

# Appendix 1

## Water Resource Zone Characteristics



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# Water Resource Zone Characteristics



The uneven nature of climate, drought, growth and environmental impacts across our region means we have developed Water Resource Zones (WRZs). WRZs are the geographical areas used to develop forecasts of supply and demand and supply-demand balances. The WRZ describes an area within which supply infrastructure and demand centres are linked such that customers in the WRZ experience the same risk of supply failure. These were reviewed in the Water Resources Management Plan (WRMP) 2019 and have changed since the last WRMP and Drought Plan.

Overall, we have increased the number of WRZs from 19 at WRMP 2015 to 28 for WRMP 2019, including the addition of South Humber Bank which is a non-potable WRZ that sits within Central Lincolnshire.

The revised list of WRZs are listed below and shown in Figure 1. For each WRZ we describe the characteristics of the zone, details of previous droughts experienced and current drought risk. Through WRMP 2019 modelling, we have assessed our drought risk for each WRZ and consider the majority to be secure up to a 1 in 200 year event. There are five zones where we have identified remaining vulnerabilities and we have proposed supply-side investment schemes in the WRMP. These will be completed by the end of AMP7. Should a severe drought occur before this time, we have identified 'interim options', in Appendix 3. Appendix 3 also includes high level options should an extreme drought (1 in 500 year event) occur, although given the unlikely and uncertain nature of such an event these options have not been detailed at a WRZ level. Demand drought measures we would undertake for each WRZ to ensure security of supply are detailed in Appendix 2.

## List of WRMP 2019 WRZs, in order of discussion:

### Area 1: Lincolnshire and Nottinghamshire

- Central Lincolnshire
- Bourne
- East Lincolnshire
- Nottinghamshire
- South Lincolnshire

### Area 2: Rutland

- Rutland Central
- Rutland North
- Rutland South
- Rutland West

### Area 3: Fenland

- North Fenland
- South Fenland

### Area 4: Norfolk

- Happisburgh
- North Norfolk Coast
- North Norfolk Rural
- Norwich and The Broads
- South Norfolk Rural

### Area 5: East Suffolk and Essex

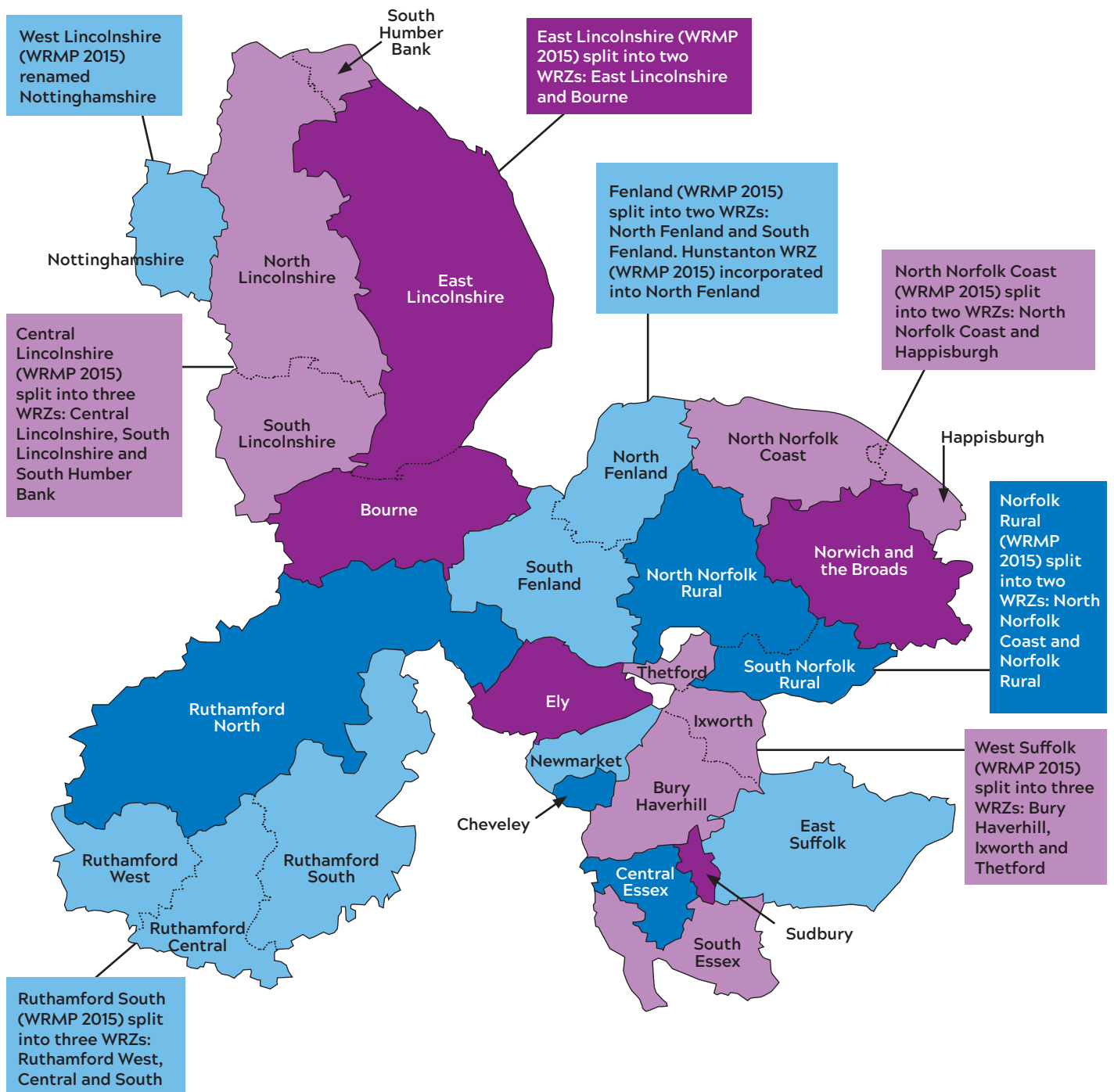
- Central Essex
- East Suffolk
- South Essex

### Area 6: Cambridgeshire and West Suffolk

- Bury Haverhill
- Cheveley
- Ely
- Ixworth
- Newmarket
- Sudbury
- Thetford

### Area 7: Hartlepool

- Hartlepool





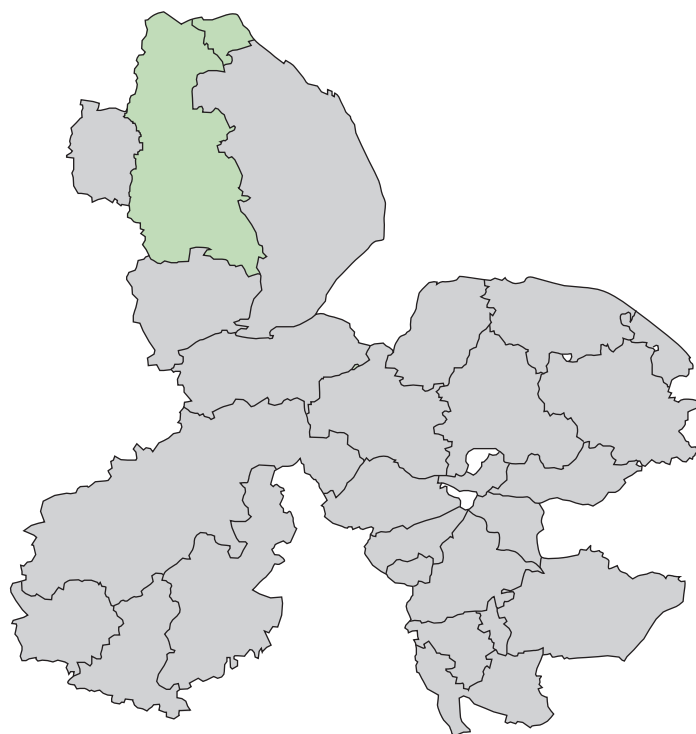
# Area 1: Lincolnshire and Nottinghamshire

## Central Lincolnshire



### Characteristics

The Central Lincolnshire WRZ covers an area of 2072km<sup>2</sup> and extends south from the Humber. It includes groundwater abstraction from the Lincolnshire Limestone and a surface water abstraction from the River Trent. It is based on the supply systems for Scunthorpe and Lincoln. The new Hall WTW was opened in July 2014, which will treat water abstracted directly from the River Trent for supply to customers in Lincoln.



### Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
Central Lincs	Branston Booths	GW	Confined Lincs Limestone	83	17
	Dunston	GW	Confined Lincs Limestone		
	Hall	SW	River Trent		
	Newton	GW	Sherwood Sandstone		
	Waddingham	GW	Confined Lincs Limestone		
	Welton	GW	Confined Lincs Limestone		
	Barrow	GW	Lincs Chalk		
	Elsham (Potable)	GW/SW	River Ancholme / Lincs Chalk		
	Winterton	GW	Confined Lincs Limestone		

## **Drought risk**

Drought risk has been assessed for up to a 1 in 200 year drought event as part of our WRMP 2019. This identified the Hall surface water intake on the River Trent as being vulnerable to a drought of this severity. There are three classified drought vulnerable boreholes (Tier 1): Goxhill, Welton and Winterton Holmes.

We have also reviewed our risk to a 1 in 500 year extreme drought. This identified additional vulnerability is likely to be seen at the River Trent intake, and the groundwater sources of; Barrow, Barton, Ulceby, Branston Booths, Glenthams, Hibaldstow Bridge, Redbourne, Spridlington, Waddingham.

## **Drought Plan Management Actions**

There is an interim option proposed for Central Lincs to mitigate modelled vulnerability to a severe drought in this zone. This option is a drought permit on the River Trent at our Hall WTW intake to lower the minimum residual flow to allow increased abstraction in times of low flows.

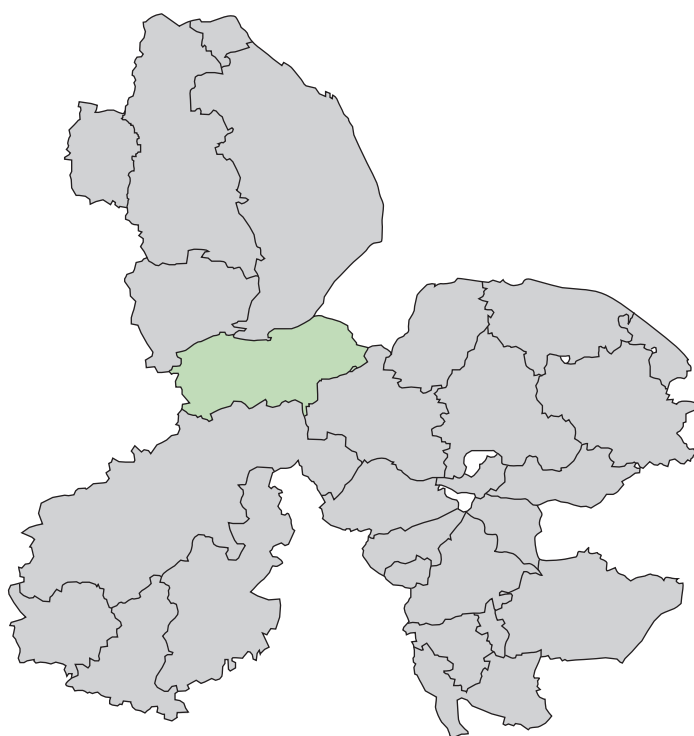
To ensure security of supply is maintained at the drought vulnerable boreholes, we can increase abstraction from less vulnerable sources within the zone and have also invested in a new borehole at Winterton to maintain supply.

Cadney direct intake is reliant on augmentation of the flow of the River Ancholme by the Environment Agency's Trent-Witham-Ancholme (TWA) transfer scheme during lower summer flows. The TWA scheme is managed by the Environment Agency under a Section 20 agreement. Analysis shows this intake is secure against the worst historic and modelled 1 in 200 year droughts<sup>1</sup>.

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<sup>1</sup> Atkins (2017) Trent Witham Ancholme Assessment Memo

# Bourne



## Characteristics

The Bourne WRZ covers an area of 1087km<sup>2</sup> and lies to the south west of the Wash. It is based on the supply systems for Bourne, Spalding and Stamford. Water is abstracted from groundwater sources in the Southern Lincolnshire Limestone aquifer.

## Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
Bourne	Bourne	GW	Confined Lincs Limestone	100	0
	Etton	GW	Confined Lincs Limestone		
	Pilsgate	GW	Confined Lincs Limestone		
	Tallington	GW	Confined Lincs Limestone		
	Wilsthorpe	GW	Confined Lincs Limestone		

The need for river support in the lower reaches of the River Glen was addressed through the commissioning of the Gwash-Glen transfer scheme in 1991. The scheme is operated by the Environment Agency through a Section 20 Agreement with Anglian Water by which water is released from Rutland Water on request. This secures an increased level of abstraction from the Southern Limestone aquifer.

## Drought risk

Drought risk has been assessed for up to a 1 in 200 year drought event as part of our WRMP 2019. This

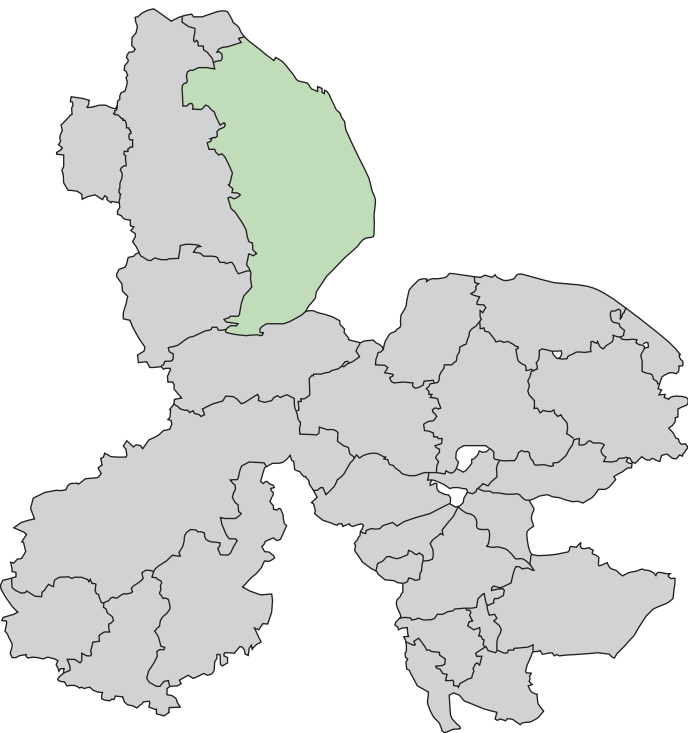
identified that this zone as not being vulnerable to a drought of this severity.

We have also reviewed our risk to a 1 in 500 year extreme drought. This identified additional vulnerability is likely to be seen at; Bourne, Pilsgate, Tallington, and Wilsthorpe.

## Drought Plan Management Actions

There are no specific drought measures other than demand management actions.

# East Lincolnshire



### Characteristics

The East Lincolnshire WRZ covers an area of 2783km<sup>2</sup>, extending from Humber to the Wash and is based on the supply systems for Grimsby, Louth, Skegness, and Boston. The supplies are primarily groundwater abstractions from the Lincolnshire Chalk, Lincolnshire Limestone and Spilsby Sandstone. There is also surface water abstraction from the Louth Canal into Covenham pumped storage reservoir.

### Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
East Lincs	Candlesby	GW	Confined Spilsby Sandstone	67	33
	Driby	GW	Confined Spilsby Sandstone		
	Fordington	GW	Spilsby Sandstone		
	Fulstow	GW	Lincs Chalk		
	Maltby le Marsh	GW	Lincs Chalk / Spilsby Sandstone		
	Manby	GW	Spilsby Sandstone		
	Mumby	GW	Lincs Chalk / Spilsby Sandstone		
	Raithby	GW	Spilsby Sandstone		
	West Pinchbeck	GW	Confined Lincs Limestone		
	Barnoldby	GW	Lincs Chalk		
	Covenham	GW	Louth Canal		



WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
East Lincs	Habrough	GW	Lincs Chalk	67	33
	Healing	GW	Lincs Chalk		
	Little Coates	GW	Lincs Chalk		
	Little London	GW	Lincs Chalk		
	Tetney	GW	Lincs Chalk		
	Weelsby	GW	Lincs Chalk		

A Section 20 Water Resource Management Agreement with the Environment Agency serves to protect and limit the use of the Northern Lincolnshire Chalk aquifer during periods of naturally low groundwater levels, which can result in low spring flows from the Lincolnshire Wolds and saline intrusion along the south bank of the Humber Estuary.

We abstract from the Louth Canal to fill Covenham reservoir. We also have the option to operate the Great Eau transfer scheme to provide a significant increase to the contributory catchment and augment the yield of Covenham reservoir during drought periods. The Great Eau scheme is managed with the Environment Agency under a section 20 agreement.

There are two river support schemes in the WRZ, where we provide support from our groundwater sources; one on the Laceby Beck and one on the River Freshney. These are in place during periods of low flow.

### Drought Risk

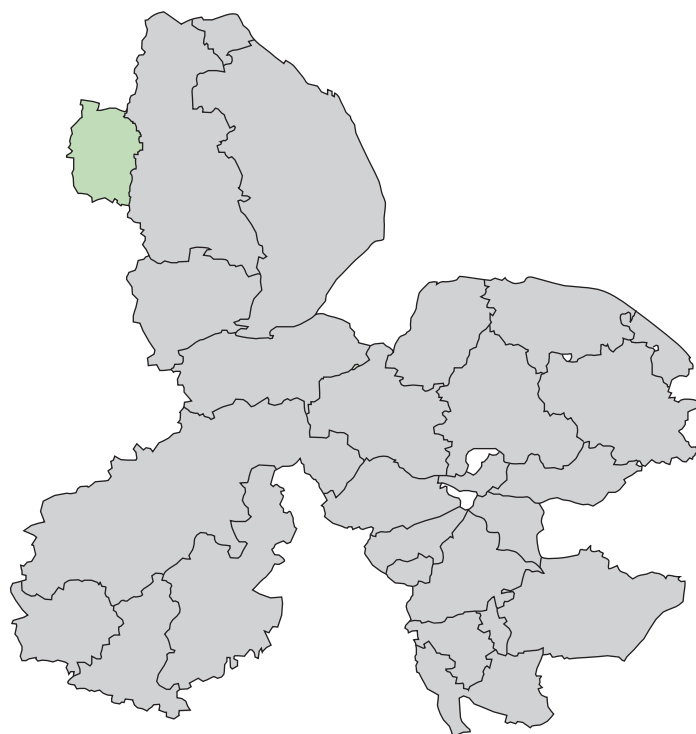
Drought risk has been assessed for up to a 1 in 200 year drought event as part of our WRMP 2019. This identified that this zone as not being vulnerable to a drought of this severity.

We have also reviewed our risk to a 1 in 500 year extreme drought. This identified there is no additional vulnerability.

### Drought Plan Management Actions

The Section 20 management agreement for transfers from Great Eau into the Louth Canal, can be utilised on agreement with the Environment Agency.

# Nottinghamshire



## Characteristics

The Nottinghamshire WRZ covers an area of 672km<sup>2</sup> and lies to the west of the River Trent. The zone is based on the supply systems for Gainsborough and Retford. Customers in the zone receive groundwater abstracted from the Sherwood Sandstone aquifer. The WRZ was previously labelled as the West Lincolnshire WRZ.

## Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
Nottinghamshire	Everton	GW	Sherwood Sandstone	100	0
	Gainsborough	GW	Sherwood Sandstone		
	Retford	GW	Sherwood Sandstone		

## Drought Risk

Drought risk has been assessed for up to a 1 in 200 year drought event as part of our WRMP 2019. This identified that there are no sources vulnerable to a drought of this severity.

We have also reviewed our risk to a 1 in 500 year extreme drought. This identified no additional vulnerability.

## Drought Plan Management Actions

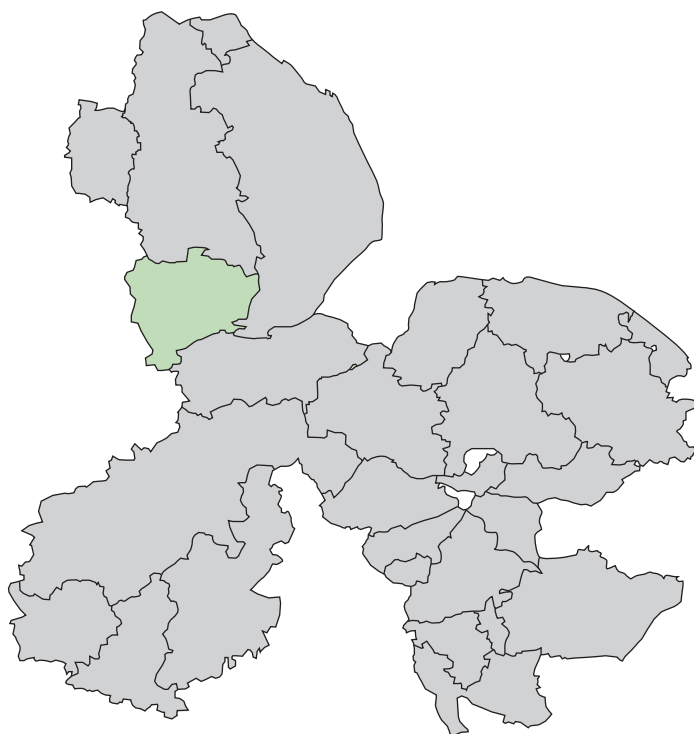
There are no specific drought measures for this WRZ other than demand management actions.

# South Lincolnshire



## Characteristics

The South Lincolnshire WRZ covers an area of 888km<sup>2</sup> and is based on the supply systems for Grantham and Sleaford. The zone comprises of groundwater abstractions from the Lincolnshire Limestone aquifer. This WRZ has been split from the Central Lincolnshire WRZ in the previous drought plan.



## Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
South Lincs	Aswarby	GW	Confined Lincs Limestone	42	58
	Billingborough	GW	Confined Lincs Limestone		
	Clay Hill	GW	Confined Lincs Limestone		
	Saltersford	SW	River Welland/ River Nene (Rutland Water)		

## Drought risk

Drought risk has been assessed for up to a 1 in 200 year drought event as part of our WRMP 2019. This identified that there are no sources vulnerable to a drought of this severity.

We have also reviewed our risk to a 1 in 500 year extreme drought. This identified additional vulnerability is likely to be seen at the following groundwater sources; Aswarby, Billingborough, Drove Lane, Kirkby La Thorpe, and Swaton.

## Drought Plan Management Actions

There are no specific drought measures for this WRZ other than demand management actions.

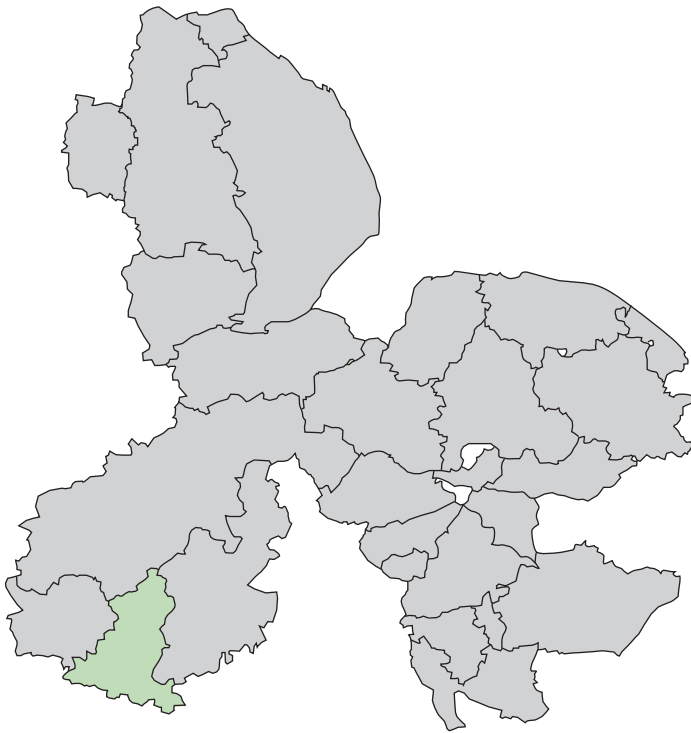
## Area 2: Ruthamford

# Ruthamford Central



### Characteristics

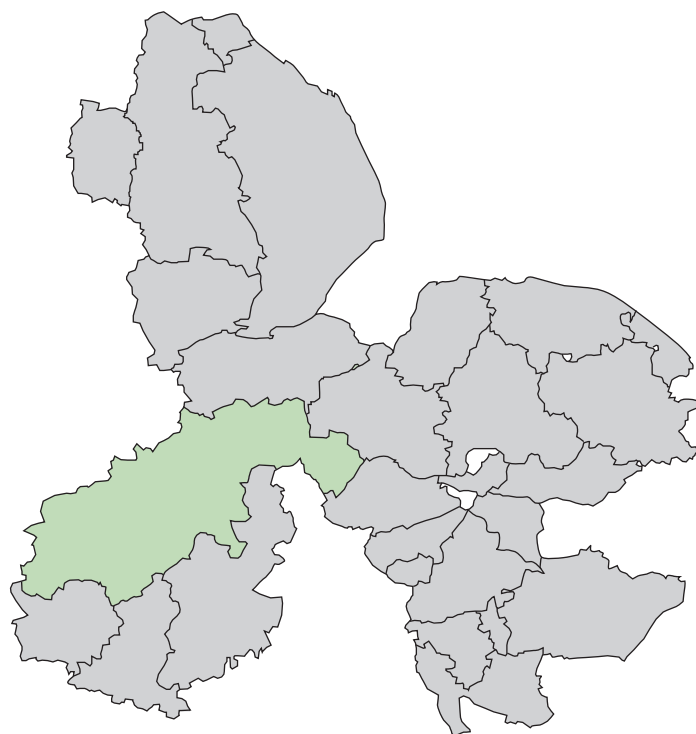
The Ruthamford Central WRZ covers an area of 719km<sup>2</sup> and includes the supply system for Milton Keynes. In the previous drought plan Ruthamford Central was part of Ruthamford South, as it relies solely on imports from Ruthamford South and does not have its own resource.



### Drought Plan Management Actions

Conjunctive use of reservoirs in our partly integrated Ruthamford region, to allow optimisation of storage across the region. This would be modelled using our water resource system model.

# Ruthamford North



## Characteristics

The Ruthamford North WRZ covers an area of 2894km<sup>2</sup> and is based on the supply systems for Peterborough, Northampton, Wellingborough, Corby, Daventry and Kettering. This zone is supplied solely from surface water, with abstractions in the Rivers Nene and Welland filling Pitsford Water and Rutland Water reservoirs respectively. Two smaller naturally filled reservoirs, Hollowell and Ravensthorpe, also provide some resource for the zone.

## Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
RHF North	Morcott	SW	River Welland/ River Nene	0	100
	Pitsford	SW	River Nene		
	Ravensthorpe	SW	Local catchment		
	Wing	SW	River Welland/ River Nene		



Pitsford Water and Rutland Water are both pumped storage reservoirs that abstract water from the River Nene and River Welland, primarily during periods of high winter flow. Ravensthorpe and Hollowell are much smaller reservoirs that both rely on natural inflow from their catchments.

Treated and raw water supplies are exported from this WRZ to the East Lincolnshire and Central Lincolnshire WRZs. There is also an export agreement with Severn Trent Water for Rutland Water, under a statutory agreement.

A river support scheme is in place to support the Stamford Mill Stream with surface water abstracted from Tinwell.

### **Drought risk**

Drought risk has been assessed for up to a 1 in 200 year drought event as part of our WRMP 2019. This identified that there are no sources vulnerable to a drought of this severity.

We have also reviewed our risk to a 1 in 500 year extreme drought. This identified additional vulnerability is likely to be seen at all the reservoirs.

### **Drought Plan Management Actions**

We would look to optimise conjunctive use of surface water sources in this WRZ. We would also seek drought permits at the intakes for both Rutland and Pitsford reservoirs

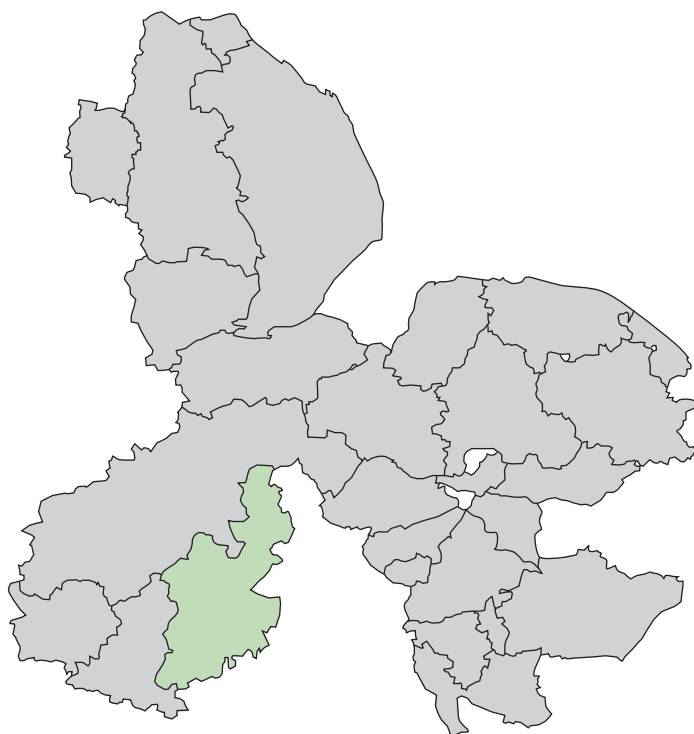
During the 2011-12 drought we took the precautionary measure of applying for winter drought permits to refill Rutland and Pitsford reservoirs. The permits enabled us to abstract more water than we would otherwise have been able to and to recover levels ahead of the higher demand summer period. The drought permits were judged not to have had any serious environmental or socio-economic impacts.

# Ruthamford South



## Characteristics

The Ruthamford South WRZ covers an area of 1419km<sup>2</sup> and is based on the supply systems for Bedford and Huntingdon. This zone is supplied from surface water, with direct abstractions on the River Great Ouse at Clapham and going to Grafham Water reservoir. There is also a small groundwater contribution from the abstraction in the Woburn Sands aquifer.



## Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
RHF South	Bedford	GW	Lower Greensand	18	82
	Birchmoor - Asley Guise	GW	Lower Greensand		
	Dunton	GW	Lower Greensand		
	Grafham	SW	River Great Ouse		
	Meppershall	GW	Lower Greensand		
	Newspring	GW	Lower Greensand		
	Pulloxhill	GW	Lower Greensand		
	Sandhouse	GW	Lower Greensand		
	Clapham	SW	River Great Ouse		

Treated water is exported from the zone to Affinity Central under the terms defined in the Great Ouse Water Act 1961.

Environmental concerns have been associated with the management of the surface water resources in the large Special Protection Area wetlands of the Wash and Ouse Washes. The Ouse and Nene Strategic Study was recommissioned following the 1997 Drought Order applications to help refill Grafham Water and Pitsford reservoirs. This work forms the basis for our Environmental Assessments for these reservoirs.

In the last drought plan this WRZ included Ruthamford West and Central WRZs.

### **Drought risk**

Drought risk has been assessed for up to a 1 in 200 year drought event as part of our WRMP 2019. This identified that there are no sources vulnerable to a drought of this severity.

We have also reviewed our risk to a 1 in 500 year extreme drought. This identified additional vulnerability is likely to be seen at the following sources; Grafham reservoir, Clapham intake, Battlesden, Birchmoor, and Pulloxhill.

### **Drought Plan Management Actions**

We would look to optimise conjunctive use of groundwater and surface water sources in this WRZ. We would also seek to apply for a drought permit at the intake for Grafham Water, to allow for increased abstraction.

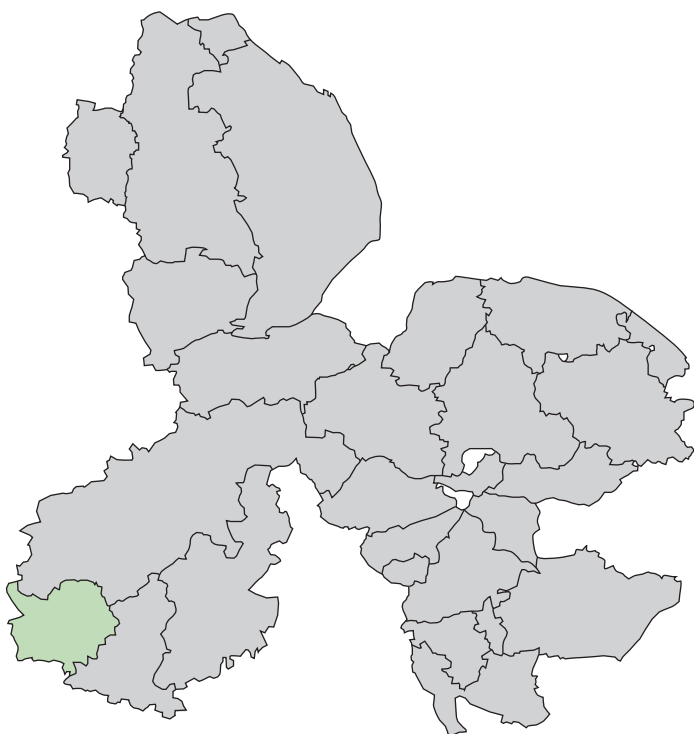
During drought, low flows in the River Great Ouse at Clapham do not generally occur at this abstraction point owing to the extent of effluent returns in the upstream catchment; therefore, abstraction is unlikely to be affected.

# Ruthamford West



## Characteristics

The Ruthamford West WRZ covers an area of 618km<sup>2</sup> and is based on the supply systems for Buckingham and Brackley. In the last drought plan this WRZ was included as part of the Ruthamford South WRZ, as it relies solely on imports and does not have its own resource.

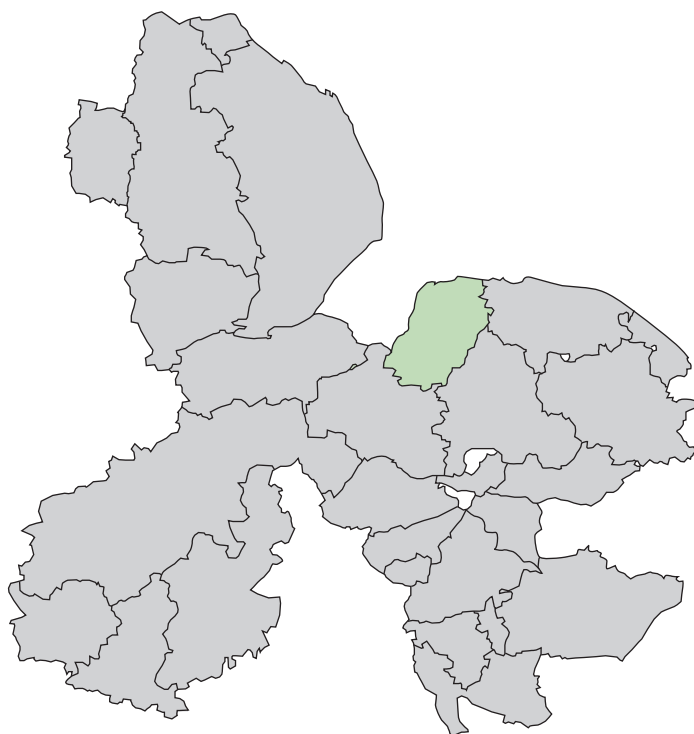


## Drought Plan Management Actions

Conjunctive use of reservoirs in our partly integrated Ruthamford region, to allow optimisation of storage across the region. This would be modelled using our water resource system model.

## Area 3: Fenland

# North Fenland



### Characteristics

The North Fenland WRZ covers an area of 672 km<sup>2</sup> and is based on the supply system for King's Lynn. Water is supplied from groundwater abstractions in the Norfolk Chalk and Sandringham Sands aquifers, and a surface water abstraction from the River Wissey.

This WRZ has been updated since the previous drought plan; the resource zones were previously Hunstanton (now in the North Fenland) and Fenland (which has now been split into North and South).

### Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
North Fenland	Fring	GW	Norfolk Chalk	67	33
	Hillington	GW	Norfolk Chalk / Sandringham Sands		
	Ringstead	GW	Norfolk Chalk		
	Stoke Ferry	GW	River Wissey		

A river support scheme, which augments the River Wissey with water from the Stoke Ferry surface water abstraction, operates in this WRZ.

### Drought risk

Drought risk has been assessed for up to a 1 in 200 year drought event as part of our WRMP 2019. This identified that there are no sources vulnerable to a drought of this severity. There are two classified drought vulnerable boreholes (Tier 1): Congham and Gayton.

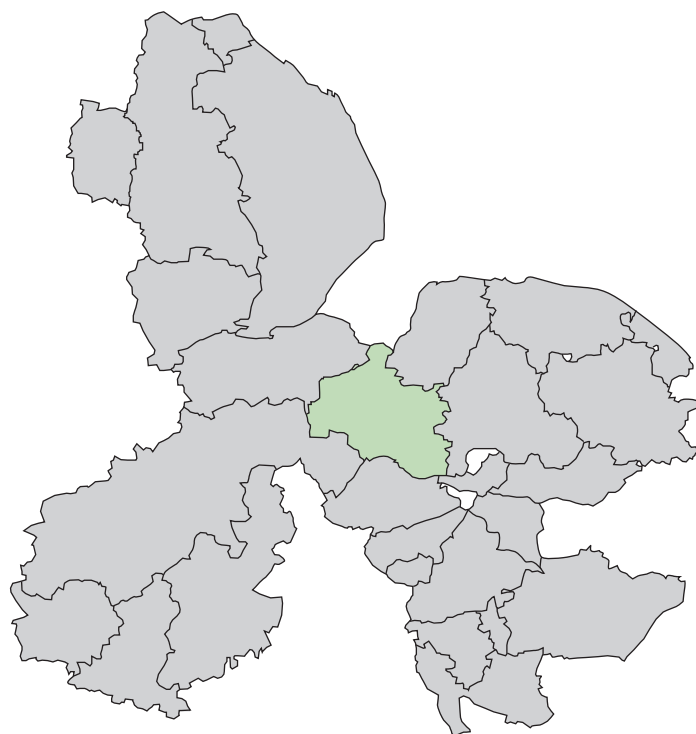
We have also reviewed our risk to a 1 in 500 year extreme drought. This identified no additional vulnerability.

### Drought Plan Management Actions

During the 2011-12 drought we focussed our efforts on use of the Cut-Off Channel at Stoke Ferry and the Wellington Wellfield extension. These resources are considered to be resilient during a drought. Therefore, during future droughts we will continue the transfer of water from the adjacent Cut-Off Channel for release as compensation to the River Wissey, depending on water quality. We can also augment supply from local groundwater sources (Wellington Wellfield). We propose a drought permit to temporarily increase the Wellington Wellfield abstraction licence.



# South Fenland



## Characteristics

The South Fenland WRZ covers an area of 984 km<sup>2</sup> and lies to the south of the Wash. It is based on the supply system of Wisbech. Water is supplied from a combination of groundwater abstractions in the Norfolk Chalk and a surface water abstraction from the River Nar. The west of the zone is supplied by surface water from Rutland Water transferred via Peterborough.

## Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
South Fenland	Denton Lodge	GW	Norfolk Chalk	47	53
	Marham	GW/SW	River Nar / Norfolk Chalk		
	Ryston	GW	Norfolk Chalk		

## Drought risk

Drought risk has been assessed for up to a 1 in 200 year drought event as part of our WRMP 2019. This identified that Marham is vulnerable to a drought of this severity. There is one classified drought vulnerable borehole (Tier 1): Marham.

We have also reviewed our risk to a 1 in 500 year extreme drought. This identified no additional vulnerability.

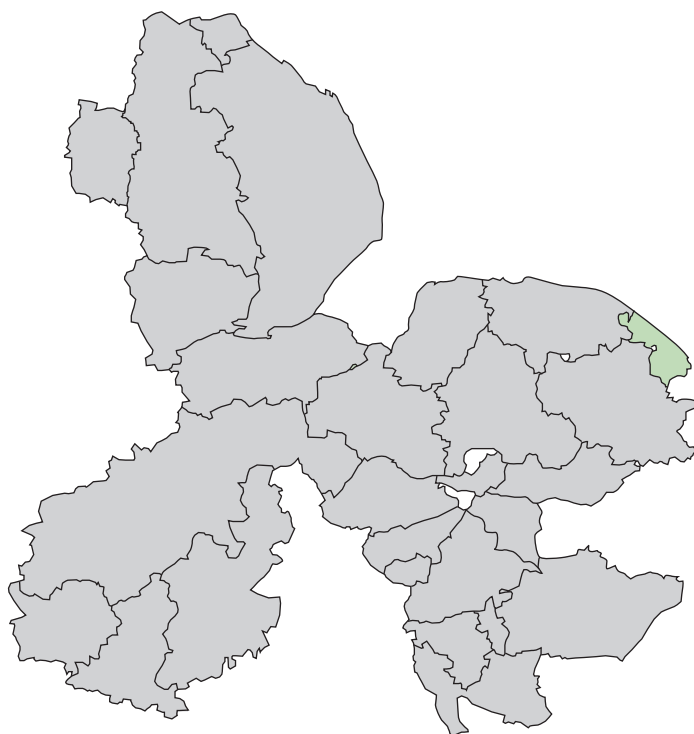
## Drought Plan Management Actions

During a drought water would be pumped from neighbouring North Fenland WRZ to support the supplies. This action was tested during the 2018 dry summer.

The Marham groundwater source would be supported from emergency standby from Wellington Wellfield. Additional severe drought risk would be managed by interim options until 2024 WRMP investment.

## Area 4: Norfolk

# Happisburgh



### Characteristics

The Happisburgh WRZ covers an area of 190 km<sup>2</sup> and sits along the Norfolk coastline. It is primarily supplied by abstraction from the Norfolk Chalk.

The Happisburgh WRZ in the 2014 drought plan was part of the North Norfolk Coast zone.

### Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
Happisburgh	Ludham - Catfield	GW	Crag	100	0
	East Ruston	GW	Norfolk Chalk		
	Royston Bridge	GW	Norfolk Chalk		

### Drought risk

The groundwater sources in this resource zone have not been historically impacted by drought.

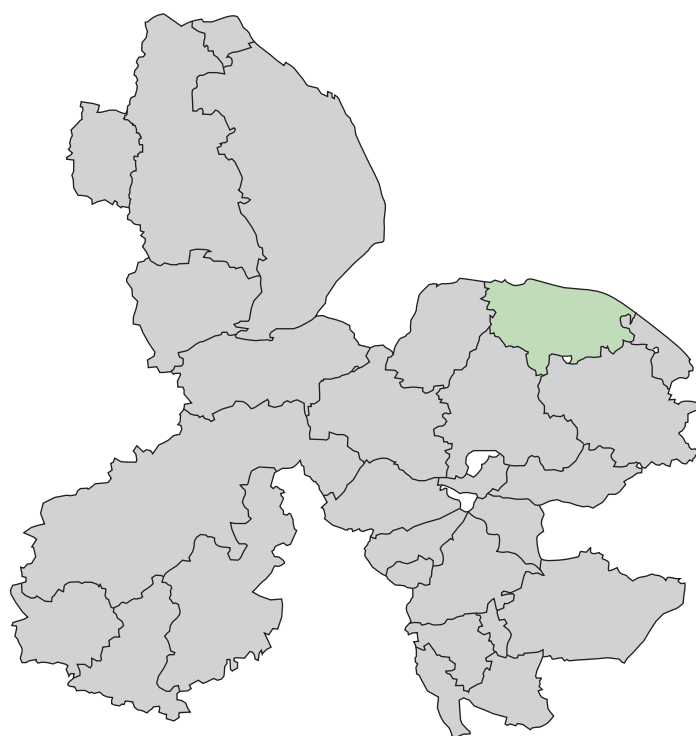
Drought risk has been assessed for up to a 1 in 200 year drought event as part of our WRMP 2019. This identified that there are no sources vulnerable to a drought of this severity.

We have also reviewed our risk to a 1 in 500 year extreme drought. This identified no additional vulnerability.

### Drought Plan Management Actions

There are no drought vulnerable boreholes in this zone and no identified schemes in the current investment period. There are no specific drought measures for this WRZ other than demand management actions.

# North Norfolk Coast



## Characteristics

The North Norfolk Coast WRZ covers an area of 823 km<sup>2</sup> and lies along the North Norfolk coastline and is based on the supply systems for Wells, Fakenham, Sheringham, and Aylsham. It is supplied from groundwater abstractions from the Norfolk Chalk aquifer. The WRZ has trunk main interconnections between source works, and there are only limited connections to adjacent zones.

The North Norfolk Coast WRZ in the 2014 drought plan included the Happisburgh WRZ, which has now been classified as its own WRZ.

## Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
North Norfolk Coast	Aylsham	GW	Norfolk Chalk	100	0
	Aylsham - Coldham Hall	GW	Norfolk Chalk		
	Cawston - Sall Bridge	GW	Norfolk Chalk		
	Foulsham	GW	Norfolk Chalk		
	Glandford	GW	Norfolk Chalk		
	Houghton St Giles	GW	Norfolk Chalk		
	Metton	GW	Norfolk Chalk		
	Mundesley	GW	Norfolk Chalk		
	North Walsham	GW	Norfolk Chalk		
	Sheringham	GW	Norfolk Chalk		
	Wighton	GW	Norfolk Chalk		

There are three river support schemes in the zone; the River Stiffkey is supported by the Binham and Houghton St Giles groundwater source, the ditch system adjacent to the River Bure is supported by the Coldham Hall groundwater source, and the Cley Hall Marshes are supported by the Glandford groundwater source.

### **Drought risk**

Drought risk has been assessed for up to a 1 in 200 year drought event as part of our WRMP 2019. This identified that there are no sources vulnerable to a drought of this severity. There are two classified drought vulnerable boreholes (Tier 1): Metton and North Walsham.

We have also reviewed our risk to a 1 in 500 year extreme drought. This identified no additional vulnerability.

### **Drought Plan Management Actions**

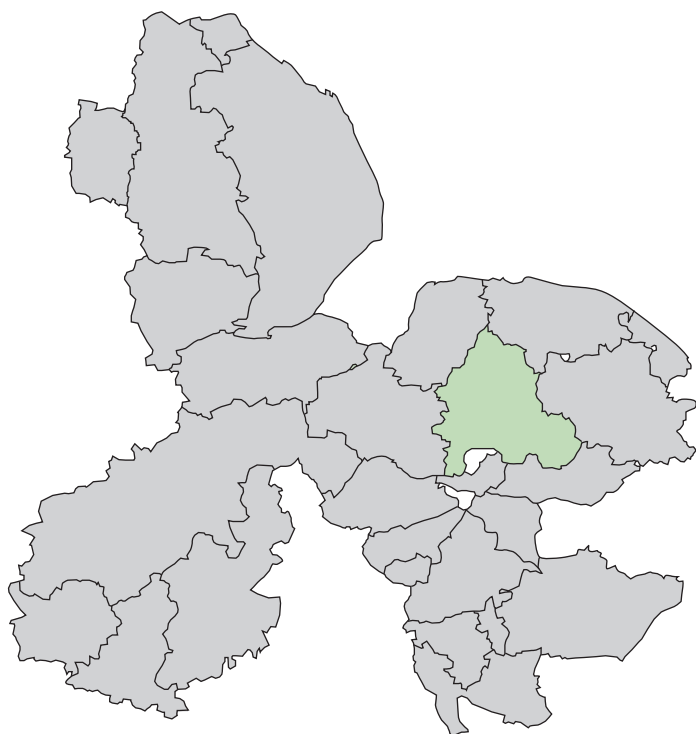
To support the continued abstraction at Metton, the tier 1 vulnerable borehole, a satellite borehole was drilled and commissioned in 2006. A new borehole was drilled at North Walsham to support continued abstraction and AMP7 investment is planned to join up drought vulnerable works.

# North Norfolk Rural



## Characteristics

The North Norfolk Rural WRZ covers an area of 1092km<sup>2</sup> and it sits in the centre of East Anglia. It lies to the west of Norwich and includes the supply systems for Swafham, Dereham, and Attleborough. Water is supplied from groundwater abstractions from the Norfolk Chalk aquifer, with some borehole sources dating back to the 19th Century.



## Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
Norfolk Rural North	Beetley	GW	Norfolk Chalk	100	0
	Carbrooke	GW	Norfolk Chalk		
	Didlington (High Ash)	GW	Norfolk Chalk		
	East Dereham	GW	Norfolk Chalk		
	North Pickenham	GW	Norfolk Chalk		
	W. Bradenham	GW	Norfolk Chalk		
	East Watton	GW	Norfolk Chalk		
	Old Buckenham	GW	Norfolk Chalk		
	Watton	GW	Norfolk Chalk		
	Wicklewood - High Oak	GW	Norfolk Chalk		



**Drought risk**

Drought risk has been assessed for up to a 1 in 200 year drought event as part of our WRMP 2019. This identified that there are no sources vulnerable to a drought of this severity.

We have also reviewed our risk to a 1 in 500 year extreme drought. This identified no additional vulnerability.

**Drought Plan Management Actions**

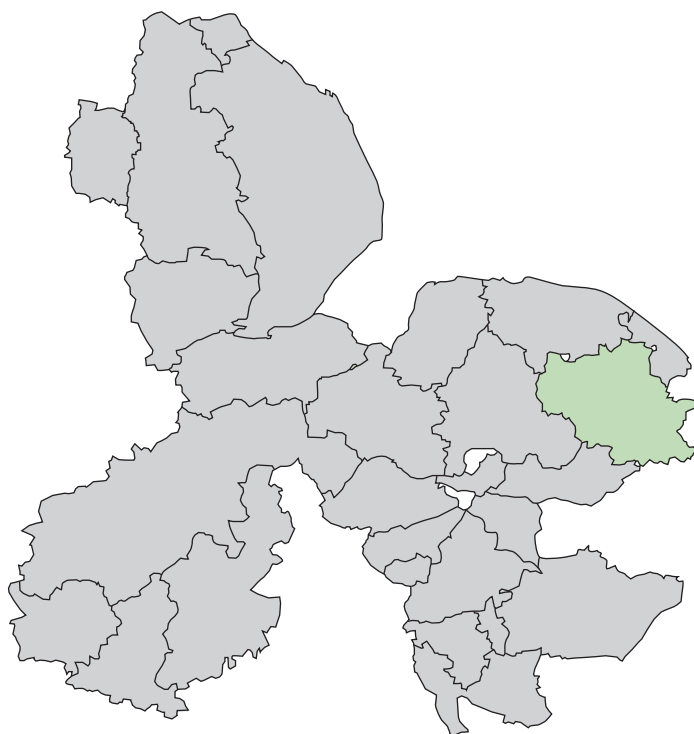
There are no specific drought measures for this WRZ other than demand management actions.

# Norwich and the Broads



## Characteristics

The Norwich and the Broads WRZ covers an area of 1123 km<sup>2</sup> and is centred on the City of Norwich and the surrounding area. Raw water is supplied from groundwater abstractions from the Norfolk Chalk aquifer and from a direct intake from the River Wensum.



## Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
Norwich and the Broads	Caistor	GW	Norfolk Chalk	45	55
	Kirby Cane	GW	Crag and Sands and Gravels		
	Little Melton	GW	Norfolk Chalk		
	Lyng Forge	GW	Norfolk Chalk		
	Mattishall	GW	Norfolk Chalk		
	Postwick	GW	Norfolk Chalk		
	Thorpe (Mousehold)	GW	Norfolk Chalk		
	Heigham	GW/SW	River Wensum / Terrace River Gravels		

The Chalk boreholes have considerable variation in yield and raw water quality requiring different treatments to maintain water quality compliance. There is one groundwater source that abstracts from the Crag aquifer. Many of the sources in this zone are at high risk of contamination from industrial and agricultural sources.

The zone has three river support schemes:

- The River Tas is supported by the Caistor St Edmunds and Bixley groundwater source;
- The West Earlham and Bowthorpe Marshes are supported by the Bowthorpe groundwater source; and
- Taverham Mill Lake is supported by the Costessey surface water source.

### **Drought risk**

Drought risk has been assessed for up to a 1 in 200 year drought event as part of our WRMP 2019. This identified that there are no sources vulnerable to a drought of this severity.

We have also reviewed our risk to a 1 in 500 year extreme drought. This identified no additional vulnerability.

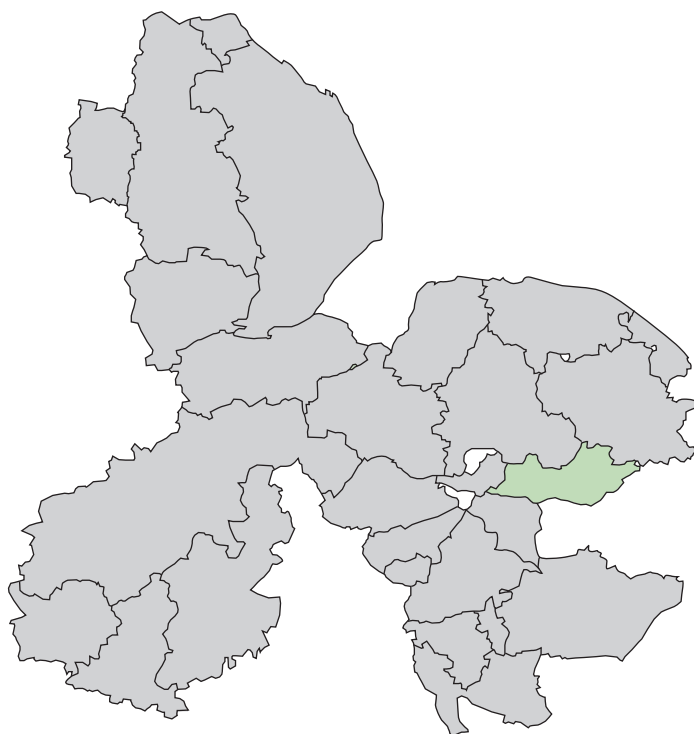
### **Drought Plan Management Actions**

To make our assets more resilient to drought we have invested in a new membrane treatment plant to increase the resilience of our Heigham intake on the River Wensum. The Hands Off Flow (HOF) at Heigham is very low, and flow analysis of worst historic and modelled 1 in 200 yr droughts suggest it is unlikely we would reach this HOF and the intake is reliable. However, in the event of a more extreme drought or unknown water quality concerns we propose a drought permit to increase the annual abstraction quantity from the boreholes at Costessey, allowing us to utilise the adjacent bankside Pits.

# South Norfolk Rural

## Characteristics

The South Norfolk Rural WRZ covers an area of 458 km<sup>2</sup> and lies in the centre of East Anglia. The zone is supplied by groundwater abstractions from the Norfolk and Suffolk Chalk aquifers. This zone was previously, along with North Norfolk Rural, the Norfolk Rural zone.



## Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
Norfolk Rural South	Bunwell	GW	Norfolk Chalk	100	0
	Riddlesworth	GW	Suffolk Chalk		
	Rushall	GW	Norfolk Chalk		
	Quidenham	GW	Suffolk Chalk		

A river support scheme, which augments the River Waveney using water from Billingford (Rushall WTW) groundwater source operates in the WRZ.

## Drought risk

Drought risk has been assessed for up to a 1 in 200 year drought event as part of our WRMP 2019. This identified that there are no sources vulnerable to a drought of this severity.

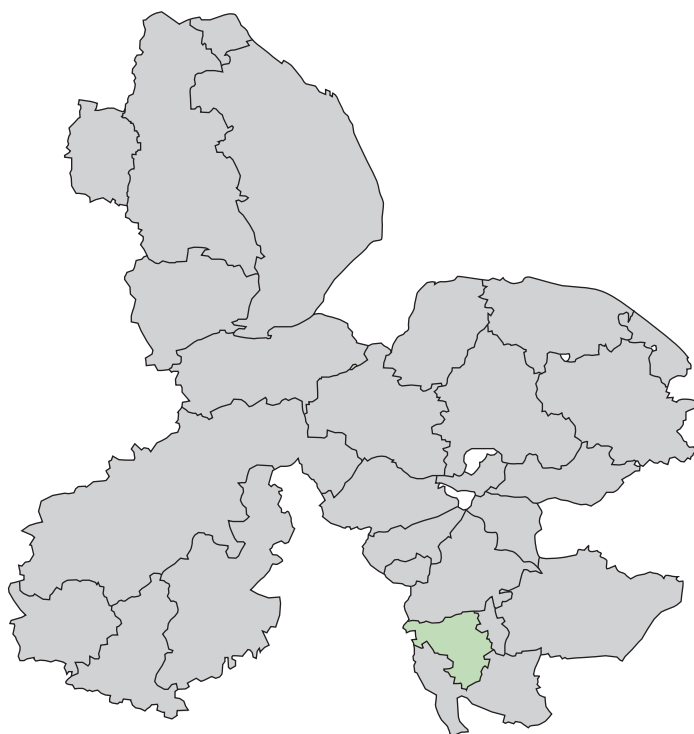
We have also reviewed our risk to a 1 in 500 year extreme drought. This identified no additional vulnerability.

## Drought Plan Management Actions

There are no specific drought measures for this WRZ other than demand management actions.

## Area 5: East Suffolk and Essex

### Central Essex



#### Characteristics

The Central Essex WRZ covers an area of 314km<sup>2</sup> and is based on the supply system for Halstead. The water resource for this WRZ is entirely dependent on abstraction from the Essex Chalk aquifer. There are no drought vulnerable boreholes in this zone.

We operate river support boreholes for the Upper Colne and Cornard Mere in this area.

#### Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
Central Essex	Castle Hedingham	GW	Essex Chalk	100	0
	Earls Colne	GW	Essex Chalk		
	Halstead - Parsonage St	GW	Essex Chalk		

#### Drought risk

The groundwater sources in this resource zone have not been historically impacted by drought.

Drought risk has been assessed for up to a 1 in 200 year drought event as part of our WRMP 2019. This identified that there are no sources vulnerable to a drought of this severity.

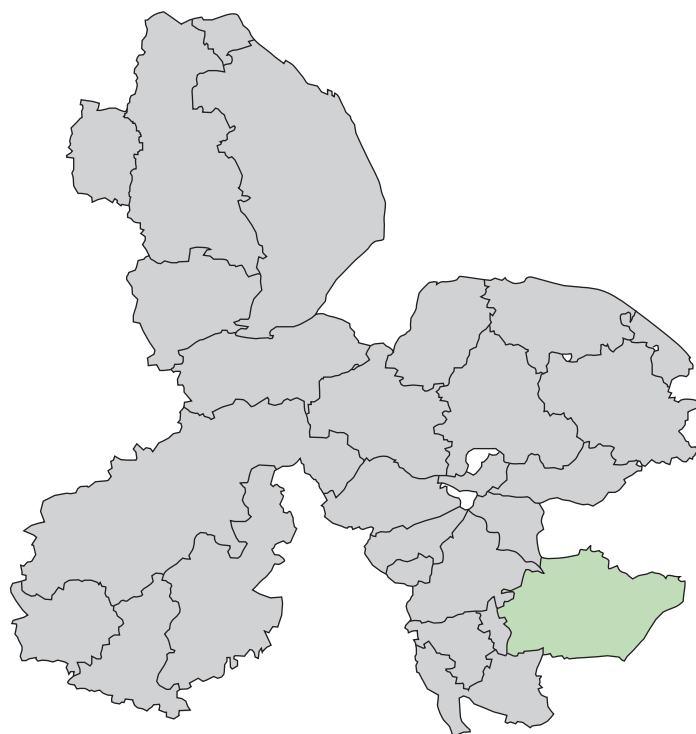
We have also reviewed our risk to a 1 in 500 year extreme drought. This identified no additional vulnerability.

#### Drought Plan Management Actions

There are no drought vulnerable boreholes in this zone and no identified schemes in the current investment period. There are no specific drought measures for this WRZ other than demand management actions.



# East Suffolk



## Characteristics

The East Suffolk WRZ covers an area of 1241 km<sup>2</sup>. The East Suffolk WRZ extends inland from Stour, Orwell and Deben estuaries and includes the supply systems for Ipswich, Felixstowe, Hadleigh, Stowmarket and Woodbridge. Supplies in the WRZ are obtained from a combination of sources that include groundwater abstracted from the Suffolk and Essex Chalk aquifers and surface water which is pumped from the River Gipping into Alton Water reservoir.

## Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
East Suffolk	Alton	SW	River Gipping	62	38
	Baylham	GW	Suffolk Chalk		
	Belstead	GW	Suffolk Chalk		
	Bramford	GW	Suffolk Chalk		
	Pettistree	GW	Suffolk Chalk		
	Raydon	GW	Essex Chalk		
	Semer	GW	Essex Chalk		
	Tuddenham	GW	Suffolk Chalk		
	Whitton	GW	Suffolk Chalk		
	Winston	GW	Suffolk Chalk		

A river support scheme, which augments the River Deben with water from the Winston groundwater source operates in this WRZ.

### **Drought Risk**

Drought risk has been assessed for up to a 1 in 200 year drought event as part of our WRMP 2019. This identified that there are no sources vulnerable to a drought of this severity. There are three classified drought vulnerable borehole (Tier 1): Belstead, Westerfield and Whitton.

We have also reviewed our risk to a 1 in 500 year extreme drought. This identified no additional vulnerability.

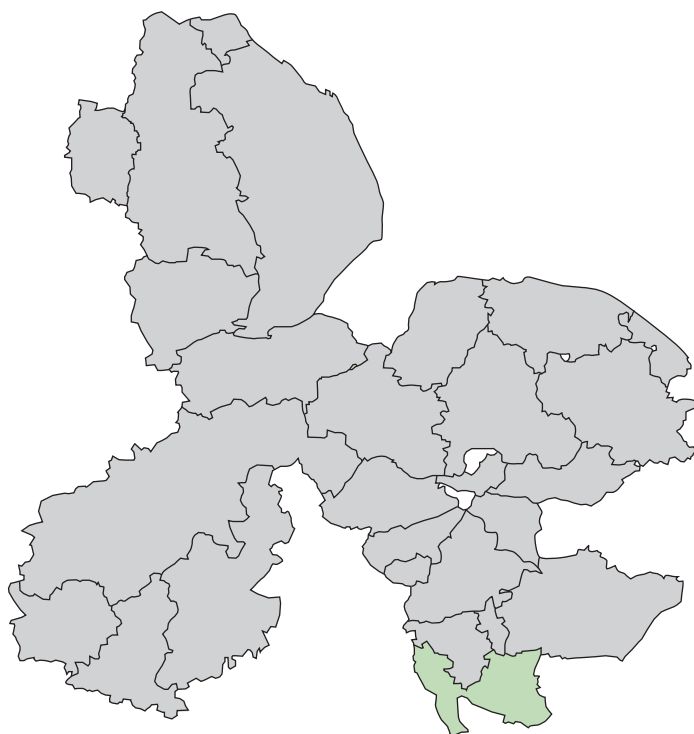
### **Drought Plan Management Actions**

We would look to optimise conjunctive use of groundwater and surface water sources in the WRZ. We would use the Bucklesham WTW transfer scheme to augment Alton Water during low flow conditions on the Mill River.

An option to reduce of the minimum residual flow by 50% in the River Gipping has been included as a contingency measure requiring an application to the Environment Agency for a drought permit.

To ensure resilience of the zone during drought new boreholes were drilled and commissioned in 2006 to support drought vulnerable sources Westerfield and Whitton.

# South Essex



## Characteristics

The South Essex WRZ covers an area of 591km<sup>2</sup> and is based on the supply systems for Colchester and Braintree. Water is supplied from a combination of groundwater abstractions in the Essex Chalk Aquifer and Ardleigh Reservoir.

## Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
South Essex	Bures	GW	Essex Chalk	62	38
	Ardleigh	SW	River Colne		
	Bocking	GW	Essex Chalk		
	Codham Mill	GW	Essex Chalk		
	Gt Horkesley	GW	Essex Chalk		
	Lexden	GW	Essex Chalk		
	Petches Bridge	GW	Essex Chalk		

Ardleigh reservoir is jointly operated with Affinity East through the Ardleigh reservoir committee. This is currently based on a 70:30 split of resources.

We are entitled to a bulk supply from the Essex and Suffolk Water Company (E&SWC) at Tiptree. The E&SWC potable water main to Tiptree passes round the north of Colchester.

Two river support schemes to augment the River Colne operate in this WRZ. They involve the following groundwater sources:

- Ardleigh source (Balkerne); and
- Colne sources (Great Yeldham)

### **Drought Risk**

Drought risk has been assessed for up to a 1 in 200 year drought event as part of our WRMP 2019. This identified that there are no sources vulnerable to a drought of this severity.

We have also reviewed our risk to a 1 in 500 year extreme drought. This identified additional vulnerability at Ardleigh reservoir to drought of this severity.

### **Drought Plan Management Actions**

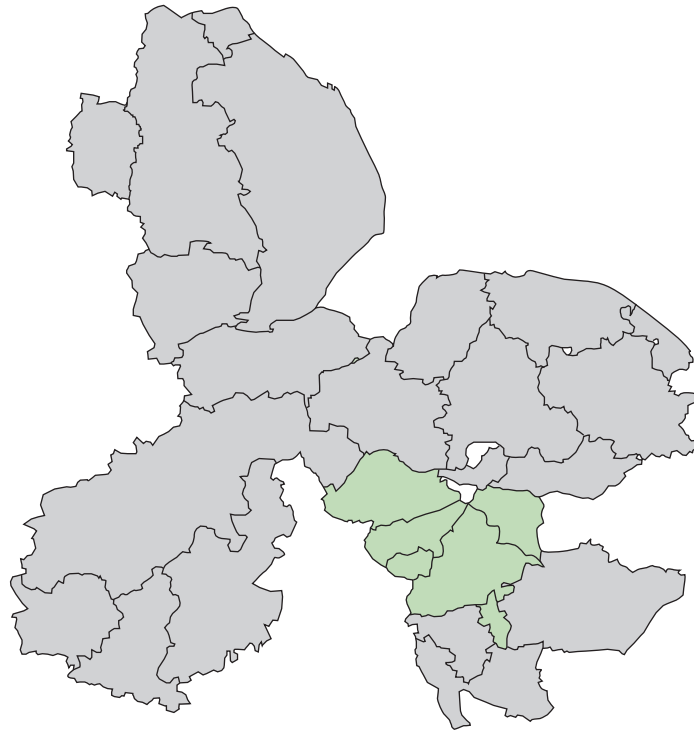
During a drought there are a number of options open to us in the zone to support the continued supply of water in the WRZ. We would implement our river augmentation scheme using Balkerne and Aldham boreholes and look to obtain a drought permit to increase the augmentation volumes by 50%.

We would seek to utilise Ely-Ouse Essex Transfer Scheme (EOETS) - this is operated by the Environment Agency and would need further discussion.

There is also the potential transfer from Essex and Suffolk Water using a direct discharge from the EOETS transfer pipeline to Abberton Reservoir, owned by Essex and Suffolk Water. Discussions with Essex and Suffolk Water have been previously held to identify opportunities to use this transfer to support Ardleigh Reservoir, if required as a contingency under exceptional circumstances.

## Area 6: Cambridgeshire and West Suffolk

# Cheveley, Ely, Newmarket, Sudbury, Ixworth, and Bury Haverhill



### Characteristics

This section covers a number of discrete WRZs that share similar characteristics. They include the WRZs of, Cheveley, Ely, Newmarket, Sudbury, Ixworth and Bury Haverhill.

#### Cheveley

Cheveley WRZ is a small discrete WRZ covering an area of 93km<sup>2</sup> with only one source works. This is supplied by groundwater abstraction from the Suffolk Chalk.

#### Ely

The Ely WRZ covers an area of 578km<sup>2</sup>. The Ely WRZ is located in the centre of East Anglia and is based on the supply system for Ely. The water resource for this WRZ is entirely dependent on abstraction from the Suffolk Chalk aquifer.

#### Newmarket

The Newmarket WRZ covers an area of 271km<sup>2</sup> and is based on the supply system for Newmarket. Customers in the WRZ are supplied with groundwater pumped from the Suffolk Chalk aquifer.

#### Sudbury

The Sudbury WRZ covers an area of 85km<sup>2</sup>. This zone is supplied by abstractions from the Essex Chalk aquifer.

#### Ixworth

The Ixworth WRZ covers an area of 265km<sup>2</sup>. It is supplied by a single source works which abstracts from Suffolk chalk aquifer.

#### Bury Haverhill

The Bury Haverhill WRZ covers an area of 689km<sup>2</sup> and lies in the centre of East Anglia. The zone abstracts from the Suffolk and Essex Chalk aquifers and is based on the supply system for Bury St Edmunds and Haverhill. The boreholes in this WRZ have been developed in the thicker Chalk aquifer where water resources are more resilient to drought.

## Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
Ely	Beck Row	GW	Suffolk Chalk	100	0
	Eriswell 1	GW	Suffolk Chalk		
	Eriswell 2	GW	Suffolk Chalk		
	Isleham	GW	Suffolk Chalk		
	Mildenhall - Twelve Acre Wood	GW	Suffolk Chalk		
	St Helena	GW	Suffolk Chalk		
Newmarket	Ashley Rd	GW	Suffolk Chalk	100	0
	Gazeley	GW	Suffolk Chalk		
	Long Hill	GW	Suffolk Chalk		
	Moulton	GW	Suffolk Chalk		
	Newmarket - Southfields	GW	Suffolk Chalk		
	Warren Hill	GW	Suffolk Chalk		
Sudbury	Conard (Blackhouse Lane)	GW	Essex Chalk	100	0
	Sudbury (Woodhall Rd)	GW	Essex Chalk		
	Conard (Bures Rd)	GW	Essex Chalk		
Ixworth	Ixworth/Stanton	GW	Suffolk Chalk	100	0
Bury-Haverhill	Barrow Heath	GW	Suffolk Chalk	100	0
	Gt. Wratting	GW	Essex Chalk		
	Kedington	GW	Essex Chalk		
	Risby	GW	Suffolk Chalk		
	Rushbrooke	GW	Suffolk Chalk		
Cheveley	Lower Links	GW	Suffolk Chalk	100	0

Many of the chalk groundwater sources contain significant nitrate levels and are subject to treatment or blending arrangements.

There is a river support scheme in the Sudbury WRZ where the Cornard Mere is supported by the Bures Road groundwater source.

### **Drought Risk**

Drought risk has been assessed for up to a 1 in 200 year drought event as part of our WRMP 2019. This identified that there are no sources vulnerable to a drought of this severity in the following WRZs; Ely, Sudbury, and Ixworth. The Lower Links source in the Cheveley WRZ and the Risby source in Bury Haverhill were identified as being vulnerable causing supply impacts in a 1 in 200 drought. In the Newmarket WRZ the following sources were identified as being vulnerable to drought of this severity; Ashby Road, Long Hill, Southfields, and Moulton.

There are six classified drought vulnerable boreholes (Tier 1): Risby (Bury Haverhill), Lower Links (Cheveley), Ashley Road (Newmarket), Long Hill (Newmarket), Moulton (Newmarket), and Southfields (Newmarket).

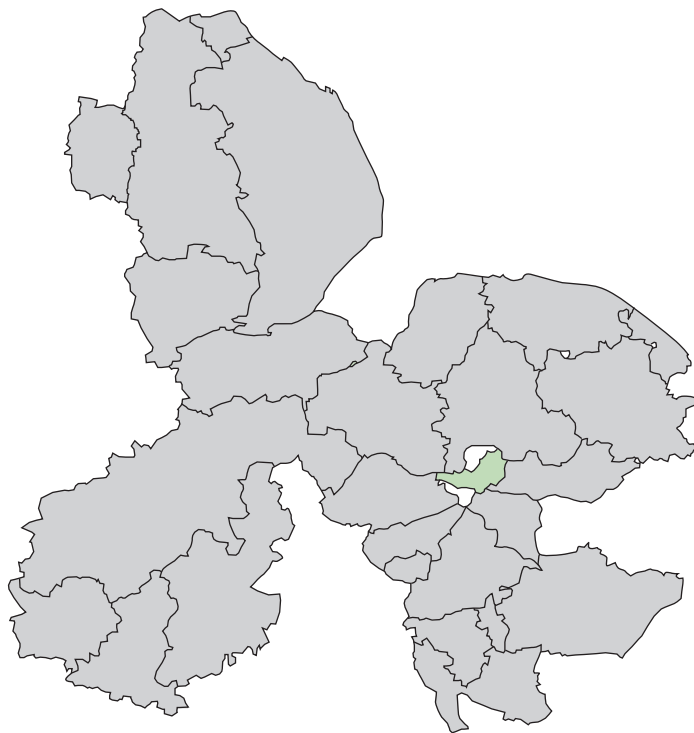
We have also reviewed our risk to a 1 in 500 year extreme drought. This identified no additional vulnerability beyond that modelled for a 1 in 200 year event.

### **Drought Plan Management Actions**

Severe drought risk will be managed by interim options until 2024 WRMP investment.

A number of boreholes were drilled and commissioned in 2006 in the area to support continued abstraction at the drought vulnerable sites. Import from Cambridge Water is also available in the zone.

# Thetford



## Characteristics

The Thetford WRZ covers an area of 129km<sup>2</sup> and lies in the centre of East Anglia. Water is primarily supplied from abstractions in the Suffolk Chalk aquifer.

## Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
Thetford	Brandon	GW	Suffolk Chalk	100	0
	Thetford - 2 Mile Bottom	GW	Suffolk Chalk		
	Thetford - Barnham Cross	GW	Suffolk Chalk		
	Thetford - Nunnery Lodge	GW	Suffolk Chalk		

The zone has one bulk import at Barnham Cross from Cambridge Water.

## Drought risk

Drought risk has been assessed for up to a 1 in 200 year drought event as part of our WRMP 2019. This identified that there are no sources vulnerable to a drought of this severity.

We have also reviewed our risk to a 1 in 500 year extreme drought. This identified no additional vulnerability to drought of this severity.

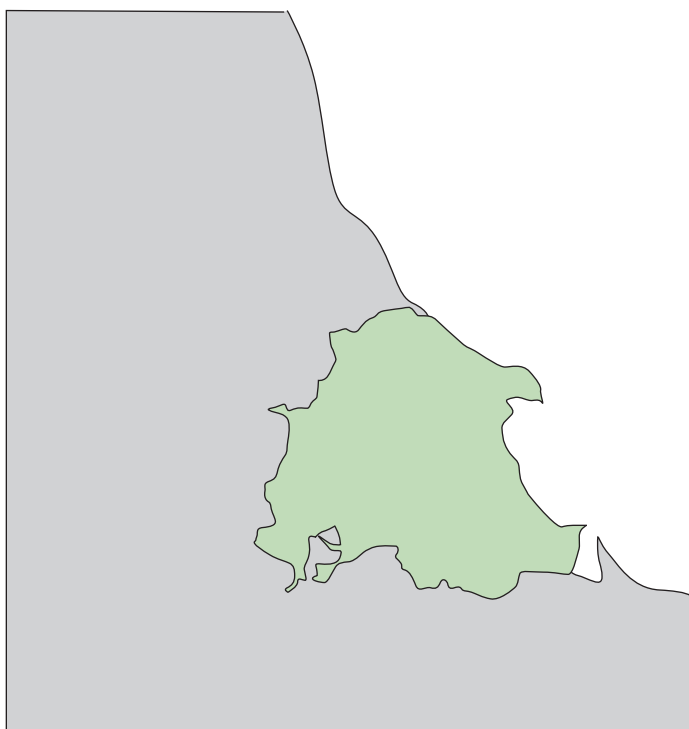
## Drought Plan Management Actions

There are no specific drought measures for this WRZ other than demand management actions.



## Area 7: Hartlepool

# Hartlepool



### Characteristics

The Hartlepool WRZ comprises the entire area supplied by Hartlepool Water, in the North-East of England and is geographically separate from the other WRZs in the Anglian region. The water resources are entirely groundwater abstracted from the Magnesian Limestone aquifer.

### Source details

WRZ	Water Treatment Works	Source type	Water source	Approximate % groundwater/ surface water WRZ split	
				% groundwater	% surface water
Hartlepool	Dalton Piercy	GW	Magnesian Limestone	100	0

All of the groundwater sources pump to a strategic treated water storage reservoir where they can be blended to maintain consistent and compliant water quality. This is a well-integrated system.

The two small surface water reservoirs at Crookfoot and Hurworth Burn previously used to provide non-potable industrial supplies have been sold.

A new groundwater source has been developed at Hopper House. This will provide a contingency for drought management, if required.

### Drought risk

There have never been any recorded historical periods of droughts in this area.

### Drought Plan Management Actions

There are no specific drought measures for this WRZ other than demand management actions. Hartlepool would be considered separately to any drought situation developing in the wider Anglian region.



**Cover photo** - Anglian Water's Grafham Water reservoir, an 806-hectare biological Site of Special Scientific Interest, southwest of Huntingdon in Cambridgeshire. It was designated an SSSI in 1986.