Binstead Section 19 Flood Investigation

Final Report

June 2022

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Contract

This report describes work commissioned by James Brewer, on behalf of Isle of Wight Council, by an email dated 07 September 2021. Isle of Wight Council's representative for the contract was James Brewer. Peter Rook and Abigail Legge of JBA Consulting carried out this work.

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Purpose

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Acknowledgements

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Executive summary

Background

Following flooding in Binstead on 25 July 2021, the Isle of Wight Council (IWC) as the Lead Local Flood Authority (LLFA) is undertaking a formal flood investigation under Section 19 of the Flood and Water Management Act 2010.

It is a statutory requirement for LLFAs to investigate flooding to the extent that it considers it necessary or appropriate.

Binstead is a village on the Isle of Wight, in the South East of England. It is located in the northeast of the Island, approximately 2.4km west of Ryde. The village is surrounded by woodland and agricultural farms in the south and west, with the coast to the north. Binstead stream is a small watercourse which runs through the village towards the Solent.

The flooding that occurred in Binstead caused internal flooding to at least 20 properties and fulfils the criteria for a Section 19 investigation. IWC has appointed JBA Consulting to undertake this investigation on its behalf.

For more information see Section 1.

Stakeholder engagement

As part of the Section 19 investigation, we engaged with local stakeholders in Binstead, including residents, community representatives and other Risk Management Authorities.

The objectives of engagement are to:

- Gather facts, opinions and data to aid the understanding of the investigation
- Enable the involvement and buy-in of the community in the investigation
- Disseminate the findings of the investigation to the community

For more information see Section 2.

Catchment characteristics

Section 3 describes the watercourses, urban drainage network, topography and geology of Binstead.

Long-term flood risk information

Section 4 summarises the existing long-term flood risk information on the risk of flooding from rivers, surface water and groundwater. Historically, Binstead is an area of frequent flooding, particularly from surface water and as a result of drainage issues. However fluvial flooding is also a risk due to the presence of the Binstead Stream.

Flood Risk Management

Responsibility for flood risk can be divided into "flood risk management" and "emergency response". Section 5 describes the roles and responsibilities of the various bodies involved in flood management and emergency response. Section 5.3 describes the existing flood risk management activities undertaken, including: flood warning; flood alleviation schemes; property flood resilience; Community Flood Plan; and planning and development control activities.

For more information see Section 5.

Hydrological analysis of 25 July 2021 event

The storm event that affected Binstead on 25 July was estimated to have been between a 1 in 42 and a 1 in 110 year event which can be expressed as a storm event with approximately a 1% - 2.5% chance of occurring in any given year. Therefore, the storm event was an extreme rainfall event, with a large volume of rainfall occurring in a relatively short amount of time.

For more information see Section 6.

Incident response

Several agencies responded to the flooding event in Binstead, including the Isle of Wight Council, Hampshire Police, Hampshire and Isle of Wight Fire and Rescue service, and Island Roads. A timeline of the incident response is given in Table 7 1.

Source-pathway-receptor analysis

The sources, pathways and receptors of flooding were as follows:

- Sources – extreme rainfall, combined sewer, Binstead Stream
- Pathways – overland flow, surface water drainage exceedance
- Receptors – confirmed internal flooding of at least twenty residential properties, resident displacement, loss of possessions, negative mental and physical health impacts. Flooding of at least one commercial property, road closures.

For more information see Section 8.

Capacity review

As outlined in Section 6, the rainfall event on 25 July 2021 had a rarity of between a 1 in 42 and a 1 in 110 year event (1 – 2.5% annual probability of occurrence), which is an extreme rainfall event. Whilst Southern Water reported capacity issues on the sewer network during the event, this is unsurprising considering the volume of rainfall that fell on Binstead and the fact that the sewer system is combined and has to accept both surface water and foul flows, including discharges from the highway drainage system.

Based on the presence of foul sewage in flood water on Cemetery Road, it can be ascertained that the combined sewer system suffered a hydraulic overload during the event, which resulted in foul sewage emerging from the system and mixing in with surface water runoff.

Discussion, appraisal and recommendations

In this section, we discuss in more detail some of the aspects of flood risk management in the Isle of Wight, what worked well and not so well during the 25 July 2021 event, and we consider potential options to mitigate flood risk and reduce damages caused by flooding.

We undertook a high-level option appraisal focussing on the potential benefits, practicality and viability of each option. We carried out a multi-criteria analysis to compare each option which included consideration of a range of different factors, for example the potential contribution towards reducing flood risk to property, people and communities. For more information see Section 10 and Appendix B.

Conclusion

A series of recommended actions for the Risk Management Authorities and stakeholder organisations are presented below.

For more information on options, recommendations and conclusions see Section 10.

Recommendation	Organisation(s) responsible	Multi-criteria analysis score	Timescale
Rain gardens along the Greenway	Isle of Wight Council/ Island Roads	10	1 – 5 years
Underground storage tanks along the Mall to Sandpath footpath	Isle of Wight Council/ Island Roads	10	1 – 5 years
Investigate condition and capacity of the watercourse in Cemetery Road	Isle of Wight Council/ Southern Water	9	< 1 year
Property Flood Resilience (PFR) Scheme	Isle of Wight Council	7	1 – 5 years
Community flood resilience	Isle of Wight Council/ Flood Action Groups	7	< 1 year

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Abbreviations

AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
BGS	British Geological Society
CCTV	Closed Circuit Television
DTM	Digital Terrain Model
EA	Environment Agency
FEH	Flood Estimation Handbook
GIS	Geographic Information Systems
IWC	Isle of Wight Council
JBA	Jeremy Benn Associates
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
PFR	Property Flood Resilience
RMA	Risk Management Authority
RoFSW	Risk of Flooding from Surface Water (Environment Agency mapping)
SWMP	Surface Water Management Plan
WASC	Water and Sewerage Company
WTW	Waste Treatment Works

1 Introduction

1.1 Background to investigation

Following flooding in Binstead on 25 July 2021, the Isle of Wight Council (IWC) as the Lead Local Flood Authority (LLFA) is undertaking a formal flood investigation under Section 19 of the Flood and Water Management Act 2010[1].

It is a statutory requirement for LLFAs to investigate flooding to the extent that it considers it necessary or appropriate. IWC has outlined its criteria for undertaking a Section 19 investigation in its **Flood Investigation Protocol**[2].

- *Where there is ambiguity surrounding the source or responsibility of a flood incident;*
- *Where internal flooding of one property has been experienced on more than one occasion; OR*
- *Where internal flooding of a group of properties has been experienced during a single flood incident; OR*
- *Where flooding resulted in disruption of one or more items of critical infrastructure; OR*
- *Where a single flood incident resulted in flooding that affects vulnerable individuals; OR*
- *Where there is risk to life as a result of flooding.*

The flooding that occurred in Binstead caused internal flooding to at least 20 properties and fulfils these criteria. IWC has appointed JBA Consulting to undertake this investigation on its behalf.

1.2 Site location

Binstead is a village on the Isle of Wight, in the South East of England. It is located in the northeast of the Island, approximately 2.4 km west of Ryde. The village is surrounded by woodland and agricultural farms in the south and west, with the coast to the north. Binstead Stream is a small watercourse which runs through the village towards the Solent.

1.3 Data collection

A wide range of data has been collected and assessed to inform the Section 19 investigation. This has been used to understand the causes of flooding in Binstead and to establish the context of the area and includes the following:

- Open-source data from GOV.UK
- Photographs from the site visit, showing flood sources, pathways and receptors
- Hydrometric data
- Residents' questionnaires
- Information from authorities on drainage infrastructure, such as highways and water companies
- Other data such as photographs, newspaper articles and notes from the event

1 Flood and Water Management Act 2010 Section 19 (accessed 19 November 2021): https://www.legislation.gov.uk/ukpga/2010/29/section/19

2 Isle of Wight Council Flood Investigation Protocol: https://www.iow.gov.uk/azservices/documents/2821-Flood-Investigation-Protocol-March-2015.pdf

2 Stakeholder engagement

We engaged with multiple local stakeholders in Binstead, including residents, community representatives, landowners, other Council departments, Council Members and Risk Management Authority (RMA) partners.

The objectives of engagement are to:

- Gather facts, opinions and data to aid the understanding of the investigation
- Enable the involvement and buy-in of the community in the investigation
- Provide more technical debrief with RMA and operational partners
- Disseminate the findings of the investigation to the community

A list of key stakeholders and how we engaged with them is given in Table 2-1. The engagement terminology is taken from Environment Agency's 'Working with Others' (2013) methodology:

- Inform - provide information
- Consult - receive, listen, understand and feedback
- Involve - decide together
- Collaborate - act together
- Empower - support independent action

Table 2-1: Key stakeholders

Role	Organisation	How to engage	Type of engagement
Residents	N/A	Consult	Site visit, online questionnaire, correspondence
Ward Councillor	Cllr Ian Dore	Consult	Invitation to contribute, correspondence, public engagement meeting
Water and Sewerage Company (WASC)	Southern Water	Involve	Invitation to contribute, correspondence, data provision
Highways Authority	Isle of Wight Council / Island Roads	Involve	Invitation to contribute, correspondence, data provision
Environment Agency	Environment Agency	Involve	Correspondence, data provision
LLFA	Isle of Wight Council	Involve	Invitation to contribute, correspondence, online survey distribution, site visit, data provision
Council Members	Isle of Wight Council	Consult	Invitation to contribute
Emergency Planning	Emergency Management IWC	Consult	Invitation to contribute, correspondence

3 Catchment characteristics

3.1 Topography

The area of Binstead is mostly low lying, as shown in Figure 3-1, with the elevation ranging between 15mAOD and 60mAOD. Higher elevations can be found in the southwest, with the lower areas found in the north towards the coast, and the lowest lying ground associated with the Binstead Stream floodplains. The general topography of the area slopes towards the coastline to the north of the study area.

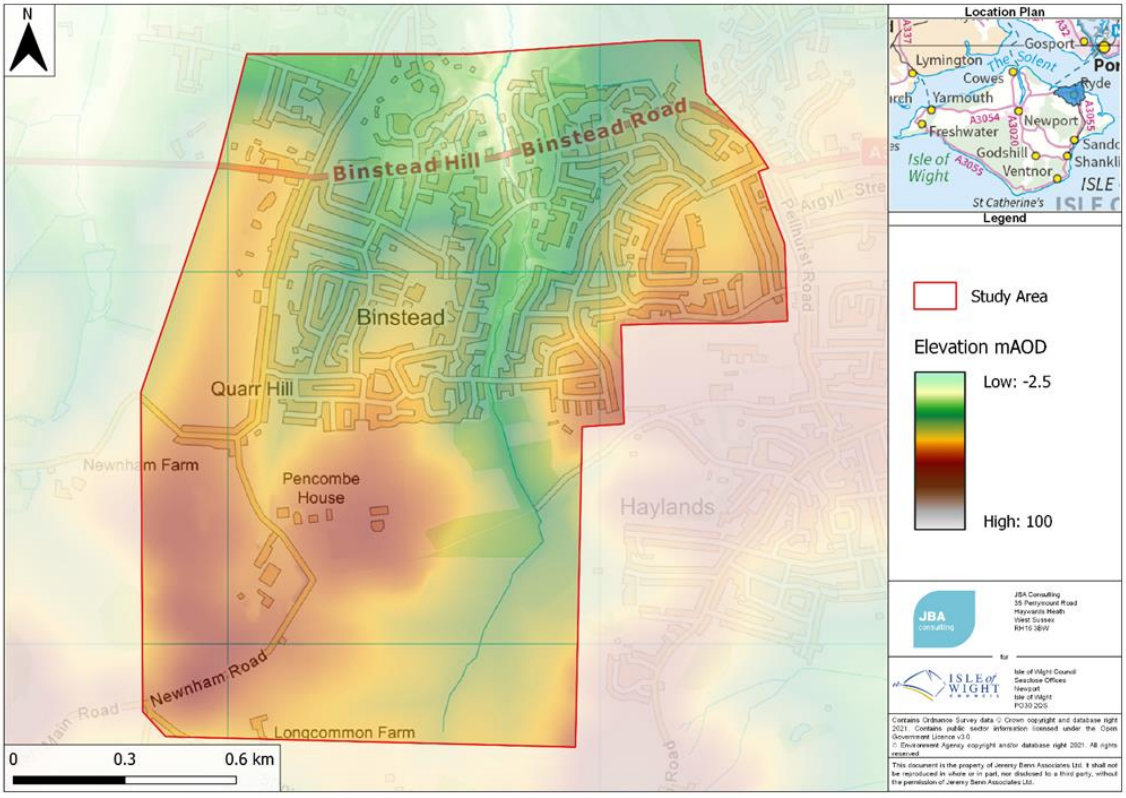

Figure 3-1: The topography of the Binstead study area

3.2 Geology and soils

British Geological Survey (BGS) 50K mapping indicates Binstead is underlaid by bands of various rock strata, shown in Figure 3-2. The bedrock of the main residential area of Binstead is the Bembridge Marls Member (calcareous mudstone and limestone), with a wide band of Hamstead Member (clay, silt and sand) found in the south. The BGS Aquifer Designation Map[3] shows that the bedrock is designated as Secondary A strata: permeable layers capable of supporting water supplies at a local scale and can form an important source of base flow to rivers.

The superficial deposits in Binstead, as seen in Figure 3-3, are mostly associated with the floodplain of Binstead Stream which includes Alluvium (clay, silt, sand and gravel). There are also pockets of Head Deposits (gravel, silt, sand and clay) and the Wootton Gravel Complex (gravel, sandy, clayey and silty) in the west of the area.

[3] https://magic.defra.gov.uk/MagicMap.aspx

The soils in the area, defined by the Soilscapes map[4], are mostly slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils with impeded drainage. Freely draining slightly acid loamy soils can be found in the low-lying areas of Newnham Road, as well as The Mall and Verwood Drive.

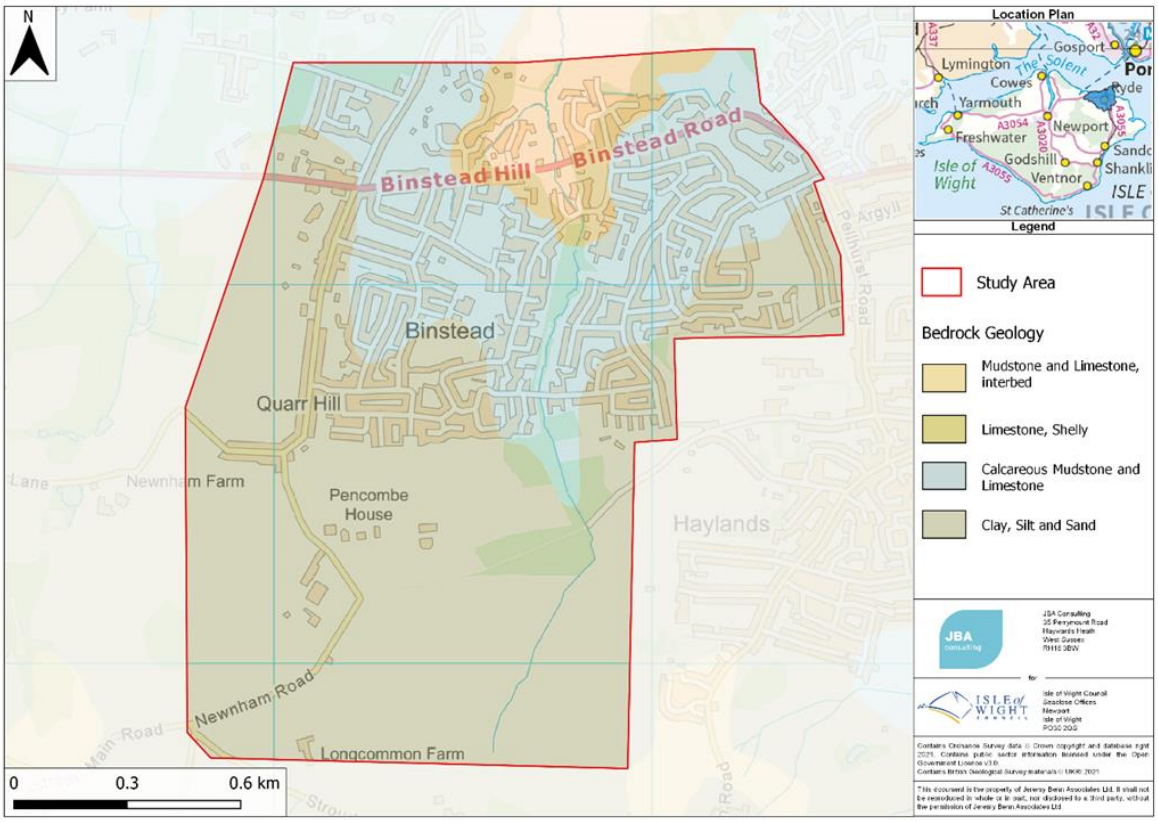

Figure 3-2: The bedrock geology of Binstead

These deposits and soils are diverse, and it is likely that permeability would be variable across the Binstead study area, with areas where permeability may be higher and others where it may be very low. Furthermore, the catchment is steep and heavily urbanised towards the north which, combined with variable permeability, may lead to increased volumes of surface water runoff.

[4] Cranfield University http://www.landis.org.uk/soilscapes/

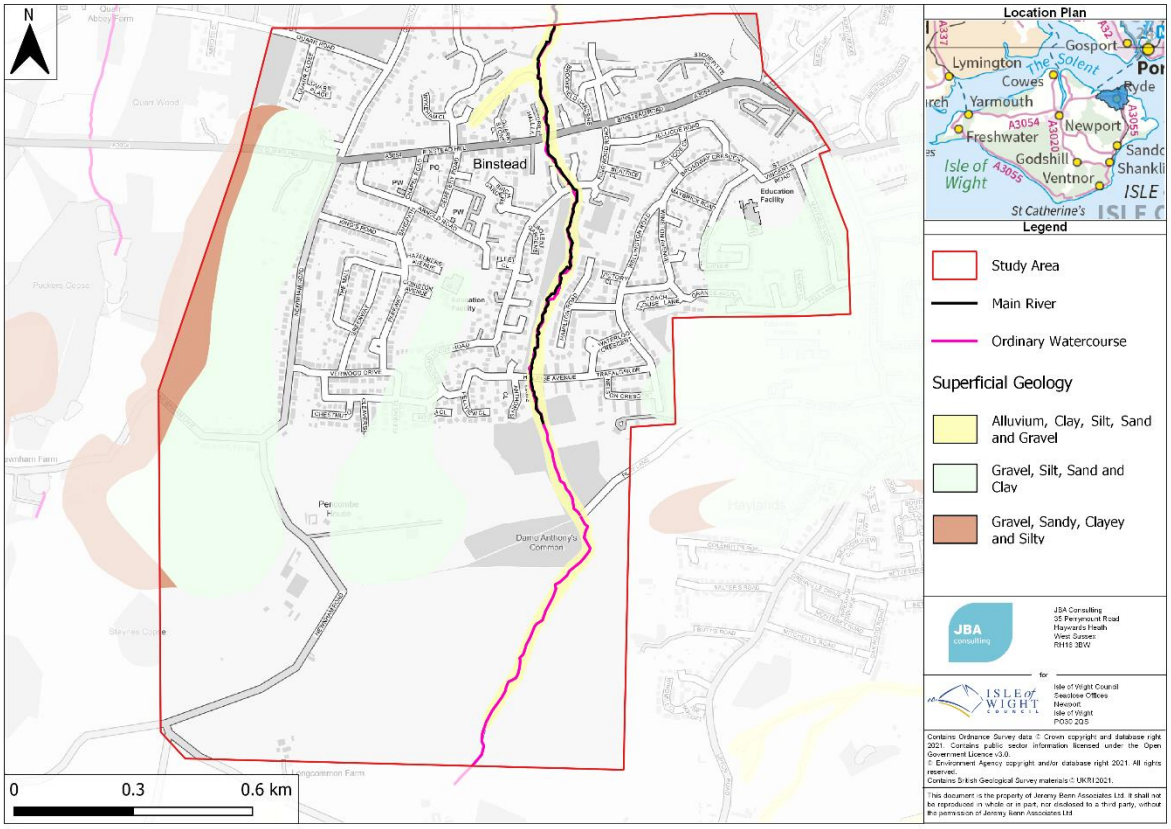

Figure 3-3: The superficial geology of Binstead

3.3 Drainage system and river network

It is the responsibility of the Environment Agency to carry out maintenance, improvement and construction work on main rivers is England to manage flood risk. Other rivers are designated as 'ordinary watercourses'. Maintenance work in most cases is the responsibility of individual riparian owners, however the LLFA has a responsibility to ensure that landowners are undertaking their riparian responsibilities under the Land Drainage Act (1991). The LLFA also has discretionary powers to undertake flood risk management works on ordinary watercourses. The LLFA will work with all relevant Risk Management Authorities to collect and share relevant information that may assist with the LLFA responsibility to ensure riparian responsibilities are undertaken.

Binstead has one main river, Binstead Stream, running through the centre of the village. Figure 3-4 shows how the stream begins just north of Stroud Farm and flows approximately 2 km northwards where it discharges into The Solent. The stream is classified as an ordinary watercourse in its upper reaches and becomes a main river where it enters Binstead. There is also an unnamed watercourse to the west of Binstead village that Environment Agency mapping (Appendix A) has identified as an ordinary watercourse (tertiary river) that is culverted along much of its length. The Environment Agency has carried a site visit and has confirmed that:

'The open watercourse runs down Sandpath which is then culverted under Arnold Road and Gordon Close back to open watercourse to the rear of houses on Cemetery Road, then culverted under the main road to the rear of The Forge on Binstead Hill from which it is then open watercourse until it joins up with the Main River Network at Brock Edge'.

The wastewater drainage in Binstead is managed by Southern Water. Binstead falls under the Sandown New WTW (waste treatment works) sewer catchment. The sewage network is made up of gravity sewers and rising mains (pumped systems). Surface water runoff from this catchment is discharged to the English Channel via a long outfall pipe.

The highways drainage network across the Isle of Wight is managed by Island Roads, in agreement with the IWC. This includes the maintenance of the drainage network, such as gully and drain cleansing and maintenance of highway ditches. The land drains in the surrounding fields, which fall under riparian ownership, have been mentioned in the responses to the stakeholder engagement survey and are thought to contribute to the flooding.

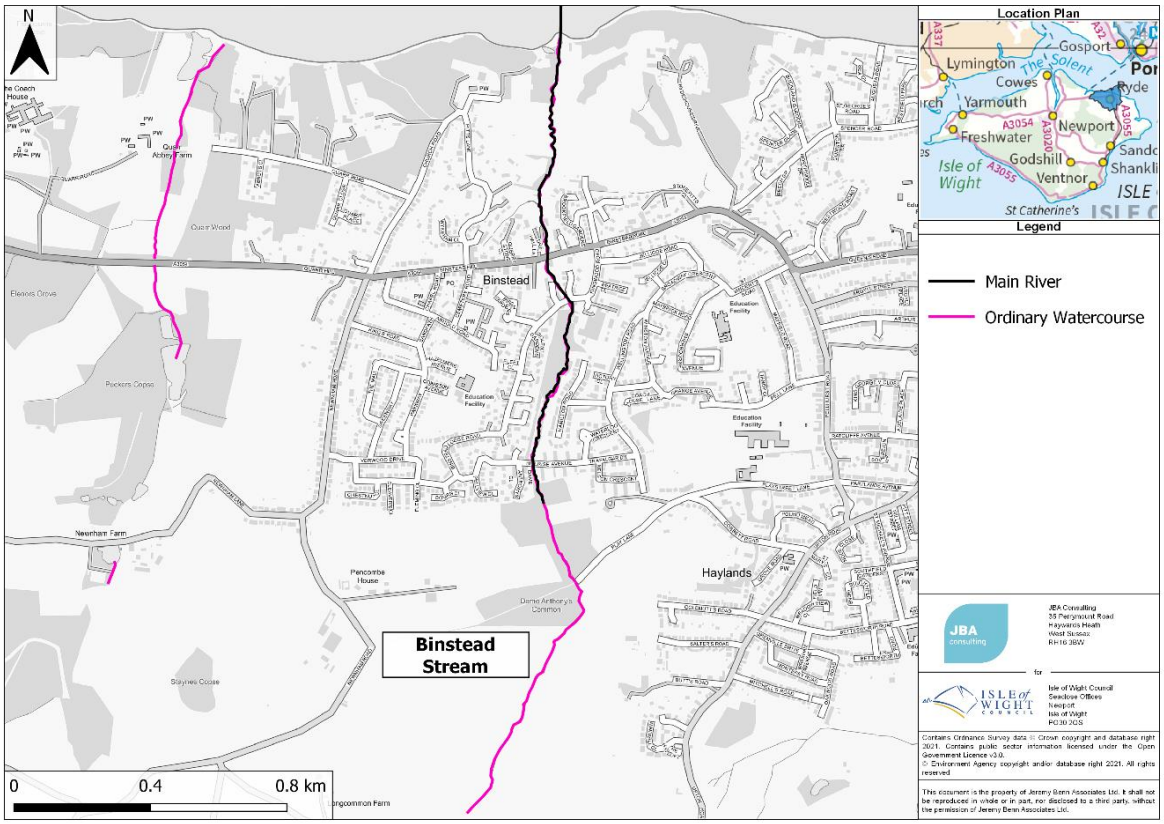

Figure 3-4: The watercourses in Binstead

Figure 3-5: The Binstead Stream looking south from Binstead Road

4 Long-term flood risk information

4.1 Risk of flooding from rivers and sea

The Environment Agency's Flood Zone data, shown in Figure 4-1, defines areas at risk of flooding from fluvial and tidal sources. Areas within Flood Zone 2 have between a 0.1% and 1.0% chance of flooding from rivers (or between a 0.1% and 0.5% chance of flooding from the sea) in any given year. Areas within Flood Zone 3 have greater than a 1.0% chance of flooding from rivers (or greater than a 0.5% chance of flooding from the sea) in any given year. In the study area, the risk of flooding from rivers and sea is mostly confined to the course of Binstead Stream, the majority of which is in Flood Zone 2. It should be noted that these Flood Zones represent undefended flood risk and therefore do not take into account existing flood defences.

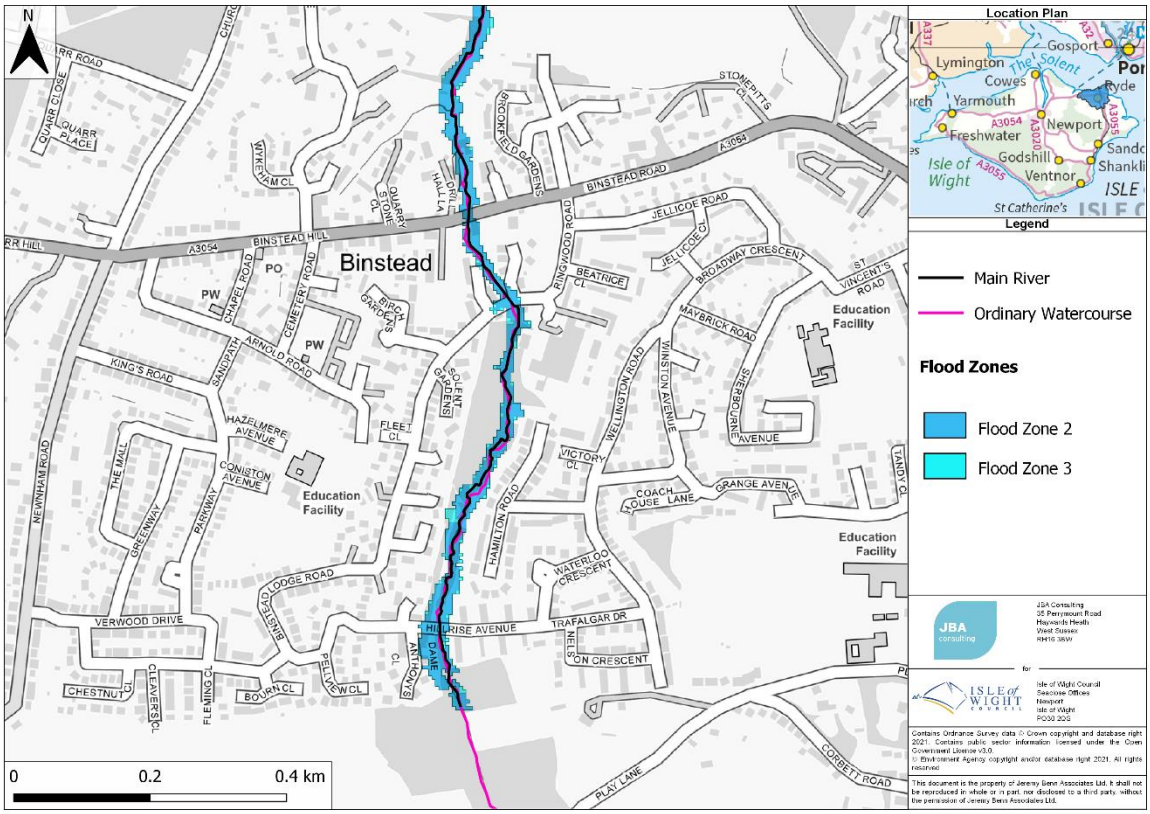

Figure 4-1: Risk of flooding from rivers and the sea

4.2 Risk of flooding from surface water

Flooding from surface water runoff (or 'pluvial' flooding) is caused by intense short periods of rainfall. It often occurs where the natural (or artificial) drainage system is unable to cope with the volume of water. Surface water flooding problems are inextricably linked to issues of poor drainage (or drainage blockage by debris) and sewer flooding.

The Risk of Flooding from Surface Water (RoFSW) data is national scale mapping showing the risk of flooding from surface water runoff, published by the Environment Agency. The map in Figure 4-2 shows the areas at risk of flooding in response to rainfall events with the following chance of occurring in any given year:

- High risk – greater than a 3.33% chance (1 in 30 years)
- Medium risk – between a 3.33% and 1.0% chance (1 in 100 years)
- Low risk – between a 1.0% and 0.1% chance (1 in 1,000 years)

The highest risk of flooding from surface water in the Binstead area mostly occurs around the watercourses in the area, for rainfall events with greater than a 3.33% chance of occurring in any year. This is because the RoFSW mapping picks up topographic low points which also correspond to the fluvial floodplain. Figure 4-2 shows a flow path of surface water originating to the west of Binstead Sream, by Newnham Road in rainfall events during medium risk rainfall events (with between a 3.33% and 1.0% chance of occurring). It travels northwards through Quarr Hill towards Binstead Hill, before joining Binstead Stream to the north of Binstead Road.

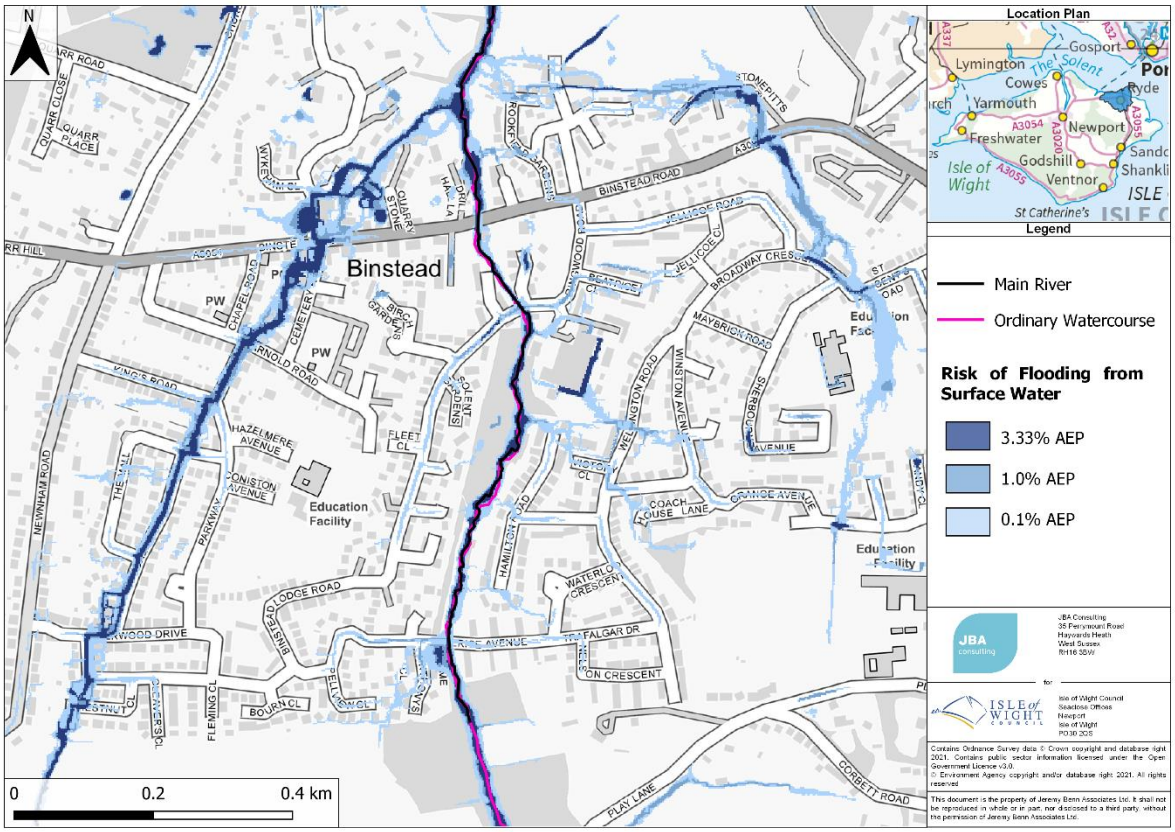

Figure 4-2: Risk of flooding from surface water

4.3 Groundwater flooding

Flooding from groundwater occurs when the water table within the underlying rock or soil rises above ground level or interacts with properties or infrastructure below ground level. Data on groundwater has not been available for the Section 19 investigation. However, based on the underlying geology and soil types, muddy limestones and indications of impeded drainage, groundwater is not expected to be a significant flood risk in Binstead. Furthermore, responses from stakeholders have not indicated this to have been a significant issue.

4.4 Flood history

Historically, Binstead is an area of frequent flooding, with Table 4-1 detailing the known and significant flood history of the area.

Table 4-1: Flood history

Date	Source of flooding	Description of impacts
2000	Foul sewer drainage and groundwater	Approximately 70 properties in the Ryde area were flooded.
Nov 2010	Drainage	Flooding to at least one property caused by blocked drainage
Dec 2010	Drainage/ surface water	Unknown
July 2012	Unknown	Caused internal flooding to at least one property on Cemetery Road
Dec 2013 / Jan 2014	Multiple sources including surface water	Caused internal flooding to at least one property on Cemetery Road to a depth of approximately 250mm

4.5 Flood Risk Assessments

Development sites may require a Flood Risk Assessment (FRA) to be submitted in support of a planning application, information as to when this may be required and **how to complete a Flood Risk Assessment**[5] can be found online. An FRA will be required if a site is:

- in flood zone 2 or 3 including minor development and change of use
- more than 1 hectare (ha) in flood zone 1
- less than 1 ha in flood zone 1, including a change of use in development type to a more vulnerable class (for example from commercial to residential), where they could be affected by sources of flooding other than rivers and the sea (for example surface water drains, reservoirs)
- in an area within flood zone 1 which has critical drainage problems as notified by the Environment Agency

5 Flood risk assessments if you're applying for planning permission: https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications (accessed 20 June 2022)

5 Flood risk management

Responsibility for flood risk can be divided into "flood risk management" and "emergency response". The following section describes the roles of the various bodies involved in flood management, with roles and responsibilities for emergency response described in Section 7.

It should be noted that the responsibility for reducing the impacts of flooding to any property remain with the owner of that property, not with any risk management authority. Isle of Wight Council, the Environment Agency and other risk management authorities have the statutory powers to carry out works for flood risk management purposes or other works to reduce flooding but are under no statutory duty to do so.

5.1 Flood risk management roles and responsibilities

Flood risk in England is managed by a range of different Risk Management Authorities (RMAs)[6]. The Flood and Water Management Act places a duty on all flood risk management authorities to co-operate with each other. The act also provides Lead Local Flood Authorities and the Environment Agency with a power to request information required in connection with their flood risk management functions.

5.1.1 Lead Local Flood Authority (LLFA)

LLFAs are responsible for managing the risk of flooding from surface water, groundwater (water which is below the water table under the ground) and ordinary watercourses (non-main rivers) and lead on community recovery. The LLFA is also responsible for developing, maintaining and applying a strategy for local flood risk management in their area and for maintaining a register of flood risk assets.

Isle of Wight Council is the LLFA for Binstead.

5.1.2 Environment Agency

The Environment Agency is sponsored by the Government's Department for Environment, Food & Rural Affairs (Defra), and is tasked with the protection and conservation of the water environment in England, the natural beauty of rivers and wetlands and the wildlife that lives there.

The Environment Agency's responsibilities include: water quality and resources; fisheries; conservation and ecology; and operational responsibility for managing the risk of flooding from main rivers (usually large streams and rivers), reservoirs, estuaries and the sea.

Flood risk management work can include: constructing and maintaining 'assets' (such as flood banks or pumping stations); works to main rivers to manage water levels and to make sure flood water can flow freely; operating flood risk management assets during a flood; channel maintenance on the river; issuing flood warnings; and responding to incidents.

The Environment Agency can also do work to prevent environmental damage to watercourses, or to restore conditions where damage has already been done.

The strategies for flood and coastal erosion risk management show how communities, the public sector and other organisations can work together to manage this risk.

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6 https://www.gov.uk/guidance/flood-risk-management-information-for-flood-risk-management-authorities-asset-owners-and-local-authorities

5.1.3 Water and Sewerage Company

Water and sewerage companies are responsible for managing the risks of flooding from surface water and foul or combined public sewer systems providing drainage from buildings and yards.

Southern Water is the water and sewerage company for Binstead.

5.1.4 Highway Authority

The Highway Authority for Binstead is the Isle of Wight Council, and the highways function is managed by Island Roads. The Highway Authority is responsible for maintaining the highway drainage system to an acceptable standard and ensuring that road projects do not increase flood risk.

5.1.5 Riparian landowners

Riparian landowners who own land or property next to a river, stream or ditch, (including where this runs through a pipe or culvert), have rights and responsibilities over the management of the land including: a responsibility to let water flow through the land without any obstruction, pollution or diversion which affects the rights of others; keeping banks clear of anything that could cause an obstruction and increase flood risk; maintaining the bed and banks of the watercourse; and keeping structures clear of debris. There is more information on these rights and responsibilities in the Environment Agency online guidance 'Owning a watercourse'[7].

5.1.6 Local residents

Local residents should find out about any flood risk in the area, sign up for the Environment Agency's free flood warnings and make a written plan of how they will respond to a flood situation. Business owners should also make a flood plan for their business. There are measures that can be taken to reduce the amount of damage caused by flooding and properties at risk should be insured. Local residents can find out if their property is at risk, prepare for flooding, get help during a flood and get help after a flood.

5.2 Emergency responsibilities

The emergency responsibilities of different organisations are outlined in Table 5-1 below. Please note that Parish and Town Councils do not have a legal obligation to respond to emergencies. Whatever service they provide is voluntary and unique to each Parish or Town Council.

Table 5-1: Roles and responsibilities in an emergency, during and after a flood event

Local (County and District) Authorities
Coordinate emergency support within their own functions
Deal with emergencies on 'non main rivers'
Coordinate emergency support from the voluntary sector
Liaise with central and regional government departments
Liaise with essential service providers
Open rest centres
Manage the local transport and traffic networks
Mobilise trained emergency social workers

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7 Environment Agency (2018) Owning a watercourse. Available at: https://www.gov.uk/guidance/owning-a-watercourse

Provide emergency assistance
Deal with environmental health issues, such as contamination and pollution
Coordinate the recovery process
Manage public health issues
Provide advice and management of public health
Provide support and advice to individuals
Assist with business continuity

Police Force	Utility Providers
Save life Coordination and communication between emergency services and organisations providing support Coordinate the preparation and dissemination	Attend emergencies relating to their services putting life at risk Assess and manage risk of service failure Assist with recovery process, that is, water utilities manage public health considerations

Fire and Rescue Service
Save life rescuing people and animals
Carry out other specialist work, including flood rescue services
Where appropriate, assist people where the use of fire service personnel and equipment is relevant

Ambulance Service	Town and Parish Councils
Save life Provide treatment, stabilisation and care at the scene	Support emergency responders Increase community resilience through support of community emergency plan development

Voluntary Services
Support rest centres
Provide practical and emotional support to those affected
Support transport and communication
Provide administration
Provide telephone helpline support

Environment Agency
Issue Flood Warnings and ensure systems display current flooding information
Provide information to the public on what they can do before, during and after a flood event
Monitor river levels and flows
Work with professional partners and stakeholders and respond to requests for flooding information and updates
Receive and record details of flooding and related information
Operate water level control structures within its jurisdiction and in line with permissive powers
Flood event data collection
Arrange and take part in flood event exercises

Respond to flooding incidents
Respond to pollution incidents and advise on disposal
Assist with the recovery process, attending flood surgeries
Advise upon and regulate flood risk activities on, and within the flood plains of main rivers

5.2.1 Local Resilience Forum (LRF)

Local Resilience Forums (LRFs) are multi-agency partnerships made up of representatives from local public services, including the emergency services, local authorities, the NHS, the Environment Agency and others. These agencies are known as Category 1 Responders, as defined by the Civil Contingencies Act.

LRFs are supported by organisations, known as Category 2 responders, such as the Highways Agency and public utility companies. They have a responsibility to co-operate with Category 1 organisations and to share relevant information with the LRF. The geographical area the forums cover is based on police areas.

The Local Resilience Forum is not a legal entity, nor does a Forum have powers to direct its members. Nevertheless, the Civil Contingencies and the Regulations provide that emergency responders, through the Forum, have a collective responsibility to plan, prepare and communicate for emergencies in a multi-agency environment.

The Local Resilience Forum for Binstead is the Hampshire and Isle of Wight Local Resilience Forum (HIWLRF). The HIWLRF has identified coastal flooding, fluvial flooding and surface water flooding as very high risk. Therefore, the HIWLRF has a Multi-Agency Flood Response Plan that provides the framework for the multi-agency response to a flooding incident and details the roles and responsibilities of each agency, as well as the estimated time of onset for flooding, the number of properties at risk, vulnerable receptors and safe evacuation points. THE HIWLRF also work with communities at risk to create Community Emergency Action Plans.

The Island Resilience Forum (IRF) was formed as a sub-group of the HIWLRF to provide an Isle of Wight dimension to planning, concentrating on the risks and challenges faced by island communities. The IRF consists of a tactical level coordinating group of emergency planners to facilitate joint working between island partners.

5.3 Existing flood risk management activities

The IWC Local Flood Risk Management Strategy (2016) details the various responsibilities of key stakeholders and organisations, and the existing flood risk management activities at the time. There are currently no known flood risk management activities taking place in Binstead.

5.3.1 Flood warning service

The Environment Agency's Flood Warning Service provides flood warnings and alerts based on constant monitoring and forecasting of flooding from rivers and sea. Binstead is not covered by the Service, and this does not currently extend to providing Flood Warnings for surface water flooding.

5.3.2 Community flood plans

There is currently no Community Action Plan or Community Emergency Plan for Binstead. However, it is understood that there was previously a Flood Action Group for Binstead that has now been disbanded.

5.3.3 Maintenance

Maintenance is an essential part of managing flood risk, with landowners, the IWC and EA involved in the maintenance of watercourses, drains and similar infrastructure, as shown in Table 2-1.

The legal responsibility for maintenance of the river lies with the riparian landowners (as set out in Section 5.1.5) rather than the Environment Agency or any other authority. The Environment Agency has powers to work on main rivers (including Binstead Stream) to manage flood risk. These powers are permissive, which means they are not a duty. The EA's powers allow them to carry out a variety of works to maintain main river channels, assets and structures in order to manage or reduce flood risk to people and property, and to safeguard the health and safety of staff and other river users.

Nationally, the Environment Agency's maintenance works can include weed and grass cutting by hand/machine, channel maintenance, obstruction removal, vermin control, tree/bush work, defence repair, flood reservoir work, structure maintenance and some works to improve habitat and biodiversity. Their maintenance work may include de-silting or dredging where this is proven to be the most cost-effective way of managing flood risk to people and property, without causing a deterioration of the water body as defined through the Water Framework Directive (WFD).

The Environment Agency undertakes an annual visual inspection of any structures and defences through Binstead that have a Flood Risk Management purpose. Any obstructions to flow, such as fallen trees or blockages are flagged and reported to the riparian landowner, where known. Grass control is carried out on various high flow cuts and flood berms. Further intermittent works may be carried out where there is a justified need and funding available. The Environment Agency may respond to reports of blockages and obstructions and carry out patrols of specific locations during flood events, where resources are available.

Island Roads has an annual programme of drain and gully cleansing for roads and are responsible for managing sandbag stock at strategic locations. It should be noted that the frequency of gully cleansing and the removal of grass cuttings from verges may impact surface water flood risk. It is recommended that Island Roads investigates the frequency of its gully cleansing programme and whether this is appropriate with respect to surface water flood risk in Binstead, and whether additional actions may be required.

6 Hydrological analysis of the 25 July 2021 event

6.1 Conditions at the time

The rain gauge at Ryde Vineyard shows that there was rainfall throughout the day of 25 July 2021 in Ryde, starting at approximately 03:45. This continued until approximately 14:45, gradually becoming more intense. The data shows that from 14:45 to 16:00 short duration, highly intense rainfall fell on Ryde, with approximately 45mm of rain falling within this period.

As there was only a single gauge that was local to Binstead, rainfall radar data (HYRAD) from the Met Office has been obtained and analysed as a point of comparison to the rain gauge data and as a sensitivity check. The HYRAD data indicates that this highly intense rainfall originated from the north before moving inland, with the most intense rainfall (Figure 6-1) occurring at approximately 15:30, with maximum recorded intensities in Binstead of 17mm in a 15-minute window. This period of high intensity rainfall ended at approximately 16:00.

A comparison of the HYRAD and tipping bucket rain gauge data (Table 6-1) showed similarities between the two datasets with regard to the daily totals and similar data for the 15-minute totals.

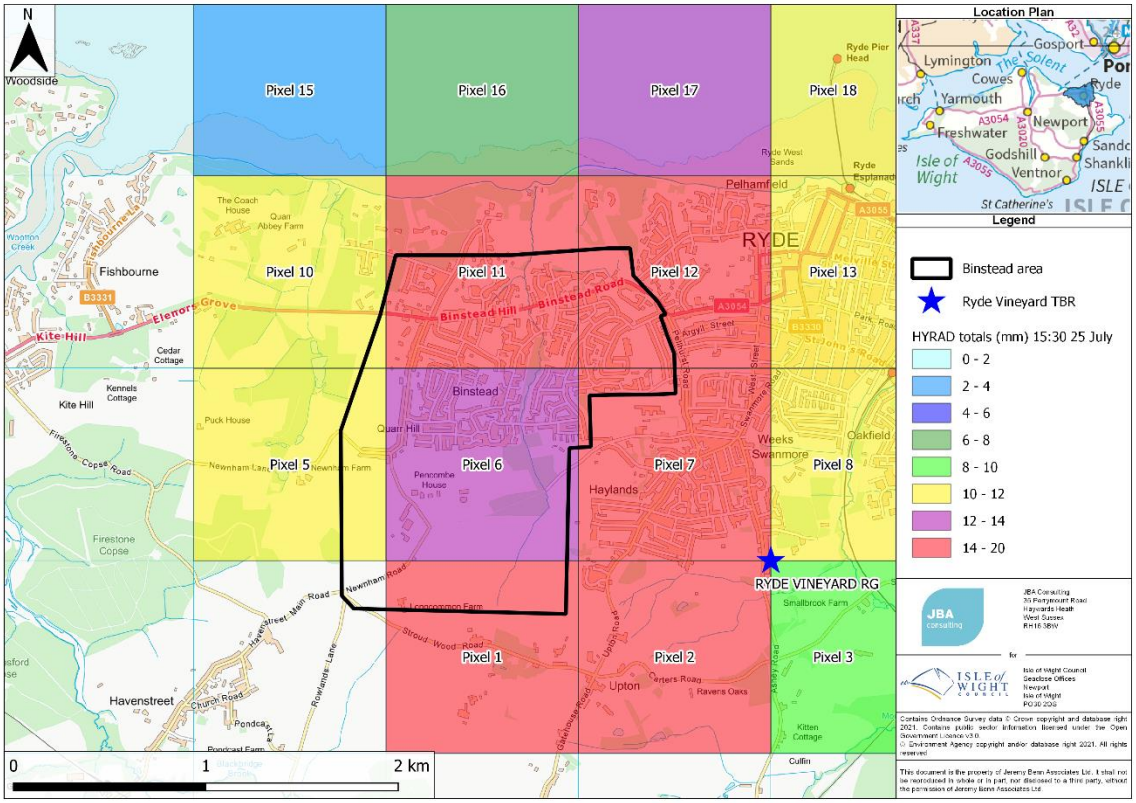

Figure 6-1: Rainfall radar (HYRAD) data for the Binstead area on 25 July 2021s at 15:30

Table 6-1: Rainfall totals in the Binstead area on 25 July 2021

Rain gauge	Distance from Binstead*	Daily total on 25/07/2021 (mm)	Grid reference
Ryde Vineyard TBR	1.64km	64.40	459000, 91000
HYRAD (pixel 6)	0.00km	70.04	457500, 91500
HYRAD (pixel 11)	0.00km	68.39	457500, 92500
HYRAD (pixel 12)	0.00km	59.69	458500, 92500

*Distance calculated from the centre of the Binstead study area

6.2 Rainfall return period estimation

Rain gauge data provided by the Environment Agency has been used to estimate the return period of the storm event on 25 July 2021 in Binstead. The closest tipping bucket rain gauge to the Binstead area is the Ryde Vineyard gauge, which is approximately 1.6km from the centre. The decision was made to use this gauge, as the data was very consistent with that of the HYRAD data.

The Flood Estimation Handbook (FEH) web service was used to purchase point descriptors for Binstead, allowing the rainfall rarity, or storm return period, to be calculated for a range of storm durations (1-hour, 2-hour and 4-hour).

Table 6-2 details the calculated rainfall return periods.

The storm event that affected Binstead on 25 July 2021 was likely to be between a 1 in 42 and a 1 in 110-year event which can be expressed as a storm event with **approximately a 1% - 2.5% probability of chance of occurring in any given year. Therefore, the storm event was an extreme rainfall event, with a large volume of rainfall occurring in a relatively short amount of time.**

Figure 6-2: Cumulative rainfall on 25 July 2021 from the Ryde Vineyard gauge

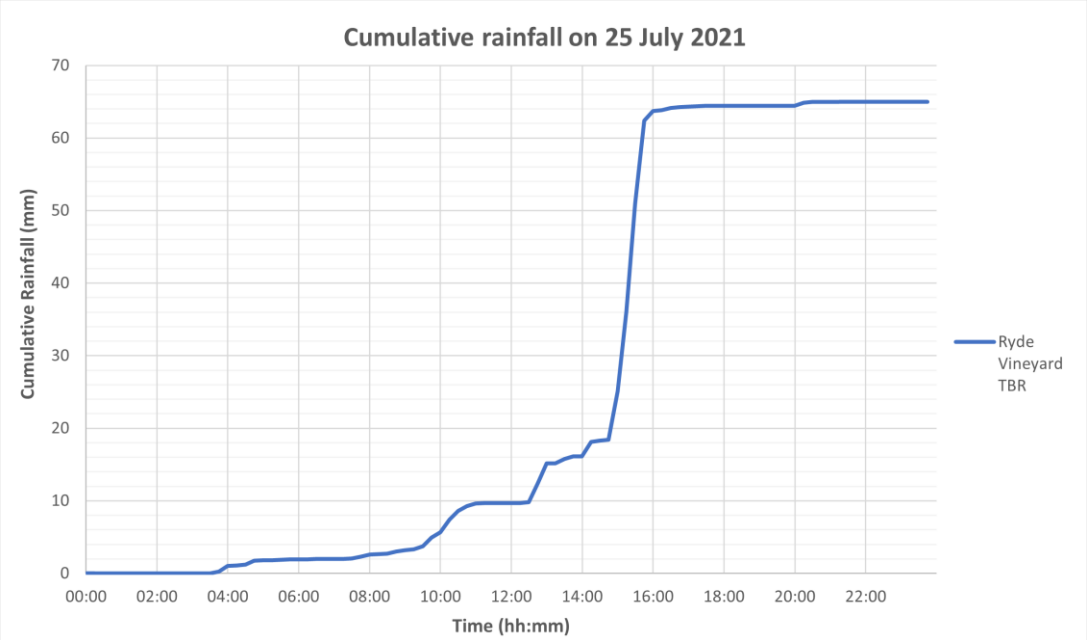

Table 6-2: Rarity of the rainfall event in Binstead on 25 July 2021 (Ryde Vineyard Gauge)

Storm Duration (Hours)	Rainfall total (mm)	Return Period	Approximate AEP
1	43.99	110.71	1.0 %
2	46.31	53.31	2.0%
4	52.75	42.93	2.5%

6.3 Summary

Responses from residents indicate that the storm event occurred from approximately 16:00 – 16:30, with flooding to properties in Cemetery Road occurring from 16:30 to 16:40. This indicates a relatively rapid response of the catchment to surface water flows, which can be explained by the steep, urbanised characteristics of the catchment and impeded drainage of the soils and underlying geology.

7 Incident response

Several agencies responded to the flooding event in Binstead, including the Isle of Wight Council, Hampshire Police, Hampshire and Isle of Wight Fire and Rescue service, and Island Roads. A timeline of the incident response is given in Table 7-1.

The Met Office issued weather warnings corresponding with the period of flooding. These warnings were as follows:

- 23 July 2021, 15:00 to 23:59, yellow wind warning with a medium likelihood of low impacts
- 24 July 2021, 20:00 to 22:00, yellow thunderstorm warning with a low likelihood of medium impacts
- 25 July 2021, 09:00 to 23:59, yellow thunderstorm warning with a very low likelihood of medium impacts.

These warnings triggered a response within the Council and the Emergency Management team corresponded with Island Roads to check that the strategic sandbag stocks were full and accessible.

The Binstead Stream catchment is not covered by the Environment Agency's Flood Warning Service. The first response to the flooding was correspondence between the Isle of Wight Council and Island Roads when IWC made a request for sandbags to be delivered to The Fleming Arms on Binstead Road at approximately 12:58. Island Roads confirmed the delivery arrived at 17:00.

There were multiple road closures, enforced by Hampshire Police and the Fire Services, to Binstead Hill, Binstead Road, Ringwood Road and Cemetery Road, occurring across the afternoon. Throughout the day of the event, Island Roads responded with the delivery of sandbags and additional gully and street cleaning.

The emergency services were overwhelmed with calls concerning the flooding and their physical response was therefore limited. Incident calls were recorded to be received between 16:30 and 17:40 to which advice was given, and residents were told to protect their houses with the available sandbags and flood boards. The fire services responded to internal flooding to properties, where the water was pumped from houses on Cemetery Road, Binstead Hill, Binstead Road, Gordon Close and Stonelands Park between 16:58 and 19:45. Unfortunately the lower floors of the houses were deemed uninhabitable, and the residents were encouraged to find accommodation elsewhere.

Table 7-1: Timeline of incident response

Date	Time	Activity/event	Agency
25/07/2021	Afternoon	Highway flooding, fire services closed Binstead Hill	Hampshire Police
25/07/2021	Afternoon	Highway flooding, request for closure for Binstead Road and Ringwood Road	Hampshire Police
25/07/2021	16:00 – 16:30	Intense rainfall causes flooding to properties in Binstead	N/A
25/07/2021	16:52	Fire services request for road closure, Cemetery Road	Hampshire Police
25/07/2021	16:56	Pumping water out of multiple properties	Hampshire and Isle of Wight Fire & Rescue Service

25/07/2021	17:00	Sandbags delivered	Island Roads
25/07/2021	17:23	Highway flooding / tree down, Newnham Lane	Hampshire Police
25/07/2021	18:00 – 19:45	Multiple properties being pumped out, vulnerable residents involved	Hampshire and Isle of Wight Fire & Rescue Service
25/07/2021	19:45	Properties in Cemetery Road and Binstead Road, all ground level of housing deemed not inhabitable	Hampshire and Isle of Wight Fire & Rescue Service
26/07/2021	12:58	Sandbags delivery request sent to Island Roads by ward councillor	Ward Councillor (via IWC and Island Roads)
26/07/2021	16:05	Two pallets of sandbags delivered to the Fleming Arms	Island Roads
27/07/2021	Unknown	Additional flooding reported in Binstead	N/A

8 Source-pathway-receptor analysis

The Source-Pathway-Receptor model is a concept that can provide an understanding of all aspects of flood hazard. It breaks a flood incident down into three elements:

- Source - the origin of flood water
- Pathway - a route or means by which a receptor can be affected by flooding
- Receptor - something that can be adversely affected by flooding (e.g. people, property, infrastructure)

We analysed all of the information available to determine the main sources of the flood water, the pathways it took and the main receptors. These are summarised in Figure 8-1 and described in the following sections.

The majority of flooding in Binstead occurred along a single pathway and Source-Pathway-Receptor mapping and analysis has been produced for this. However, responses from residents also noted a number of more isolated flooding incidents resulting from the event, including properties in the following locations.

- Newnham Road;
- Dame Anthony's Close;
- Hamilton Road;
- Broadway Crescent;
- Verwood Drive.

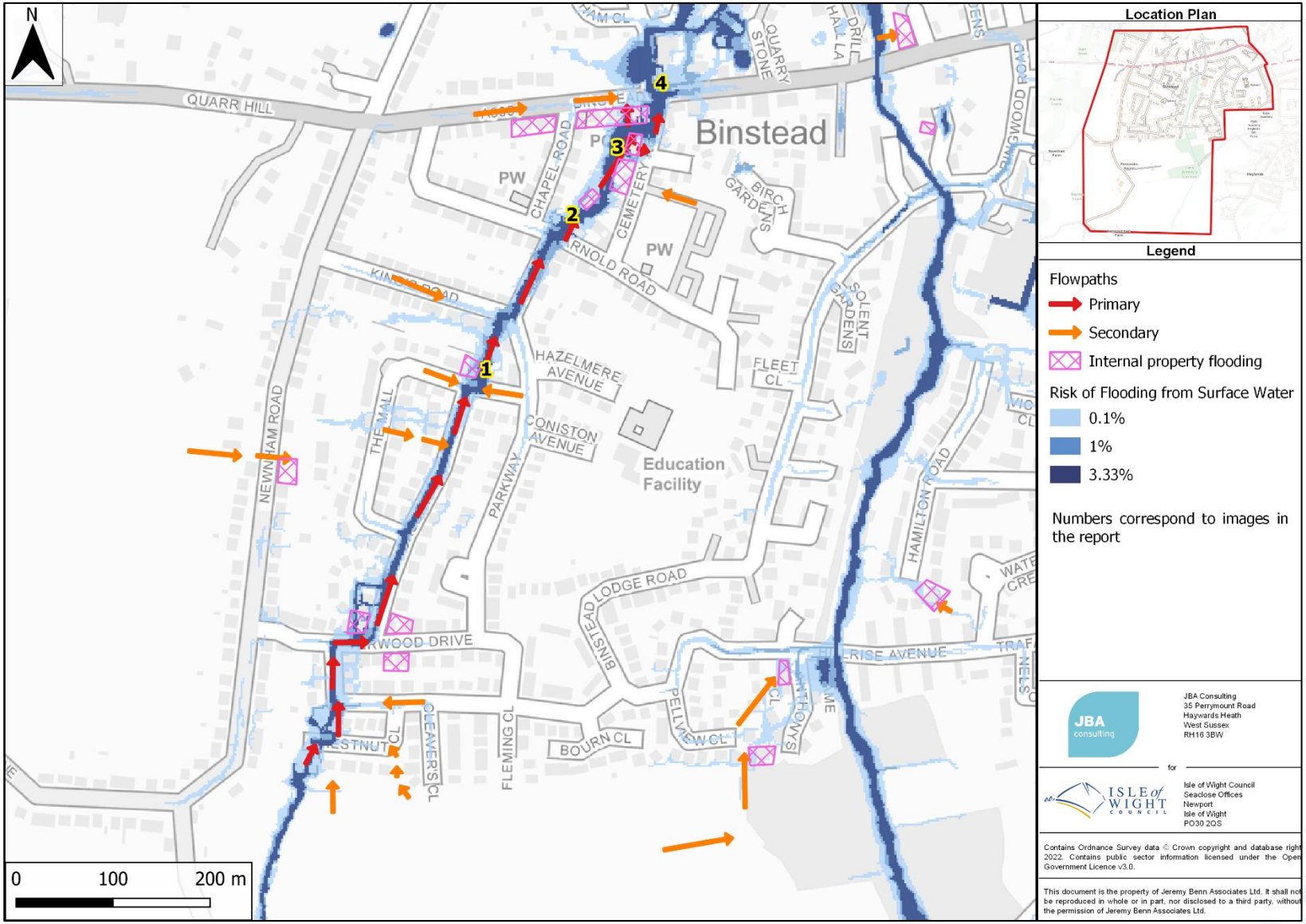

Figure 8-1: Map of sources, pathway and receptors for the west of the study area

8.1 Source

8.1.1 Extreme rainfall

The intense rainfall experienced in Binstead caused a large volume of water to fall directly onto the ground surface in the village, leading to diffuse sources of flooding. The flooding pathways are detailed in Section 8.2. Responses to the stakeholder engagement survey identify several problems with drainage as a source of flooding, with issues such as blockages and insufficient drainage generating surface water runoff and pooling.

Responses from residents indicated that the period of intense rainfall started at approximately 16:00 – 16:30. The responses have also identified surface water runoff from surrounding fields as a source of flooding. This includes the field to the west of Newnham Road and the fields north of the study area (behind Pellview Close and Chestnut Close).

8.1.2 Combined sewer

Due to the presence of foul sewage identified in the flood water, the sewer system is considered to have been an additional source of flooding. Based on the hydrological analysis from the event, hydraulic overload to this system likely took place as a result of extreme rainfall. This would have resulted in foul sewage emerging from the combined sewer manholes and mixing with flood water. However, this should be considered a secondary flood mechanism. Part of this combined sewer system is located to the rear of gardens along Cemetery Road and has also been described as a former watercourse or a culvert. It is unclear the extent to which this may have contributed to the flooding on 25 July 2021.

8.1.3 Binstead Stream

The Binstead Stream overtopped its banks on 25 July 2021. Responses to the stakeholder engagement survey identify the stream as a source of flooding into some residential gardens along Binstead Hill. However, this did not result in any internal property flooding and was a separate flood mechanism, which did not affect properties along Cemetery Road.

8.2 Pathway

Figure 8-1 demonstrates the pathways of the water during the flood event on 25 July 2021. Responses to the survey note that the flood water was fast flowing, and occurred between 16:00 and 18:00 approximately.

The main pathway for the flooding in Binstead originated in the fields behind Chestnut Close. The Risk of Flooding from Surface Water map (Figure 4 2) identifies pathways and pools in this area which reflect the flood pathway. In this pathway, roads, footpaths and gardens act as conduits for the flood water. Water was indicated to have flowed north through Verwood Drive and the Greenway, pooling at the junction of The Mall and Greenway before entering an alleyway and continuing to flow down the Sandpath (location 1, Figure 8-2).

Figure 8-2: Photograph showing significant pooling at the junction of The Mall and Greenway

Fast flowing water followed the topography, flowing around the sides and out the rear of a property on Arnold Close (location 2, Figure 8-3 and Figure 8-4) and through Gordon Close towards residential gardens along Cemetery Road (location 3, Figure 8-5). The majority of the flows pooled towards the bottom of Cemetery Road and on Binstead Hill (location 4, Figure 8-6).

Figure 8-3: Fast flowing surface water moving towards Gordon Close/ Cemetery Road

Figure 8-4: Photograph showing water flowing from Arnold Road into a driveway

Outside the main pathway, a number of other pathways relating to more isolated incidents of flooding in Binstead have been identified. In the south west, the flood water is understood from stakeholder responses to have flowed along the footpath (R113) towards Binstead Woods, into the adjacent field and then towards properties on Pellview Close through to Dame Anthony's Close. In the north of the study area, three pathways have been identified. The overtopping of Binstead Stream resulted in flood water moving into adjacent gardens, whilst surface water runoff from Broadway Crescent flowed into gardens and properties as the water flowed in a northernly direction, with the sloping elevation.

Figure 8-5: Photograph showing the flow of water through a fence into a garden on Cemetery Road

Figure 8-6: Flooding on Binstead Hill at the junction of Cemetery Road

8.3 Receptor

Responses from residents indicate that flooding occurred between 16:30 – 16:40, which indicates a rapid response of the catchment to the rainfall event, with residents having little warning time to prepare for the event.

8.3.1 People

Flooding in this area has become a frequent issue and many of the responses from residents have indicated previous flooding issues, although not of the same severity. The flooding has had detrimental effects on the residents and their wellbeing.

A number of residents who responded to the stakeholder engagement survey indicated that the flood waters contained foul sewage. Some residents have experienced physical health issues due to the flooding event and the foul sewer contamination, including breathing problems. Residents have recorded experiencing back pain and fatigue caused by moving sandbags and belongings, emptying water from their houses and from the intense cleaning that was required after the flood subsided.

The responses from the stakeholder engagement survey describe the stress and impact on mental health that has occurred due to flooding. Residents are stressed about future flooding events with many explaining their anxiety, with worry related to rain, as well as depression and loss of sleep. Residents have kept sandbags and flood boards permanently outside their homes in response to the flooding, as seen on the site visit on 21 October 2021.

A major impact of the flooding has been the disruption to normal lives experienced by the residents. Residents have had to move out of their homes into alternative accommodation, either temporary or permanently. This includes vulnerable residents who cannot stay in their homes whilst repairs are being carried out. People have lost carpets, floorboards, furniture, and belongings from the ground floor of their properties. The damage to the ground level rooms of houses has meant that many have lost the use of their kitchens and are having to rely on limited amenities to cook, such as microwaves and kettles.

Financial issues have also been experienced, in terms of insurance. Residents have identified that they are either no longer eligible for insurance or the cost of insuring their properties has been increased to an unattainable price.

8.3.2 Property

Internal flooding to at least 20 residential properties and one non-residential property was recorded for the flood event on 25 July 2021. It is suspected that additional properties flooded during the event, although it is not possible to confirm this. Responses to the survey and information provided by the emergency services imply that the flooding lasted for over two hours, with flood depths reaching between 250mm and 600mm inside properties.

Damage to ground floor rooms and garages has been recorded, the repairs of which were expected to take over three months to complete. Structural damage has been recorded with the flow of water breaking down gardens walls and scouring footpaths. Further properties were affected by external flooding, with impacts seen in gardens, garages and driveways. External flood depths were recorded to have reached between 150mm and 1m.

8.3.3 Infrastructure

The flooding event led to multiple road closures, including the following roads as reported by the emergency services:

- Binstead Hill
- Binstead Road
- Cemetery Road

- Ringwood Road

The flooding to the roads meant residents could not leave their homes, as the roads became unpassable. Damage and blockages on roads were also recorded, with Newnham Road and Quarr Hill both blocked by fallen tree branches. Additionally, Newnham Road suffered surface damage due to the flooding.

8.3.4 Services

The flooding led to the closure of local business, including the village post office and the The Fleming Arms public house. This led to disruption to public amenities and impacted local businesses at a time when they were vulnerable to the economic impacts resulting from the COVID-19 pandemic.

9 Capacity review

Southern Water's sewer records were reviewed to understand whether a lack of capacity in the surface water sewer system could have contributed to the flooding.

9.1 Review of sewer network

A review of Southern Water's sewer network indicates that the majority of sewer systems in Binstead are combined, although parts of the upper catchment including Verwood Drive the Greenway are served by separate surface water and foul sewer networks. The highway drainage system also appears to discharge to the combined sewer network, particularly in Arnold Road, Cemetery Road and Binstead Hill.

An initial review of Southern Water's sewer network data indicates that there is a combined sewer (300mm diameter), running under properties in Cemetery Road, this would accept both foul and surface water flows, however Southern Water has not formally confirmed that this is correct.

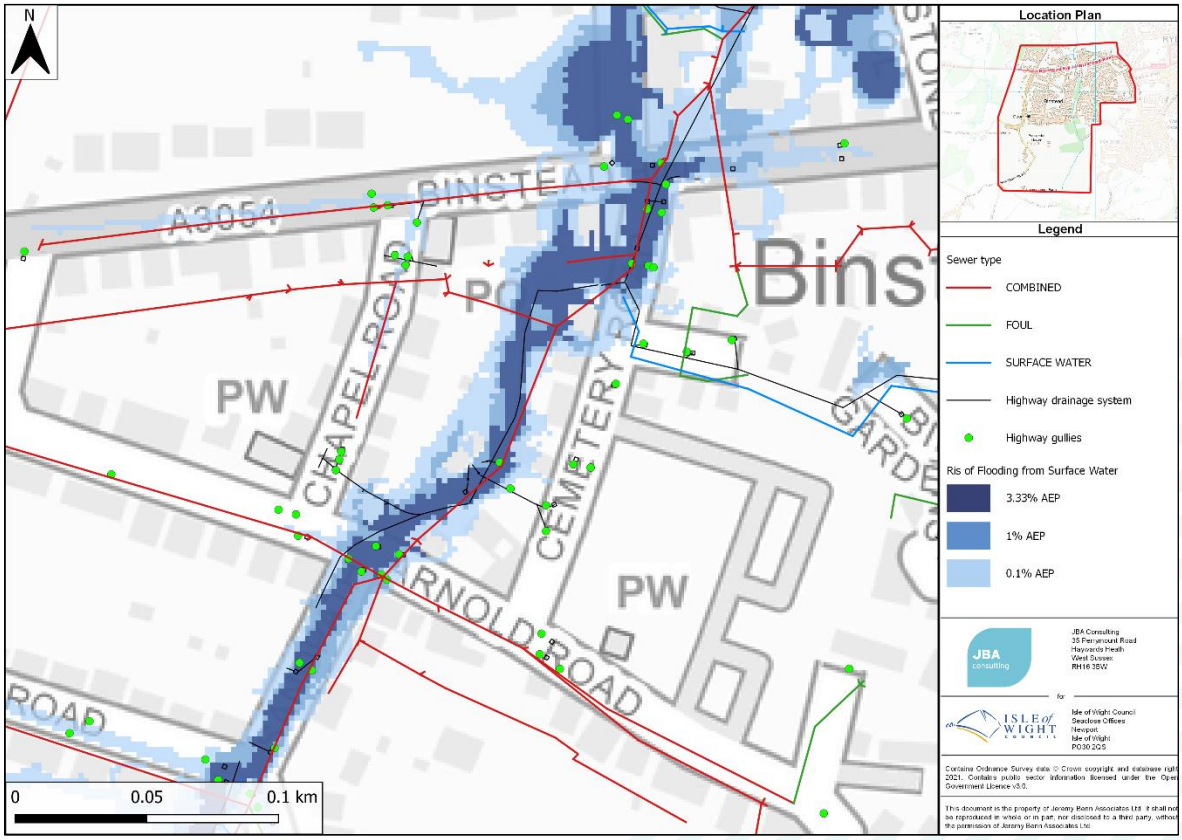

Figure 9-1: Sewer network and highways drainage system around Cemetery Road

9.2 Review of capacity

Information from Southern Water indicates that there have been previous issues with surface water drainage in Binstead, which includes 25 reported issues between 2015-2020 in the PO33 3 postcode. However, further details regarding the nature of these issues are unknown. A list of roads in Binstead with historic capacity issues has also been provided, this includes:

- Binstead Road (July 2021)
- Cemetery Road (February 2009, August 2021, December 2021);
- Gordon Close (July 2021)

The capacity issues in Binstead Road and Gordon Close are noted to have occurred on 25 and 27 July respectively, which is on the day of the event and immediately after. This may indicate that there were issues with the combined sewer system during and following the event. Responses to the stakeholder survey indicate that flood water contained foul sewage, which is a risk to health and is also indicative of exceedance of the combined sewer system.

The **Design and Construction Guidance**[8] for foul and surface water sewers has been reviewed to determine typical sewer design standards. This indicates that modern surface water sewer systems are designed to convey flows from 1 in 30-year rainfall events without flooding. It should be noted that these are present day design standards and older surface water sewer systems would not have been designed to meet these design standards. As a result, older sewers would be less able to cope with significant flows in comparison to more recently designed sewers.

9.3 Conclusions

As outlined in Section 6, the rainfall event on 25 July 2021 had a rarity of between a 1 in 42 and a 1 in 110-year event (approximately 1% – 2.5% annual probability of occurrence), which is an extreme rainfall event. Whilst Southern Water have reported capacity issues, this is to be expected considering the volume of rainfall that fell on Binstead as well as the fact that the sewer system is combined and accepts both surface water and foul flows, including discharges from the highway drainage system.

Based on the presence of foul sewage in flood water in Cemetery Road, it has been ascertained that hydraulic overload of the combined sewer system occurred during the event, which resulted in foul sewage emerging from the system and mixing with surface water runoff.

Disconnecting surface water flows from the combined system would likely improve the existing situation through providing additional sewer capacity. It may also reduce the risk of foul flooding or during extreme events.

8 Design and Construction Guidance (Appendix C): https://www.water.org.uk/wp-content/uploads/2020/03/SSG-App-C-Des-Con-Guide-v-2-100320-C.pdf

10 Discussion, appraisal and recommendations

10.1 Introduction

We undertook a high-level option appraisal focussing on benefit, practical and viability considerations. We carried out a multi-criteria analysis to compare each option, which included consideration of relative costs and timescales, buildability, health safety and environment, stakeholder perceptions and public acceptability, land ownership etc. This included consideration of:

- Contribution towards reducing flood risk to property
- Contribution towards reducing flood impacts on people/communities
- Contribution to improving the availability of data, evidence and modelling to support option development or flood incident response
- Deliverability (including construction complexity, access, designations, services, space, land ownership, available materials and expert equipment or advice required)
- Community / resident acceptability
- Contribution towards biodiversity and water quality betterment
- Contribution towards amenity benefits
- Contribution to carbon reduction
- Maintenance requirements

Relative costs and timescales have been provided for information only and are not included in the scoring. The scoring criteria and full results are described in more detail in Appendix B. Options with a score of 7 or above were taken forward to become recommendations.

It is important to note that this is a high-level, preliminary assessment undertaken by and on behalf of Isle of Wight Council. Therefore, it is for the relevant responsible body or persons to assess these recommendations in terms of their legal obligation, resource implications, priority and the costs and benefits of undertaking such options.

In particular, where taking forward a recommendation is likely to be reliant on securing grants from central government to fund the project[9], significant further work by the responsible organisation will be required to assess the costs/benefit of the proposals, and consideration will need to be given to the timing and availability of funding. This is likely to be the case for the recommendations within this section. For such projects to be taken forward to design and construction, a business case may need to be made into a national programme, with the success of the bids dependent on the following:

- Any works are cost beneficial and financially viable
- The works will provide a sufficient level of benefit for the residents at flood risk
- Any project has considered all sources of flood risk
- The project does not increase flood risk to others (people, property, business)
- The works do not cause environmental harm
- Any proposals are accepted by the community and residents

Based on the identified causes and mechanisms of flooding, we have considered the following options.

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9 For further information regarding funding of flood risk management, please see: https://www.local.gov.uk/topics/severe-weather/flooding/paying-flood-and-coastal-erosion-risk/funding-arrangements

10.2 Investigate condition and capacity of the watercourse in Cemetery Road

There is evidence that there may have been a former open watercourse running through the rear of gardens along Cemetery Road, from conversations with residents and historic mapping. Information provided by the Environment Agency (Appendix A) indicates that this is culverted along much of its length, including under Arnold Road although there may be a section of open channel in the rear gardens of Cemetery Road before it enters a culvert. Our site visit was unable to establish this and there is significant uncertainty as to the present condition and capacity of this system.

The 2015 Ryde Surface Water Management Plan identified the need to liaise with landowners on Cemetery Road to discuss improvements to the culverted stream. It is unknown whether this was undertaken, and it is recommended that investigating the current extent, condition and capacity of this system could help Risk Management Authorities to identify further options for potential improvements. Much of this system runs along rear gardens in Cemetery Road and gaining access to private property would need to be a consideration.

10.3 Appraise the feasibility of providing flood attenuation upstream

Incorporating flood storage upstream of the affected properties could slow down surface water flows and reduce the impacts of flooding in Binstead. This could include the use of Sustainable Drainage Systems (SuDS) such as rain gardens, basins or underground storage tanks to intercept and temporarily store flows during extreme rainfall events, reducing the impact of these events on existing drainage systems.

A scheme utilising flood storage within a single location or multiple storage features could be taken forward and assessed in terms of feasibility. This is likely to be a relatively expensive option due to construction costs and the need to undertake surveys.

The location of storage features would be important to consider, with regard to the steep topography and urbanised catchment. Land ownership and maintenance requirements would also be issues to consider. The **Ryde Surface Water Management Plan**[10] (SWMP) considered a number of options to mitigate flood risk in Binstead. Based on the flooding that occurred during the 25 July 2021 event (as outlined in Section 8), a series of flood attenuation options which could potentially mitigate the risk of a similar flood event occurring in the future, are summarised in Sections 10.3.1 and 10.3.110.3.2.

10.3.1 Rain gardens along the Greenway

This option was identified and modelled in the Ryde SWMP (option 5) 'Investigate the potential of using rain gardens along Greenway to reduce the flow path down Greenway and reduce surface water flooding in Binstead'. Rain gardens could potentially reduce the volume of flow entering the surface water network, mitigate flooding at Cemetery Road/Binstead Hill and The Mall, and enhance the appearance of streetscape. This option includes the potential for rain gardens to be installed along the Greenway, which has wide verges potentially suitable for such a scheme. As this was the location of a primary flow path, rain gardens on the Greenway could have an impact in mitigating flood risk to properties in Cemetery Road, further down the catchment.

10 Ryde Surface Water Management Plan (May 2015): https://www.google.com/search?q=ryde+swmp&rlz=1C1GCEU_en-GBGB903GB903&oq=ryde+swmp&aqs=chrome.0.69i59l2j69i64j69i60.1575j0j7&sourceid=chrome&ie=UTF-8

Figure 10-1: The Greenway looking south

10.3.2 Underground storage tanks along The Mall to Sandpath footpath

This option was identified and modelled in the Ryde SWMP (options 4 and 4a) with Island Roads considering installation of an attenuation storage tank beneath the footpath connecting The Mall to the Sandpath. This could potentially reduce flows in the surface water network and mitigate flooding along Cemetery Road and Binstead Hill.

This option would likely require more ongoing investment and involvement from Island Roads and Southern Water as underground storage tanks require more specialised maintenance regimes than rain gardens and other above ground SuDS features, which can often be included within existing landscaping maintenance schedules.

Figure 10-2: The footpath looking south towards Greenway

10.4 Appraise the feasibility of providing additional sewer capacity

10.4.1 Upgrade existing sewer capacity

It appears unlikely that the existing combined sewer system has the capacity to manage flows from highways drainage, in addition to surface water runoff and foul flows from development. The existing combined sewer could be upgraded to improve its capacity.

There would be a number of constraints to this approach, including significant, lengthy disruption to the roads, and the re-routing of the various below ground services which cross the sewer network. Much of the sewer system runs in rear gardens along Cemetery Road, and gaining access to private property would also be a consideration. A full survey of below ground services would be required and the presence of services would influence the cost of the works. However, upgrading the sewer would also have water quality benefits as it would reduce the potential for foul flooding entering surface water runoff and watercourses.

10.4.2 Disconnecting roof water drainage

Disconnecting existing rainwater downpipes and redirecting surface water runoff into rain gardens, above ground water butts or underground rainwater harvesting tanks, could relieve pressure on the existing combined sewer network throughout Binstead and provide sustainability benefits as a result of water re-use.

Rainwater can be reused for non-potable purposes such as gardening, toilet flushing and car washing through the use of water butts. They can be provided in different shapes and sizes, and can be incorporated into a variety of settings. Rainwater harvesting tanks are typically larger and stored underground with a pumped system to allow water re-use. As

their capacity is dependent on the re-use of water, both systems should be designed with an overflow to discharge excess water through infiltration or connection to a downstream drainage component.

It should be noted that Southern Water has a storm overflow task force and 'pathfinder project' that is looking at ways to separate surface water flows from the foul sewer system. Southern Water is engaging with Risk Management Authorities including Isle of Wight Council to do this.

10.5 Property Flood Resilience

Responses to the stakeholder engagement survey indicate that properties in Binstead Hill and Cemetery Road flooded internally to depths of between 250mm – 600mm and that this flooding occurred rapidly. It has also been ascertained that many of these properties have previously flooded as a result of surface water runoff. Property Flood Resilience (PFR) can provide effective resistance and resilience to flooding at an individual property level. Measures such as flood doors, flood barriers, automatic airbricks and non-return valves can help to reduce the impact of future floods, by aiming to limit water entry (resistance). Alternatively, the internal fabric of the property can be adapted to limit damage when water enters (resilience).

Although resistance measures are not able to entirely prevent flood water ingress, they aim to limit damage and ensure properties are adapted to cope with the impacts of floods and recover quickly from these disruptive events. They are generally significantly lower in cost than resilient adaptation works to the property fabric itself, whereby flood water entering a property would lead to minor or no damage. While constraints of both approaches include funding, homeowner willingness and individual property structural risks, the lower cost and less invasive resistance measures will often meet business case cost/benefit approval for Government funding support for community schemes in areas where flood risk is high.

It should be noted that taking forward a Property Flood Resilience scheme at Binstead is likely to be reliant on securing grants from central government to fund the project[11]. Further work will be required to assess the suitability of the properties for installation of Property Flood Resilience measures, costs/benefit of the proposals, and consideration will need to be given to the timing and availability of funding.

10.6 Community flood preparedness

It is understood that there was formerly a Binstead Flood Action Group, which was a community group intended to help share information and provide support during flooding. Residents (with support from Isle of Wight Council) could look to reform this community flood group. Emergency flood packs containing advice on emergency contact numbers and steps to take before, during and after a flood could also be created. Once re-established, the group could apply for community group funding to purchase communal flood resilience measures (such as flood barriers or boards, pumps, inflatable barriers etc.) that can be deployed to areas at risk of flooding during an event. The Emergency Management Team are currently working with the local Councillor to produce a Community Flood Action Plan which will aim to inform residents how to prepare for, respond to and recover from flooding.

It has been established that Binstead is at clear risk of flooding with a rapid catchment response to rainfall giving residents limited warning. The Emergency Management Team and residents may wish to consider storing sandbags and other equipment in a convenient local place for emergency use. This may help improve preparedness to flooding and help enable a faster response.

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11 For further information regarding funding of flood risk management, please see: https://www.local.gov.uk/topics/severe-weather/flooding/paying-flood-and-coastal-erosion-risk/funding-arrangements

10.7 Improved asset mapping

It is evident that there are uncertainties regarding the extent and capacity of the culverted watercourse/sewer in the rear gardens along Cemetery Road. Poor understanding of existing assets can lead to potential issues, such as lack of ownership and maintenance, which can cause or exacerbate flooding issues if left unaddressed. As a result, it is recommended that additional surveying and mapping of drainage assets at Cemetery Road is undertaken to ensure that the location and ownership of all drainage assets, as well as the maintenance requirements, is known. This will also help risk management authorities to identify the significance of their assets in flood risk terms, enabling them to better prioritise maintenance.

10.8 Raising kerb levels

During the site visit, a number of kerbs along Cemetery Road, Gordon Close and Arnold Close were noted to have been very near to pavement level, and may have aided in the conveyance of flood water off the road network during the event. It is recommended that the potential for raising these kerb levels is investigated in select locations throughout Binstead, as this may help limit the conveyance of water toward property.

Figure 10-3: Low kerb levels along Cemetery Road

11 Conclusions and recommendations

11.1 Conclusion

The flooding that occurred in Binstead on 25 July 2021 caused internal flooding to at least 20 properties. It is suspected that more properties flooded during the event, although it is not possible to confirm this. Isle of Wight Council, as the Lead Local Flood Authority for Binstead, has exercised their power to undertake a Section 19 investigation, as the event fulfilled its criteria of 'significant flooding'. The council has appointed JBA Consulting to undertake this investigation on its behalf.

Analysis of rain gauge and rainfall radar data from the storm event that affected Binstead on 25 July 2021, indicates that the storm was likely to have been between a 1 in 42 and a 1 in 110-year event. This can be expressed as a storm event with approximately a 1% - 2.5% probability of occurrence in any given year. Therefore, the storm event was an extreme rainfall event, with a large volume of rainfall occurring in a relatively short amount of time.

Responses from residents indicate that the storm event occurred between approximately 16:00 – 16:30, with flooding to properties in Cemetery Road occurring from 16:30 to 16:40. This indicates a relatively rapid response of the catchment to rainfall, and can be explained by the urbanised steep characteristics of the catchment and impeded drainage of the soils and underlying geology.

The intense rainfall experienced in Binstead caused a large volume of water to fall directly onto the ground surface in the village, which led to diffuse sources of flooding, the pathways of which are detailed in Section 8.2. Responses to the stakeholder engagement survey identify several problems with drainage as a source of flooding, with issues such as blockages and insufficient drainage generating surface water runoff and pooling. Due to the presence of foul sewage in flood waters, the combined sewer system is also considered to have been a secondary source of the flooding. The Binstead Stream is also noted to have overtopped, however this did not lead to any internal property flooding.

The main flood pathway in Binstead originated in the fields behind Chestnut Close. In this pathway, roads, footpaths and gardens acted as conduits for the flood water. Water was indicated to have flowed northwards through Verwood Drive and the Greenway, pooling at the junction of The Mall and Greenway before entering an alleyway and continuing to flow down the Sandpath. Fast flowing surface water runoff followed the topography, flowing around the sides and out the rear of a property on Arnold Close and through residential gardens along Cemetery Road. The majority of the flows pooled towards the bottom of Cemetery Road and on Binstead Hill, causing flooding to at least twenty properties along Cemetery Road and Binstead Hill.

The emergency services were overwhelmed with calls concerning the flooding and their physical response was therefore limited. Incident calls were recorded to be received between 16:30 and 17:40, to which advice was given, and residents were told to protect their houses with the available sandbags and flood boards. The fire services responded to internal flooding to properties, where the water was pumped from houses on Cemetery Road, Binstead Hill, Binstead Road, Gordon Close and Stonelands Park between 16:58 and 19:45. Unfortunately the lower floors of the houses were deemed uninhabitable, and the residents were encouraged to find accommodation elsewhere.

The responses from the stakeholder engagement survey describe the stress and impact on mental health that has occurred due to flooding. Residents are stressed about future flooding events, resulting in anxiety, depression and loss of sleep. Residents have kept sandbags and flood boards outside their homes in response to the flooding, as seen during the site visit on 21 October 2021.

A major impact of the flooding has been the disruption to normal lives experienced by the residents. Residents have had to move out of their homes into alternative accommodation,

either on a temporary or permanent basis. This includes vulnerable residents who cannot stay in their homes whilst repairs are being carried out. People have lost carpets, floorboards, furniture, and belongings from the ground floor of their properties. The damage to the ground level rooms of houses has meant that many have lost the use of their kitchens and are having to rely on limited amenities to cook, such as microwaves and kettles.

A review of Southern Water's sewer network indicates that the majority of sewer systems in Binstead are combined. The highway drainage system also appears to discharge to the combined network, particularly in Arnold Road, Cemetery Road and Binstead Hill. The watercourse running through the rear of gardens along Cemetery Road, from conversations with residents and historic mapping likely played a role in the flooding that occurred. There were also capacity issues noted by Southern Water in Cemetery Road in the days following the event.

However, as an extreme rainfall event (between a 1 in 42 to 1 in 110-year event), the combined sewer system would not have been able to accommodate this event, as modern sewers are typically designed to a 1 in 30-year design standard. It should be noted that these are present day design standards and older surface water sewer systems would not have been designed to meet these design standards.

11.2 Recommendations

JBA undertook a high-level option appraisal focussing on benefit, practical and viability considerations. We carried out a multi-criteria analysis to compare each option which included consideration of relative costs and timescales, buildability, health safety and environment, stakeholder perceptions and public acceptability, land ownership etc. This was used to develop recommendations to mitigate flood risk in Binstead.

The conclusions on which recommendations to consider taking forward are presented below, based on the results of the multi-criteria analysis. Options with a score of less than 7 have been discounted and the full list of assumptions and criteria used in this assessment are provided in Appendix B.

The long list options which scored the highest were providing rain gardens along the Greenway or providing underground storage tanks along the Mall to Sandpath footpath. Other high scoring options were investigating the extent of the culvert in Cemetery Road, developing a Property Flood Resilience scheme and wider community flood resilience.

Table 11-1: Recommendations from the Binstead Section 19 Investigation

Recommendation	Organisation(s) responsible	Multi-criteria analysis score	Timescale
Rain gardens along the Greenway	Isle of Wight Council/ Island Roads	10	1 – 5 years
Underground storage tanks along the Mall to Sandpath footpath	Isle of Wight Council/ Island Roads	10	1 – 5 years
Investigate condition and capacity of the watercourse in Cemetery Road	Isle of Wight Council/ Southern Water	9	< 1 year
Property Flood Resilience (PFR) Scheme	Isle of Wight Council	7	1 – 5 years
Community flood resilience	Isle of Wight Council/ Flood Action Groups	7	< 1 year

Appendices

A Environment Agency information

Binstead- Open Watercourse

Environment Agency

Legend

- Statutory Main Rivers
- Detailed River Network
  - Primary River
  - Secondary River
  - Tertiary River
  - Lake / Reservoir
  - Canal
  - Canal Tunnel
  - Extended Culvert
  - Multiple Channel Culvert
  - Underground River (potential sewer)
  - Underground River (inferred)
  - Underground River (local knowledge)
  - Undefined
- Offline Drainage features

1: 1,250

0 31

Metres

N W E S

Binstead- Southern Water Combined (red)

Environment Agency

Legend

- Hostile sites
- Southern Water sewer manholes
  - Combined
  - Foul
  - Surface Water
  - Other/Not Defined
- Southern Water sewer network
  - Combined
  - Foul
  - Surface Water
  - Other/Not Defined
- Statutory Main Rivers
- Detailed River Network
  - Primary River
  - Secondary River
  - Tertiary River
  - Lake / Reservoir
  - Canal
  - Canal Tunnel
  - Extended Culvert
  - Multiple Channel Culvert
  - Underground River (potential sewer)
  - Underground River (inferred)
  - Underground River (local knowledge)
  - Undefined
- Offline Drainage features
- Live Flood Warnings (Points)
  - Severe Flood Warning
  - Flood Warning
  - Flood Alert

1: 1,250

0 31

Metres

N W E S

B Multi-criteria analysis methodology

As part of the Binstead Section 19 flood investigation, a quantitative assessment was carried out on the long list options, to compare their relative benefits and limitations. The scoring was informed by site conditions, site visit observations and discussions within stakeholders.

The scores were totalled, with:

- A negative score meaning the option has high constraints or meets fewer objectives.
- A score of 0 meaning the option had a neutral impact
- A positive score meaning benefits outweigh constraints and the intervention meets more objectives. The larger the positive score, the more beneficial the scheme.

Table 11-2: Criteria used to assess long list options

Multi-criteria analysis category	Assessment criteria
Contribute towards reducing flood risk to property	Increase in flood risk to any property
	No perceived change
	Reduction in flood risk to property
Contribute toward reducing flood impacts on people/communities	Major / minor negative change in flood impacts on people/communities
	No perceived change
	Minor / medium / major positive change in flood impacts on people/communities
Contribute to improving the availability of data, evidence and modelling to support option development or flood incident response	Does not improve the availability of data, evidence and modelling
	Will provide additional data, evidence or modelling, helpful in development of interventions
	Improvement to data, evidence and modelling which is essential to the development of a capital scheme
Deliverability	Deliverability is at high risk of complexity/constraints
	Not known/not applicable
	Deliverability is at low risk of complexity/constraints
Community / resident acceptability	Community/residents are likely to have objections
	No known objections / constraints
	Community/residents are likely to be receptive and have no constraints

Multi-criteria analysis category	Assessment criteria
Contribute towards biodiversity and water quality betterment	Significant detriment
	No perceived change
	Significant betterment
Contribute towards amenity benefits	Significant detriment
	No perceived change
	Significant betterment
Contribute to carbon reduction	Significant net carbon increase
	Not known/no effect
	Significant net carbon reduction
Maintenance	High cost/frequency maintenance, requires new and specialised maintenance routines
	Not known/no effect
	No active maintenance required (passive maintenance designed)
Timescale	Long term strategic aim (>10yrs to progress, funding route unclear)
	Likely to be able to progress in next 1 – 5yrs
	Quick win (<1yr)
Cost	>£2m
	£500 - £1m
	<£100k

B.1 Long-list options results

An overview of the multi-criteria analysis results is shown in **Table 11-3**, with the full results shown in Table 11-4.

The long list options which scored the highest were providing rain gardens along the Greenway or providing underground storage tanks along the Mall to Sandpath footpath. Other high scoring options were investigating the extent of the culvert in Cemetery Road, developing a Property Flood Resilience scheme and wider community flood resilience.

Doing nothing was the least beneficial option with a score of -3, followed by business as usual. It should be noted that disconnected roof water drainage and improved asset mapping were also low scoring options, this mostly due to the fact these options would not result in a significant reduction in flood risk to affected properties.

Options to upgrade the existing sewer capacity also did not score highly enough, this is due to the various disruptions caused by upgrading the sewer system in an urbanised area and the lack of wider benefits.

As the flooding experienced in Binstead on 25 July 2021 was strongly linked to surface water flows, it is recommended that the flood attenuation options are explored in further detail in order to mitigate future surface water flooding.

Due to the presence of foul sewage in flood waters there is a connection between the flooding that occurred and sewer capacity, although the extent of this issue is unknown. It is recommended that the condition of the culvert to the rear of Cemetery Road is investigated to establish its condition and capacity.

Table 11-3: Multi-criteria analysis total scores for long list options

Reference	Option	Lead RMA / organisation	Multi-Criteria Analysis Total Score
1	Do nothing	N/A	-3
2	Business as usual	N/A	1
3	Rain gardens along the Greenway	Isle of Wight Council/ Island Roads	10
4	Investigate condition and capacity of the watercourse in Cemetery Road	Isle of Wight Council/ Southern Water	9
5	Property Flood Resilience (PFR) Scheme	Isle of Wight Council	7
6	Community flood resilience	Isle of Wight Council/ Flood Action Groups	7
7	Underground storage tanks along the Mall to Sandpath footpath	Isle of Wight Council/ Island Roads	10
8	Upgrade existing sewer capacity	Southern Water	6
9	Improved asset mapping	Isle of Wight Council/ Southern Water/ Island Roads	4
10	Disconnecting roof water drainage	Southern Water	3
11	Alterations to kerb levels	Isle of Wight Council (Island Roads)	6

Table 11-4: Full multi-criteria analysis results

			1	2	3	4	5	6	7	8	9	10	11	
Reference	Opportunities	Lead RMA	Flood risk benefit to property	Flood impact on people	Data and evidence	Deliverability	Community/ resident acceptability	Biodiversity and water quality betterment	Amenity benefits	Carbon reduction	Maintenance costs	Timescale	Cost (for information only)	TOTAL
1	Do nothing	N/A	-2	-2	0	0	-1	0	0	0	2	0	5	-3
2	Business as usual	All	0	0	0	0	0	0	0	0	1	0	5	1
3	Rain gardens along the Greenway	Isle of Wight Council/ Island Roads	2	4	0	-2	2	1	1	1	1	3	3	10
4	Investigate extent of culvert in Cemetery Road	Isle of Wight Council/ Southern Water	0	0	5	2	2	0	0	0	0	5	5	9
5	Property Flood Resilience (PFR) Scheme	Isle of Wight Council	2	4	0	0	1	0	0	0	0	3	4	7
6	Community flood resilience	Isle of Wight Council/ Flood Action Groups	0	4	0	1	2	0	0	0	0	5	5	7
7	Underground storage tanks along the Mall to Sandpath footpath	Isle of Wight Council/ Island Roads	2	4	0	-1	2	1	0	1	1	3	3	10
8	Upgrade existing sewer capacity	Southern Water	3	3	0	-2	1	1	0	0	0	1	1	6
10	Improved asset mapping	Isle of Wight Council/ Southern Water/ Island Roads	0	0	2	2	0	0	0	0	0	5	5	4
11	Disconnecting roof water drainage	Southern Water	0	1	0	1	1	0	0	0	0	5	5	3
13	Alterations to kerb levels	Isle of Wight Council (Island Road	1	1	0	2	2	0	0	0	0	5	5	6

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