Drainage Strategy incorporating a Flood Risk Assessment

Land off Church Lane

Laughton

BN8 6AH

RMB Consultants (Civil Engineering) Ltd

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1. Background and Introduction

This Drainage Strategy incorporating a Flood Risk Assessment accompanies a planning application submitted to Wealden District Council. The planning application is for residential development on Land off Church Lane, Laughton, BN8 6AH.

2. Development Location and Description

Development Location

The site is to the west of Church Lane, Laughton, Figure 1. It is accessed from Church Lane. The site is a greenfield site.

Figure 1. Site location plan.

Proposed Site Use

The proposed development is for four dwellings with associated access, parking and landscaping, Figure 2. The semi-detached dwellings are 2-bed, the house to the south is 3-bed and the central house is 4-bed.

Figure 2. Proposed development.

3. Policy Background

The National Planning Policy Framework

The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally-prepared plans for housing and other development can be produced.

Chapter 14 Meeting the challenge of climate change, flooding and coastal change states:

Planning and flood risk

159. Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.

160. Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards.

161. All plans should apply a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by:

a) applying the sequential test and then, if necessary, the exception test as set out below;

b) safeguarding land from development that is required, or likely to be required, for current or future flood management;

c) using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding, (making as much use as possible of natural flood management techniques as part of an integrated approach to flood risk management); and

d) where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations.

162. *The aim of the sequential test is to steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.*

163. *If it is not possible for development to be located in areas with a lower risk of flooding (taking into account wider sustainable development objectives), the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in Annex 3.*

164. *The application of the exception test should be informed by a strategic or site-specific flood risk assessment, depending on whether it is being applied during plan production or at the application stage. To pass the exception test it should be demonstrated that:*

   a) *the development would provide wider sustainability benefits to the community that outweigh the flood risk; and*

   b) *the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*

165. *Both elements of the exception test should be satisfied for development to be allocated or permitted.*

166. *Where planning applications come forward on sites allocated in the development plan through the sequential test, applicants need not apply the sequential test again. However, the exception test may need to be reapplied if relevant aspects of the proposal had not been considered when the test was applied at the plan-making stage, or if more recent information about existing or potential flood risk should be taken into account.*

167. *When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated 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 such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;

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.

168. Applications for some minor development and changes of use should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 55.

169. Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

a) take account of advice from the lead local flood authority;

b) have appropriate proposed minimum operational standards;

c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and

d) where possible, provide multifunctional benefits.

Wealden Level 1 Strategic Flood Risk Assessment

The Wealden Level 1 Strategic Flood Risk Assessment was published in May 2022.

Wealden District Council Core Strategy Local Plan 2013

The Core Strategy Local Plan 2013 was adopted in February 2013.

The following policy is relevant to flood risk and drainage:

SPO10 *We will seek to ensure the safety of residents and reduce the economic impact of flooding events by avoiding the allocation of land for employment and housing growth in areas subject to medium and high flood risk, taking into account the predicted impact of climate change*

4. Site Characteristics

Topography – Contours have been derived from Lidar data. The site generally falls from north to south with a bank along the eastern boundary falling towards Church Lane, Figure 3. The site falls from 16.0mAOD (Above Ordnance Datum) to 13.6mAOD. A detailed topographical survey has been undertaken.

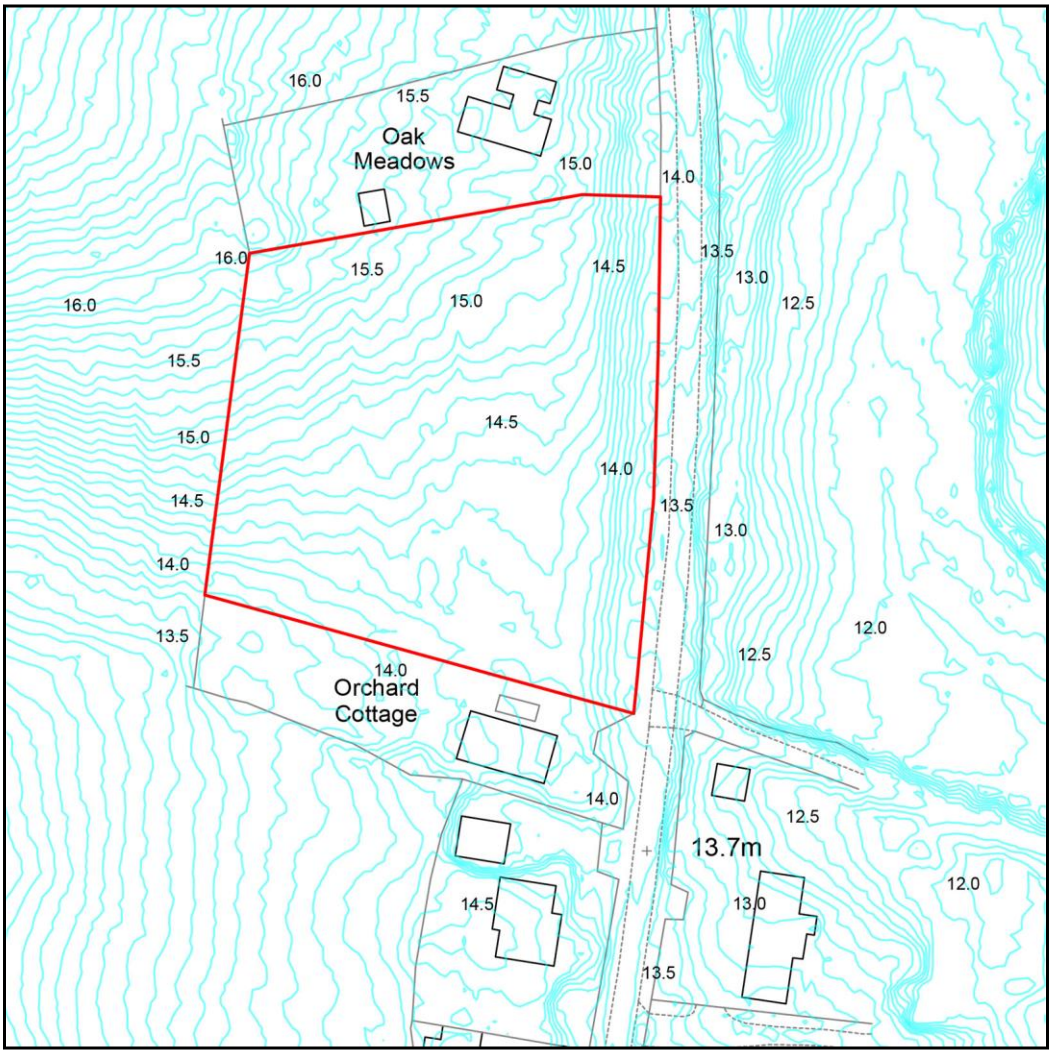


Figure 3. Local topography.

Geology and Soils - The bedrock geology consists of the Weald Clay Formation, mudstone. There are no superficial deposits recorded at the site.

Groundwater - The site does not lie within any groundwater source protection zones. The Weald Clay Formation is an unproductive strata.

Records from local boreholes indicate a groundwater level of -1 to -7mAOD approximately 15 to 21m below the lowest site level.

Infiltration Rates - Soakage testing has not been carried out at the site. Infiltration rates into the Weald Clay Formation are generally very poor and a surface water drainage strategy based on an attenuated discharge to the local stream network is likely to be the most appropriate.

Existing Site - The existing site covers 4,850m^2. It is a greenfield site.

Greenfield Runoff Rate - The greenfield runoff rate for the critical storm duration for the site has been calculated using the IH124 method from the greenfield runoff rate estimation tool published online by HR Wallingford at uksuds.com. The peak runoff is shown in Table 1.

Return Period	Runoff Rate Q l/s	
	per ha.	Site (0.485ha)
QBar	5.6	2.7
1	4.8	2.3
30	12.9	6.3
100	17.9	8.7

Table 1. Greenfield runoff rate for the site.

Existing Drainage – The site is part of the wider catchment draining to the watercourse running north to south to the east of Church Lane. The site drains to a small ditch running along the eastern boundary of Church Lane which discharges to the local watercourse network.

Sewer Record - Public foul sewers run west to east along the northern boundary and north to south along the eastern boundary of the site, Figure 4. The sewer is 150mm diameter. The public sewer record is attached at Appendix A.

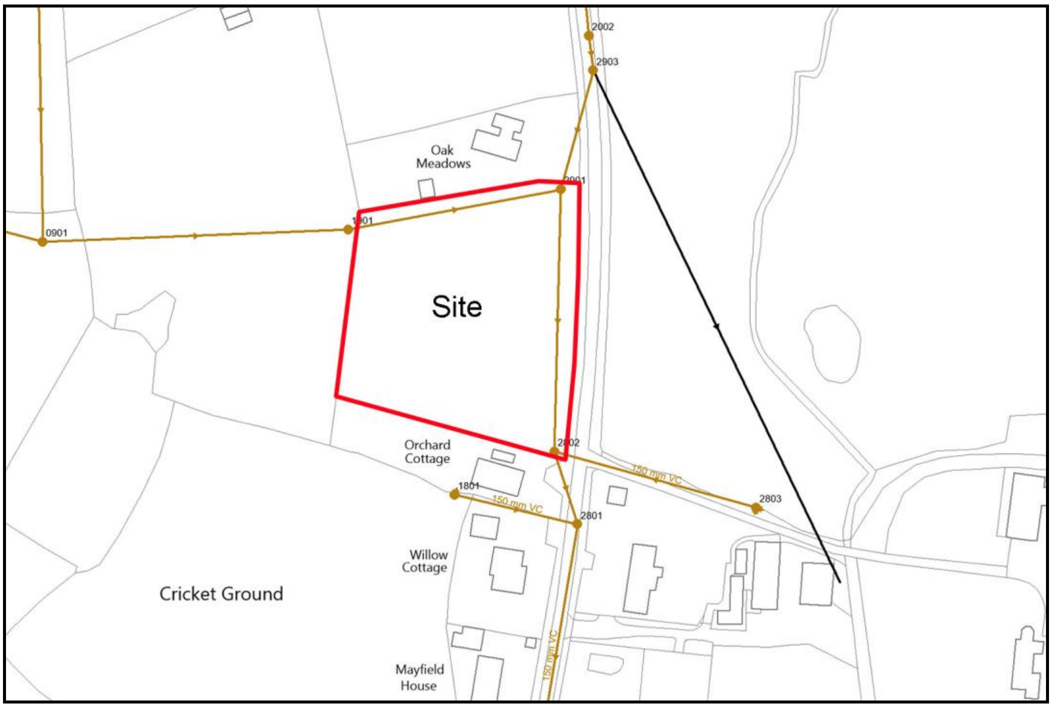


Figure 4. Sewer record with the site edged red. (© Southern Water)

5. Flood Risk Assessment

The NPPF states that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk. Local Plans should apply a sequential, risk-based approach to the location of development to avoid where possible flood risk to people and property and manage any residual risk, taking account of the impacts of climate change by applying the Sequential Test.

Flood zones are the starting point for the Sequential Test. These zones are a broad assessment of flood risk as given below.

Zone 1 Low Probability - land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

Zone 2 Medium Probability - land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year.

Zone 3a High Probability - land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

Zone 3b The Functional Floodplain - land where water has to flow or be stored in times of flood, land which would flood with an annual probability of 1 in 20 (5%) of greater in any year or designed to flood in an extreme flood.

The site lies within flood zone 1 and therefore residential development is appropriate, Figure 5.

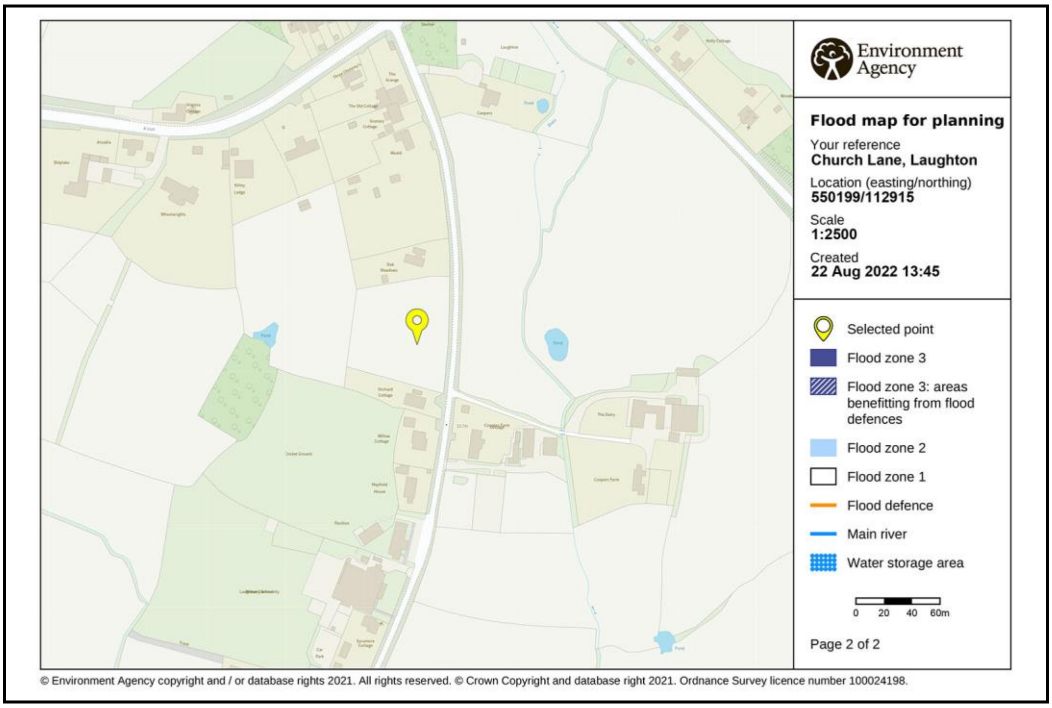


Figure 5. Flood Map for Planning.

Surface Water - The Government has published surface water flooding maps.

The whole site is at very low risk of surface water flooding, Figure 6. The definition of each category is given below:

Very Low (white) a chance of flooding of less than 1 in 1000 (0.1%)
Low (pale blue) a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%)
Medium (mid blue) a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%)
High (dark blue) a chance of flooding of greater than 1 in 30 (3.3%)

The depth of water associated with the low risk flood event is shown in Figure 7. The definition of each colour is given below:

Below 300mm (light blue)
300-900mm (medium blue)
Over 900mm (dark blue)

The surface water flood maps also give an indication of velocity and direction of flow, Figure 8. The definition of each colour is given below:

Over 0.25 m/s (dark blue)
Less than 0.25 m/s (light blue)

The arrows indicate the direction of flow.

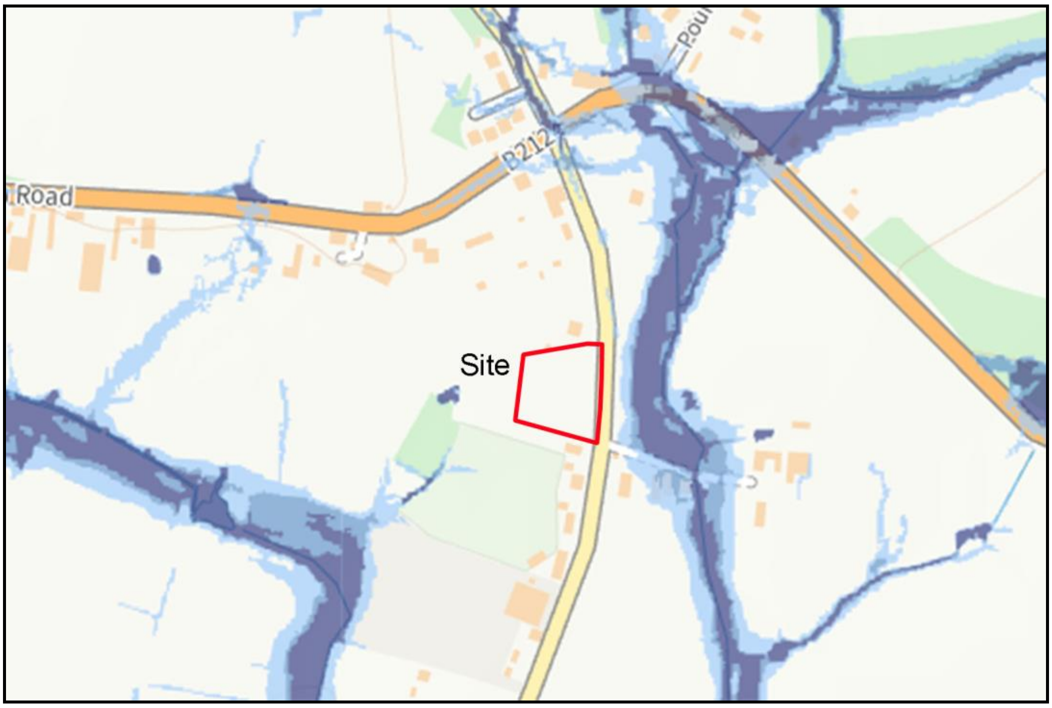


Figure 6. Surface water flood map with the site edged red.

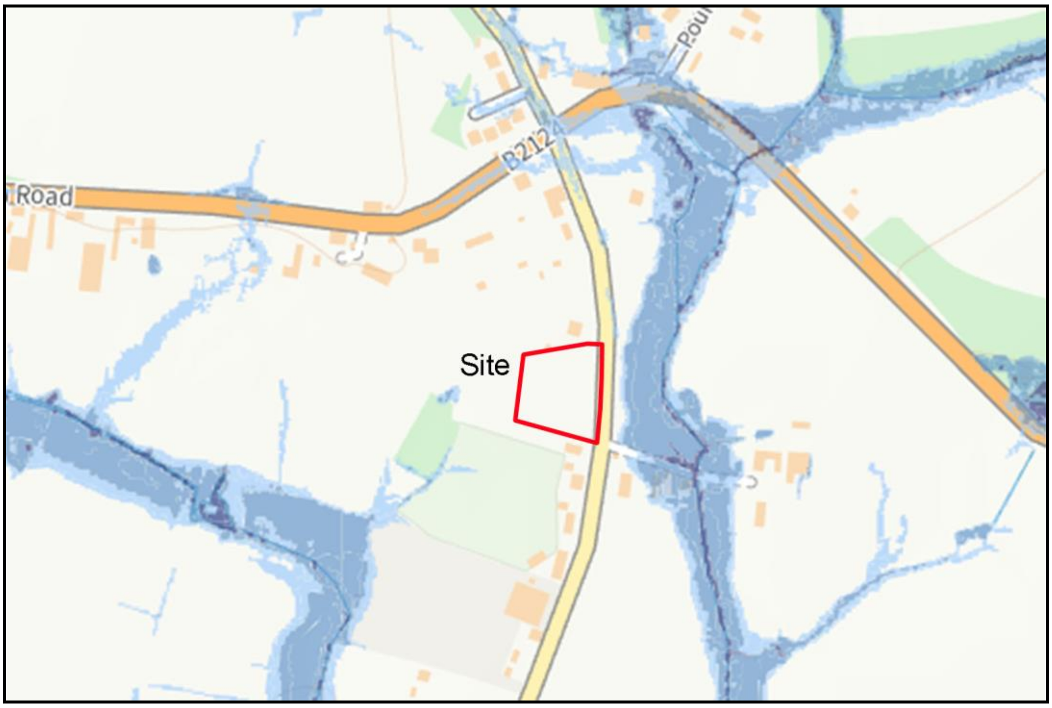


Figure 7. Surface water flood depth map for the low risk flood event with the site edged red.

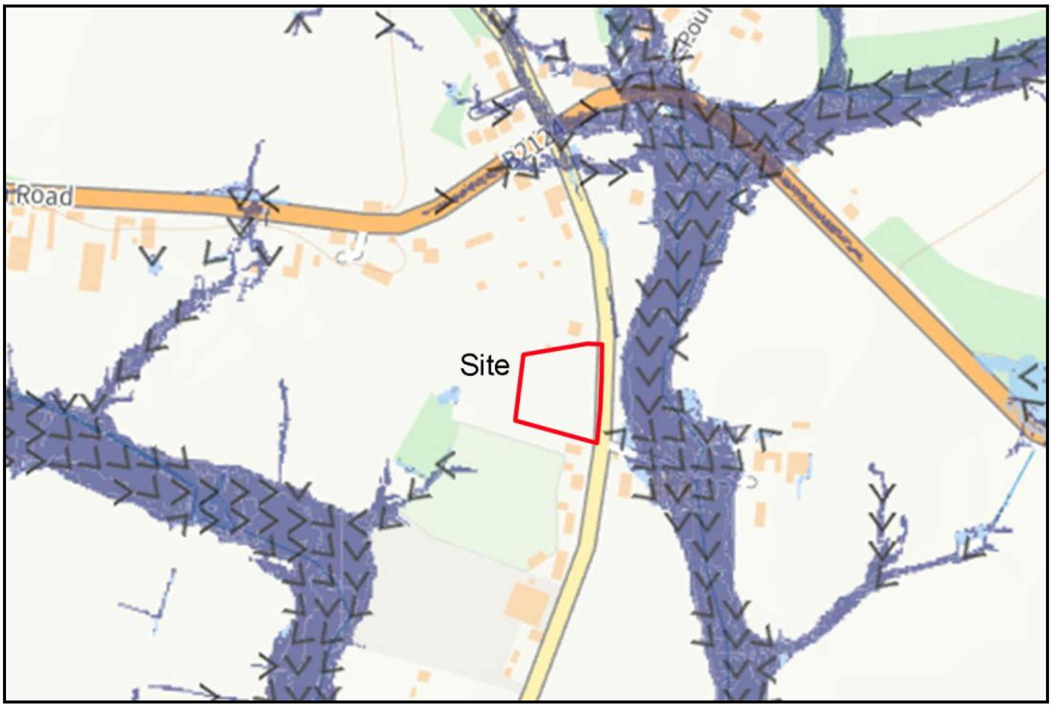


Figure 8. Surface water flood velocity map for the low risk flood event with the site edged red.

Groundwater - Water levels below the ground rise during wet winter months, and fall again in the summer as water flows out into rivers. In very wet winters, rising water levels may lead to the flooding of normally dry land, as well as reactivating flow in 'bournes' (streams that only flow for part of the year). Where land that is prone to groundwater flooding has been built on, the effect of a flood can be very costly, and because groundwater responds slowly compared with rivers, floods can last for weeks or months.

The site does not lie within any groundwater source protection zones. The Weald Clay Formation is an unproductive strata.

Records from local boreholes indicate a groundwater level of -1 to -7mAOD approximately 15 to 21m below the lowest site level.

The risk of groundwater flooding at the site is therefore considered to be very low.

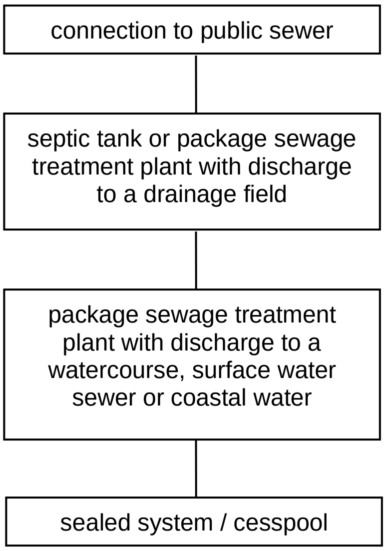
Infrastructure - The site is served by public foul sewers which run within the site. Significant volumes of water would be required for flooding to occur from these sewers. Any flooding is likely to occur at lower levels downstream and the risk of infrastructure flooding at the site is considered to be very low.

The site lies within flood zone 1 and is at very low risk of flooding from all other sources.

6. Foul Drainage Strategy

Choosing the right sewage treatment and disposal method is essential for the protection of public health and the environment and ensures effective long term performance of the system. Sewage treatment and disposal can be provided by a sewerage undertaker or by a private treatment system.

There is a hierarchy of methods for disposing of foul sewage.



Connection to Public Sewer

Public foul sewers run within the site. The depth of the sewers and the topography of the site mean that it is possible to connect the development to the public foul sewer via gravity. The invert levels of the public foul sewer within the site are not shown on the public sewer record and these have been estimated using available invert levels from upstream and downstream manholes.

Foul Sewage Flows

The *Design and Construction Guidance for foul and surface water sewers offered for adoption under the Code for adoption agreements for water and sewerage companies operating wholly or mainly in England ("the Code")* states that design flow rates for dwellings should be 4,000 litres per dwelling per day. For four dwellings this equates to a design flow of 0.19 l/s.

Foul Drainage Strategy

The preliminary foul drainage design is based on two gravity connections to the public foul sewer running north to south through the site. An illustrative foul water drainage design is shown on drawing 1144/203A attached at Appendix B.

The preliminary foul drainage design has been analysed using FLOW software published by Causeway. The foul drainage design is attached at Appendix C.

7. Climate Change

The global climate is constantly changing, but it is widely recognised that we are now entering a period of accelerating change. Climate change will result in an increase in sea levels, rainfall intensity and river flows.

The impact of climate change will be to reduce the standard of protection provided by current defences with time and increase the risk of flooding in undefended areas. The Planning Practice Guidance to the National Planning Policy Framework (NPPF) recommends using the following range of increases in peak rainfall intensity due to climate change to 2115 in any assessment:

Upper End	+40%
Central	+20%

The range is based on percentiles. The 50th percentile is the point at which half of the possible scenarios for peak rainfall intensity fall below it and half fall above it. The Central allowance is based on the 50th percentile whilst the Upper End is based on the 90th percentile.

The Central allowance is 20% and scientific evidence suggests that it is just as likely that the increase in rainfall intensity will be more than 20% as less than 20%. The Upper End allowance is 40% and current scientific evidence suggests that there is a 90% chance that peak rainfall intensity will increase by less than this value, but there remains a 10% chance that peak rainfall intensity will increase by more.

The Planning Practice Guidance suggests that flood risk assessments and strategic flood risk assessments should assess both the Central and Upper End allowances to understand the range of impact.

The surface water calculations include an increase of 20% in peak rainfall intensity for the sizing of structures. The impact of an increase of 40% in peak rainfall intensity is then considered.

8. Detailed Development Proposals

Following development 1,130m^2 of the site will be covered with impermeable materials, consisting of 410m^2 of roof area and 720m^2 of paved area, Figure 9.

Figure 9. Proposed impermeable areas.

The peak rate of runoff and volume of runoff for the critical storm duration for the existing and proposed site is shown in Table 2. The greenfield runoff and volume have been calculated using ReFH2 in Causeway FLOW.

Storm Return Period (years)	Peak Runoff (Q l/s)		Volume of Runoff 360 minute duration storm (m^3)	
	Existing Greenfield (1,130m^2)	Proposed (1,130m^2)	Existing Greenfield (1,130m^2)	Proposed (1,130m^2)
2	1.3	16.2	18	21.7
30	3.5	45.7	40	46.7
100	4.5	58.8	51	59.2
100 + 20%	5.4	70.6	61	71.0
100 + 40%	6.3	82.4	71	82.7

Table 2. Peak rate of runoff and volume of runoff from the existing and proposed site.

9. Surface Water Management Strategy

Objectives

The following constraints have informed the surface water management strategy:

- The Weald Clay Formation is unlikely to allow infiltration to ground.
- There is a ditch on the eastern boundary of Church Road that drains to the local watercourse network.
- There are no public surface water sewers in the vicinity of the site.

Given the above a surface water management strategy based on an attenuated discharge to the local watercourse network is proposed.

Drainage Elements

The appropriateness of different SuDS is considered in Table 3.

SuDS Type	Appropriate to site	Comment
Permeable paving (Infiltration)	No	The Weald Clay Formation is unlikely to support infiltration.
Permeable paving (Attenuation)	Possible	Permeable paving could be used for attenuation with a limited discharge to the local watercourse.
Green roof	No	Traditional pitched roofs are proposed.
Filter strips	No	Site layout gives limited opportunity for filter strips.
Swales	No	Site layout gives limited opportunity for swales.
Infiltration devices	No	The Weald Clay Formation is unlikely to support infiltration.
Filter drains	No	The Weald Clay Formation is unlikely to support infiltration.
Infiltration basin	No	The Weald Clay Formation is unlikely to support infiltration.
Detention pond	No	Site layout gives limited opportunity for detention ponds.
Wet pond	No	Site layout gives limited opportunity for wet ponds.
On/offline storage	Yes	Can be used for attenuation with a limited discharge to the local watercourse.

Table 3. SuDS suitability for development.

The following drainage elements are identified as being the most appropriate to the site:

- On/offline storage

Surface Water Management Strategy

The surface water management strategy is to attenuate surface water runoff and discharge it to the ditch on the eastern boundary of Church Road. The discharge ditch is shallow and any attenuation structures need to be kept shallow whilst maintaining sufficient cover. 650mm deep concrete box culverts are proposed at this stage. The type of attenuation structure will be confirmed as part of the detailed design. Discharge is limited to 2 l/s.

An illustrative surface water drainage design is shown on drawing 1144/203A attached at Appendix B.

A preliminary surface water drainage design has been analysed using FLOW software published by Causeway. The surface water drainage design is attached at Appendix D.

This demonstrates that disposal of surface water via attenuation and discharge to the local watercourse is an appropriate surface water management strategy for the site. There is no above ground flooding under the 1 in 100 year rainfall event with an allowance of 40% for climate change.

Exceedance flows from rainfall events greater than the 1 in 100 year rainfall event with an allowance of 40% for climate change are shown on drawing 1144/203A, attached at Appendix B. Exceedance event flows are to Church Lane and to lower land east of the site.

A SUDS Maintenance and Management Plan is attached at Appendix E.

10. Water Quality

The SuDS Manual gives the following as standards of good practice for water quality:

Water quality standard 1: Prevent runoff from the site to receiving surface waters for the majority of small rainfall events.

No runoff should be discharged from the site to receiving surface waters or sewers for the majority of small (eg < 5 mm) rainfall events. This is termed Interception.

Water quality standard 2: Treat runoff to prevent negative impacts on the receiving water quality.

Runoff should be adequately treated to protect the receiving water body from:

1. Short-term acute pollution that may result from accidental spills or temporary high pollution loadings within the catchment area.
2. Long-term chronic pollution from the spectrum of runoff pollutant sources within the urban environment.

Water Quality Standard 1 - Interception

Interception structures such as water butts, silt traps, trapped gullies plus the attenuation structure will hold water, promoting water loss from reuse and evaporation. This will reduce or prevent runoff from the site from the majority of rainfall events of less than 5mm.

Water Quality Standard 2 - Treatment

The extent of treatment required depends on the land use, the level of pollution prevention in the catchment and for groundwater the natural protection afforded by underlying soil layers. High hazard sites will have a higher potential pollution load and higher potential maximum pollution concentrations. They therefore tend to require more treatment than low hazard sites in order to deliver discharges of an acceptable quality.

The SuDS Manual sets out minimum water quality management requirements for discharges to receiving surface waters and groundwater for various land use types, Table 4. The site consists of two land use types:

1. Roofs to houses classed as *residential roofs*, very low pollution hazard.
2. The access and parking areas classed as *property driveways/low traffic roads*, low pollution hazard.

Land use	**Pollution hazard level**	**Requirements for discharge to:**	
		surface waters	groundwater
Residential roofs	Very low	Removal of gross solids and sediments only	
Individual property driveways, roofs (excluding residential), residential car parks, low traffic roads (eg cul de sacs, home zones, general access roads), non-residential car parking with infrequent change (eg schools, offices)	Low	Simple index approach Note: extra measures may be required for discharges to protected resources	
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	Simple index approach Note: extra measures may be required for discharges to protected resources	In England and Wales, Risk Screening must be undertaken first to determine whether consultation with the environmental regulator is required.
Trunk roads and motorways	High	Follow the guidance and risk assessment process set out in HA (2009)	
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels are to be delivered, handled, stored, used or manufactured, industrial sites	High	Discharges may require an environmental licence or permit. Obtain pre-permitting advice from the environmental regulator. Risk assessment is likely to be required.	
Note 1. Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements, and this should be taken into account in the design and Maintenance Plan. Note 2. Ponds and wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water. Note 3. Where a wetland is not specifically designed to provide significantly enhanced treatment, it should be considered as having the same mitigation indices as a pond.			

Table 4. Water quality requirements for discharge to surface waters and groundwater.

For each land use type a simple index approach is appropriate which involves the following steps:

1. Allocate suitable pollution hazard indices for the proposed land use, Table 5.
2. Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index.
3. Where the discharge is to protected surface waters or groundwater, consider the need for a more precautionary approach.

Land Use	Pollution hazard level	Total suspended solids	Metals	Hydro-carbons
Residential Roofs	Very low	0.2	0.2	0.05
Other roofs (commercial/industrial)	Low	0.3	0.2[1]	0.05
Individual property driveways, residential car parks, low traffic roads and non-residential car parking with infrequent change (eg schools, offices) <300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites, sites where chemicals and fuels are to be delivered, handled, stored, used or manufactured, industrial sites, trunk roads and motorways[2]	High	0.8[3]	0.8[3]	0.9[3]
Note 1. Up to 0.8 where there is potential for metals to leach from the roof. Note 2. Motorways and trunk roads should follow the guidance and risk assessment process set out in Highways Agency (2009) Note 3. These should only be used if considered appropriate as part of a detailed risk assessment.				

Table 5. Pollution hazard indices for different land use classifications.

To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index, for each contaminant type, that equals or exceeds the pollution hazard index, for each contaminant type. Where the mitigation index of an individual component is insufficient, two components, or more, in series will be required. A factor of 0.5 is used to account for the reduced performance of secondary or tertiary components.

The site constraints make attenuation storage the most appropriate mechanism for attenuating runoff from the site. Silt traps and trapped gullies will remove sediments. If additional treatment is required a proprietary vortex separator can be installed to capture and retain sediments, debris and hydrocarbons from the surface water runoff.

11. Conclusion

This Drainage Strategy incorporating a Flood Risk Assessment accompanies a planning application submitted to Wealden District Council. The planning application is for residential development on Land off Church Lane, Laughton, BN8 6AH.

The site is to the west of Church Lane, Laughton. It is accessed from Church Lane. The site is a greenfield site.

The proposed development is for four dwellings with associated access, parking and landscaping. The semi-detached dwellings are 2-bed, the house to the south is 3-bed and the central house is 4-bed.

The site lies within flood zone 1. The site is at very low risk of surface water flooding.

Foul Drainage Strategy

Public foul sewers run within the site. The depth of the sewers and the topography of the site mean that it is possible to connect the development to the public foul sewer via gravity. The invert levels of the public foul sewer within the site are not shown on the public sewer record and these have been estimated using available invert levels from upstream and downstream manholes.

The preliminary foul drainage design is based on two gravity connections to the public foul sewer running north to south through the site.

Surface Water Drainage Strategy

Following development 1,130m^2 of the site will be covered with impermeable materials, consisting of 410m^2 of roof area and 720m^2 of paved area.

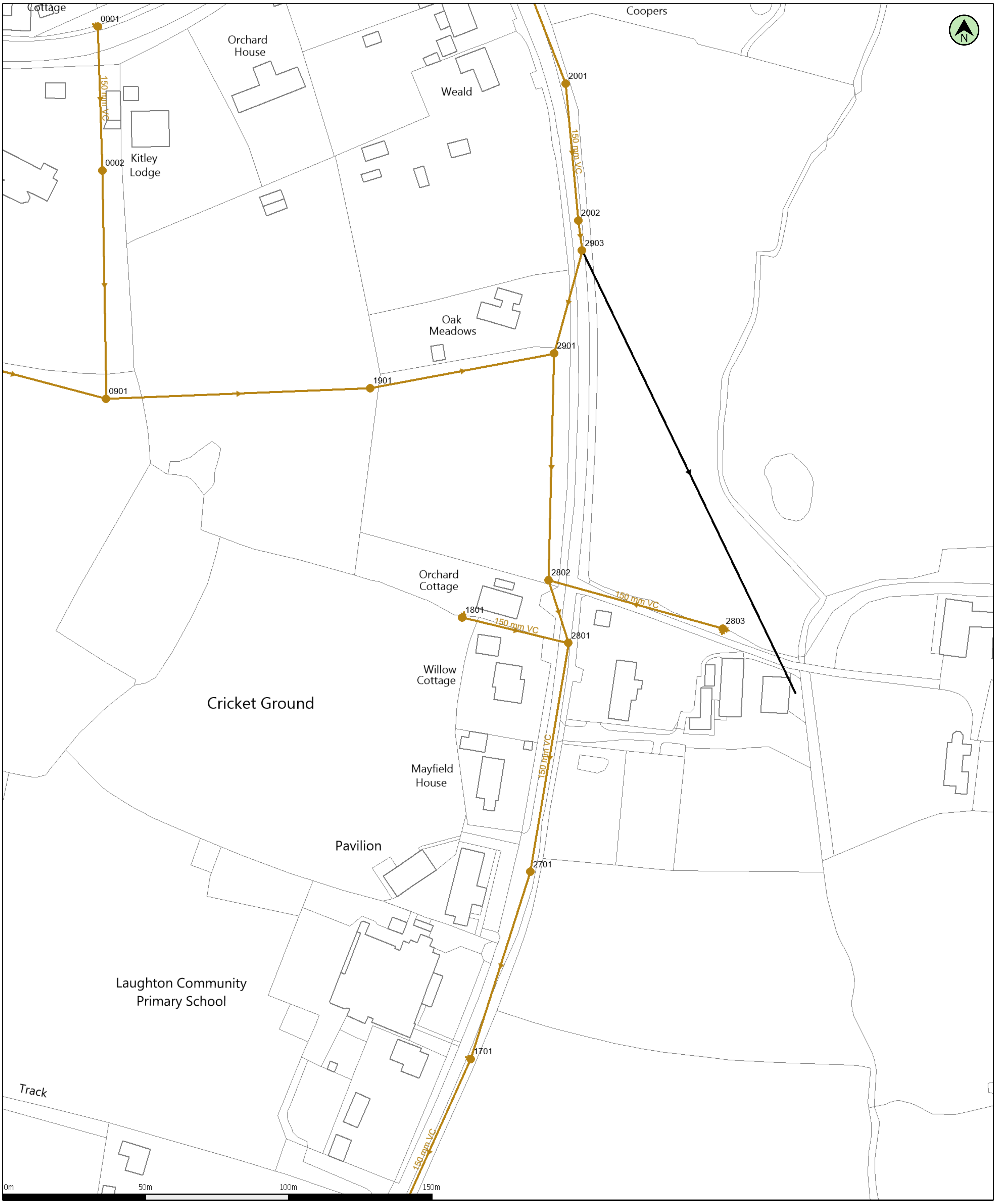
The following constraints have informed the surface water management strategy:

- The Weald Clay Formation is unlikely to allow infiltration to ground.
- There is a ditch on the eastern boundary of Church Road that drains to the local watercourse network.
- There are no public surface water sewers in the vicinity of the site.

The surface water management strategy is to attenuate surface water runoff and discharge it to the ditch on the eastern boundary of Church Road. The discharge ditch is shallow and any attenuation structures need to be kept shallow whilst maintaining sufficient cover. 650mm deep concrete box culverts are proposed at this stage. The type of attenuation structure will be confirmed as part of the detailed design. Discharge is limited to 2 l/s. There is no above ground flooding under the 1 in 100 year rainfall event with an allowance of 40% for climate change. Exceedance event flows are to Church Lane and to lower land east of the site.

The proposed development is considered acceptable from a foul and surface water drainage perspective.

Appendix A - Public Sewer Record



Data updated: 21/07/22

Scale: 1:1250

Map Centre: 550197,112875

Date: 22/08/22

Our Ref: 931603 - 1

Wastewater Plan A3

Powered by digdat

Foul Gravity Sewer
Combined Gravity Sewer
Culverted Water Course or Treated Effluent
Surface Water Gravity Sewer
Rising Main, Vacuum or Syphon
Combined Outfall
Surface Water Outfall
Foul Outfall
Surface Water Inlet
Combined Pumping Station
Surface Water Pumping Station
Foul Pumping Station
Water Treatment Works
Section 104 Area
Building Over Agreement Area
Foul Manhole
Combined Manhole
Surface Water Manhole
Side Entry Manhole, Decarcation Chamber, Dummy Manhole or Surface Water Soakaway

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Laughton

WATER for LIFE

from Southern Water.

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2022 Ordnance Survey 100031673 .This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
0001	F	19.20	18.00	
0002	F	0.00	0.00	
0901	F	0.00	0.00	
1701	F	14.05	9.89	
1801	F	14.48	13.57	
1901	F	0.00	0.00	
2001	F	15.01	11.89	
2002	F	0.00	0.00	
2701	F	13.93	0.00	
2801	F	13.77	10.76	
2802	F	0.00	0.00	
2803	F	12.33	4.03	
2901	F	0.00	0.00	
2903	F	0.00	0.00	

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Appendix B - 1144/203 Illustrative Drainage Layout

Jarvis Homes

Notes:

Please report all discrepancies, errors and omissions.

Verify all dimensions on site before commencing any work on site or preparing shop drawings.

All materials, components and workmanship are to comply with the relevant British Standards, Codes of Practice, and appropriate manufacturers recommendations that from time to time shall apply.

For all specialist work, see relevant drawings.

When this document is provided in electronic file format it is intended as a guide only and the recipient is to verify all dimensions and details with the Architects. If this is not acceptable, the files must be returned unused together with a written communication declining acceptance of this condition.

Key

- Public foul sewer
- Foul drainage
- Surface water drainage
- Exceedance event flow paths

Levels based on topographical survey carried out by others and assumptions concerning proposed levels.

Appropriate outlet to existing watercourse to be determined as part of the detailed design.

NOT FOR CONSTRUCTION

Rev A. Amended layout. 23/11/22.

N

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client	Jarvis Homes
project	Land off Church Lane Laughton BN8 6AH
drawing	Illustrative Drainage Layout
scale	1:200 @ A1
drawing no.	1144/203A
date	October 2022
drawn by	RB

Illustrative Drainage Layout
Land off Church Lane, Laughton, BN8 6AH

Appendix C - Foul Drainage Design

Design Settings

Frequency of use (kDU)	0.50	Minimum Velocity (m/s)	1.00
Flow per dwelling per day (l/day)	4000	Connection Type	Level Soffits
Domestic Flow (l/s/ha)	0.0	Minimum Backdrop Height (m)	2.000
Industrial Flow (l/s/ha)	0.0	Preferred Cover Depth (m)	1.200
Additional Flow (%)	0	Include Intermediate Ground	✓

Nodes

Name	Dwellings	Cover Level (m)	Manhole Type	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	1	14.350	Adoptable	1200	550203.310	112919.538	1.300
2		14.300	Adoptable	1200	550207.447	112919.405	1.302
3	1	14.100	Adoptable	1200	550196.348	112901.858	1.300
4		14.100			550206.874	112901.610	1.432
5		14.100	Adoptable	1200	550206.537	112891.122	1.564
5_OUT		13.600	Adoptable	1200	550214.553	112882.680	2.650
6	1	14.850	Adoptable	1200	550205.140	112943.491	1.300
7		14.500	Adoptable	1200	550211.766	112943.353	1.300
8	1	14.850	Adoptable	1200	550205.309	112950.989	1.300
9		14.630	Adoptable	1200	550211.879	112950.852	1.524
9_OUT		14.300			550215.552	112950.759	2.970

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
1.000	1	2	4.139	1.500	13.050	12.998	0.052	79.6	100
1.001	2	4	17.804	1.500	12.998	12.668	0.330	54.0	100
2.000	3	4	10.529	1.500	12.800	12.668	0.132	79.8	100
1.002	4	5	10.493	1.500	12.668	12.536	0.132	79.5	100
1.003	5	5_OUT	11.641	1.500	12.536	10.950	1.586	7.3	100
3.000	6	7	6.627	1.500	13.550	13.200	0.350	18.9	100
3.001	7	9	7.500	1.500	13.200	13.106	0.094	79.8	100
4.000	8	9	6.571	1.500	13.550	13.106	0.444	14.8	100
3.002	9	9_OUT	3.674	1.500	13.106	11.330	1.776	2.1	100

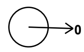
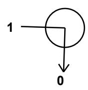
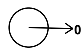
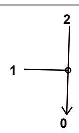
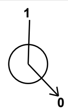
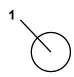
Name	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.147	0.746	5.9	0.0	1.200	1.202	0.000	1	0.0	0.0	7	0.206
1.001	0.152	0.907	7.1	0.0	1.202	1.332	0.000	1	0.0	0.0	6	0.229
2.000	0.146	0.745	5.9	0.0	1.200	1.332	0.000	1	0.0	0.0	7	0.206
1.002	0.188	0.746	5.9	0.1	1.332	1.464	0.000	2	0.0	0.0	9	0.259
1.003	0.421	2.468	19.4	0.1	1.464	2.550	0.000	2	0.0	0.0	5	0.564
3.000	0.211	1.534	12.1	0.0	1.200	1.200	0.000	1	0.0	0.0	5	0.349
3.001	0.146	0.745	5.8	0.0	1.200	1.424	0.000	1	0.0	0.0	7	0.206
4.000	0.239	1.736	13.6	0.0	1.200	1.424	0.000	1	0.0	0.0	4	0.347
3.002	0.647	4.653	36.5	0.1	1.424	2.870	0.000	2	0.0	0.0	4	0.936

Pipeline Schedule

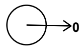
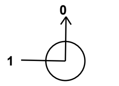
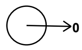
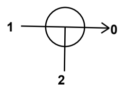
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	4.139	79.6	100	Circular	14.350	13.050	1.200	14.300	12.998	1.202
1.001	17.804	54.0	100	Circular	14.300	12.998	1.202	14.100	12.668	1.332
2.000	10.529	79.8	100	Circular	14.100	12.800	1.200	14.100	12.668	1.332
1.002	10.493	79.5	100	Circular	14.100	12.668	1.332	14.100	12.536	1.464
1.003	11.641	7.3	100	Circular	14.100	12.536	1.464	13.600	10.950	2.550
3.000	6.627	18.9	100	Circular	14.850	13.550	1.200	14.500	13.200	1.200
3.001	7.500	79.8	100	Circular	14.500	13.200	1.200	14.630	13.106	1.424
4.000	6.571	14.8	100	Circular	14.850	13.550	1.200	14.630	13.106	1.424
3.002	3.674	2.1	100	Circular	14.630	13.106	1.424	14.300	11.330	2.870

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1200	Manhole	Adoptable	2	1200	Manhole	Adoptable
1.001	2	1200	Manhole	Adoptable	4		Junction	
2.000	3	1200	Manhole	Adoptable	4		Junction	
1.002	4		Junction		5	1200	Manhole	Adoptable
1.003	5	1200	Manhole	Adoptable	5_OUT	1200	Manhole	Adoptable
3.000	6	1200	Manhole	Adoptable	7	1200	Manhole	Adoptable
3.001	7	1200	Manhole	Adoptable	9	1200	Manhole	Adoptable
4.000	8	1200	Manhole	Adoptable	9	1200	Manhole	Adoptable
3.002	9	1200	Manhole	Adoptable	9_OUT		Junction	

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
1	550203.310	112919.538	14.350	1.300	1200		0	1.000	13.050	100
2	550207.447	112919.405	14.300	1.302	1200		1	1.000	12.998	100
							0	1.001	12.998	100
3	550196.348	112901.858	14.100	1.300	1200		0	2.000	12.800	100
4	550206.874	112901.610	14.100	1.432			1	2.000	12.668	100
							2	1.001	12.668	100
							0	1.002	12.668	100
5	550206.537	112891.122	14.100	1.564	1200		1	1.002	12.536	100
							0	1.003	12.536	100
5_OUT	550214.553	112882.680	13.600	2.650	1200		1	1.003	10.950	100

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
6	550205.140	112943.491	14.850	1.300	1200		0	3.000	13.550	100
7	550211.766	112943.353	14.500	1.300	1200		1	3.000	13.200	100
							0	3.001	13.200	100
8	550205.309	112950.989	14.850	1.300	1200		0	4.000	13.550	100
9	550211.879	112950.852	14.630	1.524	1200		1	4.000	13.106	100
							2	3.001	13.106	100
							0	3.002	13.106	100
9_OUT	550215.552	112950.759	14.300	2.970			1	3.002	11.330	100

Appendix D - Surface Water Drainage Design

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	2.000
CV	0.750	Preferred Cover Depth (m)	0.600
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	500.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Manhole Type	Diameter (mm)	Width (mm)	Sump (m)	Easting (m)	Northing (m)	Depth (m)
1	0.010	5.00	14.100	Adoptable	1200			550195.581	112892.674	0.700
2	0.009	5.00	14.000	Adoptable	1200			550209.489	112891.974	0.750
3	0.011	5.00	14.100	Adoptable	1200			550182.784	112907.679	0.700
4	0.011	5.00	14.150	Adoptable	1200		0.450	550209.720	112907.272	1.691
5			14.150					550209.750	112909.272	1.241
6	0.017	5.00	14.500	Adoptable	1200			550194.007	112928.613	0.700
7	0.015	5.00	14.350	Adoptable	1200		0.450	550206.536	112928.184	1.891
8			14.300					550208.535	112928.115	1.391
9			14.300					550210.034	112928.064	1.391
10	0.009	5.00	15.000	Adoptable	1200			550196.864	112955.545	0.700
11	0.007	5.00	14.700	Adoptable	1200			550210.447	112955.340	1.150
12	0.008	5.00	14.800	Adoptable	1200			550196.254	112939.479	0.700
13	0.008	5.00	14.500	Adoptable	1200		0.450	550210.204	112939.268	2.041
14			14.500					550210.174	112937.268	1.591
15			14.350					550210.105	112932.760	1.441
16	0.009	5.00	14.100	Adoptable	1200			550213.605	112932.707	1.191
16_OUT			13.400	Headwall	150	600		550229.908	112932.459	0.600

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	2	13.926	0.600	13.400	13.300	0.100	139.3	100	5.30	52.6
1.001	2	4	15.300	0.600	13.250	12.909	0.341	44.9	150	5.50	51.8
2.000	3	4	26.939	0.600	13.400	12.909	0.491	54.9	100	5.55	51.5
1.002	4	5	2.000	0.600	12.909	12.909	0.000	0.0	150	5.58	51.4
1.003	5	9	18.794	0.600	12.909	12.909	0.000	0.0	150	5.86	50.1
3.000	6	7	12.536	0.600	13.800	12.959	0.841	14.9	100	5.21	53.1
3.001	7	8	2.000	0.600	12.909	12.909	0.000	0.0	150	5.22	53.0
3.002	8	9	1.500	0.600	12.909	12.909	0.000	0.0	150	5.24	52.9

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.650	5.1	1.5	0.600	0.600	0.010	0.0	37	0.564
1.001	1.506	26.6	2.7	0.600	1.091	0.019	0.0	32	0.965
2.000	1.042	8.2	1.6	0.600	1.141	0.011	0.0	29	0.797
1.002	1.000	17.7	5.7	1.091	1.091	0.041	0.0	0	∞
1.003	1.000	17.7	5.6	1.091	1.241	0.041	0.0	0	∞
3.000	2.011	15.8	2.4	0.600	1.291	0.017	0.0	26	1.446
3.001	1.000	17.7	4.6	1.291	1.241	0.032	0.0	0	∞
3.002	1.000	17.7	4.6	1.241	1.241	0.032	0.0	0	∞

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.004	9	15	4.697	0.600	12.909	12.909	0.000	0.0	150	5.97	49.7
4.000	10	11	13.585	0.600	14.300	13.600	0.700	19.4	100	5.23	53.0
4.001	11	13	16.074	0.600	13.550	12.909	0.641	25.1	150	5.36	52.4
5.000	12	13	13.952	0.600	14.100	12.976	1.124	12.4	100	5.11	53.5
4.002	13	14	2.000	0.600	12.909	12.909	0.000	0.0	150	5.39	52.2
4.003	14	15	4.509	0.600	12.909	12.909	0.000	0.0	150	5.47	51.9
1.005	15	16	3.500	0.600	12.909	12.909	0.000	0.0	150	6.02	49.4
1.006	16	16_OUT	16.305	0.600	12.909	12.800	0.109	149.6	150	6.29	48.5

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.004	1.000	17.7	9.8	1.241	1.291	0.073	0.0	0	∞
4.000	1.761	13.8	1.2	0.600	1.000	0.009	0.0	20	1.077
4.001	2.019	35.7	2.2	1.000	1.441	0.015	0.0	25	1.114
5.000	2.205	17.3	1.2	0.600	1.424	0.008	0.0	18	1.249
4.002	1.000	17.7	4.4	1.441	1.441	0.031	0.0	0	∞
4.003	1.000	17.7	4.4	1.441	1.291	0.031	0.0	0	∞
1.005	1.000	17.7	13.9	1.291	1.041	0.104	0.0	0	∞
1.006	0.819	14.5	14.8	1.041	0.450	0.113	0.0	127	0.930

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	13.926	139.3	100	Circular	14.100	13.400	0.600	14.000	13.300	0.600
1.001	15.300	44.9	150	Circular	14.000	13.250	0.600	14.150	12.909	1.091
2.000	26.939	54.9	100	Circular	14.100	13.400	0.600	14.150	12.909	1.141
1.002	2.000	0.0	150	Circular	14.150	12.909	1.091	14.150	12.909	1.091
1.003	18.794	0.0	150	Circular	14.150	12.909	1.091	14.300	12.909	1.241
3.000	12.536	14.9	100	Circular	14.500	13.800	0.600	14.350	12.959	1.291
3.001	2.000	0.0	150	Circular	14.350	12.909	1.291	14.300	12.909	1.241
3.002	1.500	0.0	150	Circular	14.300	12.909	1.241	14.300	12.909	1.241
1.004	4.697	0.0	150	Circular	14.300	12.909	1.241	14.350	12.909	1.291
4.000	13.585	19.4	100	Circular	15.000	14.300	0.600	14.700	13.600	1.000
4.001	16.074	25.1	150	Circular	14.700	13.550	1.000	14.500	12.909	1.441
5.000	13.952	12.4	100	Circular	14.800	14.100	0.600	14.500	12.976	1.424

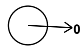
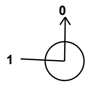
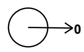
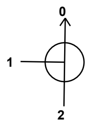
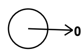
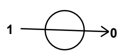
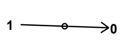
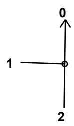
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Width (mm)	Node Type	MH Type
1.000	1	1200	Manhole	Adoptable	2	1200		Manhole	Adoptable
1.001	2	1200	Manhole	Adoptable	4	1200		Manhole	Adoptable
2.000	3	1200	Manhole	Adoptable	4	1200		Manhole	Adoptable
1.002	4	1200	Manhole	Adoptable	5			Junction	
1.003	5		Junction		9			Junction	
3.000	6	1200	Manhole	Adoptable	7	1200		Manhole	Adoptable
3.001	7	1200	Manhole	Adoptable	8			Junction	
3.002	8		Junction		9			Junction	
1.004	9		Junction		15			Junction	
4.000	10	1200	Manhole	Adoptable	11	1200		Manhole	Adoptable
4.001	11	1200	Manhole	Adoptable	13	1200		Manhole	Adoptable
5.000	12	1200	Manhole	Adoptable	13	1200		Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
4.002	2.000	0.0	150	Circular	14.500	12.909	1.441	14.500	12.909	1.441
4.003	4.509	0.0	150	Circular	14.500	12.909	1.441	14.350	12.909	1.291
1.005	3.500	0.0	150	Circular	14.350	12.909	1.291	14.100	12.909	1.041
1.006	16.305	149.6	150	Circular	14.100	12.909	1.041	13.400	12.800	0.450

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Width (mm)	Node Type	MH Type
4.002	13	1200	Manhole	Adoptable	14			Junction	
4.003	14		Junction		15			Junction	
1.005	15		Junction		16	1200		Manhole	Adoptable
1.006	16	1200	Manhole	Adoptable	16_OUT	150	600	Manhole	Headwall

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Sump (m)	Connections		Link	IL (m)	Dia (mm)
1	550195.581	112892.674	14.100	0.700	1200				0	1.000	13.400	100
2	550209.489	112891.974	14.000	0.750	1200				1	1.000	13.300	100
									0	1.001	13.250	150
3	550182.784	112907.679	14.100	0.700	1200				0	2.000	13.400	100
4	550209.720	112907.272	14.150	1.691	1200		0.450		1	2.000	12.909	100
									2	1.001	12.909	150
									0	1.002	12.909	150
5	550209.750	112909.272	14.150	1.241					1	1.002	12.909	150
									0	1.003	12.909	150
6	550194.007	112928.613	14.500	0.700	1200				0	3.000	13.800	100
7	550206.536	112928.184	14.350	1.891	1200		0.450		1	3.000	12.959	100
									0	3.001	12.909	150
8	550208.535	112928.115	14.300	1.391					1	3.001	12.909	150
									0	3.002	12.909	150
9	550210.034	112928.064	14.300	1.391					1	3.002	12.909	150
									2	1.003	12.909	150
									0	1.004	12.909	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Sump (m)	Connections	Link	IL (m)	Dia (mm)
10	550196.864	112955.545	15.000	0.700	1200			0	4.000	14.300	100
11	550210.447	112955.340	14.700	1.150	1200			1	4.000	13.600	100
								0	4.001	13.550	150
12	550196.254	112939.479	14.800	0.700	1200			0	5.000	14.100	100
13	550210.204	112939.268	14.500	2.041	1200		0.450	1	5.000	12.976	100
								2	4.001	12.909	150
								0	4.002	12.909	150
14	550210.174	112937.268	14.500	1.591				1	4.002	12.909	150
								0	4.003	12.909	150
15	550210.105	112932.760	14.350	1.441				1	4.003	12.909	150
								2	1.004	12.909	150
								0	1.005	12.909	150
16	550213.605	112932.707	14.100	1.191	1200			1	1.005	12.909	150
								0	1.006	12.909	150
16_OUT	550229.908	112932.459	13.400	0.600	150	600		1	1.006	12.800	150

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Normal	Additional Storage (m^3/ha)	0.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	1440	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	0	0	0
100	20	0	0
100	40	0	0

Node 16 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	12.909	Product Number	CTL-SHE-0070-2000-0800-2000
Design Depth (m)	0.800	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node 15 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	12.909
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	396

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	75.6	0.0	0.650	75.6	0.0	0.651	0.0	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.63%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	11	13.436	0.036	1.4	0.0413	0.0000	OK
15 minute winter	2	10	13.281	0.031	2.6	0.0354	0.0000	OK
15 minute winter	3	10	13.430	0.030	1.6	0.0335	0.0000	OK
240 minute winter	4	164	13.048	0.139	1.5	0.1572	0.0000	OK
240 minute winter	5	164	13.048	0.139	1.4	0.0000	0.0000	OK
15 minute winter	6	10	13.826	0.026	2.3	0.0292	0.0000	OK
240 minute winter	7	164	13.048	0.139	1.1	0.1569	0.0000	OK
240 minute winter	8	164	13.048	0.139	1.1	0.0000	0.0000	OK
240 minute winter	9	164	13.048	0.139	2.4	0.0000	0.0000	OK
15 minute winter	10	10	14.320	0.020	1.2	0.0226	0.0000	OK
15 minute winter	11	11	13.574	0.024	2.1	0.0276	0.0000	OK
15 minute winter	12	11	14.117	0.017	1.1	0.0196	0.0000	OK
240 minute winter	13	164	13.048	0.139	1.1	0.1567	0.0000	OK
240 minute winter	14	164	13.048	0.139	1.0	0.0000	0.0000	OK
240 minute winter	15	164	13.048	0.139	3.3	10.4731	0.0000	OK
240 minute winter	16	164	13.047	0.138	1.8	0.1562	0.0000	OK
240 minute winter	16_OUT	164	12.835	0.035	1.8	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	1.4	0.549	0.274	0.0354	
15 minute winter	2	1.001	4	2.5	0.324	0.095	0.1461	
15 minute winter	3	2.000	4	1.6	0.291	0.190	0.1314	
15 minute winter	4	1.002	5	5.1	0.416	0.289	0.0328	
15 minute winter	5	1.003	9	5.1	0.359	0.290	0.2891	
15 minute winter	6	3.000	7	2.3	1.290	0.145	0.0490	
15 minute winter	7	3.001	8	4.8	0.406	0.273	0.0305	
15 minute winter	8	3.002	9	5.6	0.529	0.318	0.0219	
15 minute winter	9	1.004	15	12.4	1.380	0.702	0.0438	
15 minute winter	10	4.000	11	1.2	1.061	0.084	0.0149	
15 minute winter	11	4.001	13	2.0	0.421	0.057	0.0830	
15 minute winter	12	5.000	13	1.1	1.222	0.064	0.0126	
15 minute winter	13	4.002	14	4.1	0.561	0.234	0.0172	
15 minute winter	14	4.003	15	4.1	1.133	0.232	0.0387	
240 minute winter	15	1.005	16	1.7	-0.137	0.095	0.0594	
240 minute winter	16	1.006	16_OUT	1.8	0.554	0.123	0.0525	22.9

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.63%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	13.467	0.067	3.9	0.0757	0.0000	OK
15 minute winter	2	10	13.302	0.052	7.0	0.0589	0.0000	OK
15 minute winter	3	10	13.450	0.050	4.2	0.0568	0.0000	OK
180 minute winter	4	148	13.264	0.355	3.8	0.4016	0.0000	SURCHARGED
180 minute winter	5	148	13.264	0.355	3.6	0.0000	0.0000	SURCHARGED
15 minute winter	6	10	13.844	0.044	6.3	0.0497	0.0000	OK
180 minute winter	7	152	13.264	0.355	2.9	0.4020	0.0000	SURCHARGED
180 minute winter	8	152	13.264	0.355	2.8	0.0000	0.0000	SURCHARGED
180 minute winter	9	152	13.264	0.355	6.6	0.0000	0.0000	SURCHARGED
15 minute winter	10	10	14.333	0.033	3.2	0.0378	0.0000	OK
15 minute winter	11	10	13.591	0.041	5.8	0.0459	0.0000	OK
15 minute winter	12	10	14.129	0.029	3.1	0.0324	0.0000	OK
180 minute winter	13	148	13.263	0.354	2.9	0.4007	0.0000	SURCHARGED
180 minute winter	14	148	13.263	0.354	2.7	0.0000	0.0000	SURCHARGED
180 minute winter	15	152	13.263	0.354	8.7	26.7800	0.0000	SURCHARGED
180 minute winter	16	148	13.263	0.354	2.1	0.4001	0.0000	SURCHARGED
480 minute summer	16_OUT	288	12.838	0.038	2.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	3.8	0.704	0.741	0.0748	
15 minute winter	2	1.001	4	6.9	0.505	0.259	0.1762	
15 minute winter	3	2.000	4	4.1	0.612	0.503	0.1584	
15 minute winter	4	1.002	5	13.6	0.770	0.767	0.0352	
15 minute winter	5	1.003	9	13.1	0.743	0.740	0.3309	
15 minute winter	6	3.000	7	6.3	1.321	0.396	0.0698	
15 minute summer	7	3.001	8	11.1	0.636	0.631	0.0352	
15 minute summer	8	3.002	9	11.3	0.671	0.642	0.0264	
15 minute winter	9	1.004	15	23.0	1.800	1.303	0.0827	
15 minute winter	10	4.000	11	3.2	1.402	0.228	0.0306	
15 minute winter	11	4.001	13	5.7	0.525	0.160	0.1688	
15 minute winter	12	5.000	13	3.1	1.373	0.177	0.0636	
15 minute winter	13	4.002	14	13.0	0.840	0.736	0.0352	
15 minute winter	14	4.003	15	12.7	1.277	0.720	0.0794	
15 minute winter	15	1.005	16	-2.1	-0.539	-0.121	0.0616	
480 minute summer	16	1.006	16_OUT	2.0	0.572	0.138	0.0571	51.5

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.63%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	11	13.482	0.082	5.0	0.0930	0.0000	OK
15 minute winter	2	12	13.393	0.143	8.9	0.1620	0.0000	OK
15 minute winter	3	12	13.483	0.083	5.3	0.0937	0.0000	OK
180 minute winter	4	172	13.386	0.477	4.8	0.5392	0.0000	SURCHARGED
180 minute winter	5	172	13.385	0.476	4.5	0.0000	0.0000	SURCHARGED
15 minute winter	6	10	13.850	0.050	8.0	0.0570	0.0000	OK
180 minute winter	7	172	13.386	0.477	3.6	0.5398	0.0000	SURCHARGED
180 minute winter	8	184	13.385	0.476	3.9	0.0000	0.0000	SURCHARGED
180 minute winter	9	176	13.386	0.477	7.1	0.0000	0.0000	SURCHARGED
15 minute winter	10	10	14.338	0.038	4.1	0.0433	0.0000	OK
15 minute winter	11	10	13.596	0.046	7.4	0.0522	0.0000	OK
15 minute winter	12	10	14.132	0.032	3.9	0.0365	0.0000	OK
180 minute winter	13	176	13.385	0.476	3.6	0.5384	0.0000	SURCHARGED
180 minute winter	14	176	13.385	0.476	3.3	0.0000	0.0000	SURCHARGED
180 minute winter	15	176	13.385	0.476	10.9	35.9837	0.0000	SURCHARGED
180 minute winter	16	176	13.384	0.475	2.1	0.5378	0.0000	SURCHARGED
120 minute winter	16_OUT	260	12.838	0.038	2.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	4.8	0.747	0.945	0.0941	
15 minute summer	2	1.001	4	8.3	0.592	0.312	0.2378	
15 minute winter	3	2.000	4	4.8	0.692	0.584	0.1988	
15 minute winter	4	1.002	5	15.6	0.889	0.885	0.0352	
15 minute winter	5	1.003	9	15.2	0.862	0.858	0.3309	
15 minute winter	6	3.000	7	7.9	1.356	0.503	0.0738	
15 minute winter	7	3.001	8	13.9	0.789	0.786	0.0352	
15 minute winter	8	3.002	9	13.3	0.754	0.751	0.0264	
15 minute winter	9	1.004	15	27.8	1.957	1.572	0.0827	
15 minute winter	10	4.000	11	4.1	1.500	0.293	0.0367	
15 minute winter	11	4.001	13	7.3	0.577	0.205	0.1784	
15 minute winter	12	5.000	13	3.9	1.320	0.224	0.0694	
15 minute winter	13	4.002	14	13.8	0.861	0.781	0.0352	
15 minute winter	14	4.003	15	14.8	1.545	0.838	0.0794	
15 minute summer	15	1.005	16	-2.6	-0.556	-0.146	0.0616	
120 minute winter	16	1.006	16_OUT	2.0	0.572	0.138	0.0571	50.1

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.63%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	12	13.601	0.201	5.9	0.2268	0.0000	SURCHARGED
240 minute winter	2	232	13.518	0.268	2.2	0.3032	0.0000	SURCHARGED
15 minute winter	3	12	13.661	0.261	6.4	0.2957	0.0000	SURCHARGED
240 minute winter	4	232	13.519	0.610	4.7	0.6894	0.0000	SURCHARGED
240 minute winter	5	232	13.517	0.608	4.4	0.0000	0.0000	SURCHARGED
15 minute winter	6	10	13.856	0.056	9.6	0.0639	0.0000	OK
180 minute winter	7	180	13.519	0.610	4.4	0.6896	0.0000	SURCHARGED
180 minute winter	8	180	13.526	0.617	4.3	0.0000	0.0000	SURCHARGED
240 minute winter	9	232	13.518	0.609	9.0	0.0000	0.0000	SURCHARGED
15 minute winter	10	10	14.342	0.042	4.9	0.0478	0.0000	OK
15 minute winter	11	10	13.600	0.050	8.7	0.0571	0.0000	OK
15 minute winter	12	10	14.136	0.036	4.7	0.0402	0.0000	OK
240 minute winter	13	232	13.517	0.608	3.6	0.6881	0.0000	SURCHARGED
240 minute winter	14	232	13.517	0.608	3.3	0.0000	0.0000	SURCHARGED
240 minute winter	15	232	13.517	0.608	10.6	45.9933	0.0000	SURCHARGED
240 minute winter	16	232	13.517	0.608	2.1	0.6876	0.0000	SURCHARGED
240 minute summer	16_OUT	432	12.838	0.038	2.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	5.3	0.745	1.043	0.1090	
15 minute summer	2	1.001	4	8.9	0.631	0.336	0.2694	
15 minute summer	3	2.000	4	5.1	0.707	0.621	0.2108	
15 minute winter	4	1.002	5	17.4	0.989	0.985	0.0352	
15 minute winter	5	1.003	9	16.9	0.960	0.956	0.3309	
15 minute winter	6	3.000	7	9.5	1.362	0.600	0.0776	
15 minute winter	7	3.001	8	16.8	0.954	0.950	0.0352	
15 minute winter	8	3.002	9	16.0	0.907	0.903	0.0264	
15 minute winter	9	1.004	15	31.2	1.774	1.767	0.0827	
15 minute winter	10	4.000	11	4.8	1.570	0.350	0.0419	
15 minute winter	11	4.001	13	8.7	0.641	0.243	0.1833	
15 minute winter	12	5.000	13	4.7	1.337	0.269	0.0720	
15 minute winter	13	4.002	14	16.3	0.928	0.924	0.0352	
15 minute winter	14	4.003	15	15.7	1.395	0.889	0.0794	
15 minute summer	15	1.005	16	-3.0	-0.543	-0.168	0.0616	
240 minute summer	16	1.006	16_OUT	2.0	0.572	0.138	0.0571	64.5

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.63%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	1	228	13.956	0.556	1.4	0.6287	0.0000	FLOOD RISK
240 minute winter	2	228	13.956	0.706	2.5	0.7983	0.0000	FLOOD RISK
240 minute winter	3	228	13.956	0.556	1.5	0.6289	0.0000	FLOOD RISK
240 minute winter	4	232	13.957	1.048	5.2	1.1847	0.0000	FLOOD RISK
240 minute winter	5	228	13.954	1.045	4.8	0.0000	0.0000	FLOOD RISK
240 minute winter	6	228	13.956	0.156	2.2	0.1764	0.0000	SURCHARGED
240 minute winter	7	232	13.956	1.047	4.2	1.1841	0.0000	SURCHARGED
240 minute winter	8	228	13.954	1.045	4.1	0.0000	0.0000	SURCHARGED
240 minute winter	9	228	13.955	1.046	8.2	0.0000	0.0000	SURCHARGED
15 minute winter	10	10	14.346	0.046	5.7	0.0523	0.0000	OK
240 minute winter	11	228	13.954	0.404	2.0	0.4572	0.0000	SURCHARGED
15 minute winter	12	10	14.139	0.039	5.5	0.0438	0.0000	OK
240 minute winter	13	232	13.955	1.046	4.1	1.1831	0.0000	SURCHARGED
240 minute winter	14	232	13.955	1.045	3.8	0.0000	0.0000	SURCHARGED
240 minute winter	15	228	13.954	1.045	12.0	49.1778	0.0000	SURCHARGED
240 minute winter	16	232	13.953	1.044	2.3	1.1812	0.0000	FLOOD RISK
240 minute winter	16_OUT	232	12.840	0.040	2.2	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	5.5	0.736	1.080	0.1090	
15 minute winter	2	1.001	4	8.7	0.617	0.329	0.2694	
15 minute winter	3	2.000	4	5.3	0.719	0.643	0.2108	
15 minute winter	4	1.002	5	19.1	1.087	1.083	0.0352	
15 minute winter	5	1.003	9	18.6	1.059	1.054	0.3309	
15 minute winter	6	3.000	7	11.0	1.494	0.696	0.0851	
15 minute winter	7	3.001	8	19.3	1.099	1.094	0.0352	
15 minute winter	8	3.002	9	18.3	1.039	1.035	0.0264	
15 minute winter	9	1.004	15	35.1	2.068	1.984	0.0827	
15 minute winter	10	4.000	11	5.6	1.632	0.408	0.0469	
15 minute winter	11	4.001	13	10.2	0.736	0.285	0.1883	
15 minute winter	12	5.000	13	5.5	1.291	0.315	0.0741	
15 minute winter	13	4.002	14	19.1	1.083	1.079	0.0352	
15 minute winter	14	4.003	15	18.4	1.509	1.039	0.0794	
15 minute summer	15	1.005	16	-3.2	-0.545	-0.180	0.0616	
240 minute winter	16	1.006	16_OUT	2.2	0.589	0.154	0.0615	84.9

Appendix E - SUDS Maintenance and Management Plan

Land off Church Lane, Laughton, BN8 6AH

Sustainable Urban Drainage Systems Management and Maintenance Plan

1. Introduction

This Sustainable Urban Drainage Systems (SuDS) Management and Maintenance Plan has been produced for SuDS elements at Land off Church Lane, Laughton, BN8 6AH.

The following SuDS elements are proposed within the development.

- Attenuation structure
- Control structure

2. Management

The residents will be responsible for the maintenance of the drainage structures. This will be achieved through setting up a management company to which the residents contribute. The management company will carry out routine management and maintenance of the drainage structures.

3. Maintenance

The following maintenance plans will be put in place for each of the SuDS elements present within the development.

Attenuation Structure

SUDS Element	**Attenuation Structure**	
Maintenance Issues	Debris entering storage causing blockage.	
Maintenance Period	**Maintenance Task**	**Frequency**
Regular	Inspect storage and inlets to identify any elements not working correctly.	Monthly for 3 months, then six monthly.
	Debris removal from gutters.	Annually in autumn after leaf fall.
	Remove sediment from silt traps.	Annually or as required.
Remedial Work	Repair inlets and silt traps	As required.
	Clear out storage if it becomes blocked	As required.

Control Structures

SUDS Element	Control Structure	
Maintenance Issues	Debris blocking control structure.	
Maintenance Period	**Maintenance Task**	**Frequency**
Regular	Inspect chamber and remove any debris from control device.	Quarterly and following heavy rainfall.
Remedial Work	Repair or replace control device if it is damaged.	As required.