Appendix 1

Hull City Council
Flood Investigation Report

City Wide Flash Flooding – August 2012

25 August 2012
Investigation Ref No HCCFWMAS190001

Revision Schedule

Hull City Council
Flood Investigation Report

25 August 2012
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Rev	Date	Details
01	**22/10/12**	**Working draft**
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02	**05/02/13**	**Scrutiny review**

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Executive Summary

Kingston upon Hull experienced widespread highway flooding and 21 properties are known to have been flooded during intense storms on 25th August 2012.

A formal investigation under Section 19 of the Flood and Water Management Act was considered appropriate, this was led by Kingston upon Hull City Council as the Lead Local Flood Authority, this report details the findings of the investigation, the cooperation of all partners was received and welcomed throughout.

Investigations have been carried out by Hull City Council and Yorkshire Water as the main operating authorities involved in a surface water event in the city, a range of findings have been reported in the investigation and works have taken place to improve the drainage network by both partners. Further works are being developed to deliver further improvements and surface water flood risk management schemes.

Formal and targeted advance warnings for surface water flooding do not exist but Environment Agency and Met Office Flood Guidance Statements highlight the potential risks from surface water flooding. Flood Guidance Statements leading up to the event showed an increased risk but no expectation was in place for the severity of risk that occurred. Recommendations are made to deliver a flood warning service for surface water flood risk.

All relevant partners responded to the event and all key infrastructure was operated, many areas experienced such rainfall volumes that flooding occurred often before the receiving drainage infrastructure could convey flows. Residents took action where possible and many contacted flood risk operating authorities and experienced protracted responses. Investigations have shown problems with a new call handling procedure implemented that weekend by Hull City Council and improvements have been identified for Yorkshire Waters call handling. Actions have been taken to ensure no further problems exist in both operating authorities.

In all cases it is expected that the main cause of flooding during the August Bank Holiday weekend was the extreme rainfall (and hailstones in places) which was isolated to a narrow east – west band across the centre of the city. Flooding from such rainfall is often a possibility and a recommendation is made to work with residents to ensure all understand the risks of surface water flooding and the ways in which a resident or community can help themselves.

1. Introduction

1.1 LLFA Investigation

HCC as the LLFA has a responsibility to record and report flood incidents as detailed within Section 19 of the FWMA:

Section 19
(1) On becoming aware of a flood in its area, a lead local flood authority must, to the extent that it considers it necessary or appropriate, investigate:

(a) which risk management authorities have relevant flood risk management functions, and
(b) whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.

(2) Where an authority carries out an investigation under subsection (1) it must:
(a) publish the results of its investigation, and
(b) notify any relevant risk management authorities.

It was deemed necessary to complete an investigation into the flood incident on 25th August 2012 as multiple properties, commercial centres and roads were reported as flooded.

This report provides the details of the conditions leading to the flooding, the impacts of the flooding and the roles and responsibilities of all operating authorities in the area. Following further investigations of relevant authorities recommendations and conclusions are given.

1.2 Site Location

A range of locations of the city were affected by an intense storm on the 25th August, the below table shows where properties were flooded – where no property numbers are recorded road flooding occurred.

Location	Post Code	No. of Properties / Commercial Properties Flooded
Noddle Hill Way, Hull. Junction with Kestrel Avenue	HU7 4	10
Holwell Road, North Point Shopping Centre.	HU7 4	1
Edendale	HU7 4	1
Coverdale/ Cotterdale	HU7 4	1
Borrowdale		4
Bisley Grove	HU7 4	

Stockholm Road, Hull. (Full Length)	HU7 0	
Copenhagen Road	HU7 0	1
Sutton Road	HU7 0	
Garrick Close	HU8 0	
Corona Drive	HU8 0	1
Ullswater Close	HU8 0	2
Lowgate		
Malham Avenue	HU4 6	
Kendal Way	HU4 7	
Hawkshead Green	HU4 7	
Foster Street	HU8	
Princes Avenue	HU5	
Calvert Lane	HU4 6	

Table 1 – Flooded locations 25th August 2012

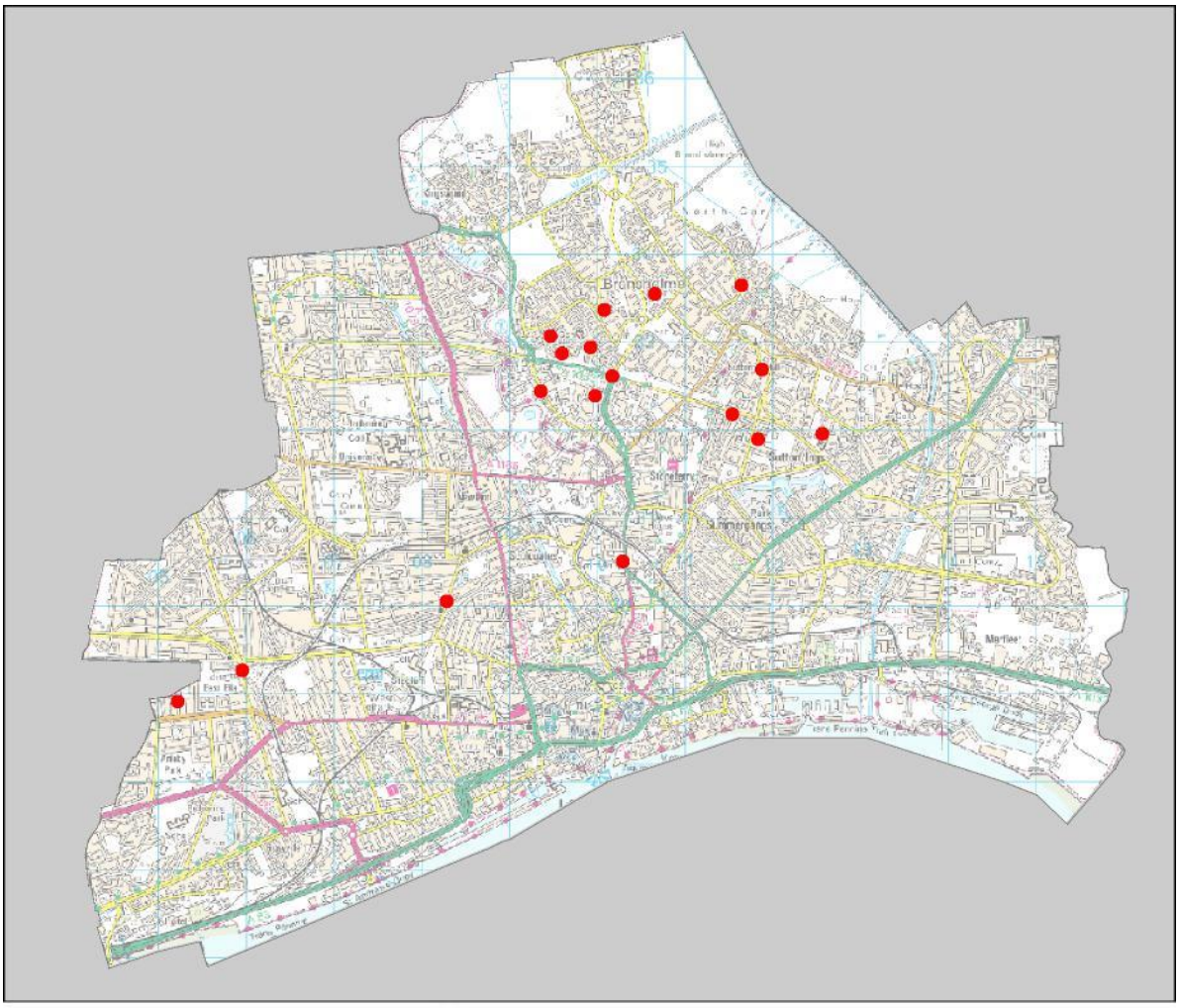

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Figure 1 - Indicative map of flooded locations 25th August 2012.

Local Drainage System

The Hull drainage system is a complex interaction of rivers, streams, ditches, dykes and sewers. Many streams and ditches flow into the city from the surrounding East Riding of Yorkshire Council area and flow through the city in a mixture of Main Rivers permissively managed by the Environment Agency (EA) and open drains and streams (Ordinary Watercourses permissively managed by local authorities, or often the responsibility of riparian landowners) but much of the system is culverted below ground.

The vast majority of the system is also classed as part of the sewerage system for the city as it passes flows derived from surface water drainage onto the hard surfaces across the city. The sewerage system is pumped in times of flood through a combination of pumping stations to the treatment works in the east of the city at Salt End, the pumping stations at West and East Hull are key to this operation. The Bransholme area of the city is served by a separate surface water drainage system which discharges flows into a storage lagoon before outfalling to the River Hull. Yorkshire Water is responsible for the cities sewerage system.

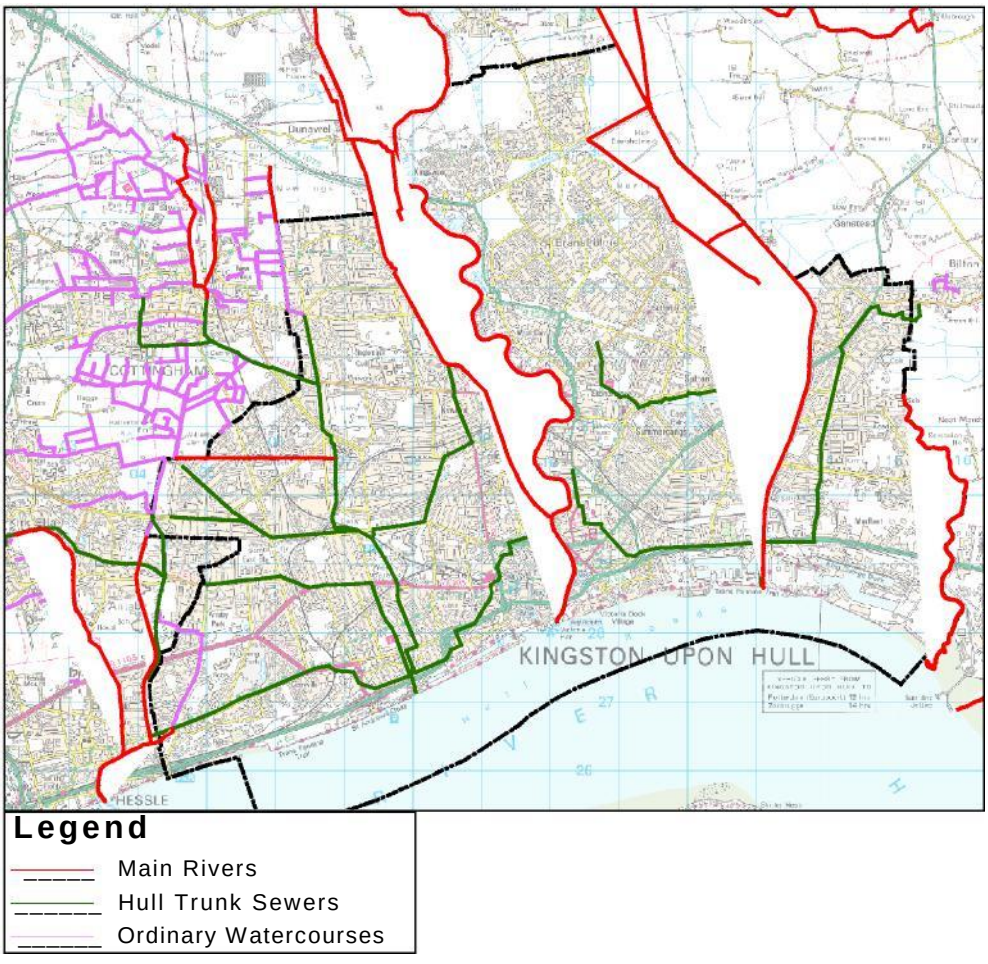

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Figure 2 Hull City Drainage Systems

2. Drainage History

2.1 Previous Flood Incidents

The floods of 2007 followed some of the highest rainfall on record across many parts of the region and many drains, ditches and watercourses were overwhelmed. Many streams and ditches flowing through the East Riding of Yorkshire Council (ERYC) villages of Anlaby, Cottingham and Willerby were overwhelmed and flood flows came out of bank and caused significant flooding through these towns, these flows then passed onto the west of the city of Hull where the flooding of Anlaby Park, Orchard Park and Derringham followed. The flooding of these areas was caused by the capacity of the drainage system being unable to pass flood flows. Similar flooding extended across large areas of the east of the city where drainage systems were unable to cope with excessive rainfall, flooding again extended outside of the city boundary with many villages east of the city suffering from flooding.

Flooding in the North East area of the city was exacerbated due to infrastructure failure at the Bransholme Pumping Station, significant areas of Bransholme and Kingswood were affected.

More than 1300 businesses and 8600 residential properties were flooded in the city, many more were affected in the ERYC villages.

2.2 25th August 2012

The flood event of 25th August 2012 was caused by an intense storm localised to the city, surrounding areas have not reported similar incidents from this event and similarly many of the other events which caused problems in surrounding areas did not impact significantly on the city. Problems were reported across the city but are broadly concentrated in a ‘central belt’, see figure 1.

19 residential and 2 commercial properties have been recorded as flooded and many other roads, all are detailed in Table 1 above. Reports of flooding have been obtained from a variety of sources including – direct calls to the council, fire services, Yorkshire Water, council area teams, Hull Daily Mail, social media and other media outlets.

Due to the intense and short nature of the storm event attendance at sites for all partners was limited, Area Team staff requested sandbags at Noddle Hill Way and council sandbag supplies were dispatched, Fire Service early responder crews and full fire appliances visited a range of sites listed in Table 1 and pumping was commenced in a range of locations.

No targeted warnings were in force as this was a surface water event, in times of forecasted intense rainfall the EA and Met Office issue Weather Warnings and Flood Guidance Statements, both reports were received by the council at various frequencies leading up to the event and did not indicate a heightened

risk or requirement to mobilise resource, a selection of outputs from the report is highlighted in figure 3 below:

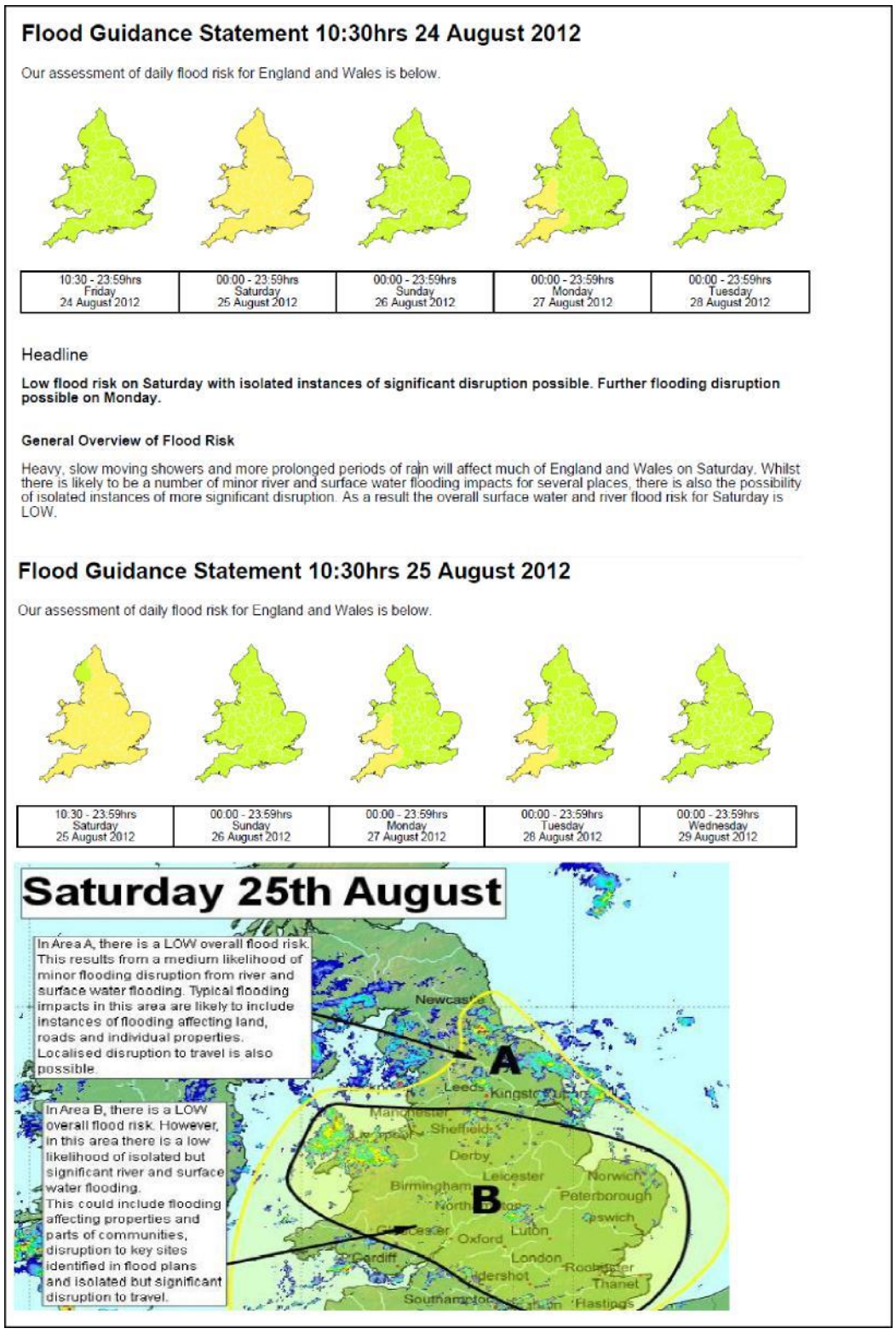

Figure 3 Selected outputs from the EA and Met Office Flood Guidance Statement

2.3 Rainfall Analysis

Rainfall data across the City and the East Riding of Yorkshire is collected at a number of sites across the area, Hull City Council has a rain gauge near the city centre and the East Riding of Yorkshire Council (ERYC) has gauges to the West and Northeast of the city. The 'Weather Underground' web site also has records from a number of privately maintained weather stations in the city.

Weather Station Records are as follows:-

Hull City Council, North Bridge
7.6mm between 14:00 & 15:00 with a maximum intensity of around 12mm/hr over 30 minutes

ERYC, Albion Mills, Willerby
Negligible rainfall

ERYC, Atwick Village Drain
Negligible rainfall

Weather Underground, Boothferry Park
34.3mm between 15:00 & 17:00 with a maximum intensity of approximately 30mm/hr over 50 minutes

Weather Underground, Tranby Lane, East Ella
6.6mm between 15:15 & 16:45 with a maximum intensity of approximately 6.5mm/hr over 50 minutes

Weather Underground, Springbank
14.0mm between 15:00 & 17:00 with a maximum intensity of approximately 15mm/hr over 45 minutes

Weather Underground, Victoria Road, Beverley.
5.1mm between 14:30 & 15:20 with a maximum intensity of approximately 7mm/hr over 30 minutes

Weather Underground, Hedon
30.0mm between 14:35 & 16:20 with a maximum intensity of approximately 90mm/hr over 20 minutes, plus a further 25mm/hr for 20 minutes

Yorkshire Water Analysis
Yorkshire Water have analysed Met Office radar data for 25th August for the Bransholme area, this data shows rainfall intensities ranging from 9.18mm in 55 minutes at the north end of Beverley Road to a maximum of 50.7mm in 35 minutes on Wawne Road, these intensities of rainfall give return periods of 1 in 1.3 years and 1 in 280 years respectively.

The above records show that the showers where localised and torrential in some areas, (thunder and hail was reported). Hull City Councils gauge at North Bridge did not record any out of the ordinary rainfall and the ERYC gauges at Albion Mills, Willerby and Atwick Village Drain both recorded

negligible rainfall, the private weather stations confirmed these records. The highest recorded intensity of rainfall was east of the city; this was confirmed by Yorkshire Waters analysis of the Met Office radar records.

2.4 Drainage Assets

This was a pluvial flood event in all locations, that is to say it was fully attributable to intense rainfall and the ability of the drainage network to receive and convey this rainfall.

In this effect the network of roadside gullies and the receiving network of drains and sewers are the key assets under scrutiny to understand the causes of flooding on the 25th of August 2012. Further details of individual locations are discussed in section 3.

3. Possible Causes

Section 2.3 highlights the localised nature of the intense rainfall, given the short duration and severity of the event it is difficult to definitively separate any problems between receiving infrastructure – road gullies etc – and conveyance infrastructure – highways drains / sewers. In all likelihood no manner of road gulley system would be designed to receive such rainfall volumes.

Once the rainfall is received by the conveying sewers the flows pass by gravity through the system, Yorkshire Water observe levels at their key pumping stations and level monitors around the city and when necessary pump the flows. Telemetry data from Yorkshire Water shows how the pumps in West, East and Bransholme pumping stations were operated. A time delay is experienced between the onset of the rainfall and pumping operations, this is to be expected.

It is suggested that due to the intensity of the rainfall many locations where roads and in some cases properties were flooded the receiving sewers were still ‘filling’ and even if flow monitors triggered pumping operations the localised nature of the rainfall may in some cases have meant that the ‘downstream’ sections of sewer were not running full and pumping would therefore be limited in its effectiveness. It is not until the flows from the area of intense rainfall pass into the downstream section of sewers that effective pumping can take place, this is often seen as a ‘drawdown’ of water level in a location as the pumping operation begins to take effect, some residents around Noddle Hill Way observed a similar phenomenon.

Investigations by Hull City Council have identified locations where we can modify road infrastructure and public realm to manage future surface water issues – Noddle Hill Way and Cotterdale. A list of required investigations was provided to Yorkshire Water and all have been undertaken and a range of de-silting, blockage removal and jetting works have been identified and the majority have been completed.

Location	Investigation Findings
1.Noddle Hill Way, junction Kestrel Avenue	Yorkshire Water found no problems on visual inspection of Noddle Hill Way surface water sewer. Residents reported flooding came from the highway and a low spot on Noddle Hill Way. Further investigations and meetings with residents have highlighted the route of flood waters and a range of capital works are being developed by HCC
2&3.Holwell Road, North point Shopping Centre	All surface water sewers in area checked by Yorkshire Water, no signs of blockages, private gullies and drains in area in poor condition, recommendation to be made to shopping centre management for preventative maintenance.
4. Edendale	Yorkshire Water inspection of surface water sewer in Nidderdale and problems identified, silt removed
5. Coverdale/Cotterdale	Yorkshire Water inspection carried out on surface water sewer in Nidderdale and problems identified, minor silt removed from Cotterdale surface water sewer and soft blockage cleared from foul sewer. HCC developing a capital scheme to manage a flood flow route identified along the footpath network, drainage and storage will be installed and a new connection to the surface water sewer
6. Bisley Grove	Large metal tube and tree roots identified in surface water sewer, man entry and jetting carried out to remove blockages, sewer now clear
7. Bransholme Pumping Station	Operated following standard telemetry triggers, records highlight an intermittent failure of one of the pumps. This was rectified quickly on each occasion and it is not expected to have had any detrimental influence on the operation of the sewerage network in this event
8,9&10 Stockholm Road	No blockages identified
11. Copenhagen Road	No blockages identified
0. Sutton Road,Jct with Holwell Road	Yorkshire Water visual inspection indicates no problems
1. Sutton Fields Branch Sewer and East Hull PS	No indications of any issues on branch Sewer and East Hull pumping station operated following standard telemetry triggers
12. Garrick Close	Yorkshire Water cctv survey revealed a broken pipe in combined sewer on Fortune Close that Garrick Close feeds into, sewer flowing ok and dig job to be done
13. Corona Drive	Combined sewer on Corona Drive checked and

	no problems identified, good flow in sewer indicates no problems with Sutton road sewer. 10 foot at the rear of the properties has only one gully serving it, gully appears to be blocked up, HCC to work with residents to rectify blocked gully
16. Ullswater Drive	Combined sewer checked and CCTV inspection, no problems found
17. Lowgate	Partial Blockage found on combined sewer and work raised to clear
18. East Hull Northern trunk sewer and East Hull PS	No indications of any issues on branch Sewer and East Hull pumping station operated following standard telemetry triggers
19,20&21 Malham Avenue, Kendal Way, Hawkshead Green	A number of fat and silt blockages identified, some cleaning work has already taken place and further cleaning work ongoing, further inspections of trunk sewer may be necessary
22. Foster Street	Combined sewer inspected at junction with Stoneferry Road, minor silt identified but sewer operational, Yorkshire Water flushed the sewer as a precaution
23. Princes Avenue	Yorkshire Water repeated jetting has taken place here to remove fat blockages from the sewer system, sewer now clear but to be monitored for fat
24. Calvert Lane	Yorkshire Water jetter van visited and identified a blocked private gully, problem reported to resident
25. West Hull PS	West Hull pumping station operated following standard telemetry triggers

Table 2 – Survey and investigations from all partner organisations

4. Roles and Responsibilities

4.1 Lead Local Flood Authority

Hull City Council is defined as a Lead Local Flood Authority in the FWMA, main responsibilities: flooding from surface runoff, groundwater and ordinary watercourses, permissive powers to maintain none Main Rivers, development of a Local Flood Risk Strategy, Asset Plans and Investigations.

The council received advance weather warnings for the 25th August 2012 event as detailed in section 2.2, the warnings showed a limited risk and no special preparations were made because of this.

A new call handling system went live on the evening of the 24th August, all none essential out of hours calls are now managed by Kingston Communications, this system of working was originally due to be implemented

earlier in 2012 but to ensure it was carefully mapped out and implemented at a quieter time it was delayed. The August Bank Holiday weekend was seen as a safe time to initiate the new approach.

Following the onset of rainfall on the 25th the Kcom call centre handled 334 calls. A lot of the calls on Saturday evening, Sunday and Monday were repeat callers ringing back for an update.

Kcom liaised with Civic 1, due to the volume of calls Kcom rang them through in batches. On site council officers supported Kcom during this time giving constant feedback on the situation as it was happening.

The flood investigation has highlighted that residents across the impacted sites found contact with the council protracted and difficult at times, the transfer of call centre responsibilities was scheduled for a potentially quiet time and the intensity of the rainfall experienced would not be seen as a foreseeable risk. The out of hours arrangements are intended to shield Civic 1 from reoccurring none emergency calls such as housing repairs, dog fouling etc, on the 25th August due to the newness of the system the issues around flash flooding were difficult to assess but the liaison between Kcom and Civic 1 initiated a workable approach on the day, this inevitably led to some delays in response and some interviewed officers confirmed that this was the case.

Discussions with call centre managers have shown that the process is now well bedded in and the likelihood of similar issues occurring are minimal, a review of the scripts and processes used around flood risk is required and this will be a recommendation in Section 5 of this report.

Flood risk management schemes are being developed for Cotterdale and Noddle Hill Way in line with the councils role as a Lead Local Flood Authority and a responsibility to manage surface water flooding, a recommendation in Section 5 is made to deliver schemes in these locations.

4.2 Environment Agency

Key responsibilities are: flooding from main rivers, the sea and reservoirs including coastal erosion risk management, permissive powers to maintain Main Rivers, Strategic Overview over all forms of flooding and development of a National Flood Risk Strategy.

Due to the event being a surface water / pluvial event the Environment Agency have no formal operational role in the management of the events of 25th August 2012. The Environment Agency's role with regard to forecasting is via Flood Guidance Statements and discussions with partners emergency planning officers, due to the difficulty in predicting the exact locations of intense events and the likelihood of surface water flooding the Agency can only advise and these issues are often discussed with partner organisations.

Work to develop warnings for surface water and pluvial flooding is being undertaken by the Agency, this will be a difficult process to deliver with any

degree of certainty but is a key requirement, this is included as a recommended action in Section 5.

4.3 Water and Sewage Company

Yorkshire Water Services are the water and sewage company covering Hull City Council and the surrounding catchment area, their key responsibilities include: managing the risks of flooding from water supply, surface and foul or combined sewer systems, working with developers and landowners to reduce the input of rainfall into sewers through the use of storage, source control and SuDS.

Yorkshire Water responded in a range of areas across the city during and after the event, their infrastructure and pumped drainage network was operated and as highlighted in Section 3 it worked as designed although it may have had limited effectiveness due to the isolated and intense nature of much of the rainfall before the system became fully ‘surcharged’.

The table 2 in Section 3 highlights a range of investigations, surveys and redemptive works carried out in response to a formal Section 19 request by Hull City Council. Where defects or blockages were found it is not considered that they were solely responsible for the issues experienced, in many cases flooding was experienced soon after the onset of rainfall and the intensity of the storm was the key cause in many cases.

Yorkshire Water continue to be involved in the Hawkshead Green area, a local residents group are pushing for further survey and works as required by Yorkshire Water, several jetting and cleansing operations have taken place and the effectiveness of the local system will now be optimised but residents observations suggest wider problems in the branch sewer network. Hull City Council are in regular contact with residents and are supportive of Yorkshire Water carrying out further work as required, this will be a recommendation in Section 5.

Communications with Yorkshire Water have been questioned by a range of residents, many reported the need for frequent call backs and delayed responses to calls. Yorkshire Water confirmed that they have reviewed call handling procedures and will implement improvements, a recommendation is made in Section 5 to ensure that this is in place.

4.4 Highways Authority

The localised nature of the flooding on the 25th August meant that the highways affected were none arterial roads and are the network managed by the council, key responsibilities are: providing and managing highway drainage and roadside ditches under the Highways Act 1980.

The intensity and severity of the storm overwhelmed many roadside drains and gullies, a risk based clearance regime is in place to ensure that roadside gulley pots are fully operational. Several site investigations have shown that

the vast majority of gullies were clear and Yorkshire Water investigations have similarly confirmed this. The storm intensity was greater than the design standards of much of the highway drainage infrastructure.

In some locations improvements are being developed by council flood risk management staff which include adaptation of and improvements to the highway drainage infrastructure – Cotterdale and Noddle Hill Way deal with the lack of footpath drainage provision and increased highway drainage provision at a low spot in the road respectively. The council as a Lead Local Flood Authority is developing both schemes – see section 4.1.

4.5 Residents

Residents are encouraged to understand the flood risk in their local area and have a flood plan to steer their response in times of flooding. Actions such as placement of sandbags, moving valuable items to a safe place and semi / permanent measures such as installation of floodgates, airbrick covers etc are encouraged to reduce the consequences of flooding at a property level.

It is recommended that residents sign up to appropriate warnings for their area and keep contact details upto date and act upon all warnings appropriately. When flooding does occur residents are encouraged to document as much information as possible to aid the investigations of all operating authorities and to provide information to their loss adjusters and insurers.

The event was surface water / pluvial in nature and due to this no formal warnings exist, the event took many by surprise due to its ‘un-seasonal’ nature – intense rain and hailstones during the August Bank Holiday are not seen as the norm. Many residents are prepared to take action and evidence has been seen of self- help and installations of airbrick covers etc, others looked to the council to respond.

Due to the problems in communicating with the council and Yorkshire Water and the unexpected nature of the rainfall many may not have been able to respond in time. A recommendation is made in Section 5 for the council to liaise with residents to highlight the potential risks of surface water flooding and to develop ways in which residents and communities can be more resilient.

5. Recommendations

The investigation has concluded that the main cause of the flooding on the 25th August 2012 was the intensity and localised nature of the rainfall, many areas experienced significant rainfall volumes and hailstones which served to show the 'un-seasonal' nature of the event.

The main operating authorise involved are Hull City Council in its Lead Local Flood Authority role and Yorkshire Water Services, investigations by both have led to a range of remediation measures and planned interventions.

Operating Authority / Stakeholder	Recommended Actions
Hull City Council	Review and update as necessary all flood risk management scripts and procedures used by Kingston Communications and Civic 1
Hull City Council	Delivery of surface water flood alleviation schemes at Cotterdale and Noddle Hill Way
Yorkshire Water	Resolution of problems at Hawkshead Green area in full coordination with the council
Yorkshire Water	Update of customer contact improvements to be discussed with the council and any further recommendations to be implemented as appropriate
Environment Agency	The surface water / pluvial nature of the event highlights the lack of warning from this flood source, all sources warnings are being developed by the Environment Agency, Hull City Council recommends that this is delivered as soon as practicable and welcomes any involvement in the delivery of the approach
Hull City Council	Communication with residents to enable a greater understanding of the risk of surface water flooding and the ways in which residents and communities can be better prepare and more resilient to flood risks

Table 3 – Recommendations

6. Conclusion

The intense rainfall of 25th August 2012 was in excess of the levels identified in the Flood Guidance Statement, residents and operating authorities were not prepared for what was extremely un-seasonal weather for the August Bank Holiday.

Extensive road and isolated property flooding occurred, all operating authorities responded and all infrastructure worked as designed, however, due to the storm intensity many areas were affected shortly after the onset of rainfall and before the receiving infrastructure accepted flows. Residents reported delays in communications with partners and a range of issues with regard to the implementation of new call management procedures has been identified, procedures are in place to avoid further issues.

The pure intensity of rainfall is identified as the main causal effect of problems on the 25th August 2012.

A range of remediation measures have been carried out by partners and others are being developed, recommendations for their delivery and continued improvements in forecasting, warning and communications have been made.

Abbreviations / Acronyms

EA Environment Agency
HCC Hull City Council
FIR Flood Investigation Report
FWMA Flood and Water Management Act 2010
LDA Land Drainage Act 1991
LLFA Lead Local Flood Authority
WRA Water Resources Act 1991

Useful Links and Contacts

Useful Contacts and Links

Environment Agency
General Enquiries 08708 506 506 (Mon-Fri, 8am - 6pm)
Incident Hotline 0800 80 70 60 (24hrs)

Lead Local Flood Authority
Hull City Council
General Enquiries (emergency calls handled via this number) 01482 300 300

Water and Sewage Operator
Yorkshire Water 0845 1 24 24 24

Flood and Water Management Act 2010:
http://www.legislation.gov.uk/ukpga/2010/29/contents

Highways Act 1980:
http://www.legislation.gov.uk/ukpga/1980/66/contents

Water Resources Act 1991:
http://www.legislation.gov.uk/ukpga/1991/57/contents

Land Drainage Act 1991:
http://www.legislation.gov.uk/ukpga/1991/59/contents

EA - 'Living on the Edge' a guide to the rights and responsibilities of river side occupation:
http://www.environment-agency.gov.uk/homeandleisure/floods/31626.aspx

EA - River and Coastal Maintenance Programmes:
http://www.environment-agency.gov.uk/homeandleisure/floods/109548.aspx

EA - Prepare your Property for Flooding:
How to reduce flood damage
Flood protection products and services
http://www.environment-agency.gov.uk/homeandleisure/floods/31644.aspx