



Norfolk County Council

Investigation Report into the flooding in Gorleston in 2016 and 2017

Report Reference: FIR024

Draft Report prepared by Mark Ogden and Bethany Green on 09 April 2019



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Executive Summary

(a) Flooding incidents

The flooding in Gorleston covered in this report occurred at various dates throughout 2016, however the majority are concentrated during the summer months. From 30 reports of flooding, 11 were identified as being internal to property. The rainfall throughout this year caused internal flooding on the following dates: 26th February, 24th June, 12th July, 13th July, 14th July, 29th August, and 30th August. The properties affected were concentrated in three separate catchments¹ with other isolated reports received outside of these. A summary of the 30 properties affected in each catchment are set out below;

- Stepshort Dyke: 11 properties
- Gorleston-on-Sea: 5 properties
- Claydon: 14 properties

The incidents of internal flooding in Gorleston and its environs occurred in the parish of Bradwell and the Great Yarmouth borough. These occurred in Burgh Road; Riverside Road; Beccles Road; Leicester Road; Nelson Road, Great Yarmouth and Long Lane, Bradwell. They were caused by a combination of: surface run-off flow paths passing close to properties; surface run-off from roads moving into properties; unmaintained, obstructed or blocked drainage systems or outfalls; loss of pre-existing drainage features; surcharging of the drainage system; drainage system overloaded and surface water washed off public highway by vehicles.

There were seven previous reports of internal flooding in this area. Of these, three were located on Beccles Road indicating a recurring susceptibility to flooding in this area. The remaining four reports were located in areas that were not internally flooded in 2016.

In addition an update on properties flooded in 2017 has been included on page 32 which relates to Baker Street and Leicester Road.

¹ **What are catchments?** - To aid the investigation process and, for ease of presentation, the incidents of flooding have been grouped within this document based on hydrological catchments. The purpose of viewing flooding incidents based on catchments reflects the reality that flooding does not respect the administrative boundaries of water management organisations. Hydrological catchments catch water and discharge it at locations known as outlets. Individual hydrological catchment boundaries are usually formed by ridges of surrounding higher ground, which separate the lower lying areas at a line known as a watershed.

(b) Flooding causes

As the incidents of flooding were spread out around the Gorleston area, the causes range from location to location. This is particularly true when considering the different run-off characteristics between more urbanised catchments such as Gorleston-on-sea and those of a more suburban mix such as Stepshort Dyke. More detail on the causes that occurred at the individual catchment level can be found in each section of this report however some of the key trends identified in the flooding of 2016 have been summarised below;

- Runoff from the road featured in many of the cases. Highways acted as overland flow paths for the heavy rain.
- In many cases the water moved downhill from the road to the entrances of buildings, which were situated below the level of the nearest highway.
- Passing vehicles created a wash that pushed excess water into properties through low thresholds.
- The capacity of surface water drainage including land drains, adopted drainage and private property drainage was exceeded due to the significant levels of rainfall. This caused surcharging of the network elsewhere as the system was unable to cope with large volumes of water.
- Flood water entered properties through the unprotected structure of the building via features such as low thresholds at entrances, unprotected air bricks, and services conduits.
- The capacity of the foul and combined network was also exceeded due to the ingress of surface water into the foul network. This caused the foul network to surcharge in a number of locations during the event with several residents reporting foul water entering their property.
- Features such as kerbs, walls, garden fences and alleyways had the effect of containing or channelling flood water near to properties. Although this protected some properties, it had the effect of directing a larger volume of water to others.
- For those properties located in the Stepshort Dyke catchment there were general concerns about the effectiveness of the pumping station at Morton Crescent and whether the response was efficient enough for the rainfall events.
- The concentration of flooding was highest in Claydon, a highly urbanised catchment.
- The combined sewer networks from Victorian times meant that there was a higher likelihood for exceeding the capacity of the network.

(C) Key recommendations

The recommendations set out in the report have been summarised below. Specific recommendations for each individual catchment are set out within the report. Please note a large number of these recommendations have already been followed up by the respective organisations identified. Progress against these recommendations will be assessed as part of an addendum to this report to be undertaken a year from the date of publication of this report.

All Risk Management Authorities should;

- Communicate with affected residents where their assets have given rise to the flooding of properties.
- Review the appropriateness of their response to flooding.
- Determine the integrity and/or capacity of their assets and their maintenance where they have contributed to the flooding of properties to understand the systems role in accommodating rainfall events as well as mitigating flooding.

Property owners of affected properties should;

- Confirm the integrity, capacity and appropriateness of their property drainage
- Determine if works are needed to remove the risk posed by structures that form obstructions to flows.
- Determine if it is appropriate for them to protect their buildings through flood protection measures.
- Seek their own legal advice if they are concerned about the responsibilities and liabilities of themselves and/or others.

Norfolk County Council should;

- Consider opportunities to route flood water on the highway away from affected properties to alternative points of discharge, or other solutions as practicable.
- Determine if works are needed to remove the risk posed by structures that form obstructions to flows and communicate with affected parties and riparian owners.

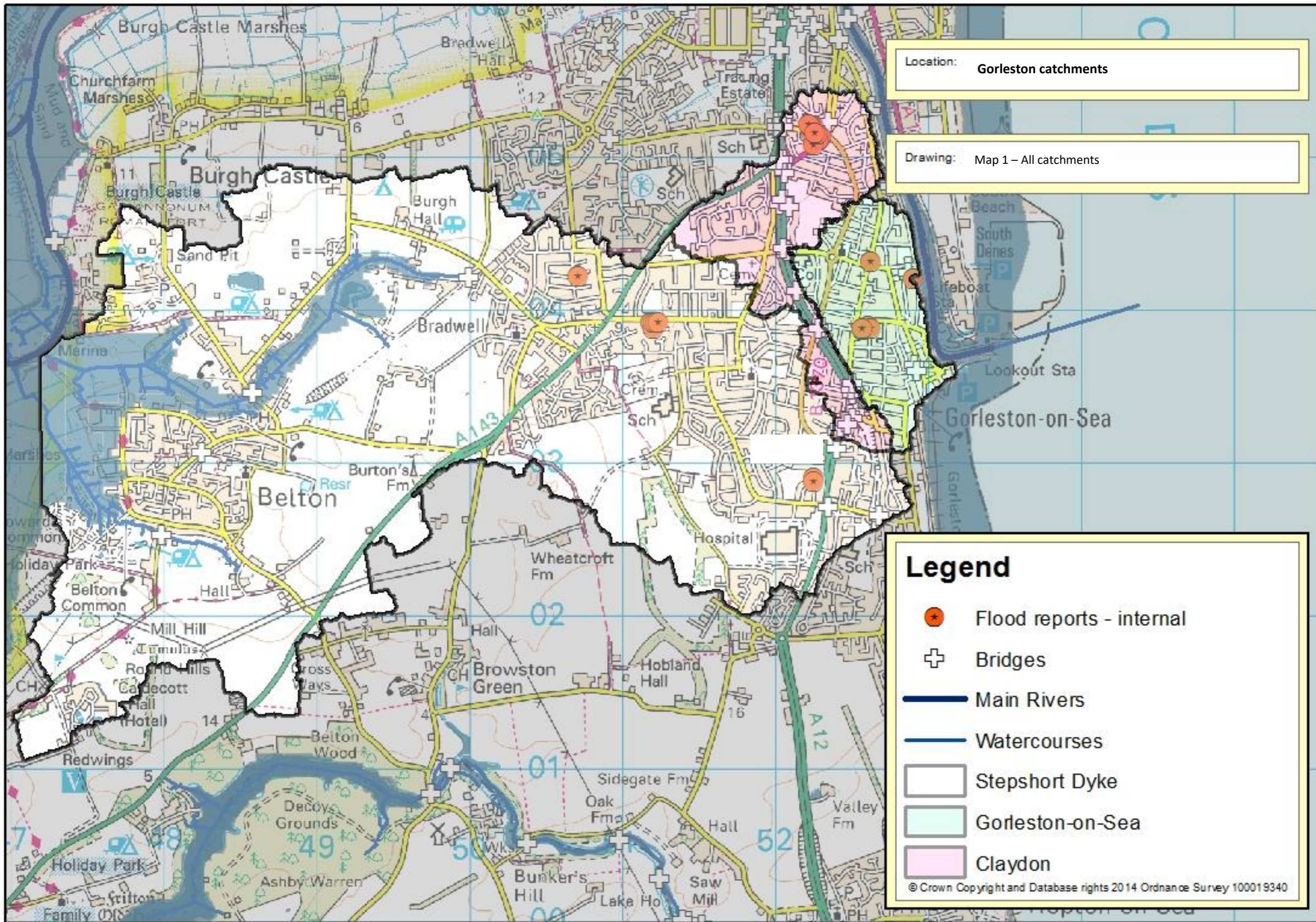
Anglian Water should;

- Work with partner organisations to identify the potential for managing the amount of surface water entering their drainage system in flood events.
- Work with property owners should remove any inappropriate surface water connections to the foul sewer system and direct flows to alternative points of discharge where it doesn't increase flood risk.

Norfolk Rivers Internal Drainage Board should;

- Determine if works are needed to increase volumetric capacity and/or remove the risk posed by structures that form obstructions to watercourse flows.






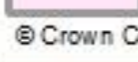
Please note that an addendum has been published to provide an update on subsequent actions taken following the initial response of Risk Management Authorities and individuals to the flood event as detailed within this report. This addendum can be found at the following [link](#).



Location: Gorleston catchments

Drawing: Map 1 - All catchments

Legend

-  Flood reports - internal
-  Bridges
-  Main Rivers
-  Watercourses
-  Stepshort Dyke
-  Gorleston-on-Sea
-  Claydon

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Justification for Flood Investigation

The purpose of this report relates to Section 19 of the Flood and Water Management Act 2010. This legislation sets out that the County Council, in its role as Lead Local Flood Authority for Norfolk, should investigate the role and response of organisations to significant flooding incidents. Significant flooding is deemed to be those incidents that impact upon people, property and infrastructure.

The Norfolk Local Flood Risk Management Strategy Policy UC2 (Flood Investigation) sets out the thresholds the Lead Local Flood Authority will apply to its formal flood investigation role. This states an investigation will be undertaken where it is determined that;

- (a) There is ambiguity surrounding the source or responsibility for a flood incident, and/or;
- (b) There is cause to investigate the flood incident, due to either its impact, or consequence

In judging the impact or consequence of a flood event Norfolk County Council uses the criteria set out below;

- Any risk to loss of life or serious injury.
- One or more residential or business property flooded internally.
- One or more critical services/installations and vulnerable person's properties flooded internally; and/or rendered inoperable or their functions severely compromised due to the access to the premises being impassable; and/or resulting in a loss of service impacting on the local community.
- Any section of a national category 3 road or above made impassable due to flooding; and/or flooding to priority 1 and 2 gritting routes.
- Flooding adversely impacting a rail link by making it impassable.

It was deemed necessary to complete a formal Investigation Report into the flooding in Gorleston in 2016 as:

- multiple residential properties were internally flooded.
- multiple commercial properties were internally flooded.

This impact met Norfolk County Council's threshold for triggering the undertaking of a formal flood investigation.

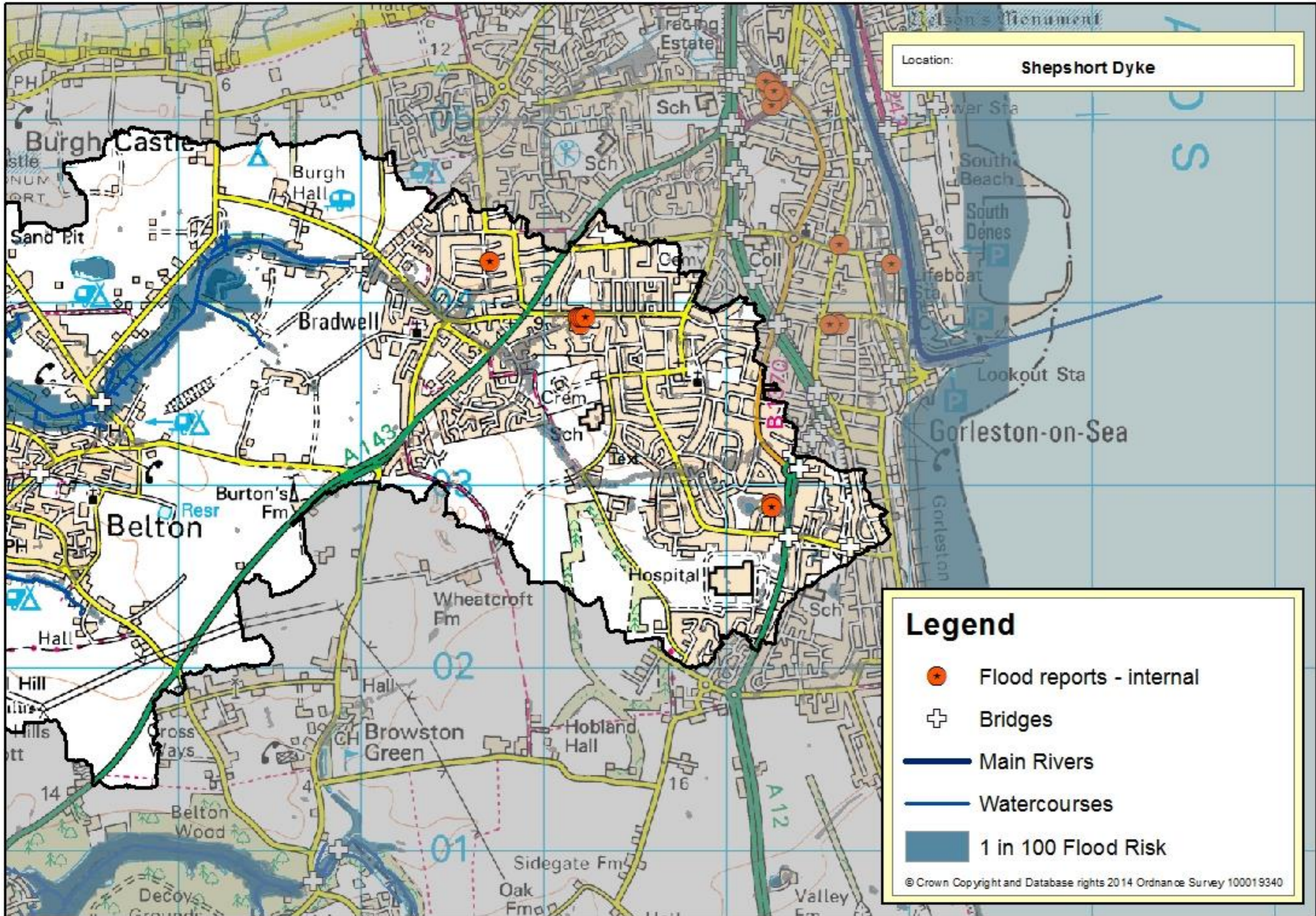
The flood investigation report aims to:

- provide a transparent and consistent review of recent flooding.
- identify those organisations and individuals who have responsibility to manage the causes of the flooding.
- identify what their response has been or will be to the flooding.
- make recommendations as to how the flood risk could be mitigated or reduced.
- provide new evidence of the level of risk faced by communities in Norfolk that can be used in current funding bids in support of flood mitigation schemes.

Mitigation measures include property level protection: reinstating lost drainage features: reviewing or increasing maintenance regimes and increasing the capacity of the drainage network.






The flood investigation report cannot:

- Resolve the flooding issues or provide designed solutions.
- Force authorities to undertake any of the recommended actions.



Location: **Shephoort Dyke**

Legend

-  Flood reports - internal
-  Bridges
-  Main Rivers
-  Watercourses
-  1 in 100 Flood Risk

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Flooding and flood risk within the Stepshort Dyke catchment

Description of catchment

A mix of urban and rural which includes parts of Bradwell, Gorleston and Belton. Water flows east to west, outfalling at the River Waveney. Most of the flood reports were from the upper reaches of the catchment near Bradwell.

Flood Risk within the catchment

The flood risk from local sources (ordinary watercourses and surface run-off) and strategic sources (fluvial above 3 square km and the sea) of flooding within this catchment has been assessed. The number of properties at risk are set out in the table below for two different risk bandings, the 1 in 30 year event and the 1 in 100 year event. This assessment does not take into account flood risk from groundwater or reservoir failure.

Flood Risk Data Source	Critical Services	Residential	Non-residential
[a] No. of properties subject to surface water flood risk at 1 in 30 year event:	2	196	4
[b] No. of properties subject to surface water flood risk at 1 in 100 year event:	7	424	9
[c] No. of properties subject to flood risk from rivers and the sea at 1 in 30 year event:	0	18	1
[d] No. of properties subject to flood risk from rivers and the sea at 1 in 100 year event:	4	57	4
[e] No. of properties only subject to both flood risk from surface water and rivers and the sea (combined risk) at 1 in 30 year event:	0	0	0
[f] No. of properties only subject to both flood risk from surface water and rivers and the sea (combined risk) at 1 in 100 year event:	0	0	0

Flood incidents within this catchment

Within this catchment 11 reports of external and internal flooding have been received. Out of these 11 reports, 5 incidents of internal flooding have been confirmed and assessed as part of this investigation. These incidents are detailed in the table below.

Incident as reported	What was the response to the flood incident
<p>On the 14/07/2016 - 4 properties were internally flooded on Long Lane, Bradwell. These incidents were reported by:</p> <ul style="list-style-type: none"> Great Yarmouth Borough Council via email correspondence on the 14 July 2016, (FWF/16/6/3059) (FWF/16/6/3062) (FWF/16/6/3063) (FWF/16/6/3064) 	<ul style="list-style-type: none"> Anglian Water Services Ltd responded and pumped out after the incident. They also visited affected residents to offer advice and to gather information after the incident. The Environment Agency visited affected residents to offer advice and to gather information after the incident. A local community group visited affected residents to offer advice and to gather information after the incident. <ul style="list-style-type: none"> Norfolk County Council (Lead Local Flood Authority) contacted the resident to offer advice and gather information after the incident. NCC assessed the flood report and concluded that internal flooding had occurred.
<p>On the 29/08/2016 - 1 property was internally flooded on Long Lane, Bradwell. This incident was reported by a resident via email correspondence on the 29 August 2016, (FWF/16/6/3272)</p>	<p>Norfolk County Council (Lead Local Flood Authority) contacted the resident to offer advice and gather information after the incident. NCC assessed the flood report and concluded that internal flooding had occurred.</p>

Recent rainfall within the catchment

This report seeks to draw on rainfall data to ascertain the intensity of the rainfall events experienced in the catchment that led to the flooding. This analysis is useful in assessing (in broad terms) if the design capacity of drainage systems within the affected areas was exceeded.

Norfolk County Council has sought to use data from rain gauges where incidents of flooding are located within a 2.5 km radius of the instrumentation. This distance meets the requirements of British Standards and aims to capture localised rainfall patterns. Where there is no available data within this radius this will be stated.

There were no rain gauges within 2.5km of the incidents of flooding within this catchment.

Historic flooding incidents within the catchment

The following table lists flooding incidents within the catchment that have been recorded:

Date of incident	Impact	Rainfall intensity
13 July 2014	One resident at Wanuci Crescent reported external surface water flooding occurring on this date.	Unknown
	One resident at Margeurite Close reported internal flooding coming up from a foul drain on this date.	

Causes of flooding within the catchment and recommendations

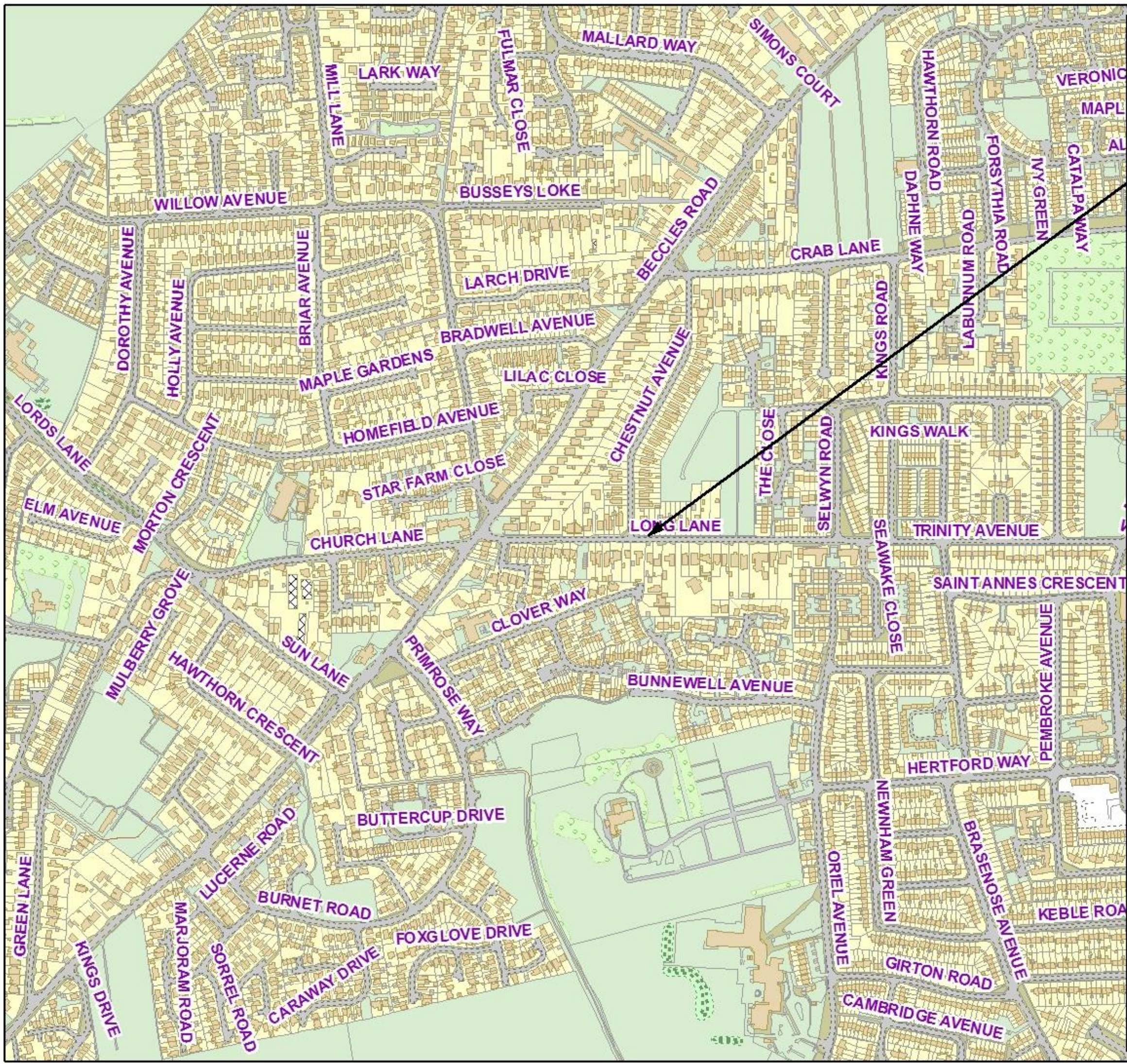
The findings of the investigation are detailed on the following pages. The first table details the causes that led to flooding within the catchment as well as when and where they were experienced. It also sets out which Risk Management Authorities have responsibility to help manage the causes of the flooding. The second table sets out recommendations to mitigate the causes and impacts of the flooding experienced within this catchment.

Following flooding to people, property and infrastructure;

- Risk Management Authorities should
 - communicate with affected residents where their assets have given rise to the flooding of properties.
 - review the appropriateness of their response to flooding.
 - Determine the integrity and/or capacity of their assets where they have contributed to the flooding of properties to understand the systems role in accommodating normal rainfall events as well as mitigating flooding.
- Property owners of affected properties should seek their own legal advice.
- NCC should
 - incorporate all relevant information of actual flooding into the review of the Norfolk Preliminary Flood Risk Assessment (“PFRA”).
 - review and monitor the delivery of recommendations within this and other relevant flood investigation reports.

Flooding experienced at / on	Causes of flooding	Who has responsibilities to manage the cause(s) of the flood?
Long Lane, Bradwell, 14/07/2016	Surface run-off from rainfall made its way onto the highway and flowed along the road network and onto the accesses of affected properties that were situated lower than these features.	Property owners, Norfolk County Council
	Significant rainfall was concentrated on the highway. Vehicles using the highway passed through the flood water causing it to wash towards the affected properties.	Property owners, Norfolk County Council
	The foul drainage system which includes two pumps at Morton Crescent Pumping Station may have been working with reduced efficiency after a recent power failure. This may have put pressure on the upstream drainage system contributing to flooding at the affected properties.	Anglian Water
	Run-off from significant rainfall was directed towards the surface water and foul drainage network. These flows could not be accommodated as the system was already overloaded. This directed flood water towards the affected properties.	Anglian Water, Norfolk County Council, Property owners
	Significant rainfall was directed into the foul system causing it to surcharge elsewhere. This surcharging contributed to the flooding at the affected properties.	Anglian Water
Long Lane, Bradwell, 29/08/2016; 14/07/2016	Run-off from the rainfall was concentrated along overland flow paths on which the affected properties are positioned.	Property owners, Norfolk County Council
	The flood water entered the properties through low thresholds at entrances and doors.	Property owners, Land owners,

Flooding experienced at / on	Recommendation	Who has responsibility to follow up the recommendation?	Timescale
Long Lane, Bradwell, 29/08/2016; 14/07/2016	Norfolk County Council will investigate with third parties the potential to fund to small scale improvement schemes to mitigate the risk experienced at this location. This would include assessing the potential to install property level protection measures, reduce run-off and increase the attenuation of flood water to reduce the impacts of flooding. Property owners could also carry out their own measures where funding is not forthcoming or residents are unwilling to wait for measures to be approved through national funding schemes.	Property owners, Land owners, Riparian owners, Anglian Water, Norfolk County Council	12 months
	Property owners should protect their buildings through flood protection measures where appropriate. Norfolk County Council will communicate with local residents to advise them of the appropriate measures they could take to protect their property without prejudicing the rights and responsibilities of adjoining property holders.	Property owners Norfolk County Council	12 months
Long Lane, Bradwell, 14/07/2016	Norfolk County Council will consider opportunities to route flood water on the highway away from affected properties to alternative points of discharge, or other solutions as practicable.	Norfolk County Council	12 months
	Anglian Water should work with partner organisations to identify the potential for managing the amount or rate of surface water entering their drainage system in flood events.	Anglian Water	12 months



Location: Long Lane, Bradwell

Drawing: Map 3 – Flood and Drainage details

Long Lane – Internal and external flooding on 29 August 2016.

Causes – Heavy rainfall concentrated along the overland flow paths. This runoff was directed along the roads which, combined with the movement of cars, created a wash pushing more water into the properties through low threshold entrances.





Recommendations – Norfolk County Council will look for funding for individual property level protection and advise residents on appropriate measures. Meanwhile, property owners should protect their buildings where funding is not forthcoming.

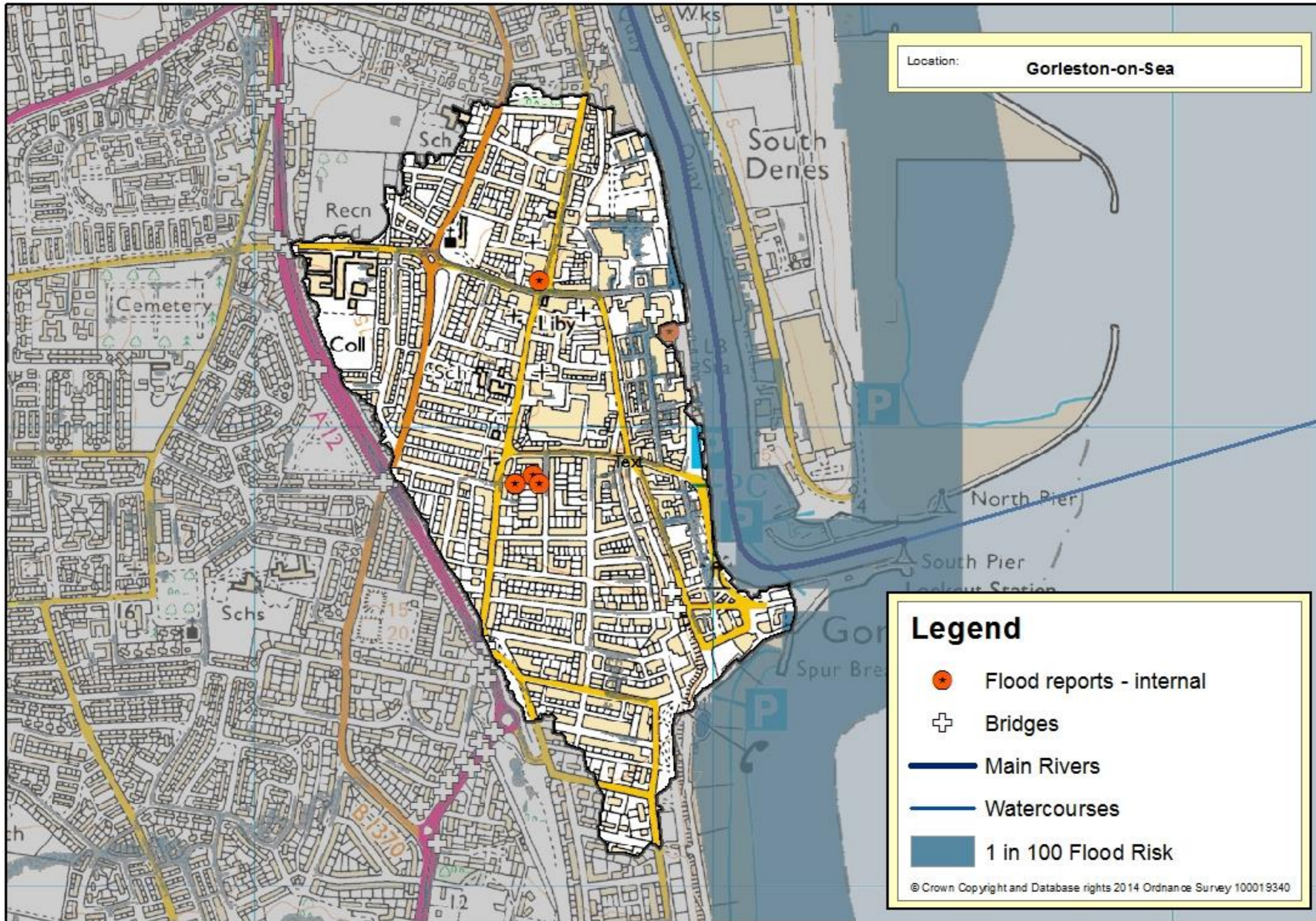
Long Lane – Internal and external flooding experienced on 14 July 2016.

Causes – Significant rainfall was directed into both the surface water and foul networks. This caused the system to become overwhelmed and surcharge elsewhere. A slow response time of the nearby pumping station and Morton Crescent reduced the efficiency of the drainage system. Furthermore, vehicles using the highway directed more water towards the affected properties.

Recommendations – Norfolk County Council and Anglian Water will work together to route surface flood water entering the drainage system to alternative points of discharge. Property owners should protect their buildings through flood protection measures where appropriate. NCC will communicate with local residents to advise them of the appropriate measures they could take to protect their property.

Legend

-  Bridges
-  Watercourses
-  Main Rivers
-  Water bodies



Flooding and flood risk within the Gorleston-on-Sea catchment

Description of catchment

Steep, urban catchment which flows directly east to the River Yare. The majority of the drainage network is pumped up to Caister Water Treatment Works.

Flood Risk within the catchment

The flood risk from local sources (ordinary watercourses and surface run-off) and strategic sources (fluvial above 3 square km and the sea) of flooding within this catchment has been assessed. The number of properties at risk are set out in the table below for two different risk bandings, the 1 in 30 year event and the 1 in 100 year event. This assessment does not take into account flood risk from groundwater or reservoir failure.

Flood Risk Data Source	Critical Services	Residential	Non-residential
[a] No. of properties subject to surface water flood risk at 1 in 30 year event:	2	35	19
[b] No. of properties subject to surface water flood risk at 1 in 100 year event:	3	145	51
[c] No. of properties subject to flood risk from rivers and the sea at 1 in 30 year event:	0	0	2
[d] No. of properties subject to flood risk from rivers and the sea at 1 in 100 year event:	0	0	2
[e] No. of properties only subject to both flood risk from surface water and rivers and the sea (combined risk) at 1 in 30 year event:	0	0	0
[f] No. of properties only subject to both flood risk from surface water and rivers and the sea (combined risk) at 1 in 100 year event:	0	0	1

Flood incidents within this catchment

Within this catchment 5 reports of external and internal flooding have been received. Out of these 5 reports, 3 incidents of internal flooding have been confirmed and assessed as part of this investigation. These incidents are detailed in the table below.

Date of Incident	Incident as reported	What was the response to the flood incident
24/06/2016	1 property was internally flooded on Riverside Road, Great Yarmouth. This incident was reported by a resident via an online flood report form on the 24 June 2016, (FWF/16/6/3916)	Norfolk County Council (Lead Local Flood Authority) visited affected residents to offer advice and to gather information after the incident.
29/08/2016	1 property was internally flooded on Leicester Road, Great Yarmouth. This incident was reported by a resident via an online flood report form on the 29 August 2016, (FWF/16/6/3235)	Norfolk County Council (Lead Local Flood Authority) visited affected residents to offer advice and to gather information after the incident.
30/08/2016	1 property was internally flooded on Nelson Road, Great Yarmouth. This incident was reported by a resident via an online flood report form on the 30 August 2016, (FWF/16/6/3236)	No authority visited the affected property however Norfolk County Council (Lead Local Flood Authority) contacted resident to offer advice and to gather information after the incident.

Recent rainfall within the catchment

This report seeks to draw on rainfall data to ascertain the intensity of the rainfall events experienced in the catchment that led to the flooding. This analysis is useful in assessing (in broad terms) if the design capacity of drainage systems within the affected areas was exceeded.

Norfolk County Council has sought to use data from rain gauges where incidents of flooding are located within a 2.5 km radius of the instrumentation. This distance meets the requirements of British Standards and aims to capture localised rainfall patterns. Where there is no available data within this radius this will be stated.

There were no rain gauges within 2.5km of the incidents of flooding within this catchment.

Historic flooding incidents within the catchment

The following table lists flooding incidents within the catchment that have been recorded:

Date of incident	Impact	Rainfall intensity
1 September 2015	A resident reported reoccurring external flooding at Church Road on this date.	Unknown

Causes of flooding within the catchment and recommendations

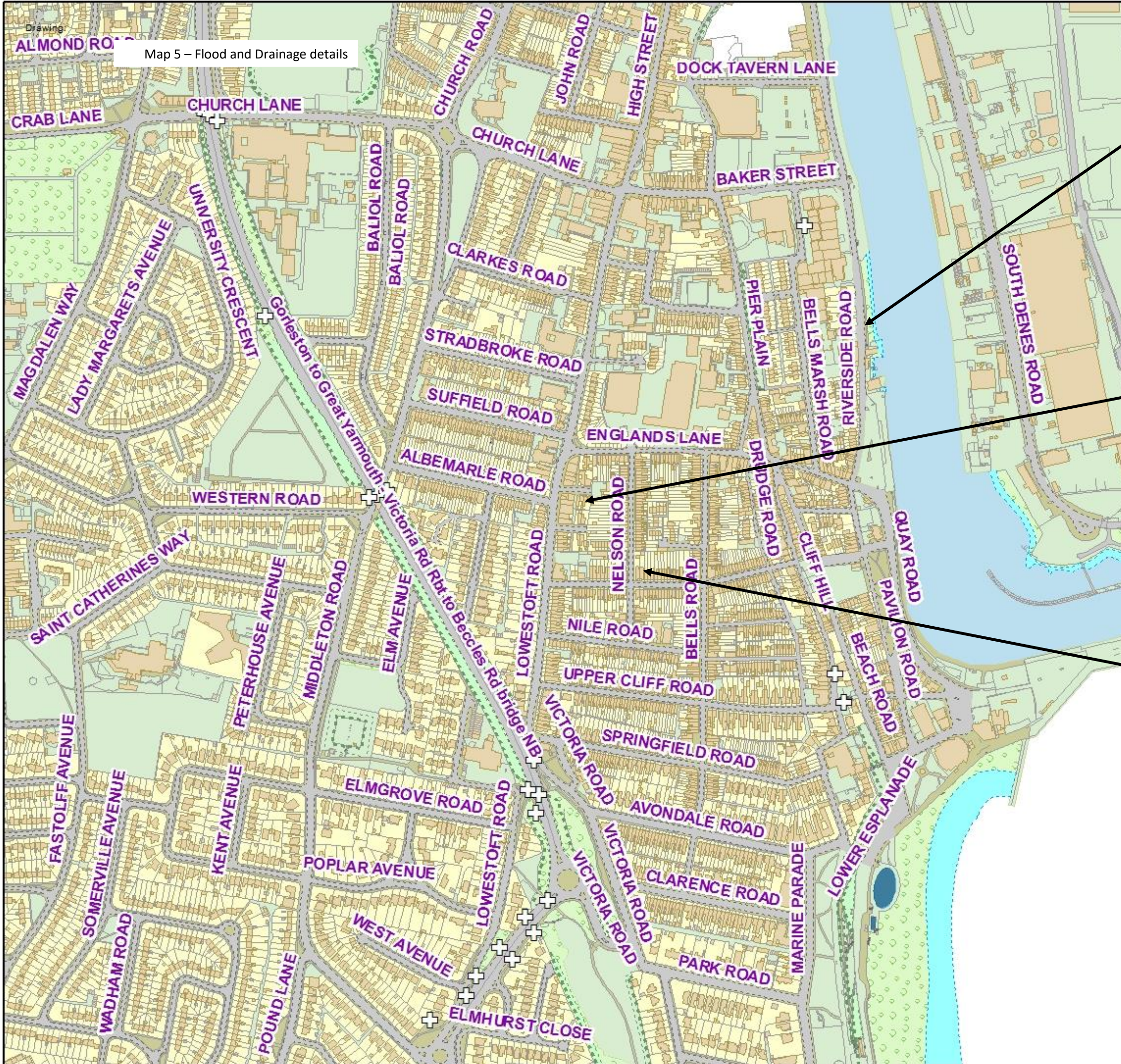
The findings of the investigation are detailed on the following pages. The first table details the causes that led to flooding within the catchment as well as when and where they were experienced. It also sets out which Risk Management Authorities have responsibility to help manage the causes of the flooding. The second table sets out recommendations to mitigate the causes and impacts of the flooding experienced within this catchment.

Following flooding to people, property and infrastructure;

- Risk Management Authorities should
 - communicate with affected residents where their assets have given rise to the flooding of properties.
 - review the appropriateness of their response to flooding.
 - Determine the integrity and/or capacity of their assets where they may have contributed to the flooding of properties to understand the systems role in accommodating normal rainfall events as well as mitigating flooding.
- Property owners of affected properties should seek their own legal advice.
- NCC should
 - incorporate all relevant information of actual flooding into the review of the Norfolk Preliminary Flood Risk Assessment (“PFRA”).
 - review and monitor the delivery of recommendations within this and other relevant flood investigation reports.

Flooding experienced at / on	Causes of flooding	Who has responsibilities to manage the cause(s) of the flood?
Nelson Road, Great Yarmouth, 30/08/2016 Leicester Road, Great Yarmouth, 29/08/2016	Run-off from significant rainfall was concentrated along overland flow paths on which the affected properties are located.	Norfolk County Council, Property Owners
Leicester Road, Great Yarmouth, 29/08/2016 Riverside Road, Great Yarmouth, 24/06/2016	Surface run-off from the wider area made its way onto the highway and flowed along the road network, onto the access of the properties, which contributed to the flooding of the affected properties.	Norfolk County Council, Property Owners
Nelson Road, Great Yarmouth, 30/08/2016 Leicester Road, Great Yarmouth, 29/08/2016	Significant rainfall was directed into both the surface water and the foul drainage system causing it to surcharge elsewhere. This surcharging contributed to the flooding at the affected properties.	Anglian Water, Norfolk County Council
Nelson Road, Great Yarmouth, 30/08/2016 Leicester Road, Great Yarmouth, 29/08/2016 Riverside Road, Great Yarmouth, 24/06/2016	The flood water entered the properties via the toilet and through external doors.	Anglian Water, Property Owners

Flooding experienced at / on	Recommendation	Who has responsibility to follow up the recommendation?	Timescale
<p>Nelson Road, Great Yarmouth, 30/08/2016 Leicester Road, Great Yarmouth, 29/08/2016</p>	<p>Norfolk County Council will work with partner organisations to identify funding for flood mitigation. This would include assessing the potential to install property level protection measures, reduce run-off and increase the attenuation of flood water to reduce the impacts of flooding. Property owners could also carry out their own measures where funding is not forthcoming or residents are unwilling to wait for measures to be approved through national funding schemes.</p>	<p>Property owners, Land owners, Riparian owners, Anglian Water, Norfolk County Council</p>	<p>12 months</p>
<p>Leicester Road, Great Yarmouth, 29/08/2016 Riverside Road, Great Yarmouth, 24/06/2016</p>	<p>Norfolk County Council will consider opportunities to route flood water on the highway away from affected properties to alternative points of discharge, or other solutions as practicable.</p>	<p>Norfolk County Council</p>	<p>12 months</p>
<p>Nelson Road, Great Yarmouth, 30/08/2016 Leicester Road, Great Yarmouth, 29/08/2016</p>	<p>Norfolk County Council and Anglian Water should review the level of maintenance required to sustain the design efficiency of their drainage systems that serves the flooding location in line with the risk identified.</p>	<p>Norfolk County Council, Anglian Water</p>	<p>12 months</p>
<p>Nelson Road, Great Yarmouth, 30/08/2016 Leicester Road, Great Yarmouth, 29/08/2016 Riverside Road, Great Yarmouth, 24/06/2016</p>	<p>Property owners should protect their buildings through flood protection measures where appropriate. Norfolk County Council will communicate with local residents to advise them of the appropriate measures they could take to protect their property without prejudicing the rights and responsibilities of adjoining property holders.</p>	<p>Property owners</p>	<p>12 months</p>



Map 5 – Flood and Drainage details

Location: **Gorleston-on-Sea**

Riverside Road – Internal and external flooding on 24 June 2016.
Causes – Flood water entered the property through external doors due to run-off from the nearby highway.
Recommendations – Norfolk County Council will consider opportunities to reroute the flood water to different points of discharge or other solutions as practicable.

Leicester Road – Internal and external flooding on 29 August 2016.
Causes – Significant rainfall led to the surface and foul water drains surcharging and entering the property. Run-off from the road was directed into the property.
Recommendations – Norfolk County Council should secure funding where possible and advise on property level protection.

Nelson Road – Internal and external flooding on 28 August 2016.
Causes – Heavy rain caused the foul and surface water drains to surcharge. Overflow from the drains was directed towards the property along the overland flow path.
Recommendations – Norfolk County Council should secure funding where possible and advise on property level protection.

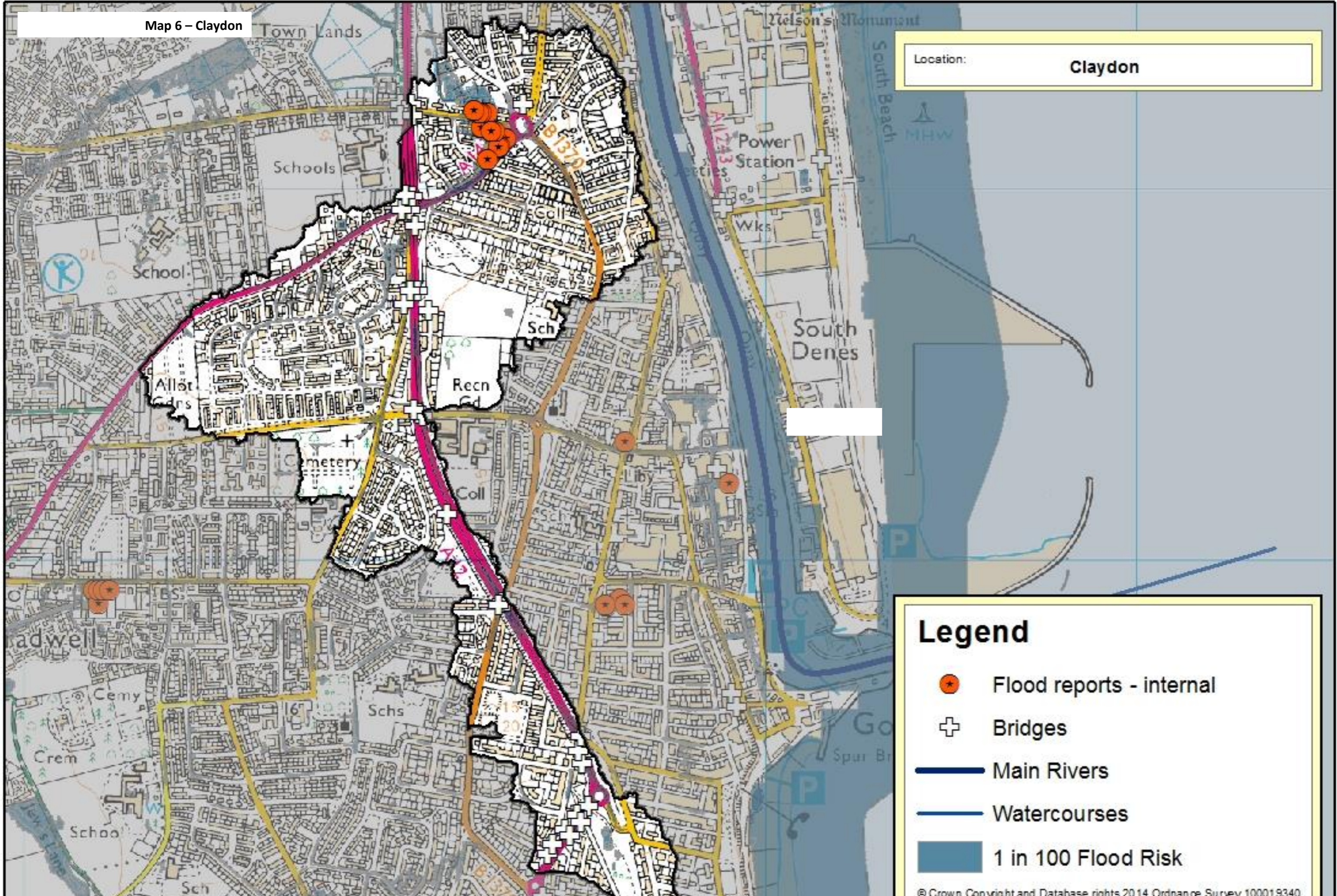
Legend

- ⊕ Bridges
- Water bodies

Map 6 – Claydon

Location:

Claydon



Legend

-  Flood reports - internal
-  Bridges
-  Main Rivers
-  Watercourses
-  1 in 100 Flood Risk

Flooding and flood risk in the Claydon catchment

Description of catchment

Fully urban catchment with little permeable ground to drain from. Some areas of the catchment sit below sea level and are served by a pumping station, Morton Crescent SPS. Water flows northeast and to the north, outfalling into a ditch network which makes its way via a series of culverts to Breydon Water.

Flood Risk within the catchment

The flood risk from local sources (ordinary watercourses and surface run-off) and strategic sources (fluvial above 3 square km and the sea) of flooding within this catchment has been assessed. The number of properties at risk are set out in the table below for two different risk bandings, the 1 in 30 year event and the 1 in 100 year event. This assessment does not take into account flood risk from groundwater or reservoir failure.

Flood Risk Data Source	Critical Services	Residential	Non-residential
[a] No. of properties subject to surface water flood risk at 1 in 30 year event:	2	69	0
[b] No. of properties subject to surface water flood risk at 1 in 100 year event:	2	124	2
[c] No. of properties subject to flood risk from rivers and the sea at 1 in 30 year event:	0	0	0
[d] No. of properties subject to flood risk from rivers and the sea at 1 in 100 year event:	0	0	0
[e] No. of properties only subject to both flood risk from surface water and rivers and the sea (combined risk) at 1 in 30 year event:	0	0	0
[f] No. of properties only subject to both flood risk from surface water and rivers and the sea (combined risk) at 1 in 100 year event:	0	0	0

Flood incidents within this catchment

Within this catchment 14 reports of external and internal flooding have been received. Out of these 14 reports, 3 incidents of internal flooding have been confirmed and assessed as part of this investigation. These incidents are detailed in the table below.

Date of Incident	Incident as reported	What was the response to the flood incident
13/07/2016	On the 13/07/2016 - 1 property was internally flooded on Burgh Road , Great Yarmouth. This incident was reported by Great Yarmouth Borough Council via email correspondence on the 13 July 2016, (FWF/16/6/3049)	The Fire and Rescue Service responded and pumped out during the incident.
12/07/2016	On the 12/07/2016 - 1 property was internally flooded on Burgh Road , Great Yarmouth. This incident was reported by Great Yarmouth Borough Council via email correspondence on the 13 July 2016, (FWF/16/6/3057)	The Fire and Rescue Service responded and pumped out during the incident.
	On the 12/07/2016 - 1 property was internally flooded on Beccles Road , Great Yarmouth. This incident was reported by Great Yarmouth Borough Council via email correspondence on the 13 July 2016, (FWF/16/6/3038)	Norfolk County Council (Lead Local Flood Authority), Great Yarmouth Borough Council and National Flood Forum visited affected residents to offer advice and to gather information after the incident.
26/02/2016	On the 26/02/2016 - 1 property was internally flooded on Burgh Road , Great Yarmouth. This incident was reported by Great Yarmouth Borough Council via email correspondence on the 26 February 2016, (FWF/16/6/2403)	Norfolk County Council (Lead Local Flood Authority) Great Yarmouth Borough Council and National Flood Forum visited affected residents to offer advice and to gather information after the incident.

Recent rainfall within the catchment

This report seeks to draw on rainfall data to ascertain the intensity of the rainfall events experienced in the catchment that led to the flooding. This analysis is useful in assessing (in broad terms) if the design capacity of drainage systems within the affected areas was exceeded.

Norfolk County Council has sought to use data from rain gauges where incidents of flooding are located within a 2.5 km radius of the instrumentation. This distance meets the requirements of British Standards and aims to capture localised rainfall patterns. Where there is no available data within this radius this will be stated.

There were no rain gauges within 2.5km of the incidents of flooding within this catchment.

Historic flooding incidents within the catchment

The following table lists flooding incidents within the catchment that have been recorded:

Date of incident	Impact	Rainfall intensity
13 July 2014	One resident at Beccles Road reported external flooding at their property on this date.	Unknown
	Two residents on Beccles Road reported internal surface water flooding on this date.	
6 March 2015	One resident reported surface water flooding occurring on this date causing external flooding.	Unknown

Causes of flooding within the catchment and recommendations

The findings of the investigation are detailed on the following pages. The first table details the causes that led to flooding within the catchment as well as when and where they were experienced. It also sets out which Risk Management Authorities have responsibility to help manage the causes of the flooding. The second table sets out recommendations to mitigate the causes and impacts of the flooding experienced within this catchment.

Following flooding to people, property and infrastructure;

- Risk Management Authorities should
 - communicate with affected residents where their assets have given rise to the flooding of properties.
 - review the appropriateness of their response to flooding.
 - Determine the integrity and/or capacity of their assets where they have contributed to the flooding of properties to understand the systems role in accommodating normal rainfall events as well as mitigating flooding.
- Property owners of affected properties should seek their own legal advice.
- NCC should
 - incorporate all relevant information of actual flooding into the review of the Norfolk Preliminary Flood Risk Assessment (“PFRA”).
 - review and monitor the delivery of recommendations within this and other relevant flood investigation reports.

Flooding experienced at / on	Causes of flooding	Who has responsibilities to manage the cause(s) of the flood?
Burgh Road, Great Yarmouth, 13/07/2016; 12/07/2016; 26/02/2016 Beccles Road, Great Yarmouth, 12/07/2016	Run-off from significant rainfall was concentrated along overland flow paths on which the affected properties are positioned.	Property Owners
Burgh Road, Great Yarmouth, 26/02/2016	Surface run-off flowed from the highway onto the access of the properties, which contributed to the flooding of the affected properties.	Norfolk County Council, Property Owners
Beccles Road, Great Yarmouth, 12/07/2016	Significant rainfall was directed into the surface and combined drainage system causing it to surcharge elsewhere. This surcharging contributed to the flooding at the affected properties.	Norfolk County Council, Anglian Water
Burgh Road, Great Yarmouth, 13/07/2016; 12/07/2016 Beccles Road, Great Yarmouth, 12/07/2016	The flood water entered the properties through low thresholds at entrances and the electricity conduits.	Property owners, Land owners,
Burgh Road, Great Yarmouth, 26/02/2016	The loss of pre-existing drainage features (such as drains, dykes, ditches, ponds, culverts) within the catchment exacerbated the flooding.	Norfolk County Council, Anglian Water, Internal Drainage Board

Flooding experienced at / on	Recommendation	Who has responsibility to follow up the recommendation?	Timescale
<p>Burgh Road, Great Yarmouth, 13/07/2016; 12/07/2016; 26/02/2016 Beccles Road, Great Yarmouth, 12/07/2016</p>	<p>Norfolk County Council will work with partner organisations to identify funding for flood mitigation. This would include assessing the potential to install property level protection measures, reduce run-off and increase the attenuation of flood water to reduce the impacts of flooding. Property owners could also carry out their own measures where funding is not forthcoming or residents are unwilling to wait for measures to be approved through national funding schemes.</p>	<p>Property owners, Land owners, Riparian owners, Anglian Water, Norfolk County Council, Internal Drainage Board</p>	<p>12 months</p>
<p>Burgh Road, Great Yarmouth, 26/02/2016</p>	<p>Norfolk County Council will consider opportunities to route flood water on the highway away from affected properties to alternative points of discharge, or other solutions as practicable.</p>	<p>Norfolk County Council (Highways)</p>	<p>12 months</p>
	<p>Norfolk County Council and Anglian Water should review the level of maintenance required to sustain the design efficiency of their drainage systems that serves the flooding location in line with the risk identified.</p>	<p>Norfolk County Council (Highways), Anglian Water</p>	<p>12 months</p>
<p>Beccles Road, Great Yarmouth, 12/07/2016</p>	<p>Anglian Water should work with partner organisations to identify the potential for managing the amount or rate of surface water entering their drainage system in flood events to reduce the likelihood of surcharging.</p>	<p>Anglian Water</p>	<p>12 months</p>
<p>Burgh Road, Great Yarmouth, 13/07/2016; 12/07/2016 Beccles Road, Great Yarmouth, 12/07/2016</p>	<p>Property owners should protect their buildings through flood protection measures where appropriate. Norfolk County Council will communicate with local residents to advise them of the appropriate measures they could take to protect their property without prejudicing the rights and responsibilities of adjoining property holders.</p>	<p>Property owners Norfolk County Council (Lead Local Flood Authority)</p>	<p>12 months</p>
<p>Burgh Road, Great Yarmouth, 26/02/2016</p>	<p>Anglian Water could confirm, where possible, the existence of any connections to a wider drainage network. This work should seek to confirm where the drainage network conveys flows to.</p>	<p>Anglian Water</p>	<p>12 months</p>

Location: Map 7 – Flood and Drainage details

Burgh Road – Internal and external flooding on 26 February 2016 and 12/13 July 2016.

Causes – Surface and foul water surcharged the drainage system and entered properties through low thresholds at entrances.

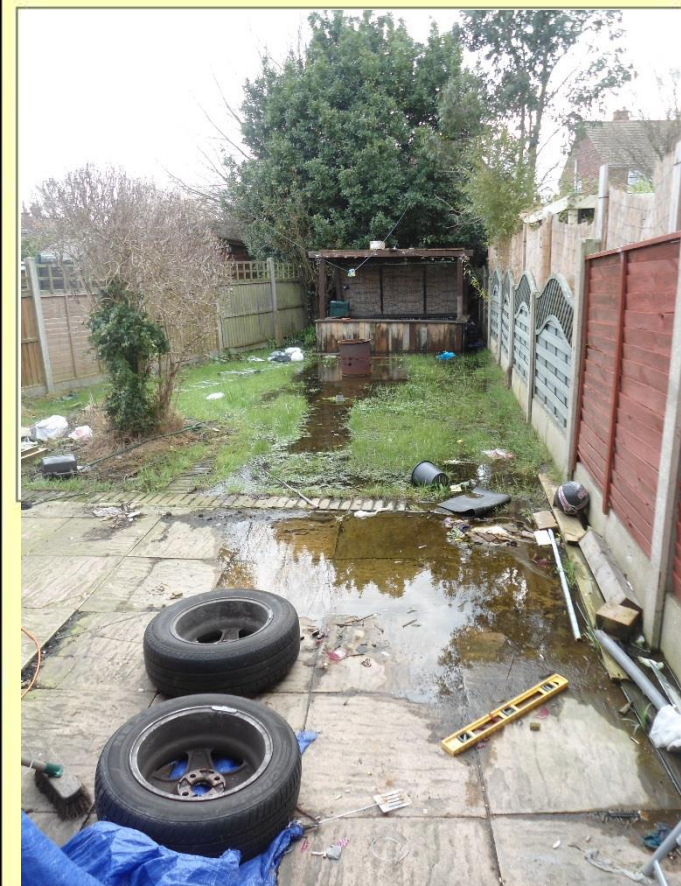
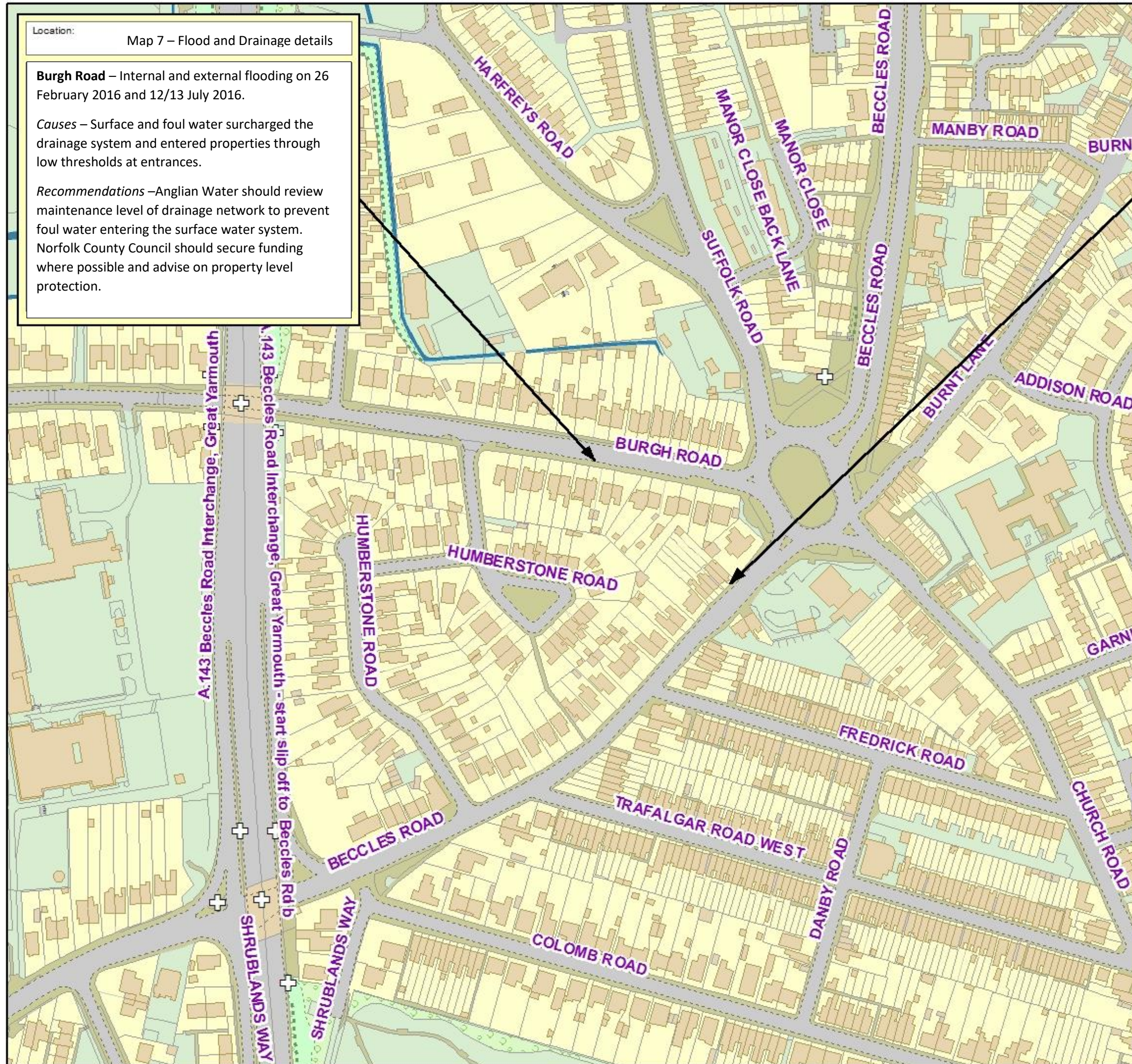
Recommendations – Anglian Water should review maintenance level of drainage network to prevent foul water entering the surface water system. Norfolk County Council should secure funding where possible and advise on property level protection.

Location: **Claydon**

Beccles Road – Internal and external flooding on 12 July 2016.

Causes – Heavy water caused drainage system to surcharge and enter property through electrical conduits.

Recommendations – Anglian Water should work to identify the possibility of managing the amount of surface water entering their system. Norfolk County Council will identify sources of funding for property level protection.



Legend

- ⊕ Bridges
- Watercourses
- Main Rivers
- Water bodies

Disclaimer

Although every effort has been taken to ensure the accuracy of the information contained within the pages of the report, we cannot guarantee that the contents will always be current, accurate or complete.

This report has been prepared as part of Norfolk County Council's responsibilities under the Flood and Water Management Act 2010. It is intended to provide context and information to support the delivery of the local flood risk management strategy and should not be used for any other purpose.

The findings of the report are based on a subjective assessment of the information available by those undertaking the investigation and therefore may not include all relevant information. As such it should not be considered as a definitive assessment of all factors that may have triggered or contributed to the flood event.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by Norfolk County Council when preparing this report, including, but not limited to those key assumptions noted in the Report, including reliance on information provided by third parties.

Norfolk County Council expressly disclaims responsibility for any error in, or omission from, this report arising from or in connection with any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the time of preparation and Norfolk County Council expressly disclaims responsibility for any error in, or omission from this report arising from or in connection with those opinions, conclusions and any recommendations.

The implications for producing Flood Investigation Reports and any consequences of blight have been considered. The process of gaining insurance for a property and/or purchasing/selling a property and any flooding issues identified are considered a separate and legally binding process placed upon property owners and this is independent of and does not relate to the County Council highlighting flooding to properties at a street level.

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Appendix A - Key definitions and responsibilities

What is flooding?

Section 1 of the Flood and Water Management Act 2010 states that: "Flood" includes any case where land not normally covered by water becomes covered by water. In addition, this section adds the caveat: "But "flood" does not include – (a) a flood from any part of the sewerage system, unless wholly or partly caused by an increase in the volume of rainwater (including snow and other precipitation) entering or otherwise affecting the system, or (b) a flood caused by a burst water main (within the meaning given by Section 219 of the Water Industry Act 1991)."

What is internal and external flooding?

For the purposes of this report, properties that have internally flooded are those where it is considered that water has entered the fabric of the building;

- Basements and below ground level floors are included.
- Garages are included if in the fabric of the building. Garages adjacent or separate from the main building are not included.
- Occupied caravans are included but not tents.

External flooding included those properties where water has entered gardens or surrounding areas which restricts access, affects the highway or where flooding has disrupted essential services to the property such as sewerage. For businesses this includes those where the flood waters are directly preventing them trading as usual.

What is Local Flood Risk?

Local Flood Risk is defined by the Flood and Water Management Act 2010 as being flood risk from surface runoff, groundwater and ordinary watercourses.

- 'Surface runoff' means rainwater (including snow and other precipitation) which is on the surface of the ground (whether or not it is moving) and, has not entered a watercourse, drainage system or public sewer.
- 'Groundwater' means all water which is below the surface of the ground and in direct contact with the ground or subsoil.
- 'Ordinary Watercourse' means a watercourse that does not form part of a main river and includes a reference to a lake, pond or other area of water which flows into an ordinary watercourse.

Roles and Responsibilities of Risk Management Authorities

Below is a short summary of those groups and Risk Management Authorities ("RMAs") that have a role in managing flooding within Norfolk. The listing of responsibilities includes those duties or powers that directly relate to managing the flood incidents or consequence. All RMAs have a duty to cooperate with other RMAs.

1. Norfolk County Council (as Lead Local Flood Authority)

- Duty to investigate significant flooding from any source.
- Duty to maintain a register of structures or features which affect flood risk from all sources.
- Power to undertake works to manage flood risk from surface run-off and groundwater.
- Powers to regulate activities on ordinary watercourses outside of Internal Drainage Board areas.
- Duties as a Category 1 Responder for Emergency Planning and the Fire & Rescue Service.

2. District Councils

- Powers to undertake works on ordinary watercourses outside of IDB areas.

- The Local Planning Authority for their District area and determine the appropriateness of developments and their exposure and effect on flood risk.
- Duties as a Category 1 Responder for Emergency Planning.

3. Internal Drainage Boards (“IDBs”)

- A duty to act in a manner consistent with the national and local strategies and guidance when exercising FCERM functions.
- Duty to act in a manner consistent with Local Flood Risk Management Strategies when exercising other functions that may affect flood risk.
- Powers to regulate activities on ordinary watercourses within IDB areas.
- Exercise a general power of supervision over all matters relating to the drainage of land within their district.
- Powers to undertake works on ordinary watercourses within IDB areas.

4. Highway Authorities (Norfolk County Council / Highways England)

- Powers to undertake works to manage water on the highway and to move water off the highway.
- Enforcement powers to unauthorised alterations, obstructions and interferences with highway drainage.
- Have responsibilities for culverts vested in the highway. Currently NCC discharges its responsibilities associated with bridges and culverts (whether as owner or highway authority) through the inspection of condition (undertaken by the Bridges team) and through maintenance activity (delivered on a as needs basis by the relevant Highways area team).

5. Water Companies

- Undertake cost beneficial capital schemes to alleviate or eliminate flooding where the flood event is associated with a failure of their assets.
- Duty to provide, improve, maintain and operate systems of public sewers and works for the purpose of effectually draining an area.
- Are responsible for flooding from their foul, combined and surface water sewers, and from burst water mains.
- Maintain ‘At Risk Registers’ for Ofwat that record properties that have flooded from public foul, combined and surface water sewers and that are at risk of flooding again.
- Water companies respond to reports from the public of flooding associated with their assets and determine an appropriate response in line with their standards or customer service.
- Duties as a Category 2 Responder for Emergency Planning.

6. Riparian Owners

- Duty of care towards neighbours upstream and downstream, avoiding any action likely to cause flooding.
- Entitled to protect their properties from flooding.
- May be required to maintain the condition of their watercourse to ensure that the proper flow of water is unimpeded.

Update to the flooding in Gorleston since 2016

Since the flood reports as covered in this Flood Investigation Report, there have been further cases of flooding in Gorleston since 2016. A total of seven flooding events were reported to Norfolk County Council during 2017. Of these, two were classified as internal. A number of the same properties that flooded in 2016 suffered repeated incidences of flooding in 2017. These include those located on Burgh Road (FWF/17/6/5809, FWF/17/6/5292, FWF/17/6/5219, FWF/17/6/5218) and Leicester Road (FWF/17/6/5121, FWF/17/6/5120). Two new locations were recorded, one at Bell's Road (FWF/17/6/5118) and the other at Baker Street (FWF/17/6/5069).

The tables below detail the causes and recommendations of the two cases of internal flooding which were both located in the **Gorleston-on-Sea** catchment.

Baker Street (FWF/17/6/5069)

Date of Incident	Incident as reported	What was the response to the flood incident
30/07/2017	1 property was internally flooded on Baker Street, Gorleston. This incident was reported by a resident via an online flood report form on the 30 th July 2017, (FWF/17/6/5069)	No authority visited the affected property however Norfolk County Council (Lead Local Flood Authority) contacted resident to offer advice and to gather information after the incident.

Causes	Who has responsibilities to manage the flood?
Flood water entered the property through external doors due to run-off from the nearby highway.	Norfolk County Council, Property Owners
Heavy rain caused the foul and surface water drains to surcharge. Overflow from the drains was directed towards the property along the overland flow path.	Norfolk County Council, Anglian Water, Property Owners

Recommendation	Who has responsibility to follow up the recommendation?	Timescale
Norfolk County Council will work with partner organisations to identify funding for flood mitigation. This would include assessing the potential to install property level protection measures, reduce run-off and increase the attenuation of flood water to reduce the impacts of flooding. Property owners could also carry out their own measures where funding is not forthcoming or residents are unwilling to wait for measures to be approved through national funding schemes.	Property owners, Land owners, Riparian owners, Anglian Water, Norfolk County Council	12 months
Norfolk County Council will consider opportunities to route flood water on the highway away from affected properties to alternative points of discharge, or other solutions as practicable.	Norfolk County Council	12 months

Norfolk County Council and Anglian Water should review the level of maintenance required to sustain the design efficiency of their drainage systems that serves the flooding location in line with the risk identified.	Norfolk County Council, Anglian Water	12 months
Anglian Water should work with partner organisations to identify the potential for managing the amount or rate of surface water entering their drainage system in flood events to reduce the likelihood of surcharging.	Anglian Water	12 months
Property owners should protect their buildings through flood protection measures where appropriate. Norfolk County Council will communicate with local residents to advise them of the appropriate measures they could take to protect their property without prejudicing the rights and responsibilities of adjoining property holders.	Property owners	12 months

Leicester Road (FWF/17/6/5120)

Date of Incident	Incident as reported	What was the response to the flood incident
09/08/2017	1 property was internally flooded on Leicester Road, Gorleston. This incident was reported by a resident via a flood report form on the 9 th August 2017 (FWF/17/6/5120)	Norfolk County Council (Lead Local Flood Authority) visited affected residents to offer advice and to gather information after the incident.

Causes	Who has responsibilities to manage the flood?
Flood water entered the property through external doors due to run-off from the nearby highway.	Norfolk County Council, Property Owners
Heavy rain caused the foul and surface water drains to surcharge. Overflow from the drains was directed towards the property along the overland flow path.	Norfolk County Council, Anglian Water, Property Owners

Recommendation	Who has responsibility to follow up the recommendation?	Timescale
Norfolk County Council will work with partner organisations to identify funding for flood mitigation. This would include assessing the potential to install property level protection measures, reduce run-off and increase the attenuation of flood water to reduce the impacts of flooding. Property owners could also carry out their own measures where funding is not forthcoming or residents are unwilling to wait for measures to be approved through national funding schemes.	Property owners, Land owners, Riparian owners, Anglian Water, Norfolk County Council	12 months
Norfolk County Council will consider opportunities to route flood water on the highway away from affected properties	Norfolk County Council	12 months

to alternative points of discharge, or other solutions as practicable.		
Norfolk County Council and Anglian Water should review the level of maintenance required to sustain the design efficiency of their drainage systems that serves the flooding location in line with the risk identified.	Norfolk County Council, Anglian Water	12 months
Anglian Water should work with partner organisations to identify the potential for managing the amount or rate of surface water entering their drainage system in flood events to reduce the likelihood of surcharging.	Anglian Water	12 months
Property owners should protect their buildings through flood protection measures where appropriate. Norfolk County Council will communicate with local residents to advise them of the appropriate measures they could take to protect their property without prejudicing the rights and responsibilities of adjoining property holders.	Property owners	12 months

Addendum: Investigation Report into the flooding in Gorleston in 2016 & 2017- Report Reference: FIR024

Update on actions taken since flood events

A number of projects have subsequently been initiated by Risk Management Authorities in response to the Flood Investigation Report.

Norfolk County Council have actioned the following:

- National Flood Forum have successfully secured funding, in partnership with Norfolk County Council for developing a project called 'Frames' which involves the instalment of a number of water butts which delay the amount of water entering the drainage system in heavy downpour. The water is infiltrated at a slower rate back into the catchment preventing the overloading of the drainage system.
- Claydon Catchment – Beccles/Burgh Road
 - Norfolk County Council Highways & LLFA, Anglian Water, Norfolk Rivers Internal Drainage Board, Great Yarmouth Borough Council, Norfolk have met and identified those authorities/riparian owners responsible for the drainage network. The IDB have carried out maintenance works to the watercourse upstream of the affected properties
 - The sewer system within is a combined system for foul and surface water and Anglian Water maintain this and highways surface water gullies are connected into this sewer system. Anglian Water, with support from Norfolk County Council Highways, are taking the lead in investigating the potential to increase the capacity of the existing system sewer system and/or divert surface water from the sewer system at the location of the affected areas. This will be subject to funding.
- Property owners have undertaken a range of different measures such as air brick covers and flood prevention gates with the help of Norfolk County Council.

Stepshort Dyke catchment – Long Lane

- Highways are undertaking a study for the Long Lane drainage system, which eventually outfalls into the system to the west which is part of the Waveney Lower Yare and Lothingland Internal Drainage District. The study will identify the necessary works needed to improve the drainage system.