

Proposed Retirement Living Apartments & Retail
Space

Water Lane, Angmering, West Sussex

Flood Risk Assessment for Proposed Development

Prepared for

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1.0 INTRODUCTION AND DEVELOPMENT DESCRIPTION

1.1 Project Introduction and Objectives

WFBA Consulting Civil & Structural Engineers, have been commissioned by McCarthy & Stone, to undertake a Flood Risk Assessment (FRA) to support the proposed development of a mixed-use residential and retail development off Water Lane, Angmering, West Sussex. This document represents a site-specific FRA for the proposed development.

1.2 Planning Policy and Guidance

This Flood Risk Assessment has been undertaken with due regard to the following national and local planning policy and flood risk guidance.

1.2.1 National Planning Policy

The National Planning Policy Framework (NPPF)¹ and associated Planning Practice Guidance for Flood Risk² aim to steer new development to areas with the lowest risk of flooding.

New development must also ensure that flood risk is not increased elsewhere, and where appropriate, planning applications should be supported by a site-specific Flood Risk Assessment.

The NPPF recommends that development should only be allowed in areas at risk of flooding where the FRA (and the sequential and exception tests, as applicable) can demonstrate that:

- a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location.
- b) the development is appropriately flood resistant and resilient.
- c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate.
- d) any residual risk can be safely managed; and
- e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

The guidance confirms that major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate.

1.2.2 Environment Agency Policy and Guidance

The Environment Agency's guidance for FRAs³ confirms that planning applications for the following development proposals must be supported by a FRA:

- ¿ Development in Flood Zone 2 or 3 including minor development and change of use
- ¿ Development sites of more than 1 hectare (ha) in Flood Zone 1
- ¿ Development sites 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)
- ¿ Development in an area within Flood Zone 1 which has critical drainage problems as notified by the Environment Agency.

The Agency's guidance supports the NPPF and specifies the requirements for FRAs based on the level of flood risk and the vulnerability of the proposed development to flooding.

In addition, Environment Agency consent is required for any proposed works or structures, in, under, over or within eight metres of the top of the bank of the watercourse, designated a 'main river', (or sixteen metres in the case of a tidal watercourse).

1.2.3 Local Policy and Guidance

The following documents provide local flood risk policy and guidance for development within the village of Angmering, West Sussex:

- ¿ Arun District Council's 2016 Level 1 and Level 2 Strategic Flood Risk Assessment (SFRA)⁴ details the local hydrology, reviews all potential sources of flooding across the region and the implications for development.
- ¿ Environment Agency's 2012 Lower Tidal River Arun Strategy Environmental Report sets out the proposed approach to flood risk management within the region for the next 100 years.
- ¿ Arun District Council's Local Plan 2011-2031 (Adopted July 2018) outlines relevant planning policy and the opportunities and constraints for development. Policy W DM2 - Flood Risk includes the following relevant statements:

Development in areas at risk from flooding, identified on the latest Environment Agency flood risk maps and the Council's Strategic Flood Risk Assessment (SFRA), will only be permitted where all of the following criteria have been satisfied:

- a. The sequential test in accordance with the National Planning Policy Guidance has been met.
- b. A site specific Flood Risk Assessment demonstrates that the development will be safe, including access and egress, without increasing flood risk elsewhere and reduce flood risk overall.
- c. The sustainability benefits to the wider community are clearly identified.
- d. The scheme identifies adaptation and mitigation measures.
- e. Appropriate flood warning and evacuation plans are in place; and
- f. New site drainage systems are designed to take account of events which exceed the normal design standard i.e. consideration of flood flow routing and utilising temporary storage areas.

In addition, Arun District Council's 2019 Surface Water Drainage Proposals Checklist (Version 3.0), outlines the expectations and requirements for sustainable surface water drainage design in the region, and has informed the proposed drainage strategy for the development.

¹ Ministry of Housing, Communities & Local Government, February 2019, National Planning Policy Framework.

² Ministry of Housing, Communities & Local Government, March 2014, Planning Practice Guidance, Flood Risk and Coastal Change.

³ Environment Agency, March 2014 (updated February 2017), Guidance - Flood Risk Assessments if you're applying for planning permission.

⁴ JBA Consulting, November 2016, Arun District Council Level 1 and Level 2 Strategic Flood Risk Assessment. Final Report.

1.3 Site Location

The application site is located off Water Lane, Angmering, West Sussex BN16 4DS, as shown on the Site Location Plan within Figure 1. The application site comprises the former Chandlers BMW car showroom, workshop and offices with associated access and parking. The site is located within the centre of the village of Angmering, approximately 5km east of Littlehampton and 3km north of the English Channel coast. The site is within a predominantly residential setting.



Figure 1. Site Location Plan

Black Ditch (classified as a main river) is culverted beneath Water Lane adjacent to the site and flows in a west-south-westerly direction to its confluence with the River Arun, approximately 6km downstream of the site.

The Environment Agency's on-line flood map for planning indicates that the north-western part of the application site lies within Flood Zone 3 (high probability of flooding) associated with Black Ditch.

The National Planning Policy Framework (NPPF) and associated technical guidance confirms that all applications for proposed new development within Flood Zone 2 or 3 and development proposals exceeding one hectare within Flood Zone 1 must be accompanied by a site-specific Flood Risk Assessment.

⁵ British Geological Survey, Geology of Britain Viewer, accessed 21st May 2021.

1.4 Topography and Existing Land Use

The application site is located on relatively low-lying land, within the narrow valley of Black Ditch, which broadens downstream to the south-west. Ordnance Survey mapping indicates ground levels in the vicinity of the application site of approximately 10mAOD.

A topographic survey of the application site is included as Appendix 1 and confirms that ground levels across the site are generally in the range 5.5mAOD to 6.0mAOD, rising locally to 7mAOD in the southern corner of the site adjacent to the High Street. The application site is currently almost entirely impermeable surfaces, comprising internal access roads, car parking and garage buildings, as indicated in Figure 2.



Figure 2. Existing Land Use, view south-east from Water Lane (extract from Google Streetview).

The application site is bound to the north by Water Lane with residential properties beyond, to the east by residential properties off Cumberland Crescent and to the west and south by mixed residential and retail properties off the High Street.

Access/egress to the site is available from Water Lane and the High Street.

1.5 Geology

British Geological Survey mapping indicates that the local geology beneath the application site comprises Superficial Head Deposits (clay, silt, sand and gravel) and River Terrace Deposits (sand, silt and clay) overlying Chalk bedrock⁵.

A ground investigation was undertaken by Ridge in November 2020 and included the installation of 13 windowless sample boreholes across the application site to a maximum depth of 5.45m below ground level (mbgl)⁶. The ground investigation confirms the presence of Made Ground across the site to a maximum depth of 0.8mbgl. Superficial Head Deposits were encountered beneath the Made Ground and described as a firm to stiff gravelly sometimes sandy Clay, with the granular portion described as sandy Gravel with occasional Cobbles. The Head Deposits extend to a maximum depth of 3.5mbgl and overlie the Chalk bedrock.

⁶ Ridge and Partners LLP, February 2021, Ground Conditions Assessment, Water Lane, Angmering.

Groundwater strikes were recorded (generally within the Chalk) at 3.0mbgl to 4.3mbgl, with subsequent monitoring recording groundwater levels of 2.0mbgl to 3.9mbgl. The Ridge report also refers to an earlier, September 2007 ground investigation within the site, which recorded groundwater levels of 0.81mbgl to 1.77mbgl; no details are provided regarding monitoring date(s) or location(s).

Due to the relatively low permeability of the surface geology and heavily urbanised nature of the local area, a high proportion of incident rainfall will form surface water runoff.

1.6 Hydrological Features

The application site lies within the surface water catchment of Black Ditch which flows in a west-south-westerly direction, culverted beneath Water Lane, immediately north-west of the site. Black Ditch discharges into the tidal River Arun, approximately 6km west of the application site. Water levels in Black Ditch become tidally influenced down-stream of Angmering⁷, where the valley widens, and it is understood that Black Ditch discharges via a tidal flap outfall into the River Arun and can become tide-locked at this location. The local hydrological site setting is presented as Figure 3.

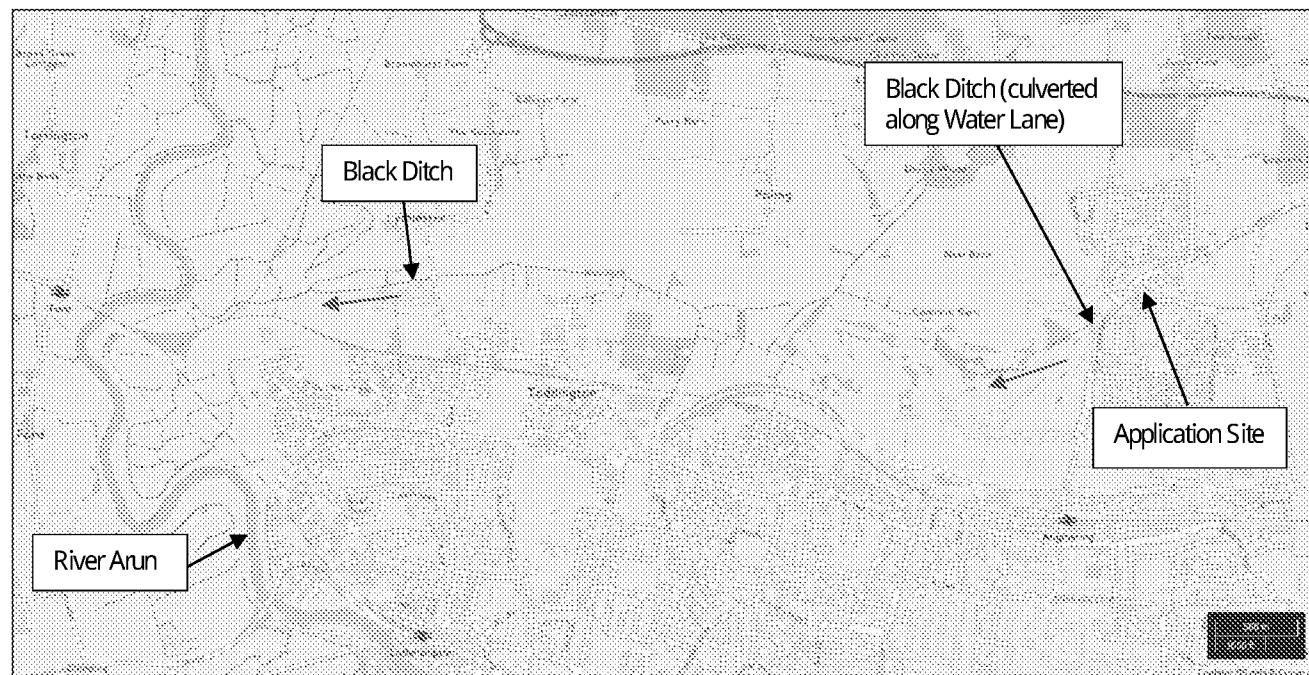


Figure 3. Hydrological Setting

Angmering Neighbourhood Plan 2014-2029 provides details on the history of local flooding and measures taken to mitigate flood risk within the village. In 2012, the Parish Council Emergency Committee was formed to work with West Sussex Council, Arun District Council and the Environment Agency to address flooding within the village. As a result, and with funding from Operation Watershed, a webcam was installed at the Black Ditch culvert entrance, off Water Lane, approximately 300m upstream of the application site. Culvert blockages/obstructions and the water level are monitored by the Environment Agency via the webcam, with appropriate remedial action taken as required. Figure 4 presents an image from the culvert entrance webcam.

⁷ Environment Agency, December 2012, Lower Tidal River Arun, Draft flood risk management strategy, consultation document.



Figure 4. Webcam image, Black Ditch culvert entrance, Water Lane

1.7 Proposed Development and Flood Risk Vulnerability Classification

The proposed development comprises demolition of the existing buildings and erection of a two-storey building providing 33 retirement living apartments and a retail unit, with associated car parking, amenity space and landscaping. A proposed site layout plan is included within Appendix 2.

In terms of flood risk vulnerability classification, residential buildings, including residential care homes, are classified as :more vulnerable~ development and retail buildings are classified as :less vulnerable~ development. This is discussed further in Section 2.3.

2.0 FLOOD RISK ASSESSMENT

2.1 Sources of Information

In addition to the flood risk planning policy and guidance outlined in Section 1.2, the following sources of information have been consulted during the preparation of this FRA:

- 2 Environment Agency website⁸ for information regarding surface water, reservoir and fluvial/tidal flood risk and outline flood zone maps.
- 2 Environment Agency :Product 4~consultation response, dated November 2020, including site-specific predicted flood water levels, historic flood outline, flood zone maps and details of local flood defences. A copy of the Environment Agency response is included as Appendix 3.

2.2 Flood Hazard

All potential sources of flooding to the application site are considered within this section of the report.

2.2.1 Environment Agency Flood Zone Map and Fluvial/Tidal Flood Risk

The Environment Agency flood zone map presents information regarding the fluvial and tidal flood risk to the application site and is included as Figure 5 below. The flood zone map indicates that the north-west of the application site is located within Flood Zone 3 and the central area is within Flood Zone 2, associated with the adjacent Black Ditch. Flood Zone 3 is defined as having a high probability of flooding and comprises land assessed as having a 1-in-100 (1%) or greater annual probability of river flooding; Flood Zone 2 is defined as land with a medium probability of flooding, assessed as between 1-in-1000 (0.1%) and 1-in-100 (1%) annual probability of river flooding.

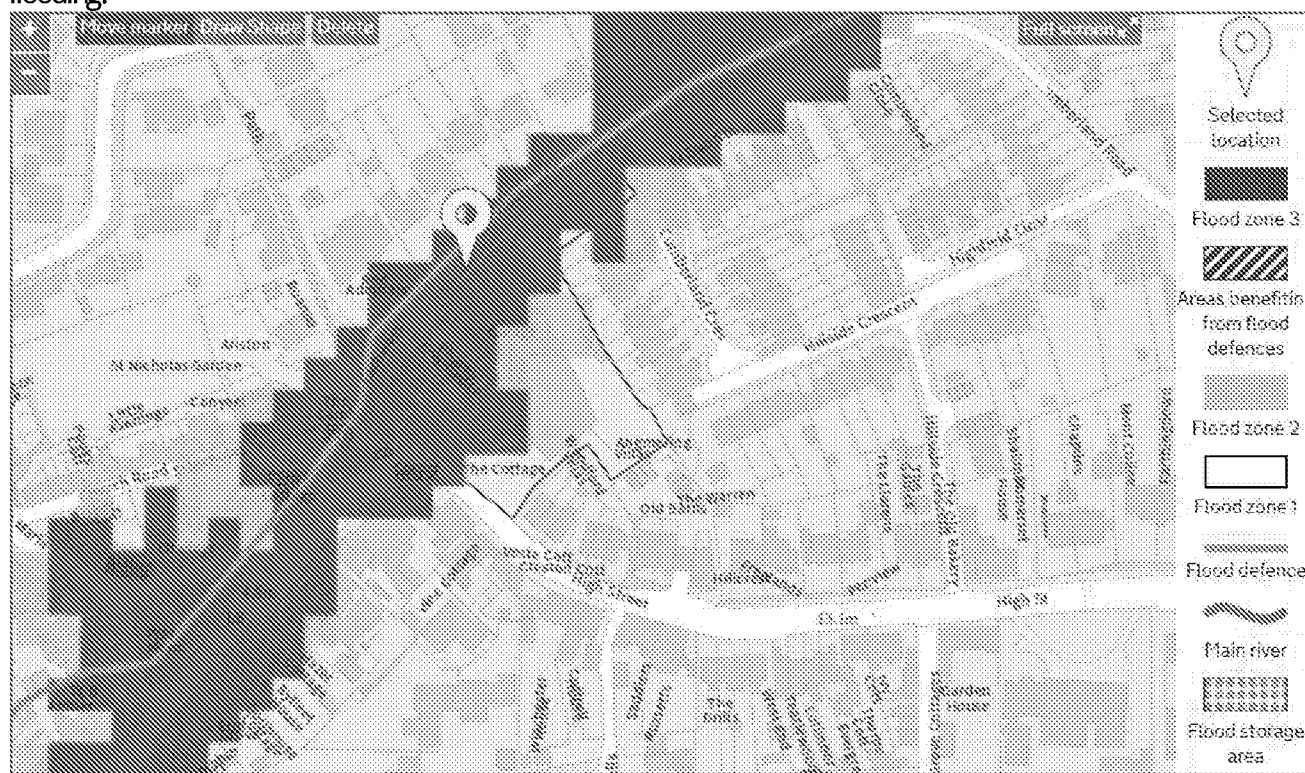


Figure 5. Environment Agency Flood Zone Map⁸

⁸ www.flood-map-for-planning.service.gov.uk accessed 21st May 2021.

Figure 6 presents an extract of the Environment Agency's flood risk map for river and sea flooding, which takes into account the presence of any flood defences. This confirms that the application site lies within an area of medium flood risk (between 1.0% and 3.3% annual probability of flooding).

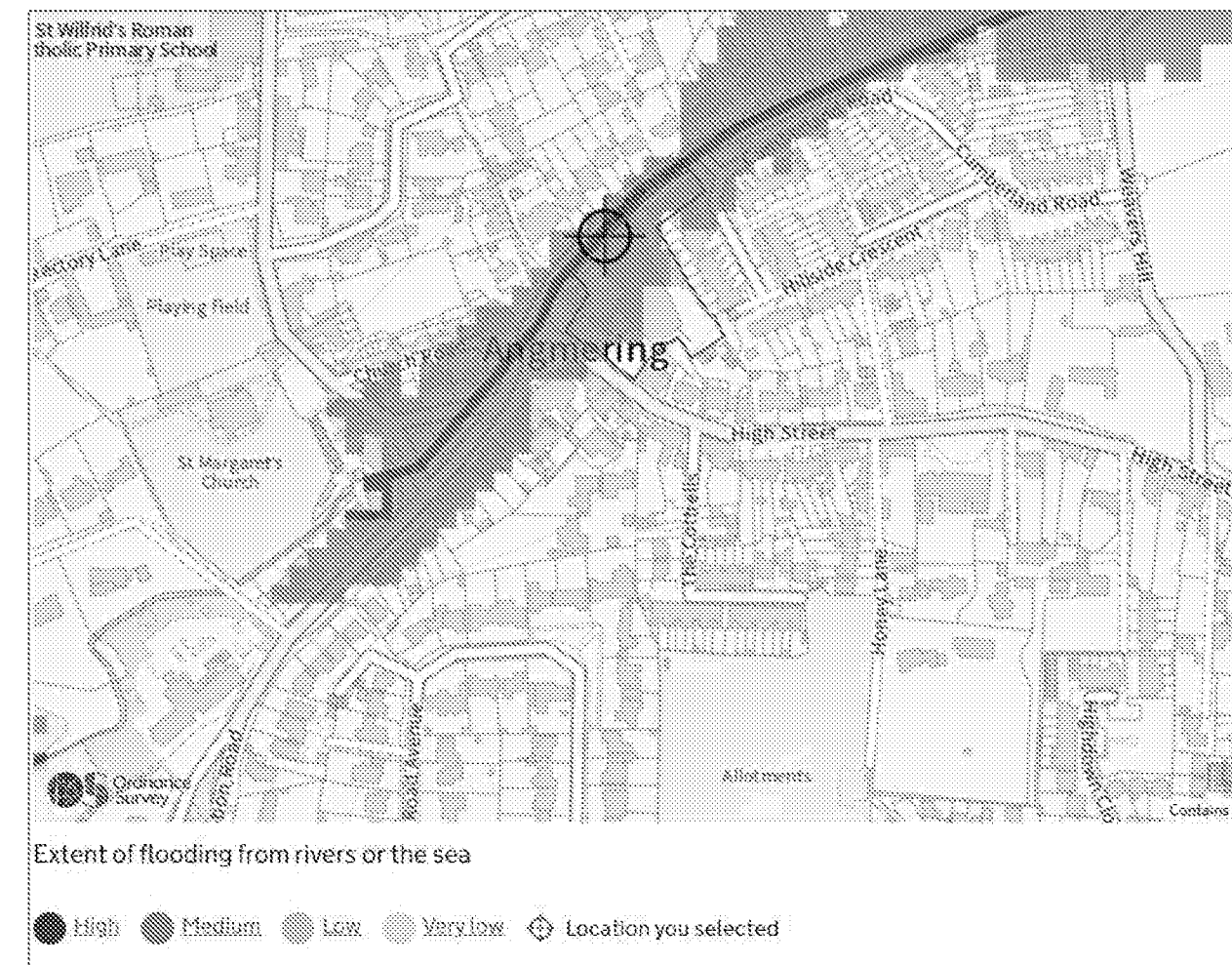


Figure 6. Environment Agency River/Sea Flood Risk Map

Site-specific predicted flood water level data has been obtained from the Environment Agency to inform the FRA; a copy of the Environment Agency's response is included as Appendix 3.

Predicted flood water levels have been provided from the 2010 Lower Tidal River Arun Strategy Study and are summarised in Table 1 below. The model node locations are indicated on Figure 7.

Table 1: Water Lane, Angmering - Predicted Fluvial Flood Water Levels
(2010 Lower Tidal River Arun Strategy Study)

Model Node & Location	Predicted Flood Water Level (mAOD) - Undefended			Predicted Flood Water Level (mAOD) - Defended		
	1% (1-in-100)	1% + Climate Change	0.1% (1-in-1000)	1% (1-in-100)	1% + Climate Change	0.1% (1-in-1000)
1 Water Lane, NE (upstream)	6.03	6.08	6.21	6.20	6.23	6.33
2 Water Lane, West (downstream)	5.63	5.67	5.74	5.52	5.52	5.67
3 High Street, West (downstream)	5.53	5.55	5.63	5.52	5.52	5.62
4 Centre of Site	No results - node location is outside of predicted flood extents					

A 20% allowance for long-term climate change was incorporated within the climate change model scenarios.

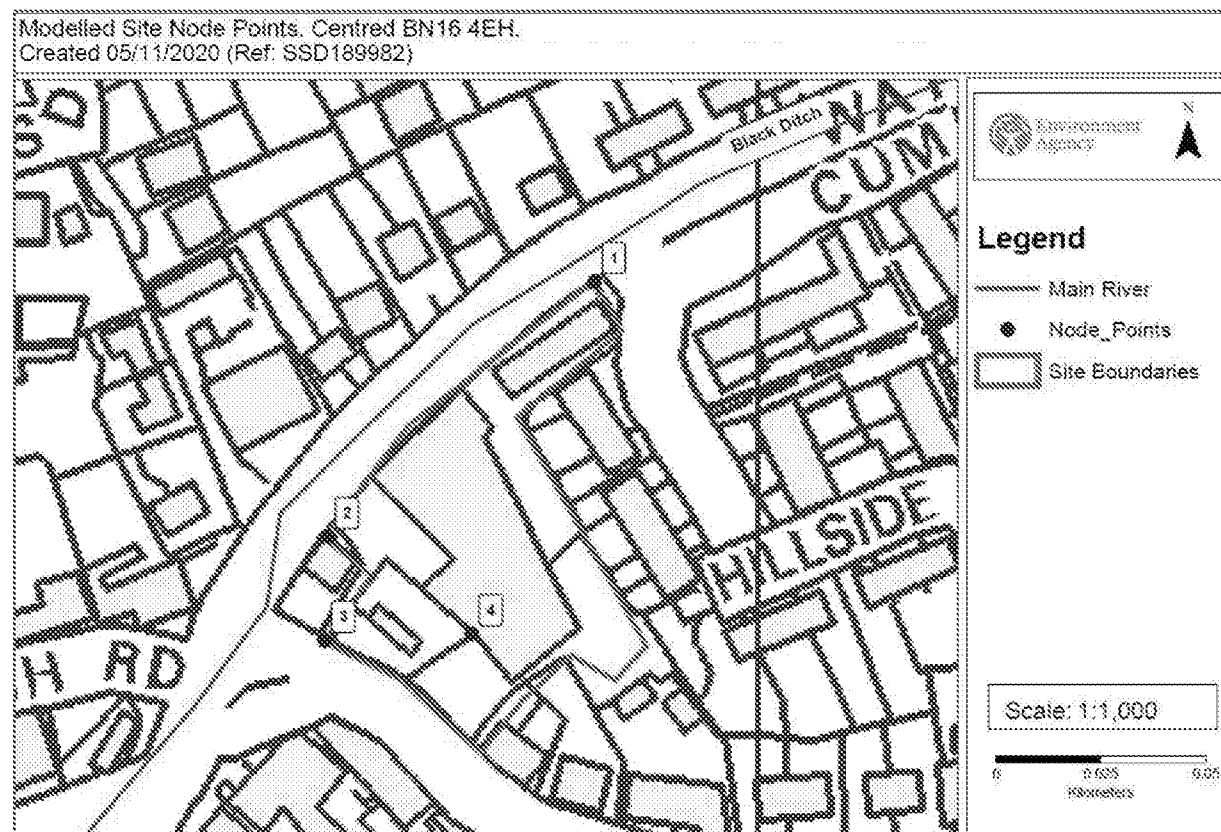


Figure 7. Model Node Locations (2010 Lower Tidal River Arun Strategy Study)

Review of the predicted flood water levels against the site topographic survey (Appendix 1) confirms the following:

- Whilst there are no local flood defences (Black Ditch is culverted adjacent to the application site), the predicted flood water levels for the 'defended' scenario, which takes into account flood defences across the study area, are generally higher (worse-case) than those for the 'undefended' scenario. The predicted flood water levels at the upstream, north-eastern end of the site (node 1) for the 1% annual probability (1-in-100

year) flood event are approximately 0.7m higher than those at the downstream, south-western end of the site (node 2).

- The 1-in-100 year defended flood water levels equate to a predicted flood water depth of approximately 0.5m in the north-east and approximately 0.1m in the south-west of the site.
- Predicted flood water levels for the 1-in-100 year + 20% climate change scenario are only marginally higher than the 1-in-100 year levels.
- The 1-in-1000 year (0.1% annual probability) defended flood water levels equate to a predicted flood water depth of approximately 0.6m in the north-east and approximately 0.2m in the south-west of the site.
- The central and south-eastern areas of the site, as reflected by model node 4, remain outside of the 1-in-100 year and 1-in-1000 year predicted flood extents (i.e. are within Flood Zone 1).

Details of historic flood records are provided in Section 2.2.3.

The SFRA notes that the Lower Tidal River Arun Draft Flood Risk Management Strategy (2014) provides recommendations for Black Ditch (Strategy Unit 7) to maintain the existing infrastructure, with a new inland defence proposed.

Appropriate site-specific flood risk mitigation measures for the proposed development are discussed below in Section 2.4.

2.2.2 Other Potential Sources of Flooding

The local SFRA and online flood maps have been reviewed to identify any other potential sources of flood risk to the application site and evidence of historic flood events in the local area. This information is presented in Table 2 below.

Table 2: Water Lane, Angmering – Potential Sources of Flooding

Potential Source	Potential Risk at Application Site?	Reasoning
Fluvial Flooding	Yes	The Environment Agency's flood zone map for planning indicates that the application site is located partially within Flood Zones 2 and 3 associated with Black Ditch.
Tidal Flooding		
Flooding from High Groundwater	Yes	Appendix F of the SFRA presents regional mapping of areas susceptible to groundwater flooding. This confirms that the application site is within a 1km grid square where 50% to 75% of the area is potentially susceptible to flooding. Section 5.7 of the SFRA which discusses groundwater flooding across the region, does not identify Angmering as an area that has suffered groundwater flooding in the past. However, the ground investigations across the application site have confirmed the presence of shallow groundwater (<2m below ground level).
Surface Water Flooding	Yes	The Environment Agency's online mapping indicates that parts of the application site have a low to high risk of surface water flooding.
Flooding from Artificial Drainage Systems	No	There are no records of sewer flooding within the immediate vicinity of the application site. The potential risk of flooding associated with the Black Ditch culvert is assessed within the fluvial flood risk above.
Flooding due to Infrastructure Failure	No	Review of the Environment Agency's online mapping confirms the application site is not within the predicted maximum extent of flooding of local reservoir(s).

Table 2 confirms that the potential sources of flood risk identified within the application site are: fluvial flood risk from the adjacent Black Ditch, flooding from groundwater emergence and flooding from surface water runoff.

The fluvial flood risk is detailed in Section 2.2.1 and appropriate mitigation measures are discussed below in Section 2.4.

Groundwater has been encountered at shallow depths beneath the application site and the site is within an area identified as being at risk of groundwater emergence. The risk of groundwater emergence is limited to the low-lying, north-western part of the application site and flood water is unlikely to accumulate to any significant depth due to the local topographic fall towards the south-west. No basement development is proposed, and the mitigation measures proposed to address the fluvial flood risk will be adequate to ensure protection against any groundwater flood risk.

Figure 8 below presents the Environment Agency's surface water flood risk map for the application site and confirms that the risk of surface water flooding is high (>3.3% annual probability) along and adjacent to Water Lane, which forms a local valley feature (with Black Ditch culverted beneath) and within an isolated depression in the south of the site. Elsewhere within the application site, external areas have a very low (<0.1% annual probability) or low (between 0.1% to 1.0% annual probability) risk of surface water flooding. Figure 9 confirms that the worse-case predicted flood water depths during the low risk scenario (0.1% to 1.0% annual probability) are generally <300mm but in the range 300 to 900mm adjacent to Water Lane and in the south of the site.

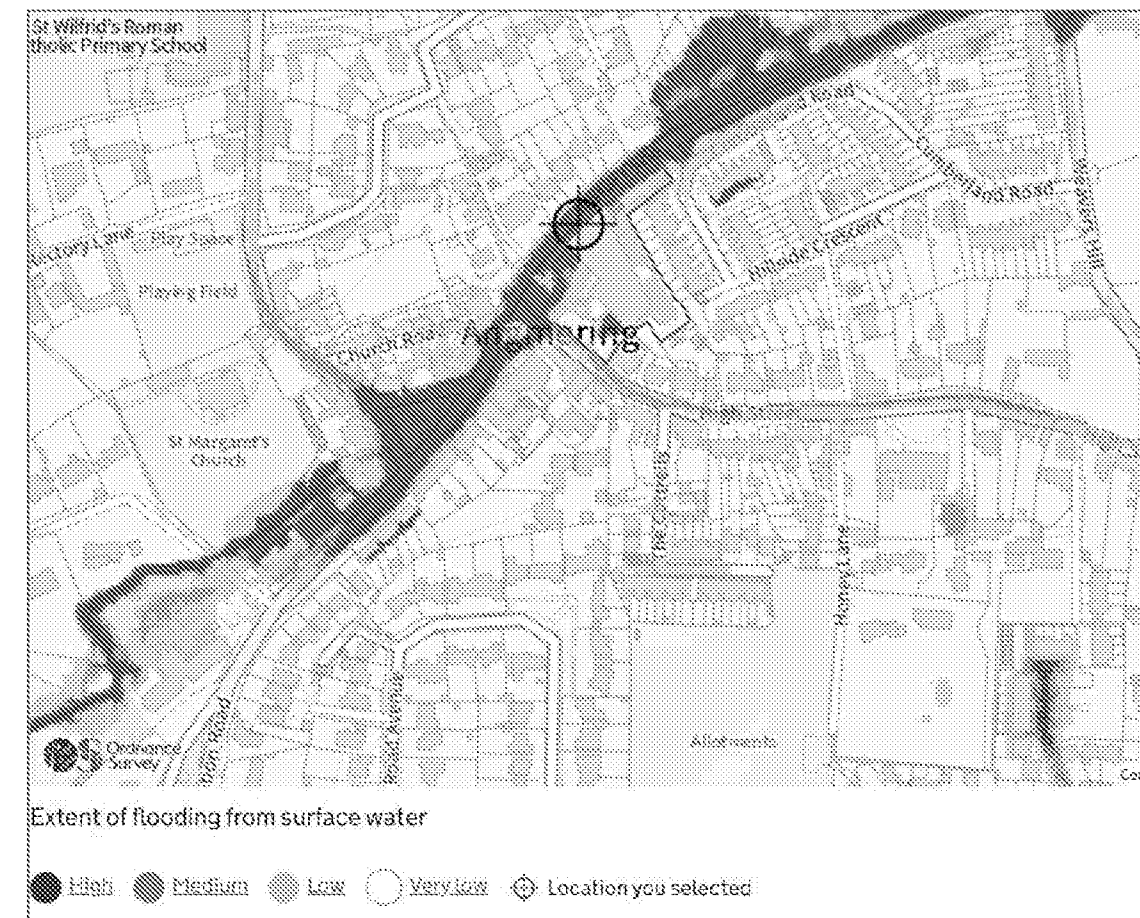


Figure 8. Environment Agency Surface Water Flood Risk Map.



Figure 9. Environment Agency Surface Water Flood Risk Map - Predicted Flood Water Depths (Low Risk Scenario).

A sustainable surface water drainage (SuDS) scheme is proposed for the development that will effectively manage and attenuate surface water runoff prior to discharge to sewer. This will ensure rainfall drains effectively to SuDS elements and the off-site discharge rate is attenuated to reduce the risk of surface water flooding both within the application site and to others downstream. In addition, the proposed fluvial flood risk mitigation measures (refer to Section 2.4) will be effective against any residual surface water flood risk.

2.2.3 Historic Flooding

Review of the Environment Agency's online historic flood map indicates that Water Lane has experienced flooding in the past (as indicated by hatched shading on Figure 10), but the extent of flooding has not encroached into the application site beyond the road frontage⁹.



Figure 10. Environment Agency Historic Flood Extent Map

Angmering's Neighbourhood Plan (2014-2029) confirms that the village has suffered from flooding over an extended period and most recently in June 2012, as indicated in Figure 11.



Water Lane June 2012

Figure 11. Angmering 2012 Flood Event (extract from Angmering Neighbourhood Plan (2014-2029))

⁹<https://environment.data.gov.uk/DefraDataDownload/?mapService=EA/HistoricFloodMap&Mode=spatial> accessed 21st May 2021.

It is noted that the application site is located partially within the Environment Agency Flood Warning Area for Black Ditch in Angmering.

2.2.4 Climate Change

It is recognised that peak river flows are predicted to increase as a result of climate change, and this must be considered within new development design. The application site lies within the South East river basin district. Review of the Environment Agency's guidance on climate change allowances¹⁰ indicates a potential worse-case increase in peak river flows of between 35% (central allowance), 45% (higher central allowance) and 105% (upper end allowance, 95th percentile) by the 2080s.

The proposed development includes :less vulnerable~retail land use, where the central and higher central allowances should be applied, and :more vulnerable~residential land use, where the higher central and upper end allowances should be applied.

The data provided from the Environment Agency's flood risk modelling study included the design flood event (1-in-100 year event) plus a 20% allowance for climate change. It is noted that the predicted flood water levels for the climate change event are only marginally higher than those for the flood event without climate change.

Due to the limited impact of climate change on the flood water levels and in the absence of data for other climate change allowances, it is proposed that the 1-in-1000 year (0.1% annual probability) flood water level data be used as the design flood event.

Table 2 of the Environment Agency's guidance on climate change allowances indicates that peak rainfall intensity within small (<5km²) and urban catchments could increase by between 20% (central allowance) and 40% (upper allowance) by the 2080s (2070 to 2115), from 1961-1990 baseline data.

The Environment Agency's guidance confirms that drainage systems should be designed for new development to ensure there is no increase in the rate of runoff discharged from the site for the upper end climate change allowance appropriate to the lifetime of the development. A surface water management plan has been designed for the development which includes appropriate allowance for long-term climate change (Section 3).

2.3 The Sequential Test, Exception Test & Environment Agency Flood Zone Compatibility

As set out in the NPPF, the aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. It is recognised however, that the application site is a brownfield development site within a village centre location. As such, Arun District Council has confirmed in their pre-application advice¹¹ that

It is noted that the site is allocated for residential use in the Neighbourhood Plan (Policy HA3) and therefore complies with the sequential test.

The Sequential Test has however been applied within the development site, with the :more vulnerable~residential development located in the south-east of the site (predominantly Flood Zone 1) and the :less vulnerable~retail development located in the north-west, within Flood Zones 2/3.

Table 3 of the Environment Agency's flood risk assessment guidance³ presents a matrix assessing the appropriateness of new development based on its flood risk vulnerability and flood zone status. In terms of flood

¹⁰ Environment Agency, February 2016 (updated July 2020), Guidance: Flood Risk Assessments: Climate Change Allowances.

risk, the proposed development includes :less vulnerable~retail land use and :more vulnerable~residential land use. Table 3 of the guidance confirms that :less vulnerable~land uses are appropriate development within Flood Zone 3, whilst :more vulnerable~land uses are appropriate within Flood Zone 3 if the Exception Test is passed.

In order to pass the Exception Test the proposed development must:

1. provide wider sustainability benefits to the community that outweigh flood risk, and
2. be safe for its lifetime without increasing flood risk elsewhere.

Arun District Council has confirmed, within their pre-application advice, that

The site is considered to be socially, environmentally and economically sustainable due to its town centre location and acceptable impact on residential amenities and visual appearance (environmental factor), as expanded above, and the contribution it is capable of making towards construction jobs (social and economic factors).

Therefore, it is concluded that first part of the Exception Test is passed. The proposed flood risk mitigation measures outlined below within Section 2.4 will ensure the development remains safe from flooding and does not increase flood risk elsewhere, thus satisfying part two of the Exception Test.

2.4 Flood Risk Mitigation Measures

Locally, in response to previous fluvial flood incidents, Angmering Parish Council and the Environment Agency have instigated flood risk management measures for Black Ditch adjacent to the site, including remote monitoring of the culvert entrance via CCTV. As Black Ditch is culverted adjacent to the application site, the proposed development is at residual risk of flooding in the event of culvert blockage or exceedance only. The Environment Agency routinely monitor the culvert entrance CCTV and, if the water level rises to 6 or above on the level gauge, they take appropriate action. In addition, debris caught on the culvert entrance safety grille is regularly cleared by the Environment Agency.

This recent introduction of CCTV surveillance of the culvert entrance, including the monitoring of water levels within Black Ditch, allows any culvert blockages to be promptly remediated and provides an early warning system in the event of rising flood water levels. It is understood that additional flood risk mitigation measures are being investigated for the village, with the Environment Agency undertaking surveys in 2017 during their appraisal process.

These measures will reduce the probability of fluvial flooding within Water Lane however, the application site remains partially within Flood Zone 3 and site-specific flood risk mitigation measures are also proposed.

In the absence of appropriate climate change allowances, it is proposed that the fluvial flood risk mitigation measures are based on the worse-case 0.1% (1-in-1000 year) annual probability flood event. The maximum predicted flood water level within the application site for the 0.1% flood event is 6.33mAOD (model node 1, located on the north-east, upstream site boundary). It is noted that predicted flood water levels fall significantly across the site from this node, towards the south and south-west; therefore 6.33mAOD is a conservative, worse-case design flood water level to consider across the entire application site.

The following flood risk mitigation measures are proposed for the development based on this design flood water level:

¹¹ Arun District Council, 12th March 2021, Pre-Application Advice, Ref: PAA/141/20.

- ¿ The proposed residential development is predominantly located within Flood Zone 1, in the central and southern parts of the application site. However, a minimum finished floor level of 6.40mAOD is proposed for all residential development across the site. This will ensure all residential properties remain safe and dry during the 0.1% annual probability flood event, ensuring their location within low probability Flood Zone 1.
- ¿ A finished floor level of 6.10mAOD is proposed for the retail building in the north of the application site. This is the highest achievable floor level for the building, due to access requirements. The finished floor level of 6.10mAOD is slightly lower than the design flood event, therefore flood resistant/resilient design is proposed. In accordance with current guidance, flood resistant design measures would be incorporated for flood water depths of up to 300mm; this is equivalent to 6.40mAOD and above the design 0.1% annual probability flood event. Such measures would include appropriate flooring and wall design to minimise water penetration, in accordance with current Environment Agency guidance, and the provision of flood resistant doors or removal flood barriers for door openings.
- ¿ All owners/occupiers of the development would develop a Flood Warning & Evacuation Plan; the Environment Agency's template is included as Appendix 4. The development is within an Environment Agency Flood Warning Area; owners/occupiers would sign up to the Agency's free Flood Warning Service and the Flood Plan would include details of the actions to be followed in the event of a Flood Alert or Flood Warning being issued.
- ¿ Safe access and egress would be available to land within low probability Flood Zone 1 via a pedestrian route from the south-west of the application site onto the High Street. This is indicated on the site layout plan (Appendix 2), with ground levels of approximately 7.3mAOD at the point of access/egress onto the High Street.
- ¿ It is recognised that built development within Flood Zone 3 can result in a loss of floodplain storage and/or interfere with flood flow routes. Review of the existing site layout (Appendix 1), the Environment Agency Flood Zone map (Figure 5) and the proposed development layout (Appendix 2) confirms that the development footprint within Flood Zone 3 is comparable pre- and post-development. Therefore, any potential change in floodplain storage has been minimised and there will be no significant change in flood flow routes, thus ensuring no increase in flood risk to others downstream.
- ¿ A sustainable surface water drainage (SuDS) strategy has been designed for the development, to manage surface water runoff during the 1-in-100 year rainfall event, with appropriate allowance for long term climate change. Full details are presented in Section 3. This will minimise surface water flood risk to the development and ensure no increased flood risk to others, in accordance with Policy W DMB of the Arun Local Plan.

3.0 SURFACE WATER DRAINAGE DESIGN

3.1 Introduction and Design Principles

- ~~3.1.1~~ The key objective is to ensure that the development does not increase the potential flooding elsewhere, and if the opportunity arises, to reduce the potential for flooding off site. This objective can be achieved by designing a drainage strategy for the development which will set the strict framework which the detailed designers of the drainage will ultimately have to work within.
- 3.1.2 A further objective is to ensure that the risk of overland flows (surface water flooding) is managed so that there is an acceptable level of protection to both new and existing developments downstream of the site.
- 3.1.3 The surface water drainage strategy will be delivered in accordance with prevailing local and national planning policy. Currently, the most significant factors influencing the design of the drainage strategy are the Flood and Water Management Act 2010, RBC SFRA, the National Planning Policy Framework (NPPF) and relevant chapters of the Planning Practice Guidance (PPG). This drainage strategy sets the guidelines for future detailed design, but more importantly, it demonstrates that a sustainable drainage solution is deliverable at the site, complying with all relevant planning and legislative criteria. The most important function of this drainage strategy is to demonstrate that the development will not increase flood risk elsewhere.
- 3.1.4 The method of discharge of surface water is critical to ensuring that flood risk will not be increased elsewhere. Planning Practice Guidance and Building Regulations dictate the hierarchy for discharge options. In order of preference these are:
- ① to the ground (infiltration).
 - ② to a surface water body.
 - ③ to a surface water sewer, highway drain or another drainage system
 - ④ to a combined sewer

The Ridge report dated February 2021 suggests 'Groundwater at depths ranging 2.00m to 4.30mbgl'. The risk from groundwater flooding is considered high within the north and west of the site and moderate-high with the centre and eastern portions of the site.

Shallow groundwater and risk of emergence limits the effective use of infiltration techniques to the standards of BRE365.

The next viable solution to consider is discharge to a watercourse.

It appears that the surface water from the site currently drains into a watercourse culvert and foul sewer beneath Water Lane immediately north of the site.

3.2 Surface Water Drainage Design

- 3.2.1 It is proposed to reuse the existing connection onto the watercourse culvert at a controlled rate to be agreed and approved with the Environment Agency.
- 3.2.2 The flow rate will be restricted from the surface water drainage system to a 50% reduction of the brownfield runoff rate for a 1 year 60-minute storm. The current figure is 19l/s. The proposed rate is 9.5l/s. During times of high rainfall, the current rate during a comparable 1 in 100-year storm is 59l/s. This represents a 84% reduction during times of high rainfall.
- 3.2.3 The surface water drainage comprises a combination of permeable paving with type 3 subbase storage and an attenuation tank beneath the rear garden. The permeable paving will act as a collection point for the carpark surface water with a gravity connection to the main attenuation tank. The attenuation tank will provide bulk storage of surface water allowing a pumped control discharge to the watercourse culvert located in Water Lane.
- 3.2.4 The attenuation tank has been located to the south of the site, rear of the development, to isolate it from the flood zone area located to the north of the site in Water Lane.
- 3.2.5 The attenuation tank is sized to accommodate the 1 in 100 year storm events + 40% for climate change.
- 3.2.6 The discharge from the attenuation tank will be controlled via a duty/standby pump control with a backup generator in the event of power outages. The Pump system will also have alarm and telemetry systems in place for individual pump failure.

3.3 Maintenance Schedule

3.3.1 SuDS Scheme Checklist

The following lists the SuDS components and extra features which are found on site:

- Cellular Crate Attenuation to collect runoff from roofs and impermeable paving allowing a controlled discharge.
- Inlet Structures such as rainwater down pipes and channel drains. They should be always free from obstruction to allow free flow through the SuDS.
- Manholes & Inspection Chambers and rodding eyes are used on bends or where pipes come together. They allow access and cleaning to the system if necessary.
- Below ground drainage pipes convey water to the SuDS system. They should be always free from obstruction to allow free flow.
- Flow Control Device such as hydro brakes or pumps.

3.3.2 Sustainable Drainage Maintenance Specification

Cellular Crate Attenuation - Polystorm/Aquacell cellular storage or equivalent approved

- Cellular crate attenuation tanks are designed to provide storage and allow a controlled discharge rate. They must be protected from silt etc.

Where shrinkage or surface damage occurs, uplift blocks, remove grit bedding layer and geotextile if present and reinstate to design profile.

As required

Cellular Crate Attenuation Tank	
Regular Maintenance	Frequency
Inspect and identify any areas that are not operating correctly. Remove debris from the catchment surface (where it may cause risk to performance). Remove sediment from inlet structures and catchpit chambers. Maintain vegetation to designed limits within the vicinity of below ground attenuation tank system to avoid damage to the system.	Monthly or as required.
Remedial Work	
Repair physical damage if necessary	As required
Remedial Work	
Inspect all inlets, outlets, and vents to ensure that they are in good condition and operating as designed.	Annually
Survey inside of attenuation tank for sediment build up and remove if necessary.	Every 5 years or as required.

Inlet structures and Inspection Chambers

- Inlet structures such as rainwater down pipes, road gullies and channel drains. They should be always free from obstruction to allow free flow through the SuDS.
- Inspection chambers and rodding eyes are used on bends and where pipes come together. They allow free access and cleaning to the system if necessary.

Inlet structures and Inspection chambers	
Regular Maintenance	Frequency
Inlet Structures Inspect rainwater down pipes, channel drains, and road gullies, removing obstructions and silt as necessary. Check there is no physical damage.	Monthly
Trim vegetation 1m min surround to structures and keep area free from silt and debris.	Monthly
Inspection Chambers Remove cover and inspect, ensuring that the water is flowing freely and that the exit route for water is unobstructed. Remove debris and silt. Undertake inspection after leaf fall in Autumn.	Annually
Occasional Tasks	
Check topsoil levels are 20mm above edges of chambers to avoid mower damage.	Annually
Remedial Work	
Repair physical damage if necessary	As required.

Permeable Paving

Maintenance Issues: Permeable surfaces are susceptible to silt blockage. The required maintenance schedule for permeable paving is described in the following table.

Permeable Paving	
Regular Maintenance	Frequency
Surface brushing to reduce silt accumulation.	Monthly or as required.
Brushing and suction sweep or jet wash and suction sweep in autumn after leaf fall.	Annually
Mow grass edges to paving at 35-50mm and remove weeds and leaves.	As required
Jetting and suction where silt has accumulated in joints or voids. Replace grit and vibrate surface to lock the sections together.	As required

Below Ground Drainage Pipes

- Below ground drainage pipes convey water to the SuDS system. They should be free from obstruction at all times to allow free flow.

Below Ground Drainage Pipes	
Regular Maintenance	Frequency
Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months then annually

Remove debris from the catchment surface (where it may cause risks to performance).	Monthly
Remove sediment from pre-treatment inlet structures and inspection chambers.	Annually or as required
Maintain vegetation to designed limits within the vicinity of below ground drainage pipes and tanks to avoid damage to system	Monthly or as required
Remedial Work	
Repair physical damage if necessary	As required
Monitoring	
Inspect all inlets, outlets and vents to ensure they are in good condition and operating as designed.	Annually
Survey inside of pipe runs for sediment build up and remove if necessary.	Every 5 years or as required.

3.3.3 Flow Control devices shall be maintained as recommended by the manufacturer.

3.3.4 Outfalls to the watercourse shall be inspected and cleaned at least once every six months.

3.3.5 Spillage - Emergency Action

Most spillages on development are of compounds that do not pose a serious risk to the environment if they enter the drainage in a slow and controlled manner with time available for natural breakdown in a treatment system. Therefore, small spillages of oil, milk or other known organic substances should be removed where possible using soak mats as recommended by the Environment Agency, with residual spillage allowed to bioremediate in the drainage system.

In the event of a serious spillage, either by volume or unknown or toxic compounds, then isolate the spillage with soil, turf or fabric and block outlet pipes from chamber(s) downstream of the spillage with bung(s). (A bung for blocking pipes may be made by wrapping soil or turf in a plastic sheet or closely woven fabric).

4.0 SUMMARY AND CONCLUSIONS

This report represents a site-specific Flood Risk Assessment to support the proposed mixed-use residential and retail development off Water Lane, Angmering, West Sussex. The application site currently comprises a vacant car showroom, workshop and offices with associated access and parking.

The Environment Agency flood zone map for planning indicates that the north-western part of the application site is located within Flood Zone 3 (high probability of flooding) and Flood Zone 2 (medium probability of flooding) associated with Black Ditch which is culverted beneath Water Lane adjacent to the site; therefore, a detailed site-specific FRA is required.

A review of all potential sources of flooding to the application site has been undertaken and, in addition to the fluvial flood risk from Black Ditch, parts of the site are at risk of flooding from surface water runoff and at risk of flooding from groundwater emergence.

Site specific predicted flood water level data has been obtained from the Environment Agency and confirm that the north-western part of the application site lies within Flood Zone 3, with predicted flood levels falling significantly across the application site.

Arun District Council's pre-application advice confirms that the application site is allocated for residential use and therefore passes the Sequential Test. It also confirms that the site location passes the sustainability criteria of the Exception Test.

Although there are records of flooding along Water Lane adjacent to the site, there is no record of historic flooding within the application site itself. The recent introduction of CCTV surveillance of the Black Ditch culvert entrance upstream of the application site, with routine monitoring and action by the Environment Agency has reduced the likelihood of local flooding due to culvert blockage.

However, due to the risk of flooding, the following flood risk mitigation measures are proposed, based on the maximum predicted 0.1% annual probability flood water level of 6.33mAOD:

- ∫ The proposed residential development is predominantly located within Flood Zone 1. However, a minimum finished floor level of 6.40mAOD is proposed for all residential development across the site. This will ensure all residential properties remain safe and dry during the 0.1% annual probability flood event, ensuring their location within low probability Flood Zone 1.
- ∫ A finished floor level of 6.10mAOD is proposed for the retail building in the north of the application site. This is the highest achievable floor level for the building, due to access requirements. The finished floor level of 6.10mAOD is slightly lower than the design flood event, therefore flood resistant/resilient design is proposed. In accordance with current guidance, flood resistant design measures would be incorporated for flood water depths of up to 300mm; this is equivalent to 6.40mAOD and above the design 0.1% annual probability flood event. Such measures would include appropriate flooring and wall design to minimise water penetration, in accordance with current Environment Agency guidance, and the provision of flood resistant doors or removal flood barriers for door openings.
- ∫ All owners/occupiers of the development would develop a Flood Warning & Evacuation Plan. The development is within an Environment Agency Flood Warning Area; owners/occupiers would sign up to the Agency's free Flood Warning Service and the Flood Plan would include details of the actions to be followed in the event of a Flood Alert or Flood Warning being issued.

- ∫ Safe access and egress would be available to land within low probability Flood Zone 1 via a pedestrian route from the south-west of the application site onto the High Street.
- ∫ The built development footprint within Flood Zone 3 is comparable pre- and post-development. Therefore, any potential change in floodplain storage has been minimised and there will be no significant change in flood flow routes, thus ensuring no increase in flood risk to others downstream.
- ∫ A sustainable surface water drainage (SuDS) strategy has been designed for the development, to manage surface water runoff during the 1-in-100 year rainfall event, with appropriate allowance for long term climate change. This will minimise surface water flood risk to the development and ensure no increased flood risk to others.

This site-specific FRA confirms that the development passes the Exception Test and is compliant with relevant local planning policies: WDM2, W DMB and W SP1 of the Arun Local Plan.

This FRA concludes that, with appropriate mitigation, the proposed development of retirement living apartments and retail space off Water Lane, Angmering, is appropriate and sustainable with regards to flood risk.

5.0 CLOSURE

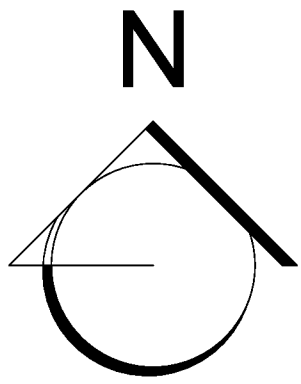
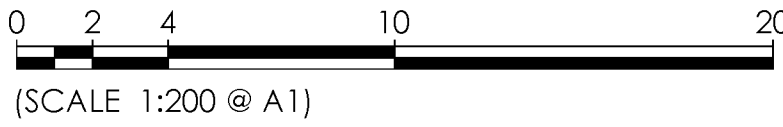
This report has been prepared by Nicola Sugg (trading style of NSugg Limited) with all reasonable skill and care, and in accordance with the services agreed with WFBA Consulting Civil & Structural Engineers. Relevant information provided by WFBA Consulting Civil & Structural Engineers has been accepted in good faith as being accurate and valid. This report is based on the relevant guidance and legislation in force at the date of the report and should be reviewed if such guidance and legislation are amended or superseded.

This report is for the exclusive use of WFBA Consulting Civil & Structural Engineers and McCarthy & Stone; no warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from Nicola Sugg.

Appendix 1: Site Topographic Survey



Appendix 2 : Proposed Development Plan



GENERAL NOTES:
1. This drawing is the copyright of KSA Architects Ltd and may not be copied, altered or reproduced in any form or passed on to a third party without written consent. If in doubt ASK.
2. The drawing reflects current standards and legislation agreed for this project at the time of original issue.

Schedule of Accommodation:

RL Apartments		
Retail Area	375 sq. m	4046 sq. ft
Ground Floor:	9 x 1 bed	4 x 2 bed
First Floor:	11 x 1 bed	9 x 2 bed

33no. Units Total
20 - 1 bed (61%), 13 - 2 bed (39%)

Parking
RL - 26 Parking Spaces
Eachways - 2 Parking Spaces
Retail Areas - 12 Spaces

Lorry Loading bay to have set delivery times with public parking capability outside of these hours?

B	14.05.21	Red line updated; Parking bay surfaces updated	EG	DK
A	12.05.21	First issue	EG	DK
Rev	Date	Description	Rev By	Ckd By



The people orientated placemakers.

Client
McCarthy Stone

Project
Former Chandler's Accident Repair Center
High Street
Angmering
BN16 4DR

Drawing Title
Proposed Site Plan

Drawing Status
PLANNING ISSUE

Document Ref.
SO - 2729 - 03 - AC - 102

RIBA  KSA Architects Ltd, Concept House
35 Kingston Crescent, North End
Portsmouth, Hampshire, PO2 8AA
Web: www.ksaltd.co.uk
Chartered Practice

Scale
1:200 @ A1

Revision
B

Drawn By
EG

Phone: 023 9267 3618
Email: info@ksaltd.co.uk
Web: www.ksaltd.co.uk

Appendix 3: Environment Agency 'Product 4' Data

Rob Lowe
WFBA,
The Old Hayloft,
Pucknall Farm,
Dores Lane,
Braishfield, Romsey Hampshire
SO51 0QJ

Our ref: SSD189982
Your ref:
Date: 05/11/2020

Dear Rob,

Enquiry Regarding Product 4 for Flood Risk Assessment for Chandler BMW site, Water Lane, Angmering, BN16 4EH.

Thank you for your enquiry which was received on 13 October 2020.

We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004. The information is attached.

The information on Flood Zones in the area relating to this address is as follows:

The site is in an area located within Flood Zone 3 as shown on our Flood Map for Planning (Rivers and Sea).

Note - This information relates to the area that the above named property is in and is not specific to the property itself as it is influenced by factors such as the height of door steps, air bricks or the height of surrounding walls. We do not have access to this information and is not currently used in our flood modelling.

Flood Zone definitions can be found at www.gov.uk/guidance/flood-risk-and-coastal-change#Table-1-Flood-Zones

Flood Defences

There are no formal raised flood defences in the vicinity of the site.

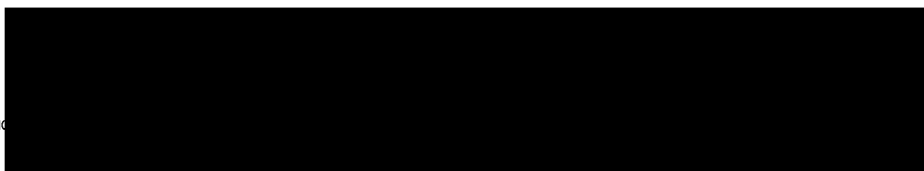
Model Information

The model used was the Lower Tidal River Arun Strategy Study which was completed by Atkins in 2010.

Flood History

We hold no record of flooding events affecting this site, but a nearby area was previously flooded in 1980 (Flood Event Code: 2043). The source of the flooding was drainage and the cause was fluvial flooding.

Please note our records are not comprehensive and may not include all events. I recommend contacting the Lead Local Flood Authority, **West Sussex County Council** or the Local Authority, **Arun District Council** for a more comprehensive flood history check.



FRA advisory text

Name	Product 4
Description	Detailed Flood Risk Assessment Map for Chandler BMW site, Bmw House, Water Lane, Angmering BN16 4EH.
Licence	<u>Open Government Licence</u>
Information Warnings	The majority of our models will not have the new climate change allowances for <u>fluvial</u> flood risk. +20% is not suitable for the majority of planning purposes and the new allowances to use should be checked here: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.
Information Warning - OS background mapping	<i>The mapping of features provided as a background in this product is © Ordnance Survey. It is provided to give context to this product. The Open Government Licence does not apply to this background mapping. You are granted a non-exclusive, royalty free, revocable licence solely to view the Licensed Data for non-commercial purposes for the period during which the Environment Agency makes it available. You are not permitted to copy, sub-license, distribute, sell or otherwise make available the Licensed Data to third parties in any form. Third party rights to enforce the terms of this licence shall be reserved to OS.</i>
Attribution	Contains Environment Agency information © Environment Agency and/or database rights. Contains Ordnance Survey data © Crown copyright 2017 Ordnance Survey 100024198.

Data Available Online

Many of our flood datasets are available online:

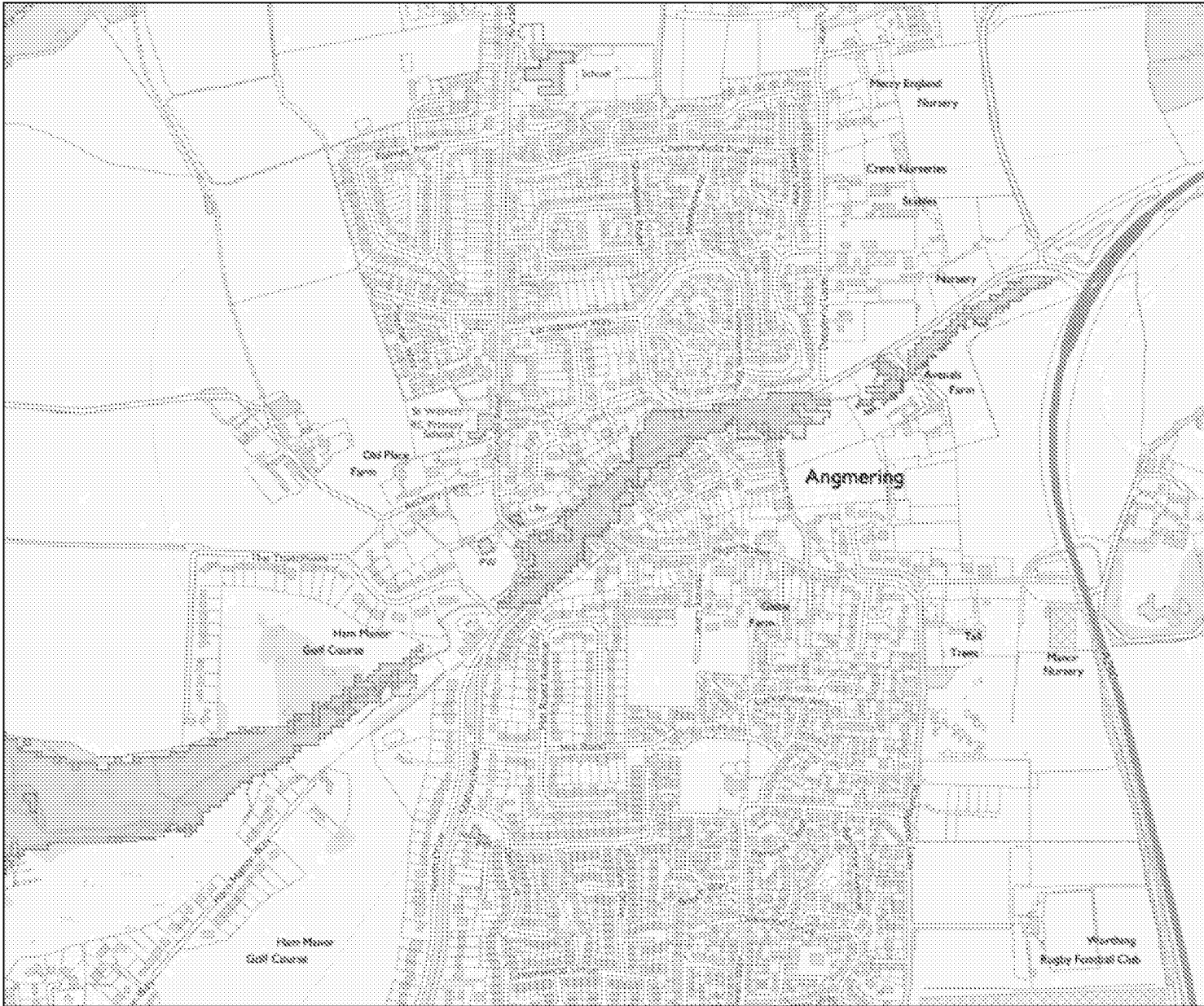
- Flood Map For Planning ([Flood Zone 2](#), [Flood Zone 3](#), [Flood Storage Areas](#), [Flood Defences](#), [Areas Benefiting from Defences](#))
- [Risk of Flooding from Rivers and Sea](#)
- [Historic Flood Map](#)
- [Current Flood Warnings](#)

Please get in touch if you have any further queries or contact us within two months if you'd like us to review the information we have sent.

Yours sincerely,

Misha Misri
Flood & Coastal Risk Management Officer,
Partnership & Strategic Overview,
West Sussex,
Solent and South Downs

Flood Map for Planning (Rivers and Sea) created 05/11/2020.



Scale 1: 10,000



Flood Map for Planning (Rivers & Sea)

-  Defences
-  Flood Storage Areas
-  Areas benefiting from flood defences
-  Flood Zone 3
-  Flood Zone 2

Flood Map Areas (assuming no defences)

Flood Zone 3 shows the area that could be affected by flooding:

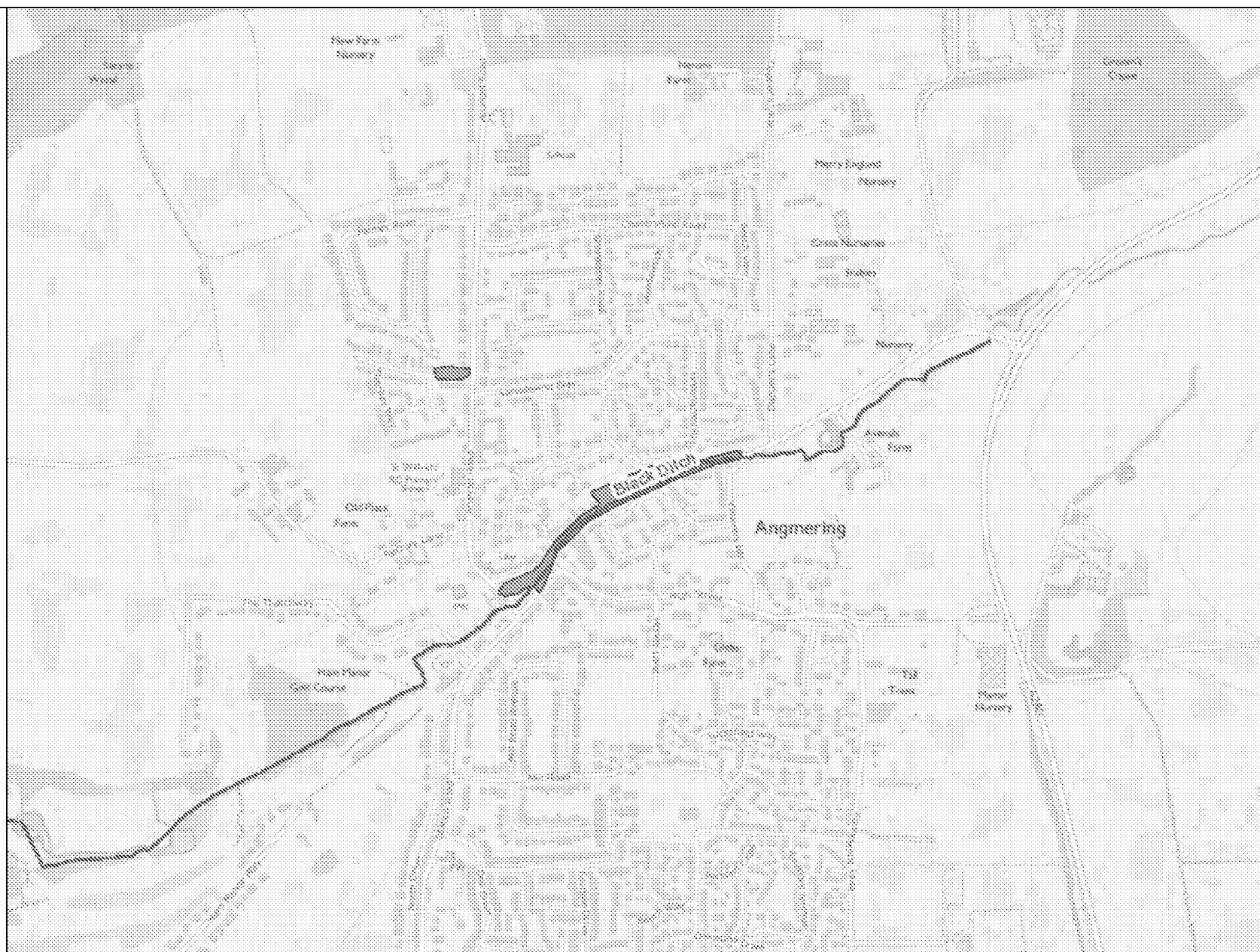
- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

Recorded Flood Events Outlines

Legend

- Sealed Main Rivers
All recorded flood outlines



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Product 4 Flood Risk Data Requested by: WFBA

Site: CHANDLERS GARAGE, BMW HOUSE, WATER LANE, ANGMERING, LITTLEHAMPTON, BN16 4EH

Table 1: Water Levels: Fluvial Undefended

	NGR		Modelled Flood Levels in Metres			
			Undefended Annual Exceedance Probability			
Node Reference	Eastings	Northings	5%	1%	1% Plus Climate Change	0.1%
1	506961	104488	-	6.03	6.08	6.21
2	506897	104427	-	5.63	5.67	5.74
3	506896	104402	-	5.53	5.55	5.63
4	506931	104404	-	-	-	-

Table 2: Water Levels: Fluvial Defended

	NGR		Modelled Flood Levels in Metres					
			Defended Annual Exceedance Probability					
Node Reference	Eastings	Northings	20%	5%	1.3%	1%	1% + CC	0.1%
1	506961	104488	-	-	6.18	6.20	6.23	6.33
2	506897	104427	-	-	5.50	5.52	5.52	5.67
3	506896	104402	-	-	5.46	5.52	5.52	5.62
4	506931	104404	-	-	-	-	-	-

Office Address: Guildbourne House, Chatsworth Road, Worthing BN11 1LD.

Table 3: Water Depth: Fluvial Undefended

	NGR		Modelled Flood Depth in Metres			
			Undefended Annual Exceedance Probability			
Node Reference	Eastings	Northings	5%	1%	1% Plus Climate Change	0.1%
1	506961	104488	-	0.35	0.41	0.53
2	506897	104427	-	0.08	0.12	0.19
3	506896	104402	-	0.05	0.08	0.15
4	506931	104404	-	-	-	-

Table 4: Water Depth: Fluvial Defended

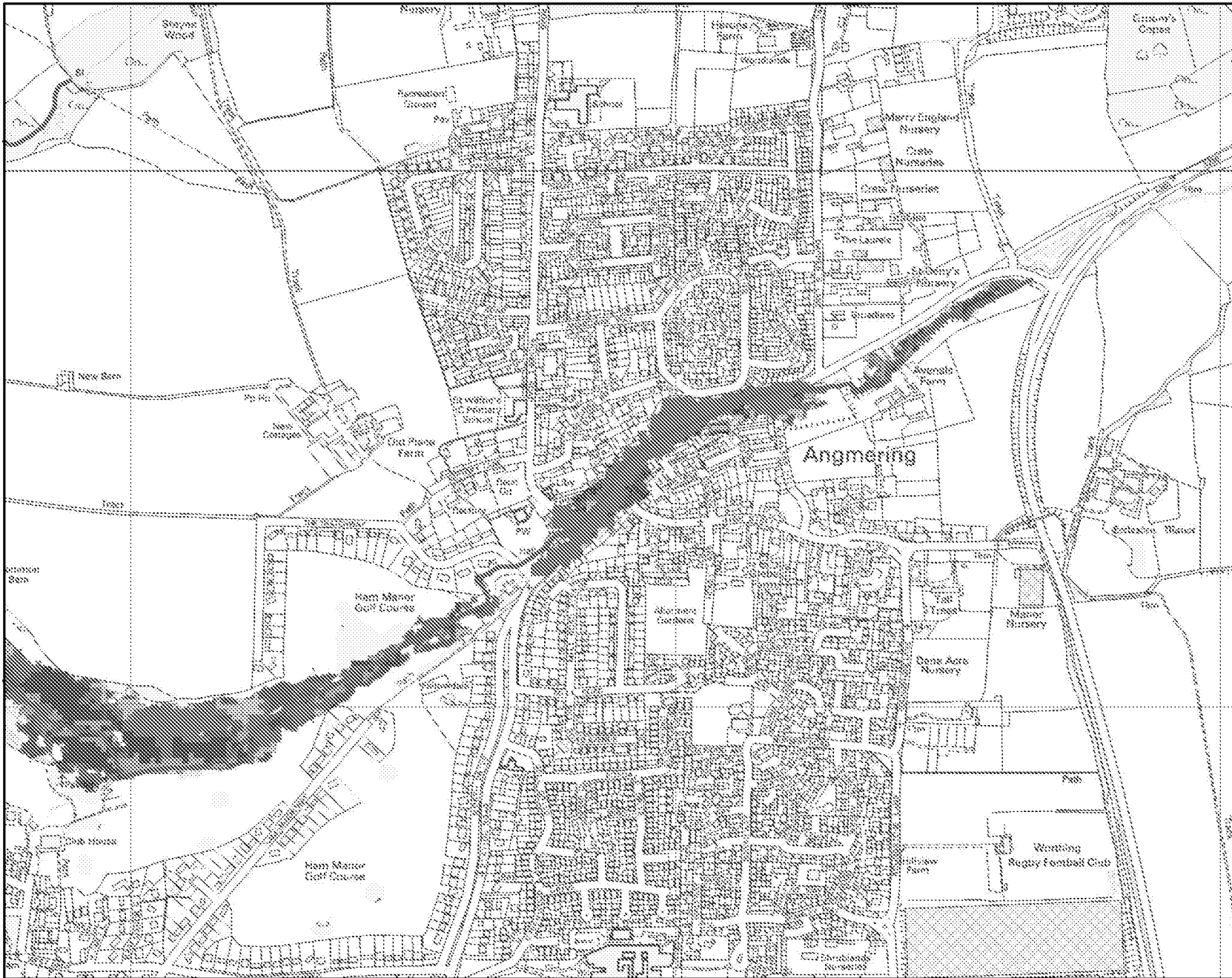
	NGR		Modelled Flood Depth in Metres					
			Defended Annual Exceedance Probability					
Node Reference	Eastings	Northings	20%	5%	1.3%	1%	1% + CC	0.1%
1	506961	104488	-	-	0.18	0.19	0.23	0.33
2	506897	104427	-	-	0.03	0.05	0.09	0.20
3	506896	104402	-	-	0.09	0.10	0.15	0.25
4	506931	104404	-	-	-	-	-	-

All levels taken from: Lower Tidal River Arun Strategy Study, completed in 2010 by Atkins

There is no additional information or health warnings for these levels/depths or the model from which they have been produced.

Produced on 05/11/2020

Office Address: Guildbourne House, Chatsworth Road, Worthing BN11 1LD.





Environment
Agency

N


Legend

- Main River
- 20% AEP (Defended Fluvial)
- 5% AEP (Defended Fluvial)
- 1.3% AEP (Defended Fluvial)
- 1% AEP (Defended Fluvial)
- 1% AEP Plus Climate Change (Defended Fluvial)
- 0.1% AEP (Defended Fluvial)

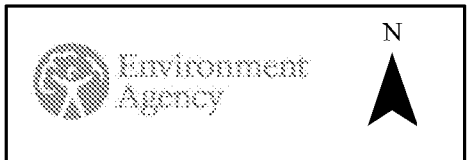
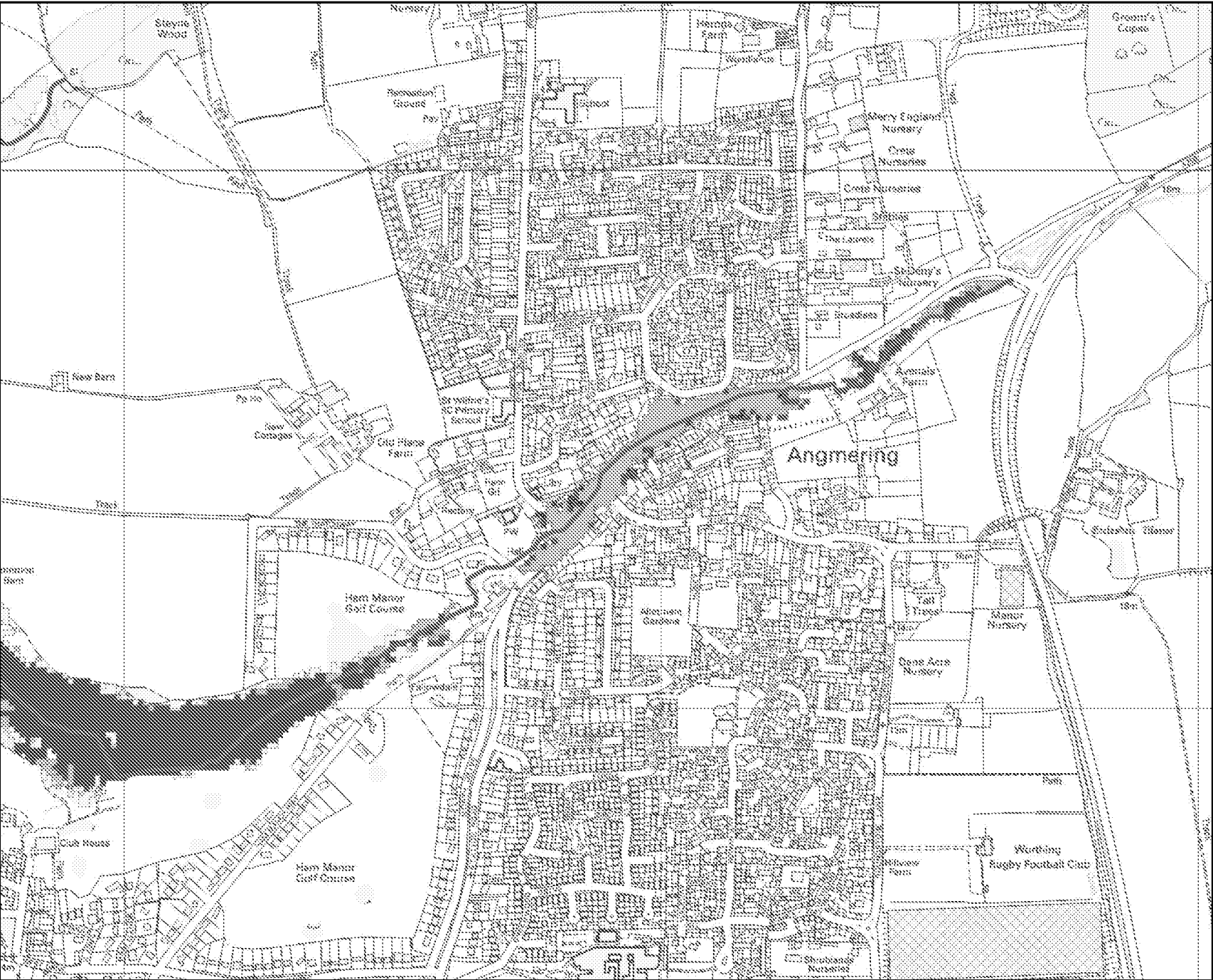
Climate Change (CC) extent based on an increase of 20% in river flows.

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000



00.250.5
Kilometers

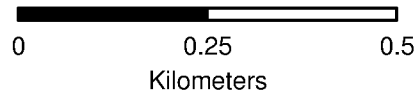


- Legend**
- Main River
 - 5% AEP (Undefended Fluvia)
 - 1% AEP (Undefended Fluvia)
 - 1% AEP Plus Climate Change (Undefended Fluvia)
 - 0.1% AEP (Undefended Fluvia)

Climate Change (CC) extent based on an increase of 20% in river flows.

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000



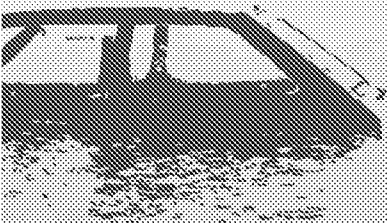
Appendix 4: Flood Plan Template



Environment
Agency

would your business stay afloat?

A guide to preparing your
business for flooding



Flooding is the most common and widespread natural disaster in the UK. Since 1998 there has been at least one serious flood every year. Businesses like yours are more likely to be flooded than destroyed by fire. As our climate changes we can expect to see more extreme weather – and more floods.

We aim to reduce the likelihood of flooding by managing land, rivers, coastal systems and flood defences. While we do everything we can to reduce the chance of flooding, it is a natural process and can never be completely eliminated.

By taking action to prepare in advance for flooding, most businesses can save between 20 and 90 per cent on the cost of lost stock and movable equipment, as well as some of the trouble and stress that goes with such an event.

This is a simple guide to some of the easy actions that you can take to make sure that your business is as well prepared as possible.

It tells you about how to find out if your business is at risk, our flood warning service and what our flood warning codes mean. It also has a simple template to use to design a flood plan for your company.

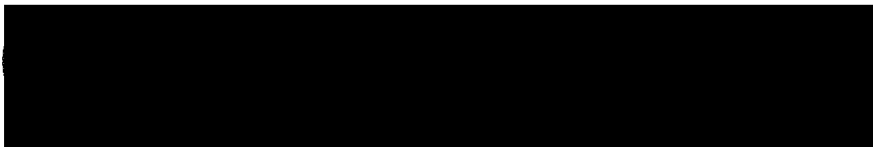
For more information about flooding, visit our website at **www.gov.uk/flood** or call Floodline on **0345 988 1188**.

Make sure that your business is prepared for flooding.

How do I find out if my business is at risk from flooding?

There are two quick and easy ways for you to find out if you're at risk.

call us on



Our Floodline service is open 24 hours, calls are charged at local rate. By taking your postcode, our operators will check and see if your business is in a flood risk area.

Look at our website

www.gov.uk/flood

You need to be aware of flooding and keep an eye on the water levels and weather situation at all times. You can do this by checking the flood forecasts and the river and sea levels on our website.

Our online flood map uses the latest technology and data gathered over many years to give the most accurate view of flooding in your area.

By entering your postcode you can find out if your business is at risk. Areas at risk from flooding are shown in dark blue and areas at risk from extreme flooding in light blue.

My business is at risk from flooding. What should I do now?

Start preparing now. If the weather conditions are right, flooding can happen at any time.

Remember, floods can happen at any time and any day — make sure you provide a number that can be contacted at all times — even out of working hours.

Sign up for flood warnings.

The first thing you should do is find out if you can receive flood warnings. In areas of high flood risk, we offer a service called Floodline Warnings Direct. This is a free, 24 hour service that sends automated flood warnings by telephone, SMS text, email, fax or pager.

To find out if you can receive this service, call Floodline on 0345 988 1188.

If your business isn't in an area covered by our warnings you can still check the latest flood warnings in force on our website.

When the situation is serious, flood warnings will also be broadcast on local television and radio news.

What practical steps can I take to protect my business?

Now that you've checked your risk and found out about flood warnings, it's time to start thinking about preparing a flood plan specifically for your business.

Taking simple steps can go a long way to protecting your business from flooding. Preparing a flood plan could:

- Significantly reduce financial losses, damage to property and business interruption;
- Help compliance with regulatory requirements (for example, Occupier's Liability Act 1984);
- Reduce exposure to civil or criminal liability;
- Enhance your company's image and credibility with employees, customers, suppliers and the community;
- Help fulfil your moral responsibility to protect employees, the community and the environment;
- Help you to obtain insurance cover.

What is a flood plan?

Just as many businesses have health and safety policies and contingency plans for an emergency, they should also have flood plans.

A flood plan is a written document that outlines how your business will respond to a flood.

This might include a list of steps you will take in case of a flood and the order you will take them in. It could also include the purchase of flood products and insurance.

A written plan can make information easy to access during a flood, easy to communicate to staff, and easy to remember.

Small businesses should make sure there is a plan of action in case of flooding. As the business owner, this may be your responsibility.

If your business is medium sized, flood preparation might be the responsibility of a team of people from different areas of the business.

If your business decides to have a flood planning team, this could be led by the business owner or Managing Director.

The leader of the flood planning team will need to let staff know about the plan once it is finished.

All members of the team should also keep a copy of important flood contacts at home for easy access.

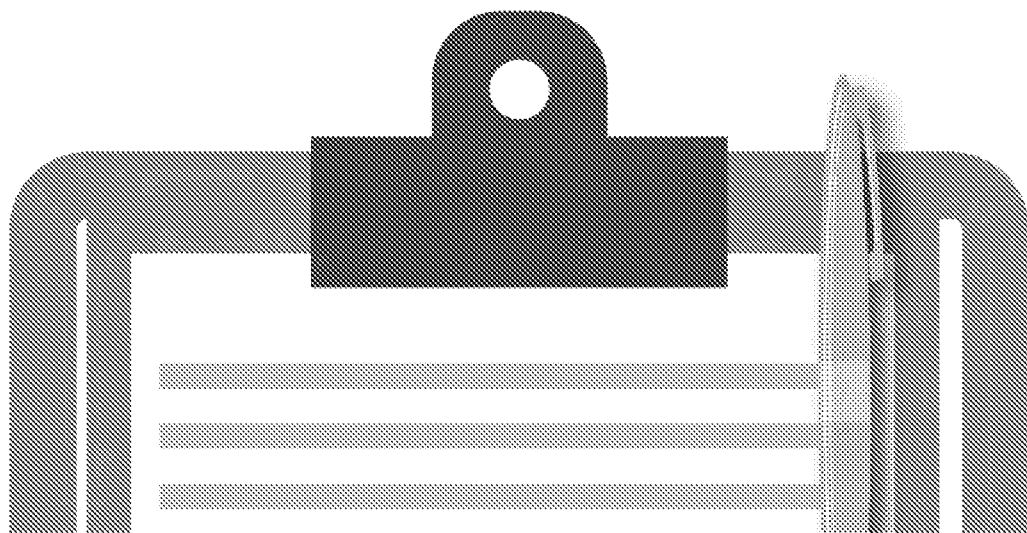
Key areas to consider in your flood plan are:

- human resources;
- maintenance/facilities;
- finance and purchasing.

Once you have completed your plan don't forget about it. Look at it regularly and make sure it is up to date and in the event of a flood use it.



business flood plan



A written flood plan is recommended for businesses.

It should include:

- A list of important contacts, including Floodline, building services, suppliers and evacuation contacts for staff;
- A description or map showing locations of key property, protective materials and service shut-off points;
- Basic strategies for protecting property, preventing business disruption and assisting recovery;
- Checklists of procedures that can be quickly accessed by staff during a flood.

If a flood is imminent, your main priority is to make sure that your staff are safe. However there may be other actions that you can take to prepare your building and its contents to minimise damage and post-flood repair and restoration costs.

Business flood plan

Flood plan for _____ dated _____

Registered address _____

Postcode _____

Staff contact list

Name	Address	Telephone/mobile	Emergency contact	Emergency telephone and address

Note staff who may require assistance in the event of a flood.

Name	Office location

Key locations

Service cut-off	Description of location
Electricity	
Gas	
Water	

Answer the following if applicable

	Description of location	How to protect from a flood (for example, move, cover, tie down)
First Aid Kit		
Oil based products (gasoline, oil, cooking oil etc.)		
Chemicals (including cleaning products)		

Protective actions

Identify stock, equipment and possessions that may need special protective measures, and describe the actions you will take to prevent damage in the event of a flood. We have suggested items and ways to protect them, but make sure you follow through on your plans.

think about:

- Computers;
- Tables / heavy furniture;
- Vehicles;
- Paper files;
- Electrical items;
- Chairs / stools;
- Databases;
- Soft furnishings;
- Computer files;
- Staff files.

ways to protect items

- Make a copy of important documentation and store in safe location;
- Raise items above ground level;
- Buy flood protection products;
- Buy new flood-resistant items;
- Move items to a safer location if possible – to an upper level of the building or off site.

Valuable item	Protective action	New location (if applicable)	Done
			☐
			☐
			☐
			☐
			☐
			☐
			☐
			☐
			☐

Suggested basic building materials to help protect your property

If materials are not needed, leave the relevant section blank

Materials	Used for	Items to protect / where to use	Storage location	Done
Sand and sand bags (unfilled), shovel	Creating flood barriers (used with plastic sheeting)			☐
Tools – hammer, nails, saw	Boarding up doors, windows and openings, creating shelves			☐
Wood – plywood, blocks of wood	Boarding up doors, windows and openings, creating shelves			☐
Sturdy plastic sheeting	Sandbag barriers, pulling up around furniture and appliances			☐
Strong plastic bags	Putting around legs of tables and chairs			☐
Pallets	Raising stored stock above flood level			☐
Emergency power generator	Maintaining function of air conditioning units (can help dry out a building), running fridges and freezers, medical equipment if appropriate			☐

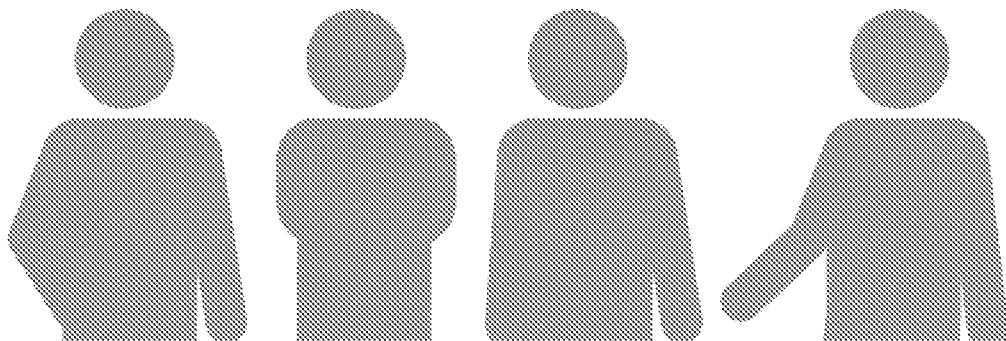
We have suggested ways they might be able to help, but you'll need to discuss this with them.

Ways people can help

- Environment Agency A guide to preparing your business for flooding 12

discussion guide

This discussion guide sums up the key areas of flood planning. Some of this information can be found in this pack to help get you started.



Research

- Look at your existing business policies, and think about whether they are appropriate in the event of a flood.

Staff

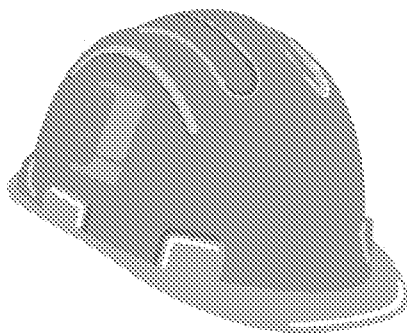
- Make a list of **employees' contact details in the event of an evacuation**. This might include mobile telephone numbers, or numbers for their home or the home of a friend or relative;
- Think about staff who **may need special assistance** in the event of a flood (for example, elderly, deaf, blind etc.)

Security procedures

- **Locking windows, doors and setting the alarm**. You might need more than one person to help do this;
- Insurance policies – **Are you insured for flood damage**, business interruption and lost revenue?
- Employee manuals – You might **add flood safety to staff information packs**, or adapt job descriptions to include flood warden duties;
- Hazardous materials plan – You must ensure that **chemicals, oils and other substances in your possession are kept safe** and do not contaminate flood water;
- Health and safety assessment – Plan to **check the functioning of flood products and flood warning systems regularly**, just as you do for fire safety equipment.

Check codes and regulations that might apply to your business in the event of a flood. The following could provide guidance on the right actions to take:

- Occupational health and safety regulations;
- Environmental regulations.



Important contacts

Make a list of important telephone numbers, including contacts for gas, electricity, water and telephone providers.

Key locations

- **Know the location** of cut-off points for gas, electricity and water. Ideally, these should be marked on a map that is stored with your flood plan;
- Know the location of chemicals, oils or other materials that could be dangerous or contaminate flood water. These should be stored safe from floods and other damage.

Protective actions

- Note key stock, equipment and possessions that may need special protection from flood water;
- Consider things you may need during or after a flood (for example, sandbags, plastic sheeting, loudspeaker);
- See if it's **possible to move key operations**, such as shipping or customer services, to another building.

Suppliers and external links

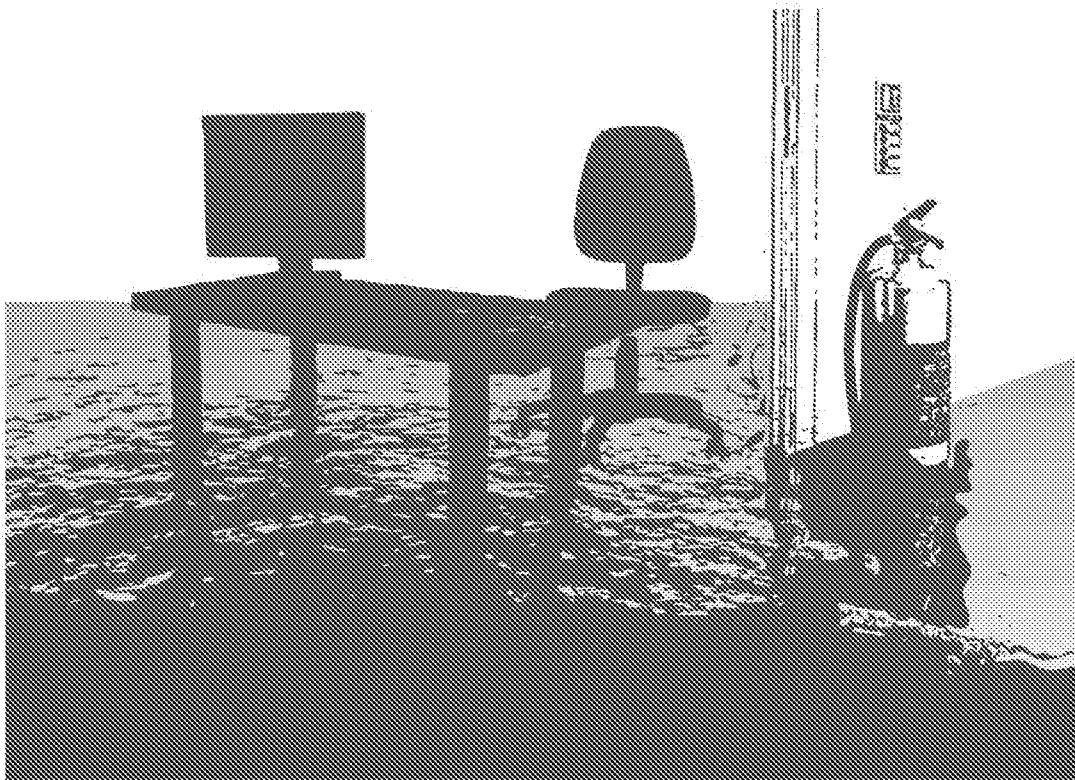
- Identify products and services you won't need in the event of a flood, or which suppliers may not be able to provide. **Make back-up plans** or arrangements for short-notice cancellation of deliveries;
- Consider contracting in advance with companies whose help you may need after a flood.

business checklist

Are you prepared for flooding?

If you answer no to any of the questions overleaf, there may be more you can do to protect your business.

The individual sections will give you valuable information on effective actions you can take to prepare for a flood.



If you can answer yes, please ☒, otherwise leave blank for no.

Know if you're at risk

- ☐ Do you know if you're at risk of flooding?
- ☐ Are flood warnings available in your area?
- ☐ Do you know how you can receive flood warnings?

Preparing a flood plan

- ☐ Do you know how your business will respond to a flood?
- ☐ Do you have a list of useful numbers including Floodline, local authority and insurance company?
- ☐ Do you know how to shut off your gas/electric/water supplies?
- ☐ Are your stock, fittings and valuable equipment stored above flood level?
- ☐ Have you developed flood contingency plans with suppliers and/or clients?
- ☐ Can you call someone to help you in the event of a flood?

Staff training and evacuation

- ☐ Are you aware of correct flood safety procedures for you and your staff?
- ☐ Have you trained your staff on flood safety procedures?
- ☐ Can your staff work quickly and efficiently to protect your business in the event of a flood?

Protecting your property

- ☐ Have you installed flood protection products?
- ☐ Do you have a stockpile of useful materials including plywood, plastic sheeting, sandbags (unfilled), sand, nails, hammer, shovel, blocks of wood and a saw?
- ☐ Have you installed non return valves in your toilets and drains?
- ☐ Do you and your staff have high ground where you can park your cars?
- ☐ Are your electrical sockets above flood level?
- ☐ Do you have computer equipment in the basement?

Flood insurance

- ☐ Do you have sufficient insurance cover in the event of a flood situation?
- ☐ Do you know what information your insurer will require to support a claim?

Evacuation

- ☐ Do you have an easy way to let your staff know about an evacuation?
- ☐ Do you know which roads will stay open in your area during a flood?
- ☐ Have you identified where staff can shelter in the event of a flood?
- ☐ Could you control staff panic during a flood?

understand your flood warning codes

Our warning service has three types of warnings - Flood Alert, Flood Warning and Severe Flood Warning - that will help you prepare for flooding and take necessary actions.

ONLINE FLOOD RISK FORECAST

What it means

Be aware.
Keep an eye on the
weather situation.

When it's used

Forecasts of flooding on
the Environment Agency
website are updated a
least once a day.

What to do

- Check weather conditions.
- Check for updated flood forecasts on our website.



What it means

Flooding is possible.
Be prepared.

When it's used

Two hours to two days
in advance of flooding.

FLOOD ALERT

What to do

- Be prepared to act on your flood plan.
 - Prepare a flood kit of essential items.
 - Monitor local water levels and the flood forecast on our website.
-



FLOOD WARNING

What it means

Flooding is expected.
Immediate action required.

When it's used

Half an hour to one day
in advance of flooding.

What to do

- Move staff, stock and valuables to a safe place.
 - Turn off gas, electricity and water supplies if safe to do so.
 - Put flood protection equipment in place.
-



SEVERE FLOOD WARNING

What it means

Severe flooding.
Danger to life.

When it's used

When flooding poses a
significant risk to life.

What to do

- Stay in a safe place with means of escape.
 - Be ready should you need to evacuate.
 - Co-operate with the emergency services.
 - Call 999 if you are in immediate danger.
-

WARNING NO LONGER IN FORCE

What it means

No further flooding is
currently expected in
your area.

When it's used

When river or sea
conditions begin to
return to normal.

What to do

- Be careful. Flood water may still be around for several days.
 - If you've been flooded, ring your insurance company as soon as possible.
-

useful contacts

Fill in the contact details you may need if your business floods.
Keep it in a safe place, where you can hold of it quickly.

Company name		
Environment Agency Floodline		
Electricity supplier and meter number		
Gas supplier and meter number		
Water supplier and meter number		
Telephone provider		
Local authority emergency services		
Insurance company 24-hour number and policy number		
Insurance agent		
Local radio station for news alerts and weather updates		
Companies that may be able to help you after a flood		
Electrician		
Plumber		
Builder		
Equipment repair/suppliers		
Security services		
Water pumping services		
Emergency power suppliers		

**Would you like to find out more about us,
or about your environment?**

Then call us on

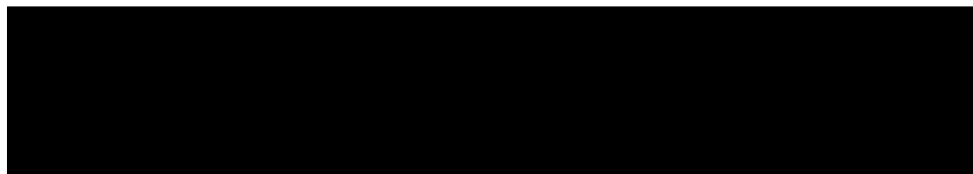


email



or visit our website

www.gov.uk/environment-agency



*** Weekday Daytime calls cost 8p plus up to 6p/min from BT Weekend Unlimited. Mobile and other providers' charges may vary.**



Environment first: Are you viewing this on-screen?

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absolutely necessary. If you're reading a paper copy,
please don't forget to reuse and recycle if possible.**

Appendix 5 Brownfield Runoff Rates

Y _T =
t _T $\frac{1}{\sqrt{1 - \beta^2}}$
5h bh α 95L

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挨	挨a	挨a	3挨	3挨	挨a	3挨	挨a	3挨	挨a
挨	挨a	挨a	3挨	3挨	挨a	3挨	挨a	挨a	挨a

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横E	横	横	三	横	三	三	横	三	横
五	三	横	三	三	横	横	横	三	桑
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西	三	横	三	三	三	三	桑	三	三
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Appendix 6 Surface Water Drainage Design & Calculations

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XP Solutions	Network 2019.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales			
Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	550	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Mn Design Depth for Optimisation (m)	0.500
Foul Sewage (l/s/ha)	0.000	Mn Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Mn Slope for Optimisation (1:X)	200

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.018	4-8	0.271	8-12	0.028

Total Area Contributing (ha) = 0.317

Total Pipe Volume (mE) = 10.308

Network Design Table for Storm

I - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I. Area (ha)	T. E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	3.993	0.033	121.0	0.032	4.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	7.362	0.074	100.0	0.012	4.00	0.0	0.600	o	100	Pipe/Conduit	
3.000	7.361	0.074	100.0	0.022	4.00	0.0	0.600	o	100	Pipe/Conduit	
2.001	9.069	0.091	100.0	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.001	14.727	0.123	120.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	8.879	0.047	190.0	0.023	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T. C. (mins)	US/IL (m)	√ I. Area (ha)	√ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	52.78	4.07	5.000	0.032	0.0	0.0	0.0	0.91	16.1	4.5
2.000	52.36	4.16	5.200	0.012	0.0	0.0	0.0	0.77	6.0	1.7
3.000	52.36	4.16	5.200	0.022	0.0	0.0	0.0	0.77	6.0	3.2
2.001	51.43	4.36	5.126	0.034	0.0	0.0	0.0	0.77	6.0	4.8
1.001	50.23	4.62	4.967	0.066	0.0	0.0	0.0	0.92	16.2	9.0
1.002	49.56	4.78	4.769	0.089	0.0	0.0	0.0	0.95	37.6	12.0

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I. Area (ha)	T. E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
4.000	4.235	0.042	100.8	0.008	4.00	0.0	0.600	o	100	Pipe/Conduit	
1.003	14.521	0.076	190.0	0.027	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.000	3.897	0.039	99.9	0.002	4.00	0.0	0.600	o	100	Pipe/Conduit	
1.004	25.545	0.134	190.0	0.018	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.005	24.081	0.127	190.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
6.000	1.816	0.023	80.0	0.003	4.00	0.0	0.600	o	100	Pipe/Conduit	
1.006	2.011	0.011	190.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.007	5.543	0.000	0.0	0.005	0.00	0.0	0.600	oo	150	Double Pipe	
7.000	5.528	0.069	80.0	0.008	4.00	0.0	0.600	o	100	Pipe/Conduit	
7.001	3.537	0.044	80.0	0.009	0.00	0.0	0.600	o	100	Pipe/Conduit	
7.002	5.380	0.000	0.0	0.000	0.00	0.0	0.600	oo	150	Double Pipe	
8.000	2.141	0.011	190.0	0.037	4.00	0.0	0.600	o	225	Pipe/Conduit	
9.000	4.160	0.042	99.0	0.014	4.00	0.0	0.600	o	100	Pipe/Conduit	
8.001	16.073	0.085	190.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
10.000	3.726	0.037	100.7	0.012	4.00	0.0	0.600	o	100	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T. C. (mins)	US/IL (m)	√ I. Area (ha)	√ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
4.000	52.68	4.09	5.570	0.008	0.0	0.0	0.0	0.77	6.0	1.1
1.003	48.50	5.04	4.723	0.124	0.0	0.0	0.0	0.95	37.6	16.2
5.000	52.72	4.08	5.562	0.002	0.0	0.0	0.0	0.77	6.0	0.3
1.004	46.77	5.49	4.646	0.144	0.0	0.0	0.0	0.95	37.6	18.2
1.005	45.26	5.91	4.512	0.144	0.0	0.0	0.0	0.95	37.6	18.2
6.000	52.96	4.04	5.650	0.003	0.0	0.0	0.0	0.86	6.8	0.4
1.006	45.14	5.95	4.385	0.147	0.0	0.0	0.0	0.95	37.6	18.2
1.007	42.03	6.94	3.150	0.152	0.0	0.0	0.0	0.69	3.3	18.2
7.000	52.61	4.11	5.700	0.008	0.0	0.0	0.0	0.86	6.8	1.1
7.001	52.28	4.18	5.631	0.017	0.0	0.0	0.0	0.86	6.8	2.4
7.002	48.08	5.14	3.150	0.017	0.0	0.0	0.0	0.69	3.3	2.4
8.000	52.95	4.04	4.820	0.037	0.0	0.0	0.0	0.95	37.6	5.3
9.000	52.70	4.09	5.081	0.014	0.0	0.0	0.0	0.77	6.1	2.0
8.001	51.35	4.37	4.809	0.051	0.0	0.0	0.0	0.95	37.6	7.1
10.000	52.74	4.08	5.170	0.012	0.0	0.0	0.0	0.77	6.0	1.7

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I. Area (ha)	T. E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
8.002	13.088	0.069	190.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.003	14.280	0.075	190.0	0.028	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.004	8.760	0.046	190.4	0.006	0.00	0.0	0.600	o	225	Pipe/Conduit	
11.000	7.445	0.067	111.1	0.013	4.00	0.0	0.600	o	100	Pipe/Conduit	
8.005	3.780	0.020	190.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.006	8.929	0.089	100.0	0.002	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.007	4.864	0.026	190.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.008	26.583	0.140	190.0	0.019	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.009	8.861	0.047	190.0	0.002	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.010	8.848	0.047	190.0	0.002	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.011	5.645	0.000	0.0	0.005	0.00	0.0	0.600	oo	150	Double Pipe	
1.008	5.439	0.000	0.0	0.000	0.00	0.0	0.600	oo	150	Double Pipe	
1.009	15.443	0.081	190.7	0.008	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.010	29.676	0.198	149.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T. C. (mins)	US/IL (m)	√ I. Area (ha)	√ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
8.002	50.32	4.60	4.724	0.063	0.0	0.0	0.0	0.95	37.6	8.6
8.003	49.24	4.86	4.650	0.091	0.0	0.0	0.0	0.95	37.6	12.2
8.004	48.61	5.01	4.575	0.097	0.0	0.0	0.0	0.94	37.5	12.8
11.000	52.31	4.17	5.090	0.013	0.0	0.0	0.0	0.73	5.7	1.9
8.005	48.34	5.08	4.529	0.111	0.0	0.0	0.0	0.95	37.6	14.5
8.006	47.89	5.19	4.509	0.112	0.0	0.0	0.0	1.31	52.0	14.6
8.007	47.56	5.28	4.420	0.112	0.0	0.0	0.0	0.95	37.6	14.6
8.008	45.84	5.75	4.394	0.132	0.0	0.0	0.0	0.95	37.6	16.3
8.009	45.30	5.90	4.254	0.133	0.0	0.0	0.0	0.95	37.6	16.4
8.010	44.77	6.06	4.208	0.135	0.0	0.0	0.0	0.95	37.6	16.4
8.011	41.66	7.07	3.150	0.141	0.0	0.0	0.0	0.09	3.31	16.4
1.008	39.11	8.05	3.100	0.309	0.0	0.0	0.0	0.09	3.31	32.7
1.009	38.46	8.32	3.100	0.317	0.0	0.0	0.0	0.94	37.5	33.0
1.010	37.11	8.93	3.000	0.317	0.0	0.0	0.0	0.82	14.57	33.0

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam, L*W (mm)	PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	5.720	0.720	Open Manhole	450	1.000	5.000	150				
2	5.730	0.530	Open Manhole	250	2.000	5.200	100				
3	5.730	0.530	Open Manhole	250	3.000	5.200	100				
4	5.750	0.624	Open Manhole	450	2.001	5.126	100	2.000	5.126	100	
								3.000	5.126	100	
5	5.800	0.833	Junction		1.001	4.967	150	1.000	4.967	150	
								2.001	5.036	100	19
6	5.950	1.181	Open Manhole	600	1.002	4.769	225	1.001	4.844	150	
7	6.100	0.530	Open Manhole	250	4.000	5.570	100				
8	6.200	1.477	Open Manhole	600	1.003	4.723	225	1.002	4.723	225	
								4.000	5.528	100	680
9	6.150	0.588	Open Manhole	250	5.000	5.562	100				
10	6.350	1.704	Open Manhole	600	1.004	4.646	225	1.003	4.646	225	
								5.000	5.523	100	752
11	6.150	1.638	Open Manhole	600	1.005	4.512	225	1.004	4.512	225	
12	6.150	0.500	Open Manhole	250	6.000	5.650	100				
13	6.150	1.765	Open Manhole	600	1.006	4.385	225	1.005	4.385	225	
								6.000	5.627	100	1117
14	6.150	3.000	Open Manhole	1200	1.007	3.150	150	1.006	4.374	225	1299
15	6.200	0.500	Open Manhole	450	7.000	5.700	100				
16	6.250	0.619	Open Manhole	450	7.001	5.631	100	7.000	5.631	100	
17	6.150	3.000	Open Manhole	1200	7.002	3.150	150	7.001	5.587	100	2387
18	5.750	0.930	Open Manhole	600	8.000	4.820	225				
19	5.611	0.530	Open Manhole	250	9.000	5.081	100				
20	5.745	0.936	Junction		8.001	4.809	225	8.000	4.809	225	
								9.000	5.039	100	105
21	5.700	0.530	Open Manhole	250	10.000	5.170	100				
22	5.740	1.016	Open Manhole	600	8.002	4.724	225	8.001	4.724	225	
								10.000	5.133	100	284
23	6.340	1.690	Open Manhole	600	8.003	4.650	225	8.002	4.655	225	5
24	6.300	1.725	Open Manhole	600	8.004	4.575	225	8.003	4.575	225	
25	5.620	0.530	Open Manhole	250	11.000	5.090	100				
26	5.800	1.271	Open Manhole	600	8.005	4.529	225	8.004	4.529	225	
								11.000	5.023	100	369
27	6.250	1.741	Open Manhole	600	8.006	4.509	225	8.005	4.509	225	
28	6.200	1.780	Open Manhole	600	8.007	4.420	225	8.006	4.420	225	
29	6.200	1.806	Open Manhole	600	8.008	4.394	225	8.007	4.394	225	
30	6.500	2.246	Open Manhole	600	8.009	4.254	225	8.008	4.254	225	
31	6.400	2.192	Open Manhole	600	8.010	4.208	225	8.009	4.208	225	
32	6.300	3.150	Open Manhole	1200	8.011	3.150	150	8.010	4.161	225	1086
33	6.150	3.050	Open Manhole	450	1.008	3.100	150	1.007	3.150	150	50
								7.002	3.150	150	50
								8.011	3.150	150	50
34	6.150	3.050	Open Manhole	1200	1.009	3.100	225	1.008	3.100	150	
35	7.000	4.000	Open Manhole	1200	1.010	3.000	150	1.009	3.019	225	94

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam, L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (m)
36	6.750	3.948	Open Manhole	0		OUTFALL		1.010	2.802	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
1	506930.960	104464.146	506930.960	104464.146	Required	
2	506943.776	104473.841	506943.776	104473.841	Required	
3	506947.134	104464.855	506947.134	104464.855	Required	
4	506940.224	104467.393	506940.224	104467.393	Required	
5	506933.625	104461.172			No Entry	
6	506943.558	104450.299	506943.558	104450.299	Required	
7	506940.964	104442.437	506940.964	104442.437	Required	
8	506937.111	104444.194	506937.111	104444.194	Required	
9	506949.805	104435.694	506949.805	104435.694	Required	
10	506946.722	104433.309	506946.722	104433.309	Required	
11	506963.515	104414.059	506963.515	104414.059	Required	
12	506946.426	104396.343	506946.426	104396.343	Required	
13	506945.604	104397.963	506945.604	104397.963	Required	
14	506943.787	104398.825	506943.787	104398.825	Required	
15	506935.003	104400.318	506935.003	104400.318	Required	
16	506939.252	104403.854	506939.252	104403.854	Required	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
17	506941.616	104401.223	506941.616	104401.223	Required	
18	506907.391	104442.900	506907.391	104442.900	Required	
19	506905.719	104438.313	506905.719	104438.313	Required	
20	506908.704	104441.210			No Entry	
21	506917.340	104426.115	506917.340	104426.115	Required	
22	506919.405	104429.216	506919.405	104429.216	Required	
23	506928.138	104419.469	506928.138	104419.469	Required	
24	506917.437	104410.014	506917.437	104410.014	Required	
25	506907.969	104422.470	506907.969	104422.470	Required	
26	506910.618	104415.512	506910.618	104415.512	Required	
27	506908.298	104412.528	506908.298	104412.528	Required	
28	506902.780	104405.508	506902.780	104405.508	Required	
29	506900.456	104401.235	506900.456	104401.235	Required	
30	506921.396	104384.859	506921.396	104384.859	Required	
31	506930.255	104385.027	506930.255	104385.027	Required	
32	506936.022	104391.738	506936.022	104391.738	Required	
33	506938.654	104396.732	506938.654	104396.732	Required	
34	506933.845	104394.192	506933.845	104394.192	Required	
35	506924.661	104381.777	506924.661	104381.777	Required	

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XP Solutions	Network 2019.1	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
36	506901.212	104399.965			No Entry	



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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C. Level (m)	I. Level (m)	D. Depth (m)	MH Connection	MH DIAM, L*W (mm)
1.000	o	150	1	5.720	5.000	0.570	Open Manhole	450
2.000	o	100	2	5.730	5.200	0.430	Open Manhole	250
3.000	o	100	3	5.730	5.200	0.430	Open Manhole	250
2.001	o	100	4	5.750	5.126	0.524	Open Manhole	450
1.001	o	150	5	5.800	4.967	0.683	Junction	
1.002	o	225	6	5.950	4.769	0.956	Open Manhole	600
4.000	o	100	7	6.100	5.570	0.430	Open Manhole	250
1.003	o	225	8	6.200	4.723	1.252	Open Manhole	600
5.000	o	100	9	6.150	5.562	0.488	Open Manhole	250
1.004	o	225	10	6.350	4.646	1.479	Open Manhole	600
1.005	o	225	11	6.150	4.512	1.413	Open Manhole	600
6.000	o	100	12	6.150	5.650	0.400	Open Manhole	250
1.006	o	225	13	6.150	4.385	1.540	Open Manhole	600
1.007	oo	150	14	6.150	3.150	2.850	Open Manhole	1200
7.000	o	100	15	6.200	5.700	0.400	Open Manhole	450

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C. Level (m)	I. Level (m)	D. Depth (m)	MH Connection	MH DIAM, L*W (mm)
1.000	3.993	121.0	5	5.800	4.967	0.683	Junction	
2.000	7.362	100.0	4	5.750	5.126	0.524	Open Manhole	450
3.000	7.361	100.0	4	5.750	5.126	0.524	Open Manhole	450
2.001	9.069	100.0	5	5.800	5.036	0.664	Junction	
1.001	14.727	120.0	6	5.950	4.844	0.956	Open Manhole	600
1.002	8.879	190.0	8	6.200	4.723	1.252	Open Manhole	600
4.000	4.235	100.8	8	6.200	5.528	0.572	Open Manhole	600
1.003	14.521	190.0	10	6.350	4.646	1.479	Open Manhole	600
5.000	3.897	99.9	10	6.350	5.523	0.727	Open Manhole	600
1.004	25.545	190.0	11	6.150	4.512	1.413	Open Manhole	600
1.005	24.081	190.0	13	6.150	4.385	1.540	Open Manhole	600
6.000	1.816	80.0	13	6.150	5.627	0.423	Open Manhole	600
1.006	2.011	190.0	14	6.150	4.374	1.551	Open Manhole	1200
1.007	5.543	0.0	33	6.150	3.150	2.850	Open Manhole	450
7.000	5.528	80.0	16	6.250	5.631	0.519	Open Manhole	450

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C. Level (m)	I. Level (m)	D. Depth (m)	MH Connection	MH DIAM, L*W (mm)
7.001	o	100	16	6.250	5.631	0.519	Open Manhole	450
7.002	oo	150	17	6.150	3.150	2.850	Open Manhole	1200
8.000	o	225	18	5.750	4.820	0.705	Open Manhole	600
9.000	o	100	19	5.611	5.081	0.430	Open Manhole	250
8.001	o	225	20	5.745	4.809	0.711	Junction	
10.000	o	100	21	5.700	5.170	0.430	Open Manhole	250
8.002	o	225	22	5.740	4.724	0.791	Open Manhole	600
8.003	o	225	23	6.340	4.650	1.465	Open Manhole	600
8.004	o	225	24	6.300	4.575	1.500	Open Manhole	600
11.000	o	100	25	5.620	5.090	0.430	Open Manhole	250
8.005	o	225	26	5.800	4.529	1.046	Open Manhole	600
8.006	o	225	27	6.250	4.509	1.516	Open Manhole	600
8.007	o	225	28	6.200	4.420	1.555	Open Manhole	600
8.008	o	225	29	6.200	4.394	1.581	Open Manhole	600
8.009	o	225	30	6.500	4.254	2.021	Open Manhole	600
8.010	o	225	31	6.400	4.208	1.967	Open Manhole	600
8.011	oo	150	32	6.300	3.150	3.000	Open Manhole	1200
1.008	oo	150	33	6.150	3.100	2.900	Open Manhole	450

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C. Level (m)	I. Level (m)	D. Depth (m)	MH Connection	MH DIAM, L*W (mm)
7.001	3.537	80.0	17	6.150	5.587	0.463	Open Manhole	1200
7.002	5.380	0.0	33	6.150	3.150	2.850	Open Manhole	450
8.000	2.141	190.0	20	5.745	4.809	0.711	Junction	
9.000	4.160	99.0	20	5.745	5.039	0.606	Junction	
8.001	16.073	190.0	22	5.740	4.724	0.791	Open Manhole	600
10.000	3.726	100.7	22	5.740	5.133	0.507	Open Manhole	600
8.002	13.088	190.0	23	6.340	4.655	1.460	Open Manhole	600
8.003	14.280	190.0	24	6.300	4.575	1.500	Open Manhole	600
8.004	8.760	190.4	26	5.800	4.529	1.046	Open Manhole	600
11.000	7.445	111.1	26	5.800	5.023	0.677	Open Manhole	600
8.005	3.780	190.0	27	6.250	4.509	1.516	Open Manhole	600
8.006	8.929	100.0	28	6.200	4.420	1.555	Open Manhole	600
8.007	4.864	190.0	29	6.200	4.394	1.581	Open Manhole	600
8.008	26.583	190.0	30	6.500	4.254	2.021	Open Manhole	600
8.009	8.861	190.0	31	6.400	4.208	1.967	Open Manhole	600
8.010	8.848	190.0	32	6.300	4.161	1.914	Open Manhole	1200
8.011	5.645	0.0	33	6.150	3.150	2.850	Open Manhole	450
1.008	5.439	0.0	34	6.150	3.100	2.900	Open Manhole	1200

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C. Level (m)	I. Level (m)	D. Depth (m)	MH Connection	MH DIAM, L*W (mm)
1.009	o	225	34	6.150	3.100	2.825	Open Manhole	1200
1.010	o	150	35	7.000	3.000	3.850	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C. Level (m)	I. Level (m)	D. Depth (m)	MH Connection	MH DIAM, L*W (mm)
1.009	15.443	190.7	35	7.000	3.019	3.756	Open Manhole	1200
1.010	29.676	149.9	36	6.750	2.802	3.798	Open Manhole	0

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Area Summary for Storm

Pipe Number	PI MP Type	PI MP Name	PI MP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.013	0.013	0.013
	User	-	100	0.018	0.018	0.032
2.000	User	-	100	0.012	0.012	0.012
3.000	User	-	100	0.022	0.022	0.022
2.001	-	-	100	0.000	0.000	0.000
1.001	-	-	100	0.000	0.000	0.000
1.002	User	-	100	0.013	0.013	0.013
	User	-	100	0.010	0.010	0.023
4.000	User	-	100	0.006	0.006	0.006
	User	-	100	0.002	0.002	0.008
1.003	User	-	100	0.026	0.026	0.026
	User	-	100	0.001	0.001	0.027
5.000	User	-	100	0.002	0.002	0.002
1.004	User	-	100	0.018	0.018	0.018
1.005	-	-	100	0.000	0.000	0.000
6.000	User	-	100	0.003	0.003	0.003
1.006	-	-	100	0.000	0.000	0.000
1.007	User	-	100	0.005	0.005	0.005
7.000	User	-	100	0.008	0.008	0.008
7.001	User	-	100	0.009	0.009	0.009
7.002	-	-	100	0.000	0.000	0.000
8.000	User	-	100	0.027	0.027	0.027
	User	-	100	0.010	0.010	0.037
9.000	User	-	100	0.014	0.014	0.014
8.001	-	-	100	0.000	0.000	0.000
10.000	User	-	100	0.010	0.010	0.010
	User	-	100	0.002	0.002	0.012
8.002	-	-	100	0.000	0.000	0.000
8.003	User	-	100	0.013	0.013	0.013
	User	-	100	0.015	0.015	0.028
8.004	User	-	100	0.006	0.006	0.006
11.000	User	-	100	0.013	0.013	0.013
8.005	-	-	100	0.000	0.000	0.000
8.006	User	-	100	0.002	0.002	0.002
8.007	-	-	100	0.000	0.000	0.000
8.008	User	-	100	0.019	0.019	0.019
8.009	User	-	100	0.002	0.002	0.002
8.010	User	-	100	0.002	0.002	0.002
8.011	User	-	100	0.005	0.005	0.005
1.008	-	-	100	0.000	0.000	0.000
1.009	User	-	100	0.008	0.008	0.008
1.010	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.317	0.317	0.317

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Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Mn Depth (m)	Cover Max Depth (m)	Pipe Type	MH Dia (mm)	MH Wdth (mm)	MH Ring Depth (m)	MH Type
1.000	1	150	0.570	0.683	Unclassified	450	0	0.570	Unclassified
2.000	2	100	0.430	0.524	Unclassified	250	0	0.430	Unclassified
3.000	3	100	0.430	0.524	Unclassified	250	0	0.430	Unclassified
2.001	4	100	0.524	0.664	Unclassified	450	0	0.524	Unclassified
1.001	5	150	0.683	0.956	Unclassified				Junction
1.002	6	225	0.956	1.252	Unclassified	600	0	0.956	Unclassified
4.000	7	100	0.430	0.572	Unclassified	250	0	0.430	Unclassified
1.003	8	225	1.252	1.479	Unclassified	600	0	1.252	Unclassified
5.000	9	100	0.488	0.727	Unclassified	250	0	0.488	Unclassified
1.004	10	225	1.413	1.479	Unclassified	600	0	1.479	Unclassified
1.005	11	225	1.413	1.540	Unclassified	600	0	1.413	Unclassified
6.000	12	100	0.400	0.423	Unclassified	250	0	0.400	Unclassified
1.006	13	225	1.540	1.551	Unclassified	600	0	1.540	Unclassified
1.007	14	150	2.850	2.850	Unclassified	1200	0	2.850	Unclassified
7.000	15	100	0.400	0.519	Unclassified	450	0	0.400	Unclassified
7.001	16	100	0.463	0.519	Unclassified	450	0	0.519	Unclassified
7.002	17	150	2.850	2.850	Unclassified	1200	0	2.850	Unclassified
8.000	18	225	0.705	0.711	Unclassified	600	0	0.705	Unclassified
9.000	19	100	0.430	0.606	Unclassified	250	0	0.430	Unclassified
8.001	20	225	0.711	0.791	Unclassified				Junction
10.000	21	100	0.430	0.507	Unclassified	250	0	0.430	Unclassified
8.002	22	225	0.791	1.460	Unclassified	600	0	0.791	Unclassified
8.003	23	225	1.465	1.500	Unclassified	600	0	1.465	Unclassified
8.004	24	225	1.046	1.500	Unclassified	600	0	1.500	Unclassified
11.000	25	100	0.430	0.677	Unclassified	250	0	0.430	Unclassified
8.005	26	225	1.046	1.516	Unclassified	600	0	1.046	Unclassified
8.006	27	225	1.516	1.555	Unclassified	600	0	1.516	Unclassified
8.007	28	225	1.555	1.581	Unclassified	600	0	1.555	Unclassified
8.008	29	225	1.581	2.021	Unclassified	600	0	1.581	Unclassified
8.009	30	225	1.967	2.021	Unclassified	600	0	2.021	Unclassified
8.010	31	225	1.914	1.967	Unclassified	600	0	1.967	Unclassified
8.011	32	150	2.850	3.000	Unclassified	1200	0	3.000	Unclassified
1.008	33	150	2.900	2.900	Unclassified	450	0	2.900	Unclassified
1.009	34	225	2.825	3.756	Unclassified	1200	0	2.825	Unclassified
1.010	35	150	3.798	3.850	Unclassified	1200	0	3.850	Unclassified

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Mn I. Level (m)	D, L (mm)	W (mm)
1.010	36	6.750	2.802	3.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10mE/ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 8 Number of Real Time Controls 0

Synthetic Rainfall Details

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Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.350		

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Online Controls for Storm

Pump Manhole: 35, DS/PN: 1.010, Volume (mE): 5.1

Invert Level (m) 3.000

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.5000	1.200	9.5000

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Storage Structures for Storm

Porous Car Park Manhole: 2, DS/PN: 2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	2.1
Membrane Percolation (mm/hr)	1000	Length (m)	20.1
Max Percolation (l/s)	11.7	Slope (1:X)	100.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.200	Cap Volume Depth (m)	0.400

Porous Car Park Manhole: 3, DS/PN: 3.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	21.6
Max Percolation (l/s)	28.8	Slope (1:X)	100.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.200	Cap Volume Depth (m)	0.400

Porous Car Park Manhole: 7, DS/PN: 4.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	12.0
Max Percolation (l/s)	16.0	Slope (1:X)	80.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.570	Cap Volume Depth (m)	0.400

Porous Car Park Manhole: 9, DS/PN: 5.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	4.8
Max Percolation (l/s)	6.4	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.562	Cap Volume Depth (m)	0.400

Porous Car Park Manhole: 19, DS/PN: 9.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	16.6
Max Percolation (l/s)	22.1	Slope (1:X)	150.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.081	Cap Volume Depth (m)	0.400

Porous Car Park Manhole: 21, DS/PN: 10.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	12.0
Max Percolation (l/s)	16.0	Slope (1:X)	20.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.170	Cap Volume Depth (m)	0.400

Porous Car Park Manhole: 25, DS/PN: 11.000

Infiltration Coefficient Base (m/hr)	0.00000	Max Percolation (l/s)	19.3
Membrane Percolation (mm/hr)	1000	Safety Factor	2.0

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Porous Car Park Manhole: 25, DS/PN: 11.000

Porosity	0.30	Slope (1:X)	20.0
Invert Level (m)	5.090	Depression Storage (mm)	5
Width (m)	4.8	Evaporation (mm/day)	3
Length (m)	14.5	Cap Volume Depth (m)	0.400

Cellular Storage Manhole: 33, DS/PN: 1.008

Invert Level (m)	3.100	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	48.0	48.0	1.200	48.0	81.6	1.201	0.0	81.6

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10mE/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coefficient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 8 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960,
1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (mE)
1.000	1	15 Summer	1	+0%	100/15 Summer				5.064	-0.086	0.000
2.000	2	15 Winter	1	+0%	100/15 Summer				5.237	-0.063	0.000
3.000	3	15 Winter	1	+0%	30/15 Summer				5.247	-0.053	0.000
2.001	4	15 Winter	1	+0%	30/15 Summer				5.188	-0.039	0.000
1.001	5	15 Winter	1	+0%	100/15 Summer				5.040	-0.077	0.000
1.002	6	15 Winter	1	+0%	30/15 Winter				4.858	-0.137	0.000
4.000	7	30 Winter	1	+0%					5.594	-0.076	0.000
1.003	8	15 Winter	1	+0%	30/15 Summer				4.822	-0.126	0.000
5.000	9	120 Winter	1	+0%					5.569	-0.093	0.000
1.004	10	15 Winter	1	+0%	30/15 Summer				4.749	-0.122	0.000
1.005	11	15 Winter	1	+0%	30/15 Summer				4.614	-0.123	0.000
6.000	12	15 Winter	1	+0%					5.670	-0.080	0.000
1.006	13	15 Winter	1	+0%	30/15 Summer				4.498	-0.112	0.000
1.007	14	60 Winter	1	+0%	1/30 Winter				3.328	0.028	0.000
7.000	15	15 Summer	1	+0%	100/15 Summer				5.728	-0.072	0.000
7.001	16	15 Winter	1	+0%	100/15 Summer				5.672	-0.059	0.000
7.002	17	60 Winter	1	+0%	1/30 Winter				3.323	0.023	0.000
8.000	18	15 Summer	1	+0%	100/15 Summer				4.883	-0.162	0.000
9.000	19	30 Summer	1	+0%	100/15 Summer				5.115	-0.066	0.000
8.001	20	15 Winter	1	+0%	100/15 Summer				4.867	-0.166	0.000
10.000	21	15 Summer	1	+0%	100/15 Summer				5.209	-0.061	0.000
8.002	22	15 Winter	1	+0%	100/15 Summer				4.795	-0.154	0.000
8.003	23	15 Winter	1	+0%	100/15 Summer				4.735	-0.140	0.000
8.004	24	15 Winter	1	+0%	30/15 Summer				4.667	-0.132	0.000
11.000	25	15 Winter	1	+0%	100/15 Summer				5.131	-0.059	0.000
8.005	26	15 Winter	1	+0%	30/15 Summer				4.638	-0.116	0.000
8.006	27	15 Winter	1	+0%	100/15 Summer				4.592	-0.142	0.000
8.007	28	15 Winter	1	+0%	30/15 Summer				4.525	-0.120	0.000
8.008	29	15 Winter	1	+0%	30/15 Winter				4.494	-0.126	0.000
8.009	30	15 Winter	1	+0%	30/15 Summer				4.361	-0.118	0.000
8.010	31	15 Winter	1	+0%	30/15 Winter				4.315	-0.118	0.000

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.38		4.3	OK	
2.000	2	0.29		1.6	OK	
3.000	3	0.43		2.3	OK	
2.001	4	0.67		3.8	OK	
1.001	5	0.47		7.7	OK*	
1.002	6	0.33		10.0	OK	
4.000	7	0.13		0.7	OK	
1.003	8	0.40		13.0	OK	
5.000	9	0.01		0.1	OK	
1.004	10	0.42		14.6	OK	
1.005	11	0.42		14.5	OK	
6.000	12	0.09		0.4	OK	
1.006	13	0.50		14.5	OK	
1.007	14	0.57		9.9	SURCHARGED	
7.000	15	0.18		1.1	OK	
7.001	16	0.36		2.0	OK	
7.002	17	0.06		1.0	SURCHARGED	
8.000	18	0.17		5.0	OK	
9.000	19	0.24		1.3	OK	
8.001	20	0.15		5.6	OK*	
10.000	21	0.29		1.5	OK	
8.002	22	0.22		7.1	OK	
8.003	23	0.30		9.8	OK	
8.004	24	0.35		10.5	OK	
11.000	25	0.32		1.7	OK	
8.005	26	0.47		12.0	OK	
8.006	27	0.29		12.2	OK	
8.007	28	0.45		12.2	OK	
8.008	29	0.39		13.7	OK	
8.009	30	0.46		14.0	OK	
8.010	31	0.46		14.0	OK	

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (mE)
8.011	32	60 Wnter	1	+0%	1/30 Wnter				3.328	0.028	0.000
1.008	33	60 Wnter	1	+0%	1/15 Summer				3.323	0.073	0.000
1.009	34	60 Wnter	1	+0%	30/15 Summer				3.313	-0.012	0.000
1.010	35	60 Wnter	1	+0%	1/15 Summer				3.295	0.145	0.000

		Pipe					
PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status	Level Exceeded	
8.011	32	0.53		9.3	SURCHARGED		
1.008	33	0.72		12.6	SURCHARGED		
1.009	34	0.38		12.7	OK		
1.010	35	0.68		9.5	SURCHARGED		

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10mE/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coefficient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 8 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR M5-60 (mm)	19.000	Cv (Summer)	0.750	
Region	England and Wales	Ratio R	0.350	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 300.0

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status ON

DVD Status OFF

Inertia Status OFF

Profile(s)

Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960,
1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

Return Period(s) (years) 1, 30, 100

Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (mE)
1.000	1	15 Wnter	30	+0%	100/15 Summer				5.133	-0.017	0.000
2.000	2	15 Wnter	30	+0%	100/15 Summer				5.289	-0.011	0.000
3.000	3	15 Wnter	30	+0%	30/15 Summer				5.311	0.011	0.000
2.001	4	15 Wnter	30	+0%	30/15 Summer				5.269	0.042	0.000
1.001	5	15 Wnter	30	+0%	100/15 Summer				5.112	-0.005	0.000
1.002	6	15 Wnter	30	+0%	30/15 Wnter				4.998	0.004	0.000
4.000	7	15 Wnter	30	+0%					5.618	-0.052	0.000
1.003	8	15 Wnter	30	+0%	30/15 Summer				4.972	0.025	0.000
5.000	9	30 Wnter	30	+0%					5.581	-0.081	0.000
1.004	10	15 Wnter	30	+0%	30/15 Summer				4.905	0.034	0.000
1.005	11	15 Wnter	30	+0%	30/15 Summer				4.776	0.039	0.000
6.000	12	15 Wnter	30	+0%					5.682	-0.068	0.000
1.006	13	15 Wnter	30	+0%	30/15 Summer				4.650	0.040	0.000
1.007	14	60 Wnter	30	+0%	1/30 Wnter				4.039	0.739	0.000
7.000	15	15 Wnter	30	+0%	100/15 Summer				5.746	-0.054	0.000
7.001	16	15 Summer	30	+0%	100/15 Summer				5.711	-0.020	0.000
7.002	17	60 Wnter	30	+0%	1/30 Wnter				4.035	0.735	0.000
8.000	18	15 Wnter	30	+0%	100/15 Summer				4.922	-0.123	0.000
9.000	19	15 Wnter	30	+0%	100/15 Summer				5.145	-0.036	0.000
8.001	20	15 Wnter	30	+0%	100/15 Summer				4.915	-0.119	0.000
10.000	21	15 Wnter	30	+0%	100/15 Summer				5.237	-0.033	0.000
8.002	22	15 Wnter	30	+0%	100/15 Summer				4.883	-0.067	0.000
8.003	23	15 Wnter	30	+0%	100/15 Summer				4.853	-0.022	0.000
8.004	24	15 Wnter	30	+0%	30/15 Summer				4.808	0.008	0.000
11.000	25	15 Wnter	30	+0%	100/15 Summer				5.161	-0.029	0.000
8.005	26	15 Wnter	30	+0%	30/15 Summer				4.771	0.017	0.000
8.006	27	15 Wnter	30	+0%	100/15 Summer				4.715	-0.019	0.000
8.007	28	15 Wnter	30	+0%	30/15 Summer				4.669	0.024	0.000
8.008	29	15 Wnter	30	+0%	30/15 Wnter				4.624	0.005	0.000
8.009	30	15 Wnter	30	+0%	30/15 Summer				4.490	0.011	0.000
8.010	31	15 Wnter	30	+0%	30/15 Wnter				4.433	0.000	0.000

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.89		10.1	OK	
2.000	2	0.53		2.9	OK	
3.000	3	0.79		4.4	SURCHARGED	
2.001	4	1.23		6.9	SURCHARGED	
1.001	5	1.00		16.2	OK*	
1.002	6	0.74		22.5	SURCHARGED	
4.000	7	0.46		2.3	OK	
1.003	8	0.98		32.4	SURCHARGED	
5.000	9	0.08		0.4	OK	
1.004	10	1.06		36.9	SURCHARGED	
1.005	11	0.99		34.1	SURCHARGED	
6.000	12	0.22		0.9	OK	
1.006	13	1.20		34.8	SURCHARGED	
1.007	14	1.37		24.0	SURCHARGED	
7.000	15	0.44		2.6	OK	
7.001	16	0.99		5.6	OK	
7.002	17	0.11		2.0	SURCHARGED	
8.000	18	0.43		12.2	OK	
9.000	19	0.71		3.7	OK	
8.001	20	0.41		15.4	OK*	
10.000	21	0.77		3.9	OK	
8.002	22	0.55		17.8	OK	
8.003	23	0.76		25.1	OK	
8.004	24	0.88		26.7	SURCHARGED	
11.000	25	0.84		4.4	OK	
8.005	26	1.19		30.5	SURCHARGED	
8.006	27	0.73		30.8	OK	
8.007	28	1.12		30.6	SURCHARGED	
8.008	29	0.96		33.5	SURCHARGED	
8.009	30	1.11		33.7	SURCHARGED	
8.010	31	1.11		33.8	SURCHARGED	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (mE)
8.011	32	60 Winter	30	+0%	1/30 Winter				4.039	0.739	0.000
1.008	33	60 Winter	30	+0%	1/15 Summer				4.034	0.784	0.000
1.009	34	60 Winter	30	+0%	30/15 Summer				4.065	0.740	0.000
1.010	35	60 Winter	30	+0%	1/15 Summer				4.072	0.922	0.000

		Pipe				Level	
PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status	Exceeded	
8.011	32	1.27		22.1	SURCHARGED		
1.008	33	0.73		12.9	SURCHARGED		
1.009	34	0.39		12.9	SURCHARGED		
1.010	35	0.68		9.5	SURCHARGED		

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Romsey	Angmering, West Sussex	
Hampshire SO51 0QJ	Full Surface Water Network	
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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10mE/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coefficient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 8 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR M5-60 (mm)	19.000	Cv (Summer)	0.750	
Region	England and Wales	Ratio R	0.350	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 300.0

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status ON

DVD Status OFF

Inertia Status OFF

Profile(s)

Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960,
1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

Return Period(s) (years) 1, 30, 100

Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (mE)
1.000	1 60 Wnter	100	+40%	100/15 Summer	5.650	0.500	0.000				
2.000	2 120 Wnter	100	+40%	100/15 Summer	5.590	0.290	0.000				
3.000	3 120 Wnter	100	+40%	30/15 Summer	5.589	0.289	0.000				
2.001	4 120 Wnter	100	+40%	30/15 Summer	5.600	0.374	0.000				
1.001	5 240 Wnter	100	+40%	100/15 Summer	5.136	0.019	0.000				
1.002	6 60 Wnter	100	+40%	30/15 Wnter	5.660	0.666	0.000				
4.000	7 60 Wnter	100	+40%		5.641	-0.029	0.000				
1.003	8 60 Wnter	100	+40%	30/15 Summer	5.659	0.711	0.000				
5.000	9 60 Wnter	100	+40%		5.610	-0.052	0.000				
1.004	10 60 Wnter	100	+40%	30/15 Summer	5.649	0.778	0.000				
1.005	11 60 Wnter	100	+40%	30/15 Summer	5.631	0.895	0.000				
6.000	12 15 Wnter	100	+40%		5.694	-0.056	0.000				
1.006	13 60 Wnter	100	+40%	30/15 Summer	5.616	1.007	0.000				
1.007	14 60 Wnter	100	+40%	1/30 Wnter	5.614	2.314	0.000				
7.000	15 15 Wnter	100	+40%	100/15 Summer	5.865	0.065	0.000				
7.001	16 15 Wnter	100	+40%	100/15 Summer	5.822	0.091	0.000				
7.002	17 60 Wnter	100	+40%	1/30 Wnter	5.608	2.308	0.000				
8.000	18 120 Wnter	100	+40%	100/15 Summer	5.609	0.564	0.000				
9.000	19 120 Wnter	100	+40%	100/15 Summer	5.611	0.430	0.000				
8.001	20 240 Wnter	100	+40%	100/15 Summer	5.139	0.105	0.000				
10.000	21 120 Wnter	100	+40%	100/15 Summer	5.607	0.337	0.000				
8.002	22 120 Wnter	100	+40%	100/15 Summer	5.605	0.656	0.000				
8.003	23 120 Wnter	100	+40%	100/15 Summer	5.602	0.727	0.000				
8.004	24 120 Wnter	100	+40%	30/15 Summer	5.596	0.796	0.000				
11.000	25 120 Wnter	100	+40%	100/15 Summer	5.595	0.405	0.000				
8.005	26 120 Wnter	100	+40%	30/15 Summer	5.592	0.839	0.000				
8.006	27 120 Wnter	100	+40%	100/15 Summer	5.590	0.856	0.000				
8.007	28 120 Wnter	100	+40%	30/15 Summer	5.586	0.941	0.000				
8.008	29 120 Wnter	100	+40%	30/15 Wnter	5.583	0.964	0.000				
8.009	30 120 Wnter	100	+40%	30/15 Summer	5.573	1.094	0.000				
8.010	31 60 Wnter	100	+40%	30/15 Wnter	5.584	1.152	0.000				

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.82		9.3	FLOOD RISK	
2.000	2	0.41		2.2	FLOOD RISK	
3.000	3	0.73		4.0	FLOOD RISK	
2.001	4	1.11		6.2	FLOOD RISK	
1.001	5	0.48		7.8	SURCHARGED*	
1.002	6	0.73		22.2	FLOOD RISK	
4.000	7	0.46		2.4	OK	
1.003	8	0.98		32.1	SURCHARGED	
5.000	9	0.21		1.1	OK	
1.004	10	1.09		38.0	SURCHARGED	
1.005	11	1.10		37.8	SURCHARGED	
6.000	12	0.40		1.7	OK	
1.006	13	1.34		38.7	SURCHARGED	
1.007	14	2.20		38.3	SURCHARGED	
7.000	15	0.78		4.7	SURCHARGED	
7.001	16	1.75		9.9	SURCHARGED	
7.002	17	0.21		3.7	SURCHARGED	
8.000	18	0.25		7.2	FLOOD RISK	
9.000	19	0.82		4.2	FLOOD RISK	
8.001	20	0.16		6.0	SURCHARGED*	
10.000	21	0.46		2.3	FLOOD RISK	
8.002	22	0.38		12.3	FLOOD RISK	
8.003	23	0.54		17.8	SURCHARGED	
8.004	24	0.63		18.9	SURCHARGED	
11.000	25	0.50		2.6	FLOOD RISK	
8.005	26	0.84		21.5	FLOOD RISK	
8.006	27	0.52		21.9	SURCHARGED	
8.007	28	0.80		21.9	SURCHARGED	
8.008	29	0.73		25.5	SURCHARGED	
8.009	30	0.85		25.9	SURCHARGED	
8.010	31	1.24		37.8	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (mE)
8.011	32	60 Winter	100	+40%	1/30 Winter				5.596	2.296	0.000
1.008	33	60 Winter	100	+40%	1/15 Summer				5.605	2.355	0.000
1.009	34	60 Winter	100	+40%	30/15 Summer				5.597	2.272	0.000
1.010	35	60 Winter	100	+40%	1/15 Summer				5.580	2.430	0.000

		Pipe					
PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status	Level Exceeded	
8.011	32	2.12		36.7	SURCHARGED		
1.008	33	1.86		32.7	SURCHARGED		
1.009	34	0.66		21.8	SURCHARGED		
1.010	35	0.68		9.5	SURCHARGED		

