

Flood Investigation Report

Harrogate – Greenfields Avenue



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Records of the public sewer system included are a facsimile of the statutory record provided by Yorkshire Water Services Ltd. For the purposes of this report minor sewers and other non-relevant data have been omitted from the plans for clarity.

Purpose

This document has been prepared specifically for the purpose of meeting the requirements of Section 19 of the Flood and Water Management Act 2010.

The purpose of this report is to investigate which Risk Management Authorities (RMAs) had relevant flood risk management functions during the flooding incident, and whether the relevant RMAs have exercised, or propose to exercise, their risk management functions (as per section 19(1) of the Flood and Water Management Act 2010). It does not address wider issues beyond that remit, nor include recommendations for future actions.

The supporting data has been put together based on records of internal property flooding and road closure information from a variety of sources. While every effort has been made to verify the locations of the Section 19s identified, the nature of the data and the methods used to collate this information mean that it does not include

every occurrence of flooding. This data only identifies where flooding has been reported and is indicative only.

Acknowledgements

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The Environment Agency

Yorkshire Water Services Ltd

Harrogate Borough Council

Site Inspection:

Thursday 8th September 2016

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1 Executive Summary

On the 26th of December 2015, heavy rainfall following Storm Eva inundated a number of residential properties in the Greenfields Avenue area of Harrogate.

Widespread and substantial rainfall had fallen over West and North Yorkshire in late December 2015. In this event, rainfall in the middle reaches of the catchment was proportionately more significant than that over the Pennines, and this pattern of rainfall had particular consequences for communities in the Mid and Lower Nidd Catchment.

It had already been very wet for an extended period of time, data shows that in the Nidd catchment, November 2015 was the third wettest since 1909 and the Nidd catchments had also received up to 1.87 times the long term average rainfall for December before the rain started to fall again on Christmas Day and Boxing Day.

In total five residential properties in the area Greenfields Avenue, Prospect Close and Hookstone Grange Way reported internal flooding.

The risk of flooding at this location was known due to previous historic incidents which had been experienced and investigated by various RMA's.

NYCC Highways are working with local riparian owners to desilt the culvert under Greenfields Avenue, and stretches upstream and downstream, to improve capacity and conveyance.

The residential properties have been provided with assistance from the government Resilience and Repair Grants.

2 Introduction

2.1 Flood and Water Management Act (2010)

In his review of the summer 2007 floods, Sir Michael Pitt recommended that local authorities should be given a duty to investigate flooding.

The Flood and Water Management Act 2010 (FWMA), defines the roles and responsibilities of 'Risk Management Authorities' and designates the unitary or upper tier authority for an area as Lead Local Flood Authority (LLFA).

The LLFA has responsibility for leading and co-ordinating local flood risk management. Local flood risk is defined as the risk of flooding from surface water runoff, groundwater and small ditches and watercourses (collectively known as ordinary watercourses). The responsibility to lead and co-ordinate the management of tidal and fluvial flood risk remains that of the Environment Agency (EA).

The Act also implements the recommendations made by Sir Michael Pitt that local authorities should have a duty to investigate flooding from all sources.

2.2 Section 19 Investigation Requirement

North Yorkshire County Council (NYCC), as LLFA, has a responsibility under Section 19 of the FWMA to investigate significant flood incidents in its area. Section 19 States:

(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.

Section 14 of the FWMA grants the LLFA power to request information associated with its functions. These powers have been exercised in the preparation of this report.

2.3 Trigger for Section 19 Report

The incident has been assessed in line with the criteria set out in Section 3 of the North Yorkshire County Council Local Flood Risk Strategy (2015) and has been judged to warrant a formal Section 19 investigation on the basis of:

- Number of properties internally flooded
- The depth, area or velocity of flooding reported
- The frequency of flooding
- The nature and extent of critical infrastructure impacted by the flood

2.4 Location

Greenfields Avenue, Harrogate is a residential area within the district of Starbeck in the Harrogate Borough Council authority area, in the county of North Yorkshire. Starbeck has a population of approximately 6,000¹. Greenfields Avenue (grid reference: SE 32897 5525) is located 2.8km east of the centre of Harrogate and 2km south west of Knaresborough as shown in Figure 2.1.

Greenfields Avenue, Harrogate is situated in the Mid and Lower Nidd Catchment².

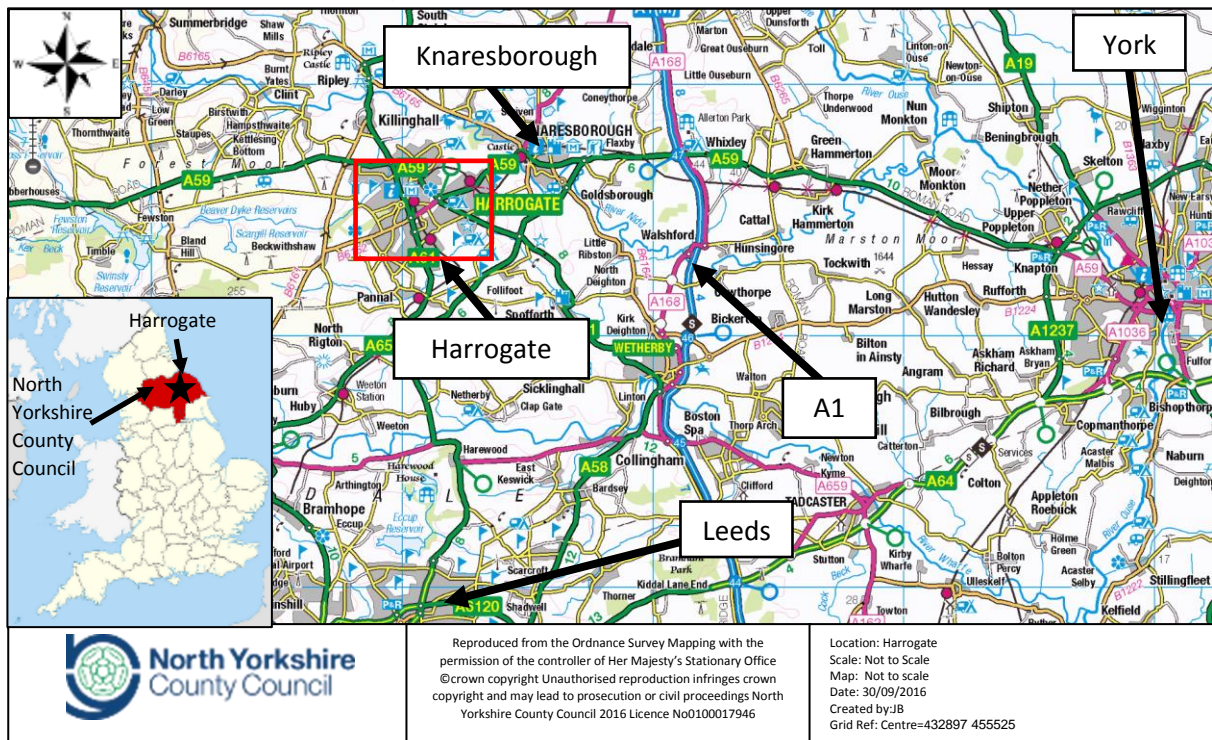


Figure 2.1 Greenfields Avenue, Harrogate location map (Source: NYCC)

In the vicinity of Greenfields Avenue five properties were affected by flooding in December 2015³. Key locations are shown in Figure 2.2.

¹ Census 2011

² Catchment and Data Explorer, Environment Agency

³ Reports of Flooding Map, NYCC

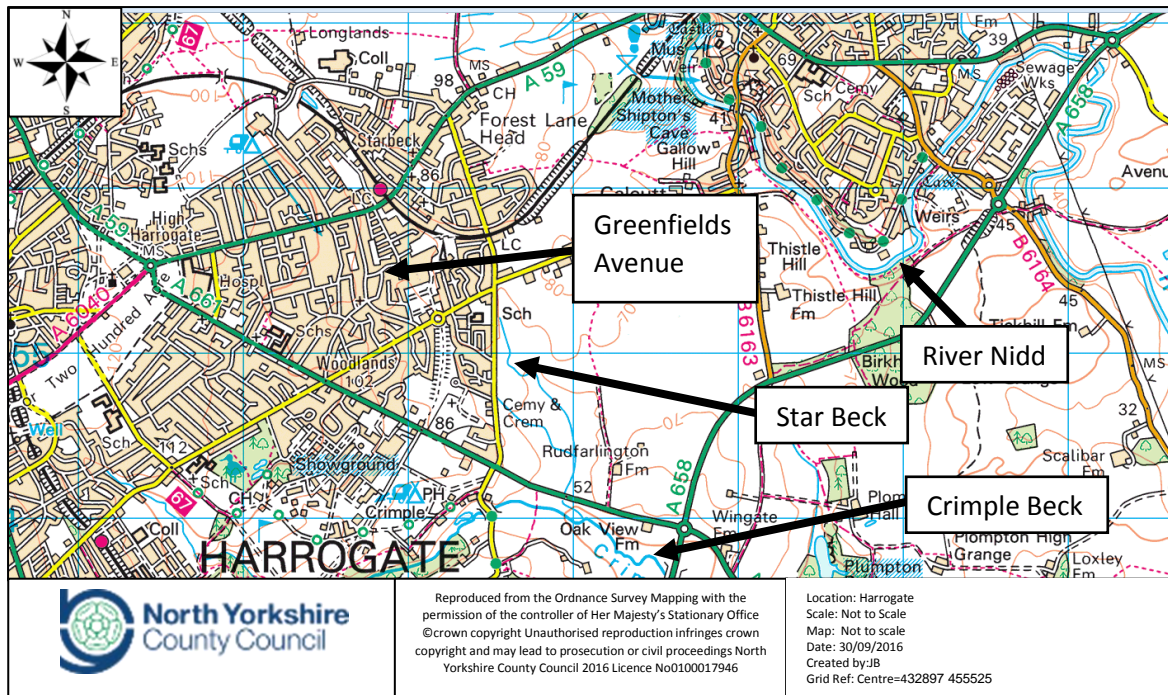


Figure 2.2 Greenfields Avenue, Harrogate local map (Source: NYCC)

2.5 Topography

Greenfields Avenue is situated in a relatively flat area of land at approximately 100m above sea level. The prevailing gradient of the land falls from northwest to south east⁴.

Though there are no major rivers in the location, the area takes its name from a local watercourse, Star Beck, which is a tributary of Crimple Beck.

Crimple Beck follows a widely meandering route, before discharging to the River Nidd over 9 km downstream, away to the west of the A1 near Walshford.

Starbeck railway station is nearby, and Star Beck flows in culvert following the route of the railway over part of its length, before emerging in an open channel.

OS mapping shows there are a series of watercourses which are mostly below ground, with only short sections of open channel. Many of these have become lost beneath housing and industrial development in the area⁵.

Greenfields Avenue is approximately 300m from where Star Beck is open channel on the eastern side of the railway.

⁴ OS Maps

⁵ Historical Maps



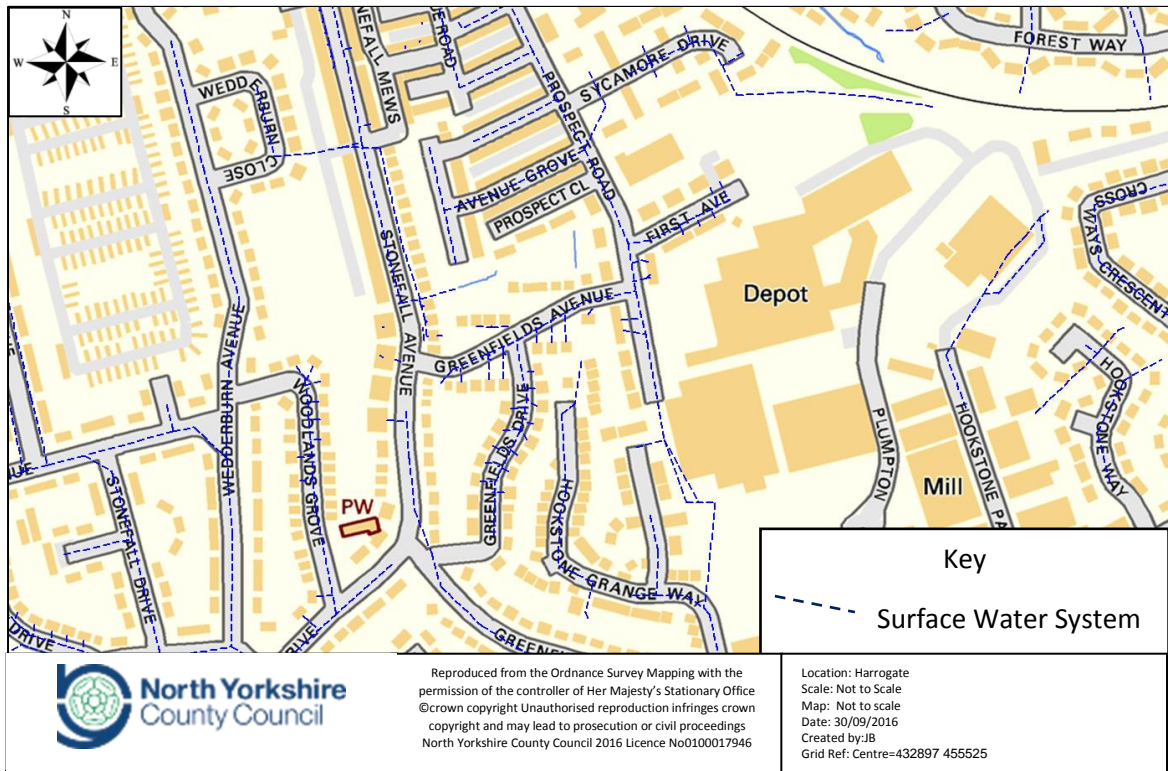
Figure 2.3 Photograph of Greenfields Avenue

2.6 Highway gullies

Highway gullies are present in Greenfields Avenue, Prospect Road and Hookstone Grange Way. They are thought to connect into the public surface water sewer system. Investigations have however identified where the watercourse is piped beneath the highway in Greenfields Avenue⁶.

2.7 Public sewers

Sewer records from Yorkshire Water Services Ltd (YWSL) show that areas around Greenfield Avenue are served by both a combined and a surface water sewer system⁷ as shown in Figure 2.4 and 2.5.



⁶ NYCC investigation
⁷ YWSL Sewer Map

Figure 2.4 Surface water sewer network Greenfields Avenue

Combined flows from this area are conveyed in a south easterly direction towards Wetherby Road. It has not been possible to determine where combined flows from this area are treated.

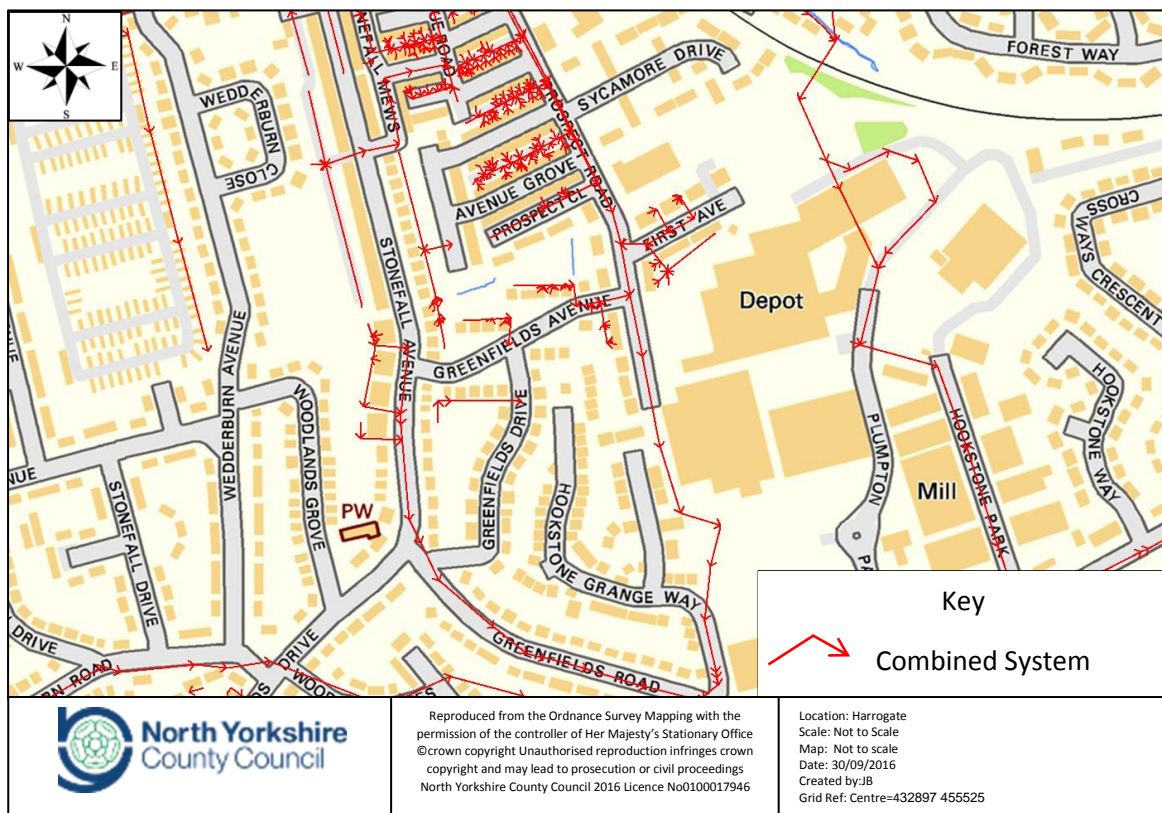


Figure 2.5 Combined sewer network Greenfields Avenue

2.8 Watercourses

OS mapping shows a short section of open watercourse between Greenfield Avenue and Prospect Close (Section C), as shown in Figure 2.6, and further section in the gardens in Greenfield Avenue (Section A).

The watercourse appears to have been culverted along the southern edge of a footpath providing pedestrian access to the properties on Prospect Close (Section B). Discussion with one resident revealed that they had observed the culvert when a neighbour had recently carried out works. It is therefore assumed that there is a continuous section of watercourse present.

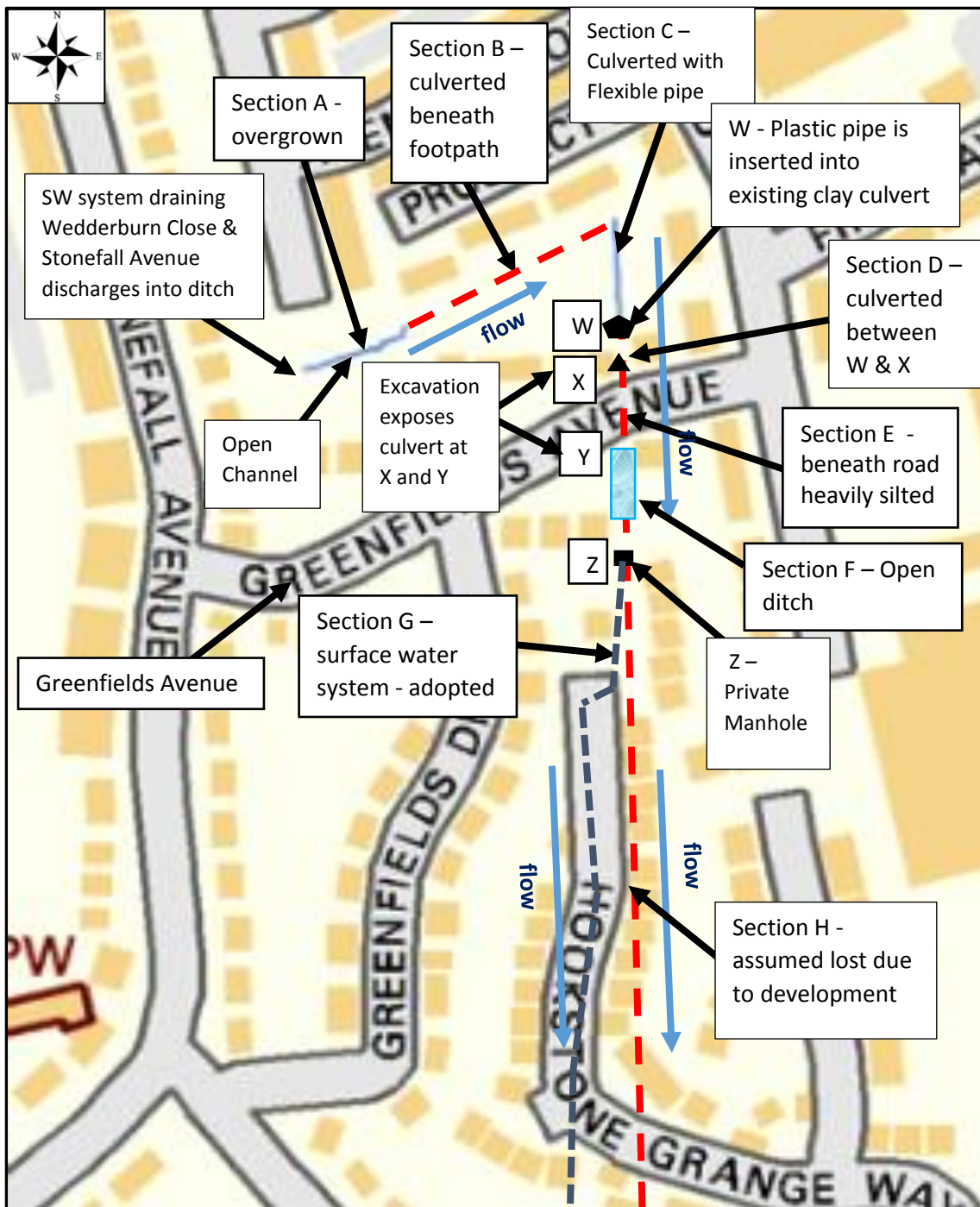


Figure 2.6 Assumed Culvert Route Greenfields Avenue

Along the assumed line of the culvert (Section B) there are a number of large trees and various fences have been constructed. This indicates that the route of the culvert could be blocked or damaged due to tree root ingress and other works. There have, however been no reports of water backing up and flooding on section A, which would indicate that this section at least, has a relatively clear outfall, and the restriction is further downstream.



Figure 2.7 Flexible piped culvert

Previous investigations by NYCC have revealed that the culvert turns sharply though 90 degrees at the bottom of the gardens of Greenfield Avenue.

At this point the watercourse has been piped in with a part buried plastic flexible pipe of approximately 450mm diameter (Section C). This butts up to the existing culvert and it is believed that this is the point at which flood water has, in the past, surcharged out into the neighbouring gardens and house.

From here the culvert continues south towards Greenfields Avenue (Section D). Excavation has been undertaken by highways North Yorkshire within the curtilage of the property to locate the culvert before it passes beneath the road at Greenfields Avenue (Section E). Investigations have shown the culvert beneath the road to be heavily silted up and capacity is significantly compromised. However, this is because the downstream open ditch has not been cleared sufficiently for the upstream sections to drain and hence remain clear of silt.



Figure 2.8 Connection between flexible pipe and culvert at 35 Greenfields Avenue

Excavations have also been carried out within gardens south of Greenfields Avenue, where the culvert appears to join a heavily silted and partly flagged-over ditch, which continues at the foot of the hedge on the eastern side of the boundary of the property (Section F).

A manhole and length of concrete culvert was constructed on the line of the existing watercourse, as part of the development of Hookstone Grange Road in 1993. This runs from the boundary of the garden of No 30 Greenfields Avenue to the head of the Yorkshire Water public sewer system in Hookstone Grange Road (see Figure 2.9).



Figure 2.9 View upstream from Manhole at Hookstone Grange Way

A review of historic maps has revealed the presence of an open drainage ditch along the route of the culvert described above.

In a map from 1907 there are field boundaries which could indicate the presence of a drainage ditch. In a map from 1938 there is a ditch shown along this route. In a map from 1952 there is a watercourse shown in blue along Sections C, D, E, F & H. This appears to discharge into Rud Beck at Greenfields Road.

3 Flood Events

The flood event occurred on Boxing Day 2015 caused by an extremely high rainfall, resulting in extensive flooding that had the largest impact in Yorkshire.

3.1 Rainfall data

3.1.1 Meteorological Conditions

The rainfall event was characterised by two distinct rainfall systems. The first rainfall system was Storm Eva which brought high winds and a band of rain which spread across the country on the 23rd & 24th December 2015. The second system was a slow moving low pressure system and warm frontal zone, moving across the region from the west, on the 25th and 26th of December. The rainfall which caused the flooding was brought on by the weaker second low pressure system.

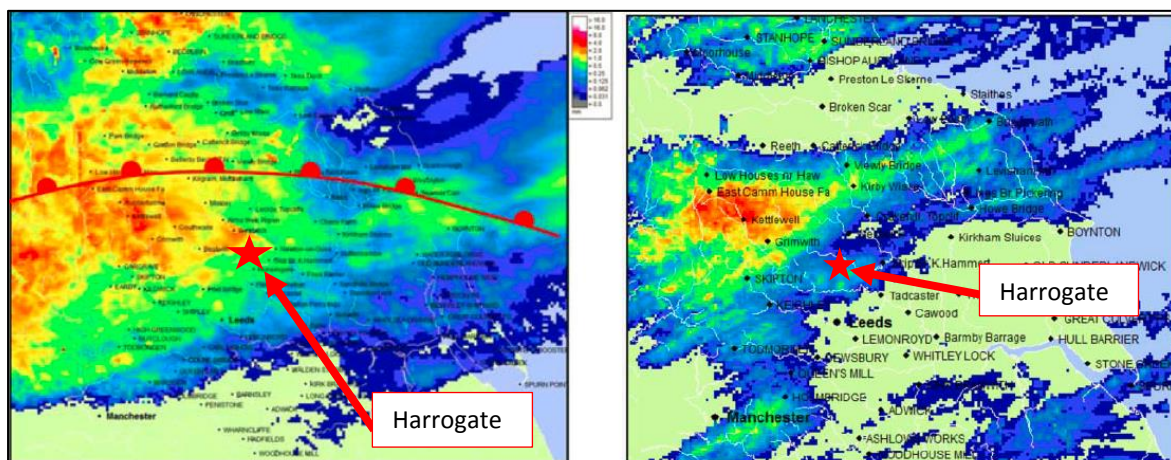


Figure 3.1 Radar image with overlaid front as of 18:00 on 25th December 2015 (left) and 01:00 on 26th December 2015 (Right) Copyright Meteorological Office

A warm frontal zone passed over the UK during the morning of 25th December, bringing scattered showers with it, and by midday there was a blanket of rainfall covering Yorkshire. During the evening of the 25th December an occluded front had set over the north west and north east and it was this front which produced the more intense storms.

There were two main pulses of heavy rainfall within 48 hours that led to the flooding experienced over North Yorkshire, in the Nidd Catchment between 58-97% of December's Long Term Average (LTA) rainfall fell in 48 hours.

The first pulse occurred once the occluded front had formed during Christmas Day afternoon and evening. The second pulse occurred in the early morning of Boxing Day. The two main pulses of heavy rainfall were mainly confined to the upper catchment of rivers Aire, Calder, Wharfe and Swale.

3.1.2 Antecedent conditions

A data set from the National Climate Information Centre (NCIC) shows that in November 2015 the Nidd Catchment had its third wettest November since 1909. It reached 230% of its long term average (LTA), which is equivalent to 2.3 times the LTA for November. This indicates that the ground was already saturated from rainfall

in November, prior to the exceptionally wet December 2015. In addition the Nidd catchments received more than the December LTA rainfall before the rain fell on Christmas Day and Boxing Day.

Catchment	Ranking of November 2015 in Rainfall Total Wettest since 1909	November 2015 rainfall as a % of the LTA
Yorkshire area	5	191 %
Nidd	3	230 %

Table 3.1 NCIC ranked rainfall totals wettest since 1909 and percentage of LTA

Soil Moisture deficit is a measure that indicates the dryness of a catchment. According to the EA its modelled Soil Moisture Deficit (SMD) was indicating that the soil in the Nidd catchment area had zero available storage at the beginning of October. The nature of the rainfall ensured that the ground remained fully saturated leading up to Christmas 2015.

3.1.3 Harrogate Rainfall Event

YWSL has provided rainfall data in the Harrogate area. This data shows that peak rainfall fell on Boxing Day producing a rainfall depth of 29.79mm in 10:25 hours, and a second lower peak on Christmas Day of 20.4mm in 09:35 hours.

Environment Agency tipping bucket rain gauge (TBR) rainfall data has been provided for Scargill. The rainfall data is illustrated in Figure 3.2. The data from the TBR shows two rainfall events, one on the 25th and the other on 26th of December 2015⁸. The rainfall event on the 25th started at 12:00 and finished at 23:30. The rainfall event on the 26th started at 00:45 and finished at 13:00 reaching a peak at 06:45.

Comparison of the data from Scargill with rainfall radar data from YWSL shows a good match.

⁸ Hydrometric Data, Environment Agency

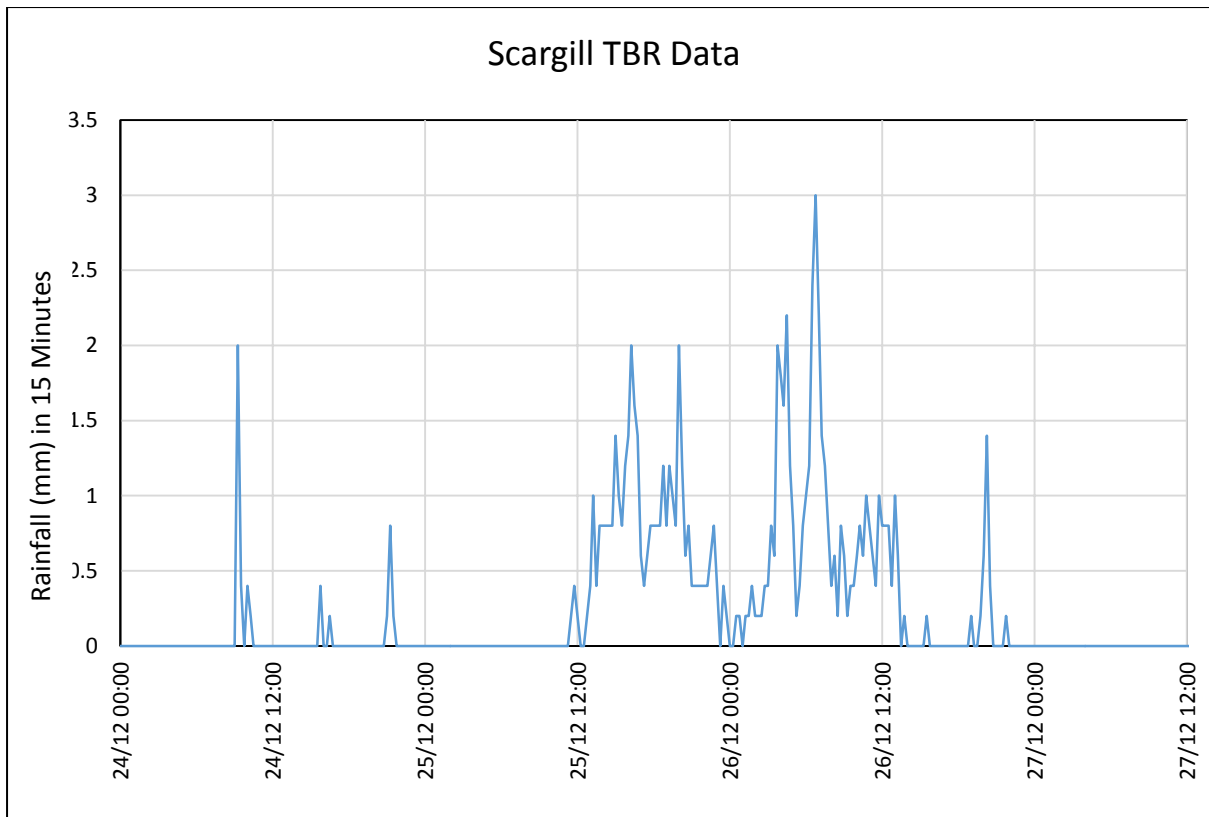


Figure 3.2 TBR data from Scargill (Source: EA)

3.2 Description of events

On Boxing Day 2015 flow escaped from the downstream end of the plastic flexible pipe in the garden properties on Greenfields Avenue and caused extensive flooding to the garden and the house.

On the opposite side of the road water ponded along the hedge bottom on the boundary of 30 Greenfields Avenue. From here, flood water overflowed to both the south and east, to cause flooding to properties on Hookstone Grange Road and Prospect Road.



Figure 3.4 Photograph of flooding at Greenfields Avenue

The investigation undertaken has identified that there is a watercourse or drain which has become progressively culverted in the location, as development has occurred.

This has meant that the number of riparian owners along its length has increased with time. From the small sections of culvert that have been accessed it is evident that the culvert is heavily silted. It is also apparent that development in the area has restricted or blocked the course of the culvert.

There are sections of the surface water system collecting flows from Wedderburn Close and Stonefall Avenue that discharge to the open ditch (section A) in the watercourse. It has not been possible to gain access to this section of open watercourse due to the significant vegetation growth.

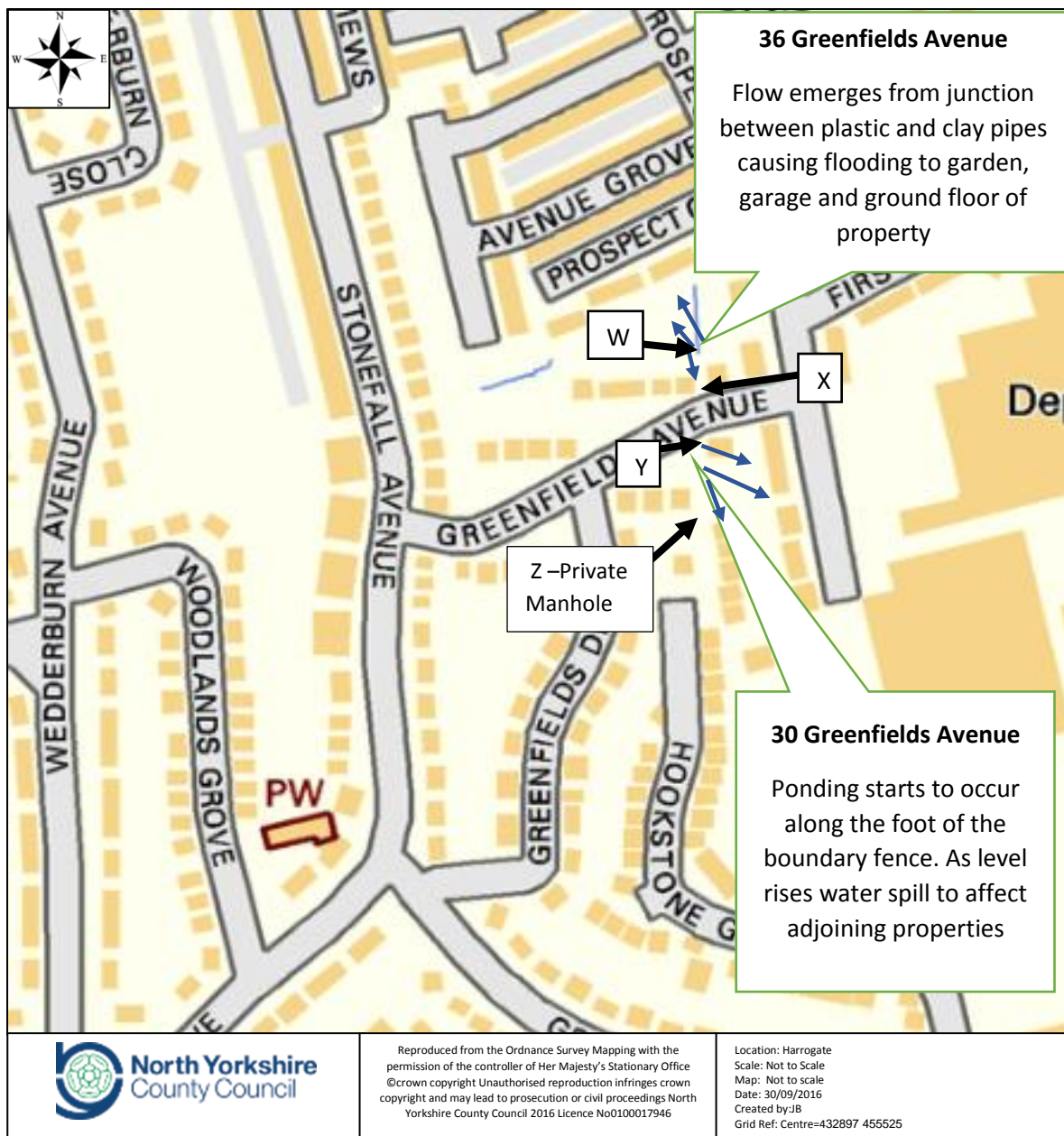


Figure 3.5 Plan showing flooding mechanisms at Greenfields Avenue

The extent of large trees and the erection of fences along Section B indicates that there may be sections of the culvert in poor condition, It is also possible that these are heavily silted.

There are no points of access to allow the culvert to be assessed or maintained. In addition, the sharp bend between Section B and C creates a restriction particularly at times of high flow.

The flexible pipe along Section C is partially buried along the line of the former open channel. The diameter of the pipe is approximately 450mm. It is poorly connected at each end and does not allow access to the culvert for inspection or maintenance.

At the downstream end, the plastic is inserted into the existing clay pipe. This is referred to as point “W” on Figure 3.5. It is reported that this is the location where flooding started, with water spreading across the garden and affecting the garage and ground floor of the property.

The watercourse is culverted between W and X within the property. Point X reflects where the top of the culvert has been broken by NYCC Highways to locate its position and to create an entry point for a CCTV camera.

Another excavation was made at point Y within the boundary of 30 Greenfields Avenue. This was also to locate the culvert and to create an entry point for a CCTV camera. Unfortunately a CCTV survey could not be carried out as the culvert was heavily silted. Plans are underway for this culvert to be desilted in order to complete the proposed CCTV survey.

Section F is not culverted, but is a heavily silted section of open ditch which runs at the foot of the boundary hedge at 30 Greenfields Avenue. In December 2015, flood water ponded in the garden along the line of the ditch. As the level rose, the water over spilled the boundaries on the east and south, to flood adjacent properties on Prospect Road and at the head of Hookstone Grange Way respectively.

At location Z in Figure 3.5 a manhole was constructed on the approximate line of the culverted watercourse as part of the housing development on Hookstone Grange Way. The section of the culvert between the boundary hedge and the manhole has been reconstructed. There is however, no formal connection created at the boundary as the old and new sit side by side. A CCTV survey has been carried out and the findings are shown in Figure 2.6 earlier in the report.

Downstream of the manhole, Section G represents a newer surface water system, which is shown by records to have a diameter of 375mm. The sewer is adopted by YWSL from the manhole downstream. It appears that Section H of the culverted watercourse has been lost, through new development on Prospect Road and Hookstone Grange Road.

The investigation has identified that there is a watercourse which has become progressively culverted as development has occurred with the Greenfields Avenue area of Harrogate. This has meant that the number of riparian land owners along its length has increased with time. It is possible that these land owners are not aware of the culvert and the responsibilities they have in respect of it.

From the small sections of culvert that have been accessed, it is evident that the culvert is heavily silted. It is also apparent that maintenance of the watercourse has not been carried out.

As no details of a single landowner have been identified it is suggested that there are multiple riparian owners along the length of the watercourse. The only exception to this is the section that passes beneath Greenfields Avenue, which can be considered the responsibility of NYCC in its capacity as highway authority.

There are two sections of the watercourse remaining in open channel. Access to the length behind numbers 1 to 13 Greenfields Avenue was not however possible due to significant vegetation along its length.

The section of culvert in No 35 Greenfields is a flexible pipe that has been joined to the existing upstream and downstream culverts.

The second open section to the south of Greenfields Avenue had been flagged over in places and had become severely silted up. So much so that the current house owner was unaware of its existence. Since the 2015 event significant material has been removed by the landowner, opening up the channel and restoring the flow path. At the time of writing this, work is ongoing in partnership with NYCC Highways and other neighbouring property owners to ensure the system can function the best it can.

The construction of the manhole on Hookstone Grange Way and the length of concrete culvert provides an outfall for this whole system into the 375mm diameter YWSL surface water sewer which appears to have replaced the original watercourse/culvert through development.

A historic drainage route has been culverted to enable development to take place. The culverting process has not made provision for access and maintenance so the presence of the culvert has been forgotten. It is expected, but not known, that the culverts are in poor condition. Evidence has been found that they are heavily silted in places and where modifications have occurred these have been poorly done. The lack of maintenance and the poor quality of works along the watercourse have resulted in the accumulation of silt and the creation of restrictions to the flow which has resulted in water emerging from the culvert and causing surface water flow. The maintenance requirements of this whole system, like many private urban drainage systems, require a cooperative effort from a number of individual home owners, as well as risk management authorities.

4 Risk Management Roles, Responsibilities and Actions

4.1 RMA Responsibilities

4.1.1 Environment Agency

Under the FWMA the Environment Agency (EA) has a strategic overview role for all sources of flooding as well as an operational role in managing flood risk from Main Rivers, reservoirs and the sea. As part of this role the EA have developed a National Flood and Coastal Erosion Risk Management Strategy for England – ‘Understanding the Risks, Empowering Communities, Building Resilience.’

This national strategy outlines the EA’s strategic functions as:

- Ensuring that flood risk management plans (FRMPs) are in place and are monitored to assess progress. The plans will set out high-level current and future risk management measures across the catchment.
- Publishing and regularly updating its programme for implementing new risk management schemes and maintaining existing assets.
- Supporting risk management authorities’ understanding of local flood risk by commissioning studies and sharing information and data.
- Supporting the development of local plans and ensuring their consistency with strategic plans.
- Managing and supporting Regional Flood and Coastal Committees and allocating funding.

The EA’s operational functions are/include:

- Risk-based management of flooding from main rivers including permissive powers to do works including building flood defences,
- Regulation of works in main rivers through the consenting process,
- Regulation of reservoirs with a capacity exceeding 10,000m³,
- Provision of a flood forecasting and warnings service, working with the Met Office Hazard Warning Service,
- The maintenance and operational management of Main River assets including flood defences,
- Statutory consultee to the development planning process,
- The power to serve notice on any person or body requiring them to carry out necessary works to maintain the flow in Main Rivers.

‘Main Rivers’ are defined through an agreed map which is updated 2-3 times per year to reflect changes in the designation of a watercourse or in the environment.

These Main Rivers tend to be the larger rivers in the country, though some smaller watercourses in sensitive locations are also defined as 'Main Rivers'.

The EA is also a category 1 responders regarding flood risk (Civil Contingencies Act 2004). They are required to warn and inform of flood risk.

4.1.2 Water Company

Water companies in England and Wales are named as a Risk Management Authority under the Flood and Water Management Act 2010 and must have regard to the Local Strategy of the LLFA. They are required to manage risks associated with assets or processes that may cause or be affected by flooding, and must share relevant data with other flood risk authorities.

They also have flood risk management functions under the Water Resources Act (1991). Relevant actions of water companies include: the inspection, maintenance, repair and any works to their drainage assets which may include watercourses, pipes, ditches or other infrastructure such as pumping stations.

The Civil Contingencies Act 2004 (CCA) also designates water and wastewater undertakers as statutory category 2 responders to national disasters and emergencies, placing on them duties to share assured information with other responders in an appropriate manner.

4.1.3 North Yorkshire County Council (NYCC)

NYCC as Lead Local Flood Authority has flood risk management functions which include but are not limited to;

- Provision of a Local Flood Risk Management Strategy (LFRMS).
- Designation and maintenance of a register of structures or features that have a significant effect on flood risk.
- Consenting and enforcement works on Ordinary Watercourses.
- Responding to statutory consultations on drainage proposals in planning applications.
- Undertaking Section 19 investigations into significant flooding incidents.

NYCC also has responsibilities as a Highways Authority and as an Emergency Responder (under the Land Drainage Act 1991 and the S19 Flood Investigation Report Civil Contingencies Act 2004 respectively) which may relate to flooding.

Highway Authorities are responsible for providing and managing highway drainage which may include provision of roadside drains and ditches, and must ensure that road projects do not increase flood risk.

The Highways Authority has a duty under the Highways Act 1980 to maintain highways that are maintainable at public expense. This includes a duty to maintain existing highways drainage. Highway drainage systems are designed to take highway surface water. Highway drainage systems are not designed as "storm drains", and do not have the capacity for the level of rainfall from an extreme flash flood. The Highway Authority has powers to improve drainage systems but no duty to do so.

Roadside gullies are subject to routine maintenance in accordance with the NYCC Highway Asset Management Plan. The frequency of cleaning is dependent on an evidence based categorisation of risk, determined by factors relating to the consequence of failure and a range of other operational factors.

4.1.4 District or Borough Council

District and Borough Councils are named as Risk Management Authorities within the Flood and Water Management Act 2010, and are required to comply with the LLFA Local Strategy. Through the planning processes, they control development in their area, ensuring that flood risks are effectively managed.

In addition, in relation to the Civil Contingency Act (2004), the Borough Council:

- Is a Category 1 Responder and may lead recovery work if specific to the Harrogate Borough area.
- Develops specific Multi Agency Flood Plans for known flood risk areas within the district.
- On a priority basis, it may provide sandbags to impacted residents and businesses where property is at risk of flooding.
- Support the Emergency Services on request by providing Incident Liaison Officers.
- Participate in identifying vulnerable people within affected areas.
- Provide emergency accommodation – i.e. set up rest centre as required and other welfare provision.
- Assist with arranging transport or evacuating areas.

4.1.5 Internal Drainage Board

Internal Drainage Boards (IDBs) are local operating authorities established in areas of special drainage need (typically low lying areas) in England and Wales. Their primary role is to manage water levels and reduce the risk from flooding within their designated drainage districts. Their work includes;

- Maintenance and improvement works on watercourses and related infrastructure.
- Consenting works on Ordinary Watercourses.
- Responding to consultations on drainage proposals in planning applications.
- Exercising permissive powers to undertake works where appropriate.

In managing water levels IDBs also have an important role in reducing flood risk in areas beyond their administrative boundary.

4.1.6 All Risk Management Authorities (RMAs)

All RMAs under the Flood and Water Management Act (2010) have a responsibility to cooperate and coordinate with regards to their flood risk management functions, including raising awareness of flood risk and the sharing of information.

4.1.7 Riparian Owners

Landowners whose land is adjacent to a watercourse are known as 'riparian owners'.

A landowner can be an individual e.g. home owner or farmer, private business or an organisation e.g. the district council as park owner, on school grounds the county council as property owner.

A watercourse is defined as every river, stream, ditch, drain, cut, dyke, sluice, sewer (other than a public sewer) and feature through which water flows, but which does not form part of a Main River.

Riparian owners have legal duties, rights and responsibilities under common law and the Land Drainage Act 1991 for watercourses passing through or adjoining their land. These responsibilities are to;

- Pass on the flow of water without obstruction, pollution or diversion affecting the rights of others,
- Accept flood flows through their land, even if these are caused by inadequate capacity downstream,
- Maintain the banks and bed of the watercourse and keep structures maintained,
- Keep the bed and banks free from any artificial obstructions that may affect the flow of water including clearing litter, heavy siltation or excessive vegetation.

Guidance on the rights and responsibilities of riparian ownership are outlined in the Environment Agency publication 'Living on the edge', available at

<http://www.environment-agency.gov.uk/homeandleisure/floods/31626.aspx>

4.2 Actions and Responses to December 2015 Floods

4.2.1 North Yorkshire County Council as Lead Local Flood Authority

The Flood Risk Management (FRM) Team provides an overarching view on flood risk management activities within the county. The FRM team have undertaken the following activities;

- Supported impacted residents in Harrogate District in obtaining Flood Resilience Grants.
- Local area officers have coordinated with other Risk Management Authorities to investigate the flood event that occurred in Harrogate.
- Engaged with YWSL, Highways and local residents to adopt a multi-agency response to flooding in Harrogate.

No alterations to the surface water drainage system in Harrogate are proposed at this stage.

4.2.2 North Yorkshire County Council as Highway Authority

The Highway Authority carries out regular maintenance of the highway drainage system. NYCC as highway authority has undertaken the following activities:

- Undertaken maintenance activities such as jetting and repair of gully pots post flood event.
- Continued to work with local riparian owners to desilt the culvert under Greenfields Avenue and sections upstream and downstream.

4.2.3 Yorkshire Water Services Ltd

YWSL have undertaken the following activities:

- Confirmed the extent of their sewer network in the vicinity of the flooded area.
- Carried out routine maintenance work of combined and surface water systems.

4.2.4 Harrogate Borough Council

Harrogate Borough Council has undertaken the following activities:

- Identified those properties affected by flooding during Storms Desmond and Eva.
- Supported affected residents with council tax relief payments.
- Supported affected residents with initial £500 flood payments.
- Supported the local community during clean-up activities.
- Carried out an investigation into flooding in Harrogate.
- Referred the issue to North Yorkshire County Council as Lead Local Flood Authority and Land Drainage Authority.

4.3 Conclusions

On the 25th and 26th of December 2015, 48 hours of heavy rainfall following Storm Eva placed an unusually heavy load on the local water courses and drainage systems. These systems were overwhelmed and flood water found its way into a number of residential properties in the Greenfields Avenue area of Harrogate.

Although this was an exceptional rainfall event, the risk of flooding at this location was known due to previous incidents. A number of maintenance issues have been identified with local riparian landowners and work continues to ensure the surface water management systems in the area are well maintained and working at their maximum capacity.

It has not been possible, under the scope of this investigation to establish the size of the catchment feeding into this system upstream of Stonefall Avenue. The only drainage records show the public sewer network at this point draining a relatively small area. Observations of the volume of water that comes into this system at times of heavy rainfall, and the speed with which the watercourses rise, would indicate a larger catchment area and drainage connectivity as yet unknown.

LLFA will continue to work with RMAs, and local stakeholders to develop action plans to address the issues raised in this report.

4.4 Recommendations

To reduce the risk of future flooding in the location, the following recommendations are made:

- NYCC in both its capacities as Highway Authority and LLFA to work with local riparian owners to desilt the culvert under Greenfields Avenue and stretches upstream and downstream to improve capacity and conveyance.
- Further investigation to be undertaken by NYCC as LLFA into the drainage network upstream of Stonefall Avenue, with a view to identifying un-mapped connections into the public sewer and overall contributing area.
- NYCC as LLFA in partnership with YWSL to work with local upstream landowners to identify opportunities for restricting/slowing surface water flow from neighbouring areas in times of extreme rainfall.

NYCC in its capacity as LLFA will continue to work with RMAs, and local stakeholders to develop action plans to address the issues raised in this report.