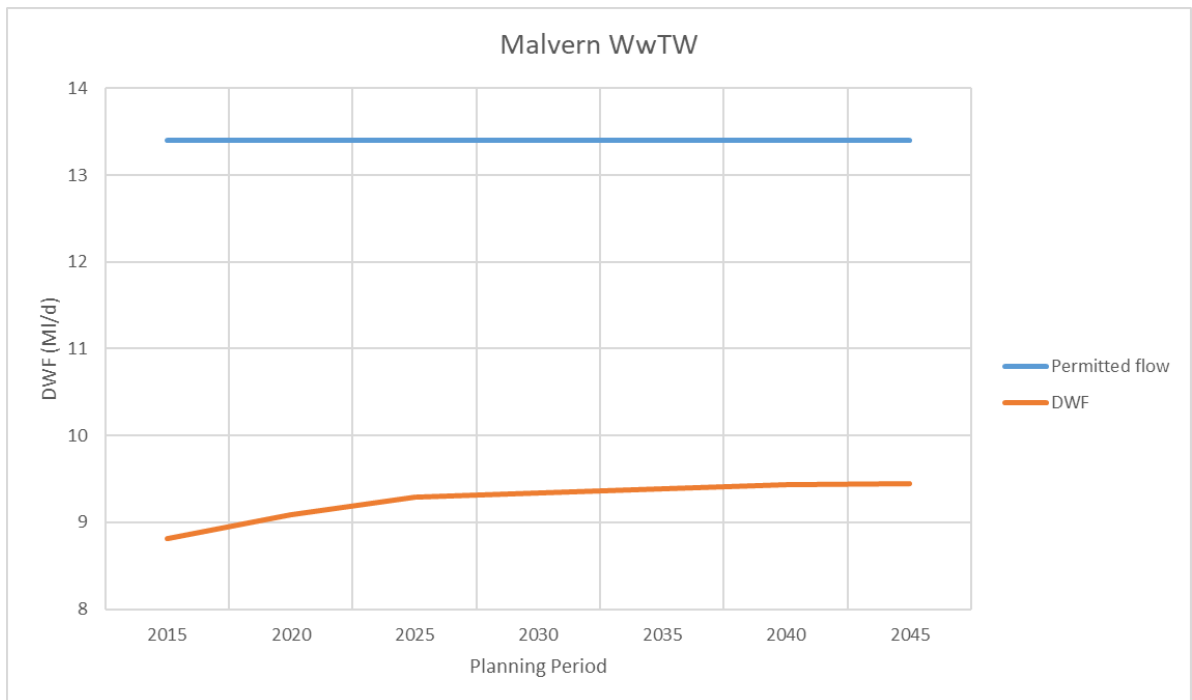
B.3 Option C – Infill/regeneration



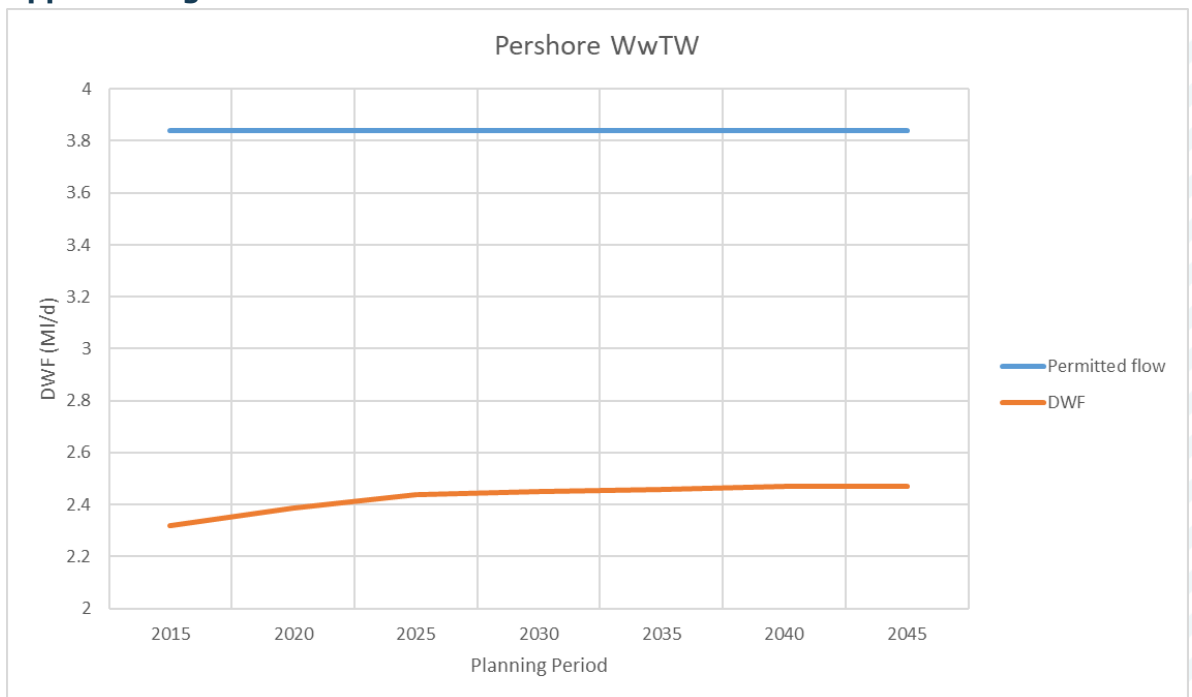
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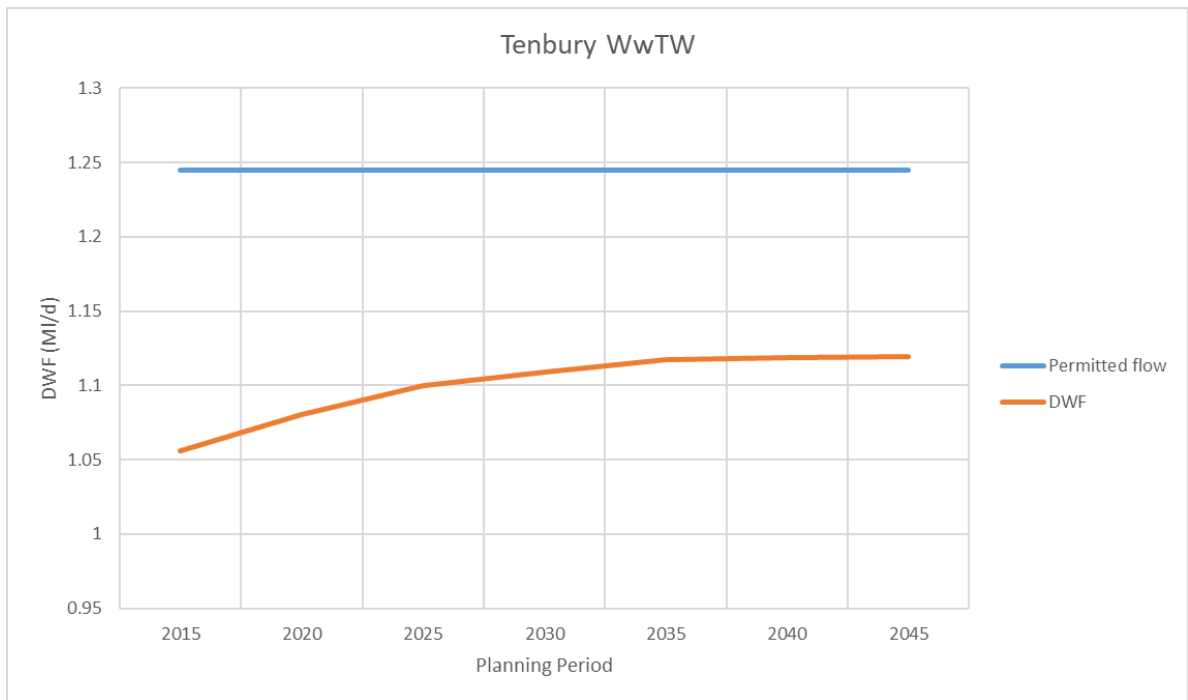
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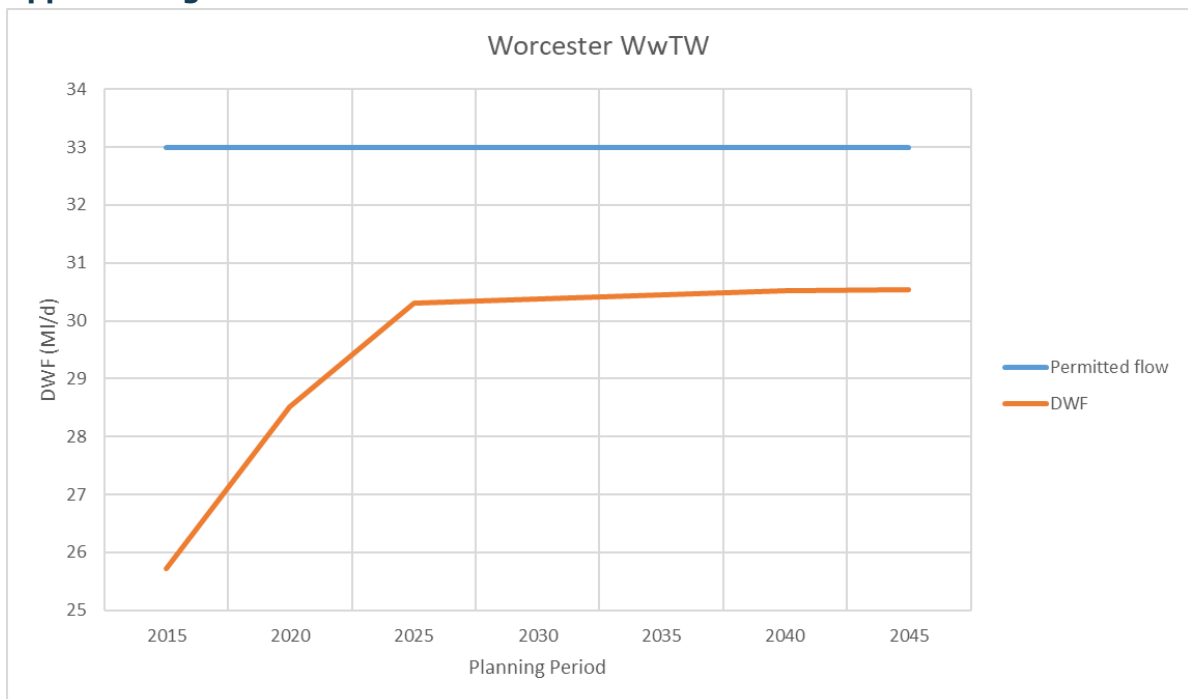
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Appendix Figure B-46

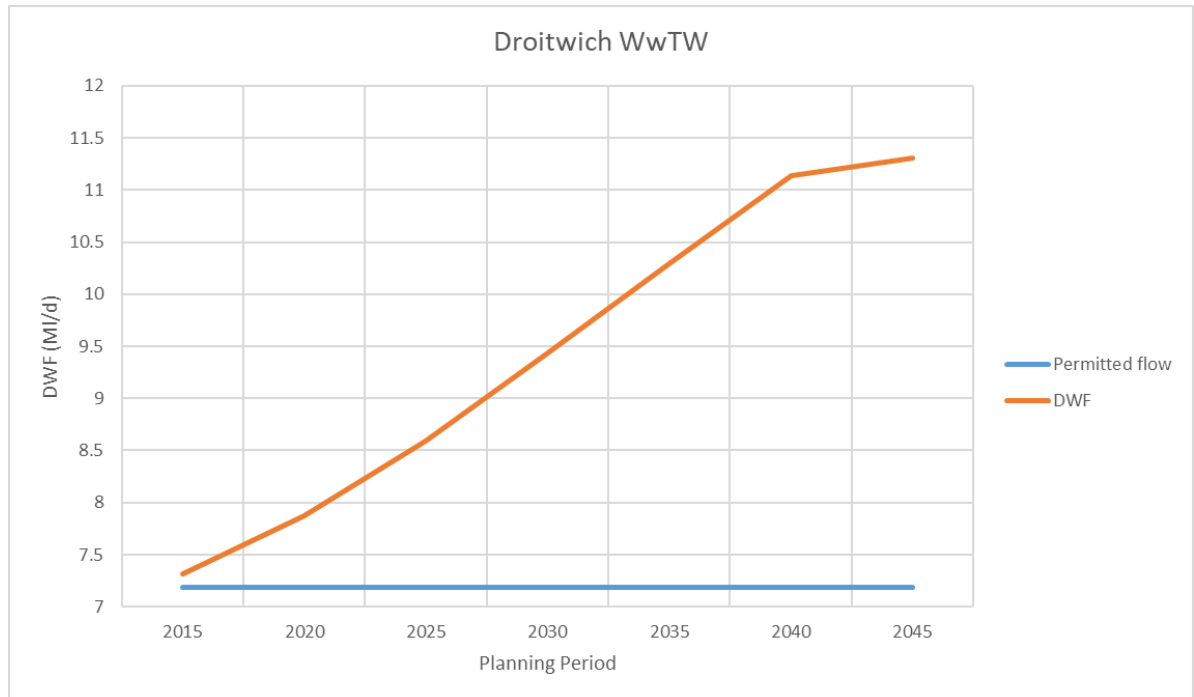


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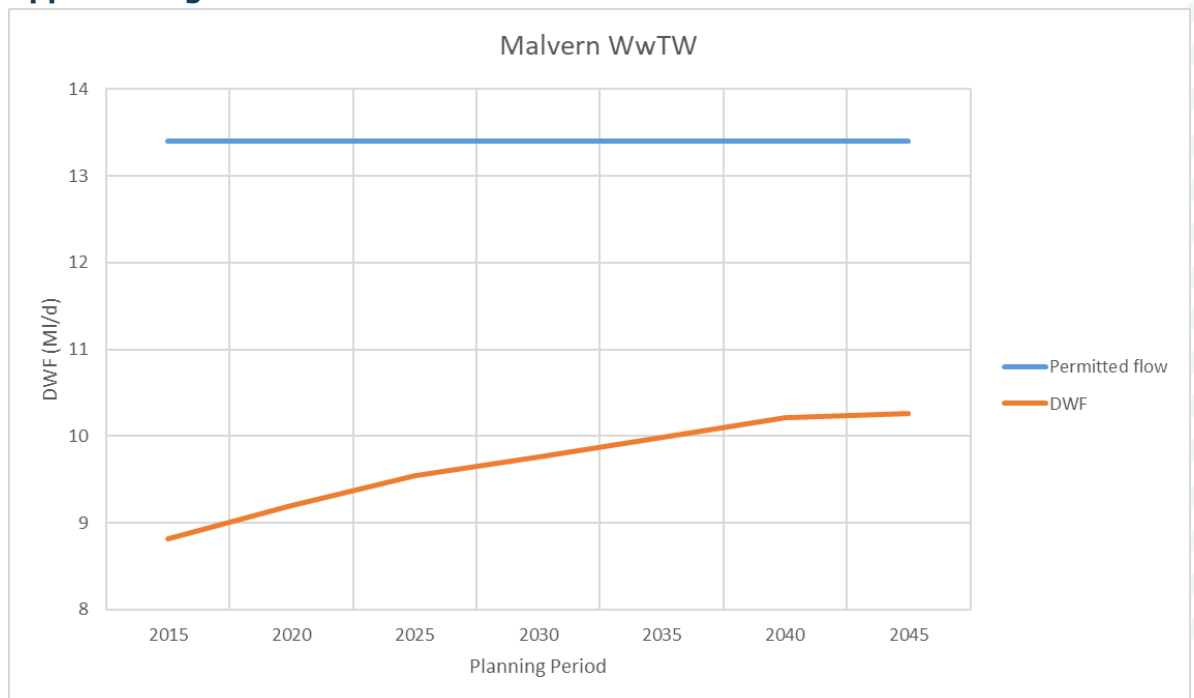


Appendix Figure B-48

B.4 Option D – Large urban extensions



Appendix Figure B-49

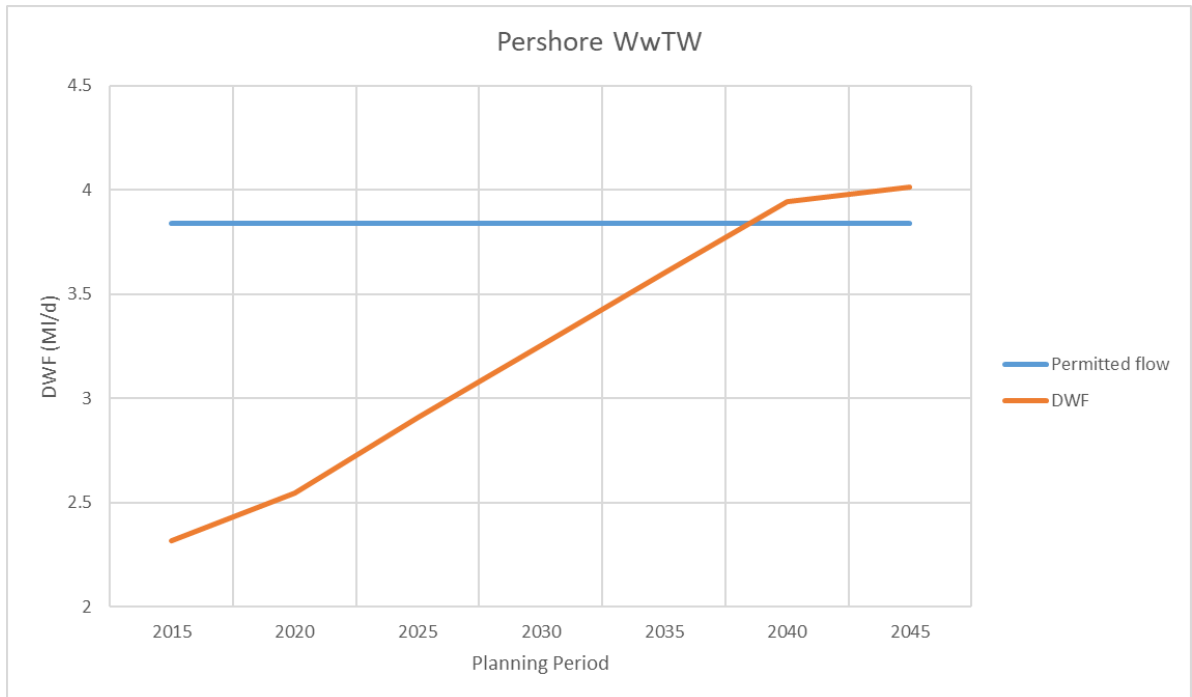


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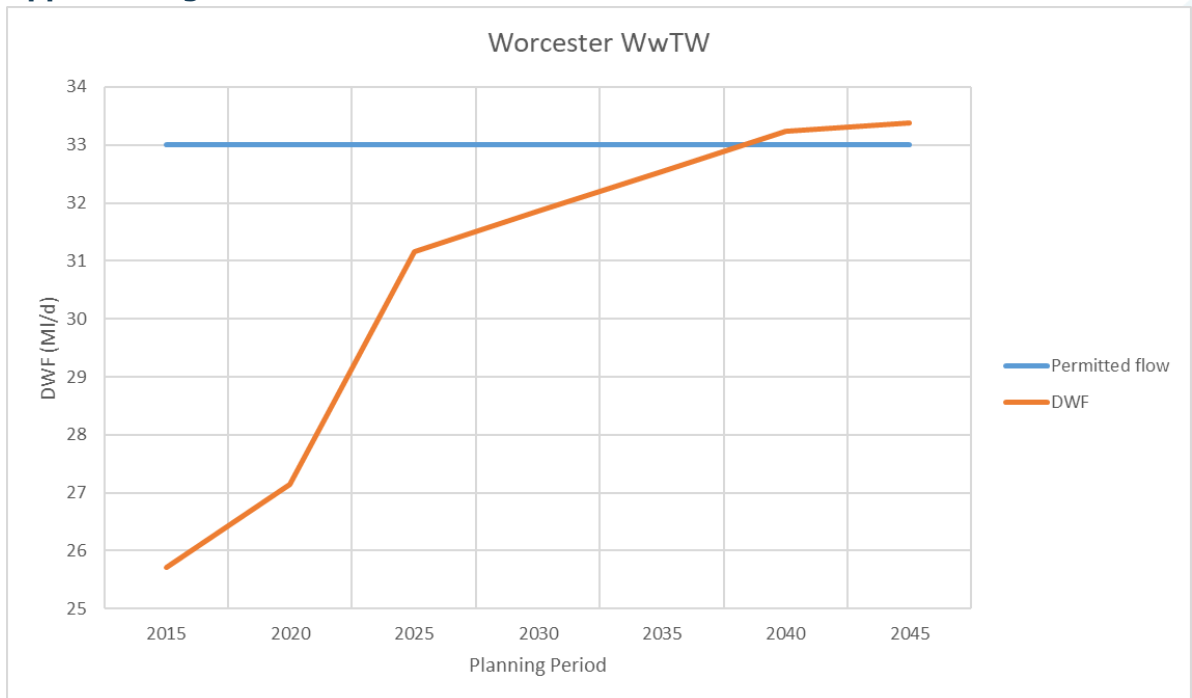


Appendix Figure B-51

B.5 Option E – New/expanded settlements



Appendix Figure B-52



Appendix Figure B-53

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