Flood Risk Assessment & Drainage Strategy

Salcombe Avenue, Jarrow

South Tyneside Homes

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CK21 Consultants LLP, Suite 2 1st Floor Shakespeare House,
18 Shakespeare Street, Newcastle upon Tyne, NE1 6AQ
Tel 0191 2616312, www.ck21.co.uk

Document Validation

Revision History

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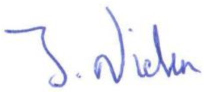
	Name	Mark Bryden	David Webb	John Nielsen
	Signature			

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Introduction

CK21 have been appointed by South Tyneside Homes to prepare a Drainage Strategy to supplement their FULL planning application for a proposed residential development off Salcombe Avenue, Jarrow.

Whilst the development area is 0.38 ha, under the 1 hectare threshold to require a full Flood Risk Assessment, the flood risk has been assessed.

The aim of this flood risk assessment report is to evaluate the current proposals with regard to flood risk and drainage, and identify potential flood risk to the development site. CK21 have undertaken the following as part of this study:

Assessment of the development potential of the site, with regard Flood Risk, in line with the National Planning Policy Framework and Technical Guidance to the National Policy Framework, (NPPF) and the South Tyneside Council Strategic Flood Risk Assessment, (SFRA).

As set out in the National Planning Policy Framework, inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere. For these purposes:

“areas at risk of flooding” means land within Flood Zones 2 and 3; or land within Flood Zone 1 which has critical drainage problems and which has been notified to the local planning authority by the Environment Agency;

“flood risk” means risk from all sources of flooding - including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

A risk based approach should be adopted at all levels of planning. Applying the source pathway-receptor model to planning for development in areas of flood risk requires;

A strategic approach which avoids adding to the causes or “sources” of flood risk, by such means as avoiding inappropriate development in flood risk areas, minimising run-off from new development onto adjacent and/or other downstream property, and into the river systems;

Managing flood “pathways” to reduce the likelihood of flooding by ensuring that the design and location of the development maximises the use of SUDS, and takes account of its susceptibility to flooding, the performance and processes of river/coastal systems and appropriate flood defence infrastructure, and of the likely routes and storage of floodwater including its influence on flood risk downstream;

Reducing the adverse consequences of flooding on the “receptors” (i.e. people, property, infrastructure, habitats and statutory sites) b avoiding inappropriate development in areas at risk of flooding.

The report is presented in the structure of *“Paragraph 068 of the Planning Practice Guidance – Model checklist for a site specific flood risk assessment”.*

1. Development Site & Location

The development site is located off Salcombe Avenue, Jarrow, South Tyneside. The site is currently a Greenfield site (farmland) and measures approximately 0.38 hectares.

- Nearest post code = NE32 3QZ
- Ordnance Survey X = 433743
- Ordnance Survey Y = 564247
- Nat Grid Ref = NZ337642

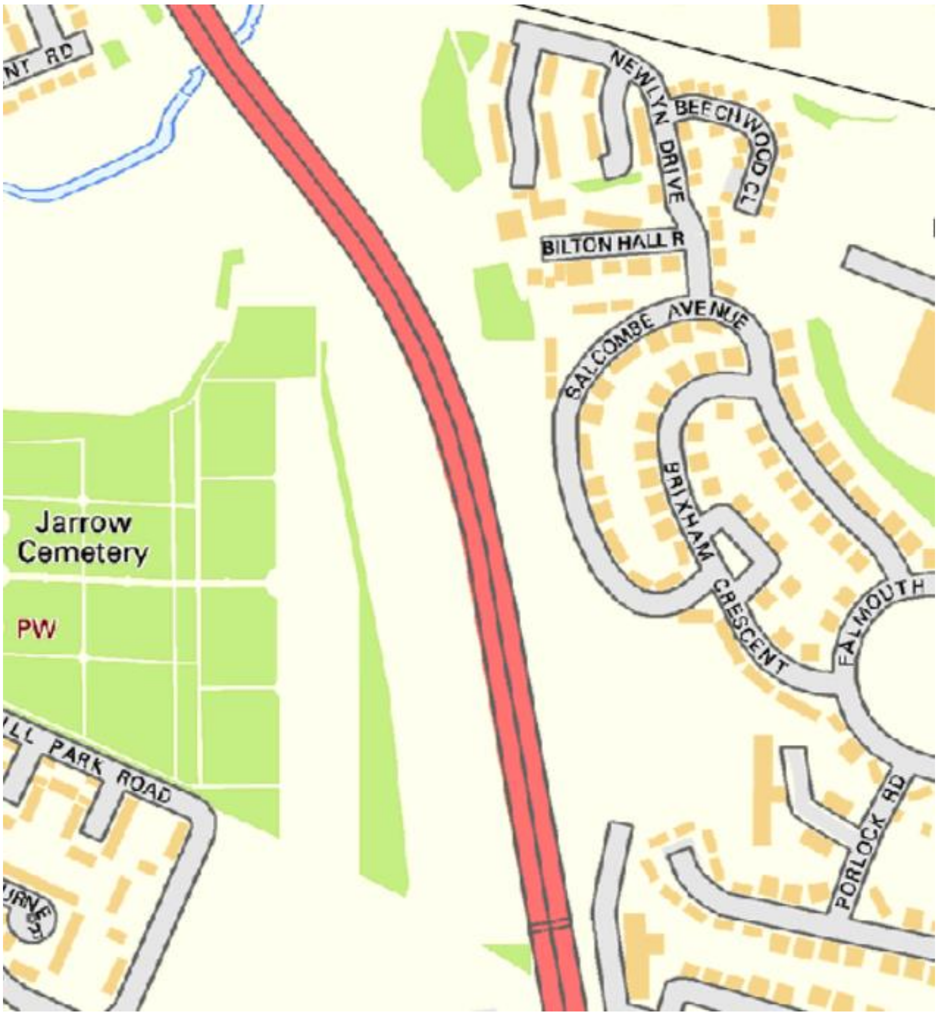


Figure 1 - Location Map

The site is within Flood Zone 1, as classified by the Environment Agency flood maps. The nearest watercourse is River Don, which is located approximately 300m to the north of the development site. The development lies within the natural catchment of the River Don.

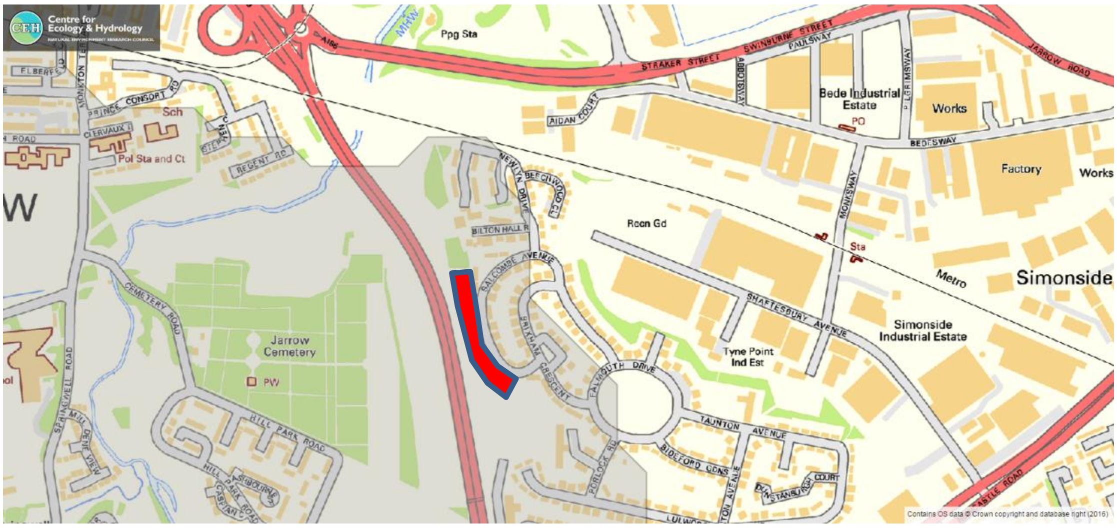


Figure 2 – Extract from FEH Catchment Map, indicating the site within the catchment of the River Don

The development proposals are to construct a 20 unit residential development off the existing Salcombe Avenue. The units consist of bungalows, 2 storey housing and apartments.

A proposed site plan can be found within the appendices.

The impermeable areas of the proposed new development will occupy approximately 60% of the developed site. An increase from the 100% permeable current site conditions.

The proposed development would not involve a change of planning use category, the developments Flood Risk Vulnerability classification is considered as **'More vulnerable'.**

2. Sequential Test

As set out in the National Planning Policy Framework, the aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. The flood zones (see table 1) are the starting point for this sequential approach. Zones 2 and 3 are shown on the flood map1 with Flood Zone 1 being all the land falling outside Zones 2 and 3. These flood zones refer to the probability of sea and river flooding only, ignoring the presence of existing defences.

Strategic Flood Risk Assessments (see paragraphs 7-8) refine information on the probability of flooding, taking other sources of flooding and the impacts of climate change (see paragraphs 11-15) into account. They provide the basis for applying the Sequential Test, on the basis of the flood zones in table 1. Where table 1 indicates the need to apply the Exception Test (as set out in the National Planning Policy Framework), the scope of a Strategic Flood Risk Assessment will be widened to consider the impact of the flood risk management infrastructure on the frequency, impact, speed of onset, depth and velocity of flooding within the flood zones considering a range of flood risk management maintenance scenarios. Where a Strategic Flood Risk Assessment is not available, the Sequential Test will be based on the Environment Agency flood zones.

The overall aim should be to steer new development to Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, local planning authorities allocating land in local plans or determining planning applications for development at any particular location should take into account the flood risk vulnerability of land uses (see table 2) and consider reasonably available sites in Flood Zone 2, applying the Exception Test if required (see table 3). Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

Table 1: Flood zones

Zone 1 - low probability Definition This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%). Appropriate uses ; All uses of land are appropriate in this zone. Flood risk assessment requirements ; For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment. This need only be brief unless the factors above or other local considerations require particular attention. Policy aims : In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems.
Zone 2 - medium probability Definition : This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year. Appropriate uses : Essential infrastructure and the water-compatible, less vulnerable and more vulnerable uses, as set out in table 2, are appropriate in this zone. The highly vulnerable uses are *only* appropriate in this zone if the Exception Test is passed. Flood risk assessment requirements : All development proposals in this zone should be accompanied by a flood risk assessment. Policy aims ; In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage systems.

Zone 3a - high probability Definition This zone comprises 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. Appropriate uses : The water-compatible and less vulnerable uses of land (table 2) are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone. The more vulnerable uses and essential infrastructure should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood. Flood risk assessment requirements : All development proposals in this zone should be accompanied by a flood risk assessment. Policy aims : In this zone, developers and local authorities should seek opportunities to: reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage systems. Relocate existing development to land in zones with ta lower probability of flooding; and Create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.
Zone 3b - the functional floodplain Definition This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify the functional floodplain. Appropriate uses Only the water-compatible uses and the essential infrastructure listed in table 2 that has to be there should be permitted in this zone. It should be designed and constructed to: - remain operational and safe for users in times of flood; - result in no net loss of floodplain storage; - not impede water flows; and not increase flood risk elsewhere. - Essential infrastructure in this zone should pass the Exception Test. Flood risk assessment requirements : All development proposals in this zone should be accompanied by a flood risk assessment.

Policy aims :

In this zone, developers and local authorities should seek opportunities to:

- reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage systems;
- relocate existing development to land with a lower probability of flooding.

Table 2: Flood risk vulnerability classification

Essential infrastructure Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. Wind turbines.
Highly vulnerable Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding. Emergency dispersal points. Basement dwellings. Caravans, mobile homes and park homes intended for permanent residential use. Installations requiring hazardous substances consent4. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as “essential infrastructure”).
More vulnerable Hospitals. Residential institutions such as residential care homes, children’s homes, social services homes, prisons and hostels. Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. Non–residential uses for health services, nurseries and educational establishments. Landfill and sites used for waste management facilities for hazardous waste6. Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less vulnerable Police, ambulance and fire stations which are not required to be operational during flooding. Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non–residential institutions not included in “more vulnerable”, and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do *not* need to remain operational during times of flood. • Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).
Water-compatible development Flood control infrastructure. Water transmission infrastructure and pumping stations. Sewage transmission infrastructure and pumping stations. Sand and gravel working. Docks, marinas and wharves. Navigation facilities. Ministry of Defence defence installations. Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. Water-based recreation (excluding sleeping accommodation). Lifeguard and coastguard stations. Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. Essential ancillary sleeping or residential accommodation for staff required by uses in this category, *subject to a specific warning and evacuation plan*

Table 3: Flood risk vulnerability and flood zone ‘compatibility’

Flood risk vulnerability classification (see table 2)	Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception Test Required	✓	✓
Zone 3a	Exception Test Required	✓	X	Exception Test Required	✓
Zone 3b functional Floodplain	Exception Test Required	✓	X	X	X

Key:

✓ Development is appropriate.

X Development should not be permitted.

Notes to table 3:

This table does not show:

a. the application of the Sequential Test which guides development to Flood Zone 1 first, then Zone 2, and then Zone 3;

b. flood risk assessment requirements; or

c. the policy aims for each flood zone.

3. Climate Change

The National Planning Policy Framework (NPPF) sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. NPPF and supporting planning practise guidance on Flood Risk and Coastal change explain when and how flood risk assessments should be used. This includes demonstrating how flood risk will be managed now and over the developments lifetime, taking climate change into account. Local planning authorities refer to this when preparing local plans and considering planning applications.

Revised Environment Agency Climate Changes Allowances for Flood Risk Assessments

In February 2016 the Environment Agency released their revised climate change allowances, for use when considering flood risk.

What are the climate change allowances?

To assess the potential impacts that climate change may have on extreme rainfall, river flood flows, sea level rise and storm surges, climate change allowances are provided in Annex 1. The climate change allowances quantify the potential change (as either mm or percentage increase, depending on the variable) to the baseline. The climate change allowances are based on the best available, credible, peer-reviewed scientific evidence from UKCP09, but given the complexity of the science around climatic projections, there are significant uncertainties attributed to the climate change allowances. This is why the climate change allowances are presented as a range of possibilities (Lower, Central, Higher Central and Upper), to reflect the potential variation in climate change impacts over three epochs from the present day to 2115. It is recommended that the performance of flood risk management options are assessed against all of the change allowances covering the whole of the decision lifetime.

	Total potential change anticipated for ‘2020s’ (2015-39	Total potential change anticipated for ‘2050s’ (2040-69	Total potential change anticipated for ‘2080s’ (2070-15)
Northumbria River Basins			
Upper (90th percentile)	20%	30%	50%
Higher Central (70th percentile)	15%	20%	25%
Central (50% percentile)	10%	15%	20%
Lower (10th percentile)	5%	5%	10%

Table 1: Potential changes in peak river flow for Northumbria River Basin District

	Total potential change anticipated for ‘2020s’ (2015-39	Total potential change anticipated for ‘2050s’ (2040-69	Total potential change anticipated for ‘2080s’ (2070-15)
Northumbria River Basins			
Upper estimate	10%	20%	40%
Central estimate	5%	10%	20%

Table 2: Change to extreme rainfall intensity compared to a 1961-90 baseline

Impact on Development

The development design proposals should allow for the effects of climate change, appropriate to the anticipated lifetime of the development.

The proposed development is outside the zone of influence of any increase in river flows, however, an allowance for 40% climate change should be allowed for in the design of the surface water drainage network. With consideration given to site and finished floor levels with regards potential flood paths for the extreme storm events.

4. Site Specific Flood Risk

The following chapter will review the potential flood risk to the development from all sources, in accordance with the requirements of both the NPPF and the Local Authority Planning Validation Checklist.

The impact of the following potential sources of risk of flooding to the proposed development over its expected lifetime, including appropriate allowances for the impact of climate change will be considered and assessed.

- Fluvial Flooding

  This occurs when a river or stream is unable to take on water draining in to it from surrounding land. The additional water causes the water to risk above its banks or retaining structures and subsequently flows onto the land.

  <u>Flood Zones</u>

  A flood zone is described as the area of land which will flood if there is river or coastal flooding. This data does not account for the presence of flood defences. This data displays the area of land that is likely to be flooded in such an event. The Flood Zones are in grouped into three categories:

  Flood Zone 1 – Low probability less than 0.1% chance in any year (any area that is not considered at risk of flooding)

  Flood Zone 2 (identified in green on the Groundsure flood maps) – Medium probability, greater than 0.1% but less than 1% from rivers and 0.5% from the sea.

  Flood Zone 3 is split into 3a and 3b.

  Zone 3a High risk (1% of greater from rivers and 0.5% or greater from the sea in any given year).

  Zone 3b is the “functional floodplain” or used as a flood storage area – this is a very high flood risk area.

- Pluvial Flooding

  Results from overland flow before the runoff enters a watercourse or sewer. It is usually the result of high intensity rainfall, but can occur with lower intensity rainfall when the land has a low permeability and/or is already saturated, frozen or developed.

- Groundwater Flooding

  Groundwater flooding is caused by the emergence of water from underground, either at point or diffuse locations. The occurrence of groundwater flooding is usually very local and unlike flooding from rivers and the sea, does not generally pose a significant risk to life due to the slow rate at which the water level rises.

- Sewerage Flooding

  Extreme rainfall events may overwhelm sewer systems and cause local flooding. This is not something that can be predicted/modelled. Historical sewer flood events can be found on the DG5 'At Risk Register' which is compiled by water companies.

Flood Risk to the Site

Fluvial Flooding

A review of the Environment Agency maps have been undertaken to assess the sites suitability for development. The site lies within flood zone 1.

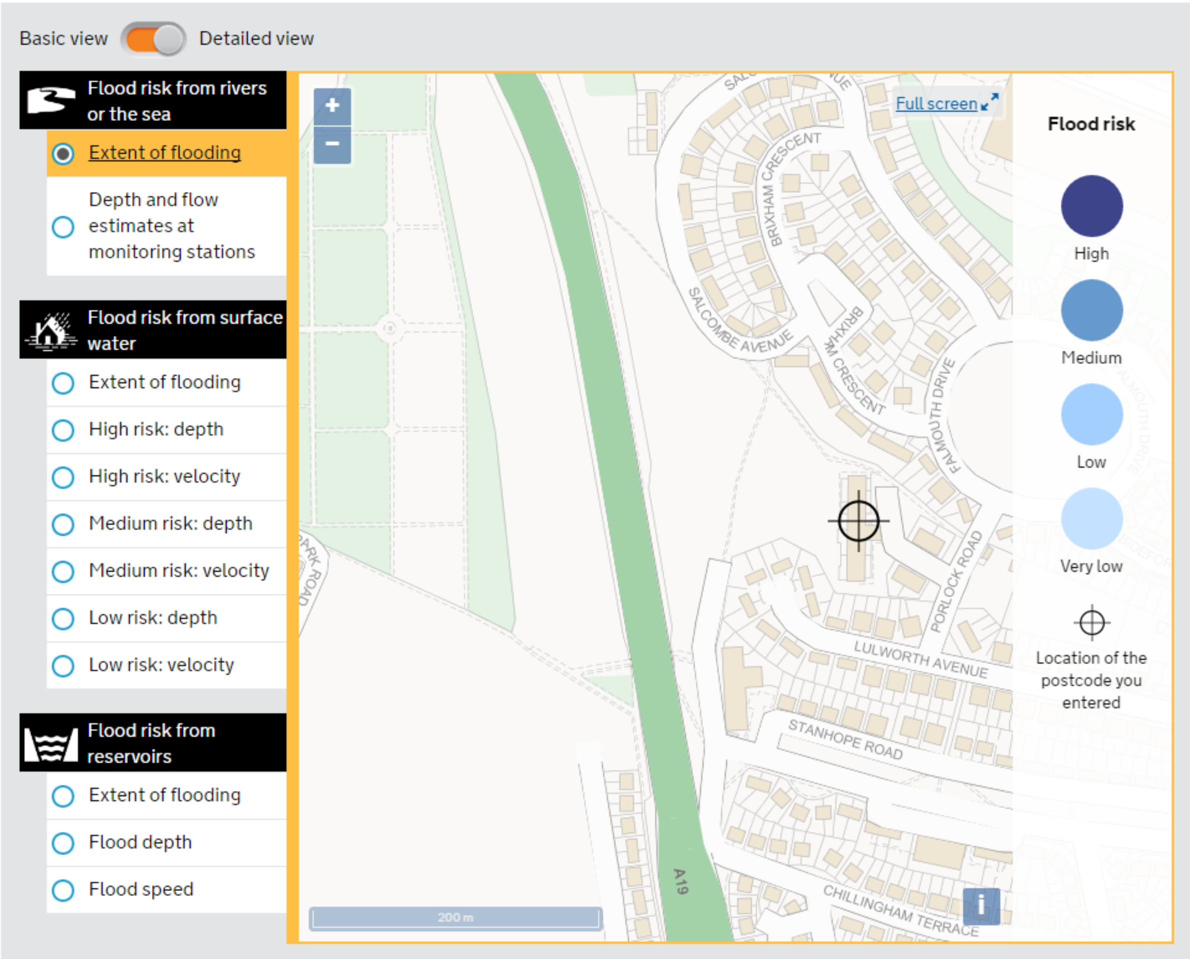


Figure 3 - Extract from Environment Agency Map "Flood Risk from rivers or the sea"

The surrounding area to the site location is confirmed on the Environment Agencies' online tool as being *"an area that has A Very Low chance of flooding from rivers or the sea as being in Flood Zone 1."*

Assessment of Impact: Low

Assessment of Probability: Low

Pluvial Flooding

Reference to the Environment Agency 'Flood Risk from Surface Water' Map indicated the site is not subject to any risk. Nor, due to the topography is the site likely to receive any significant overland flows from the neighbouring areas.

Offsite to the North east of the proposed development, there is a large are of potential 'ponding' indicated. This is on the route of the receiving watercourse, Bowburn Beck. The ponding looks to occur in a natural depression in the topography where the beck is likely culverted beneath the railway embankment.

As this is the receiving watercourse of the surface water from the proposed development, care must be taken to ensure that flows to the watercourse are not increased from the existing greenfield runoff rates.

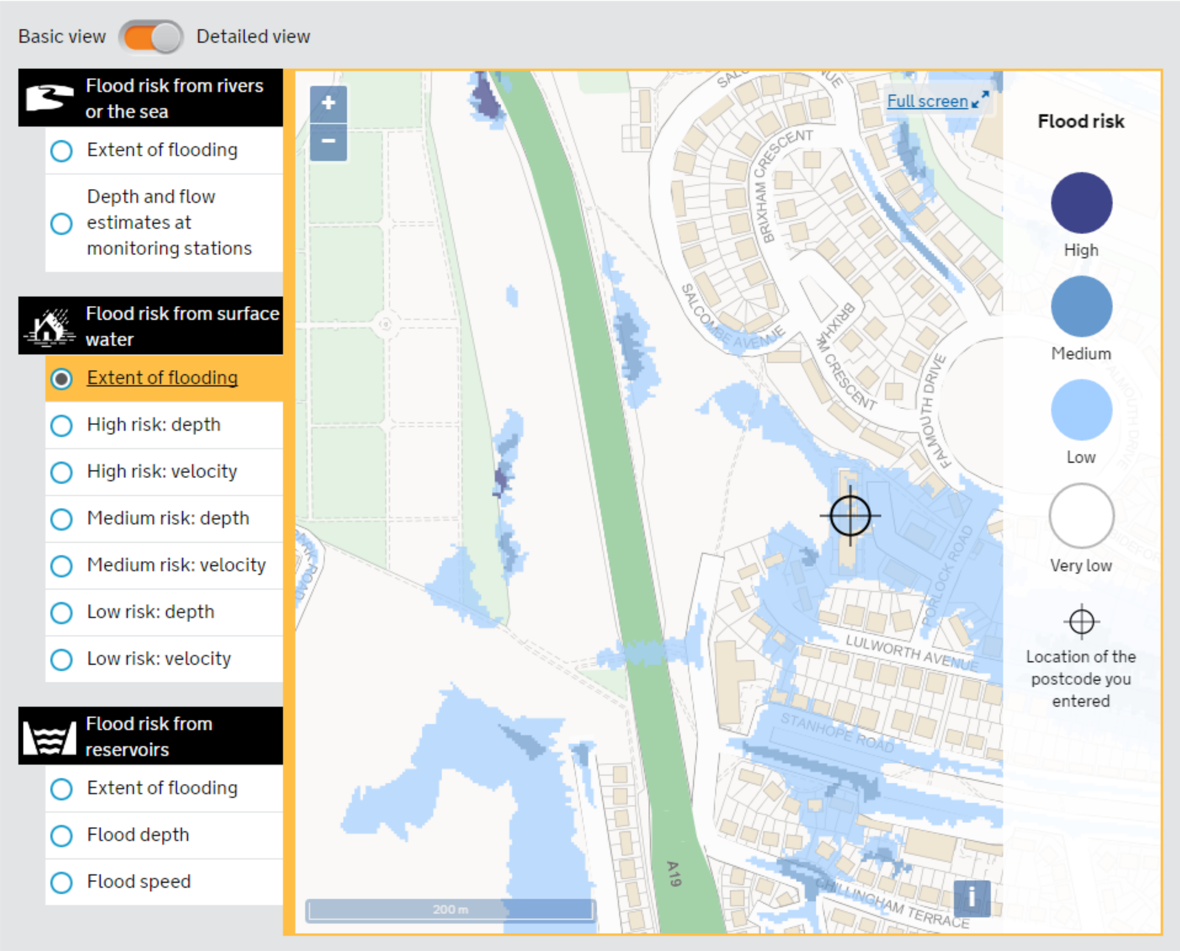


Figure 4 - Extract from Environment Agency Map "Flood risk from surface water"

Assessment of Impact: **LOW**

Assessment of Probability: **LOW**

Groundwater Flooding

The Environment Agencies Groundwater source protection Zones Map indicates that the area is not within a Groundwater Source Protection Zone.

The EA online map of groundwater vulnerability identifies the development site to be located above a Minor Aquifer high vulnerability. An aquifer at high vulnerability indicates that the area is likely to have high leaching soils which could make it unsuitable for infiltration drainage due to potential mobilisations of pollutants. This will be confirmed following a full intrusive ground investigation. Minor aquifers are typically granular bands within clay deposits and have limited resource potential.

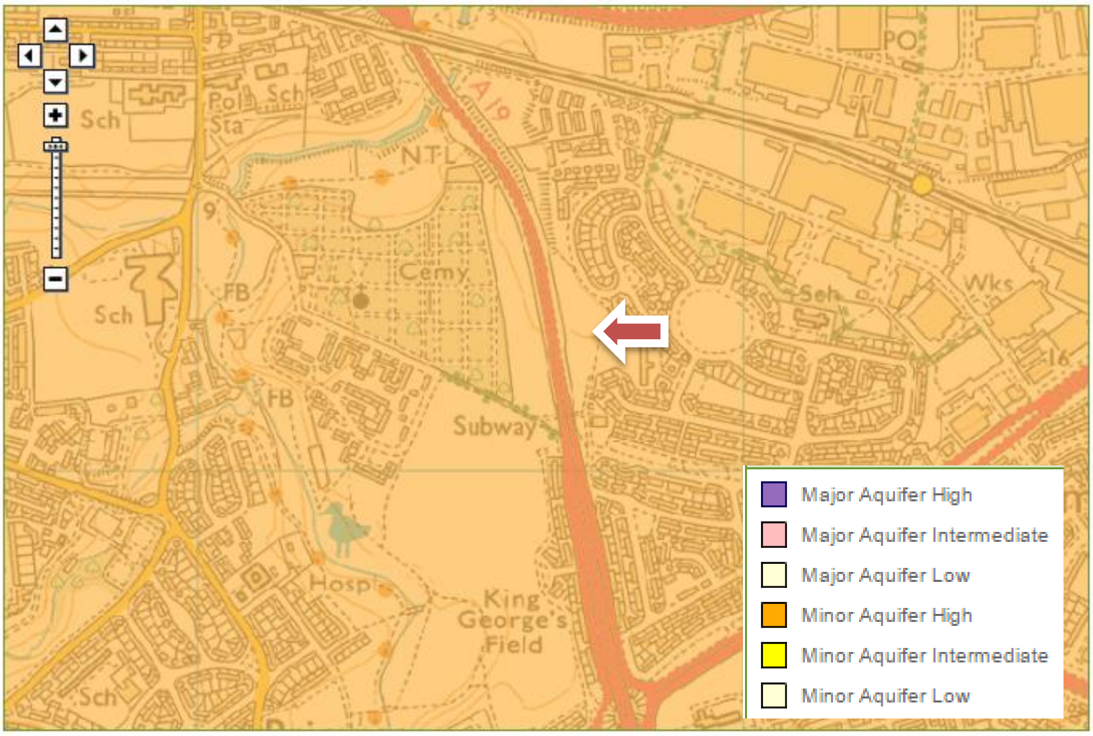


Figure 5 - Extract from Environment Agency Map 'Groundwater'

In addition an extract from the DEFRA Soilscapes map indicates that the underlying soil conditions are described as 'loamy & clayey' with 'Slowly permeable seasonally wet, slightly acid but base rich loamy and clayey soils." The drainage properties are described as 'impeded drainage'.

Freely draining soils absorb rainfall readily and allow it to drain through to underlying layers. Slightly impeded drainage refers to soils with a tight, compact deep subsoil that impedes downward water movement; after heavy rainfall, particularly during the winter, the subsoil becomes waterlogged**. In soils with impeded drainage the effect is more severe and winter waterlogging results in very wet ground conditions.** In the uplands, many soils have a greasy surface peat layer that holds water through the winter. These soils are described as having surface wetness, and can be reasonably dry beneath. In low-lying sites, permeable soils are often affected by high ground water that has drained from the surrounding landscape. They are described as naturally wet.

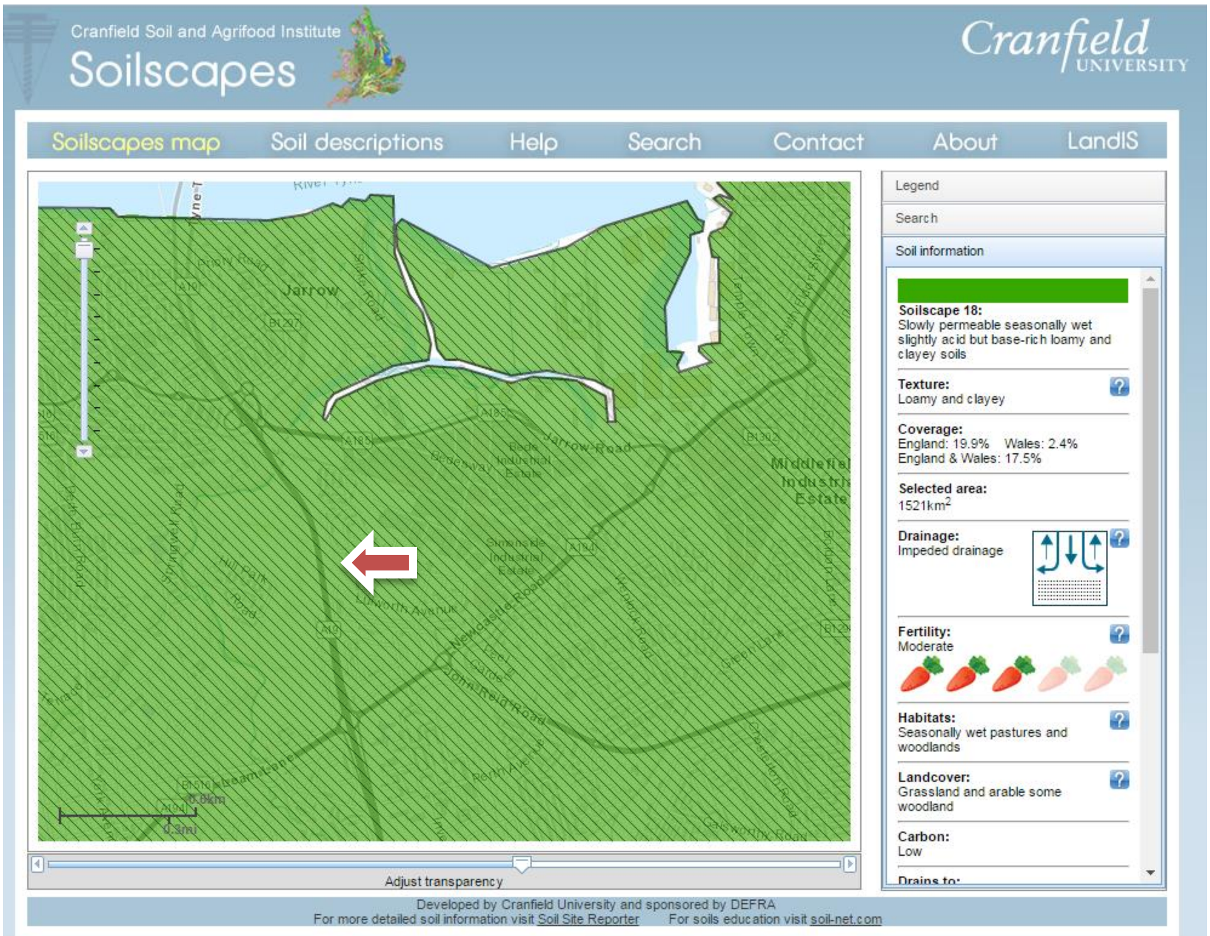


Figure 6 - Extract from DEFRA Soilscapes Map

Flooding from Ground water is considered to be of low risk.

Assessment of Impact: **LOW**
Assessment of Probability: **LOW**

Sewer Flooding

Northumbrian Water have provided a copy of the Sewer Flooding plan for the area. The plan provides an indication of 100m squares within which sewer flooding, caused by a lack of capacity, have occurred up to and including the 1 in 20 year event.

NWL have confirmed there are no reported sewer flooding incidents for this site, or in areas within the catchment of this site.

NWL categorise the risk as:

- Blue hatched areas reported sewer flooding from sewers lower than 1 in 20 year storm.

- Red hatched areas reported sewer flooding from sewers during an extreme event greater than 1 in 20 year storm.

Significant flooding is not expected from the public sewer network and therefore the risk of sewer flooding is considered to be low. This is due to the fact the "at risk" locations are positioned beyond the site and there are no sewer flooding reports in the immediate vicinity of the site.

A review of the topography confirms that there is no risk of flows in this identified area reaching the proposed development site.

Assessment of Impact: LOW
Assessment of Probability: LOW

The risk of sewer flooding is considered to be of low risk.

Conclusion

It can be concluded that the proposed development is not at risk of flooding from any of the sources examined within this assessment.

5. Surface Water Drainage Strategy

Managing surface water

In this chapter the report will show how surface water runoff generated by the developed site will be managed. This chapter should be read in conjunction with Existing & Proposed Drainage Arrangement drawings and calculations provided within the appendices.

The Drainage Hierachy

The surface water drainage strategy has been initially developed in line with, and will continue to comply with, the requirements of the Durham Validation Document (2016), Section 14.

Information needs to be submitted to evidence all surface water shall be managed for the development. The drainage hierarchy is:
1. Infiltration
2. Watercourse
3. Surface water sewer
4. Combined sewer

It requires infiltration systems to be investigated before controlled attenuation discharge to watercourse is considered. Only then if these forms of flood attenuation are not possible should developments consider surface water and eventually combined sewer means of surface water drainage.

1. Infiltration

A review of the DEFRA Soilscapes mapping and experience of development in the local area would indicate that disposal of surface water from the proposed development via means of infiltration will not be feasible. The underlying soils are not deemed to be suitable to accommodate infiltration.

2. Watercourse

An existing ordinary watercourse has been identified approximately 300m to the north of the site. Due to topography and the existing build environment it is not considered feasible to make a direct connection to the watercourse.

3. Sewers

There is an existing NWL surface water sewer, flowing South/North, on the western boundary of the development. It is proposed to make connection to this sewer. The flows will be restricted to the equivalent Greenfield run off rates. A pre development enquiry was submitted to NWL, December 2016, identifying manhole 6302 as the preferred outfall.

Design Principals

It is proposed to discharge the surface water from the development into the adjacent NWL surface water sewer. The discharge will be restricted to equivalent greenfield run off rate)discussed later within this chapter).

The surface water conveyance system will be designed to ensure no flooding during the 1 in 30 year event, ensuring no flooding from the 1 in 100 year, 6 Hour event leaves site.

In addition, if necessary the system will be designed as such to ensure that any flood volumes leaving site, from the critical 1 in 100 year design storm, are no greater than the equivalent pre development run off.

An allowance for the impact of climate change will be included for within the design. The Environment Agency generally advises that a lifespan of 100 years should be used for residential developments. The Technical Guidance to the NPPF states that for the time period 2070 to 2115, peak rainfall should be increased by 40% to account for the possible impacts of climate change.

Careful design of on site features and levels will be necessary to ensure that no property is at risk of damage during these events.

Surface water disposal will be managed through the incorporation of appropriate Sustainable Urban Drainage Systems (SuDS). There are many different SuDS components that can be used on a site. Each site will have unique characteristics and these should guide the selection of the most appropriate set of SuDS techniques.

Existing Greenfield Runoff rates

The existing 0.38 hectare site is currently occupied 100% be greenfield (farmland). The development site is within the catchment of the River Don, which lies approximately 300m to the north of the site.

The following existing greenfield run off rates have been calculated:

Estimated Site Discharges	IH124 Results
Qbar (l/s)	0.95
1 in 1 year (l/s)	0.82
1 in 30 year (l/s)	1.67
1 in 100 year (l/s)	1.98

Figure 7 - Existing Greenfield runoff rates

(Full calculation can be found within the appendices)

Proposed Post Development Mitigation

It is proposed to limit the peak discharge from the site to the outfall of the receiving sewer to the equivalent greenfield runoff rates. However it is recognised that a minimum flow rate of 5 l/s should be applied to any site.. This would be achieved through the use of SUDs and flow control devices.

The drainage network, attenuation systems and site levels would be designed to accommodate a critical rainfall event of 1:100 year + 40% allowance for climate change.

The methodology outlined within EA/DEFRA R&D Technical Report W5-074 'Preliminary Rainfall Runoff Management for Developments' has been utilised in order to calculate the approximate post development surface water runoff volumes and thus the required storage volumes.

Estimated Storage Volumes	Volume m3
Interception Storage	8.80
Attenuation Storage	91.85
Long term storage	0.00
Total Storage	100.65

Figure 8 - Estimated Storage Volumes

Note the above volumes are based on single calculation. Results may vary from the modelling of the actual network within software, such as Windes. The results of the Windes modelling may result in greater, or lesser, attenuation requirements.

This advice of the SUDS Manual (CIRIA C697) is that where applicable storage requirements are defined as Interception storage, Attenuation Storage, Long term storage.

Interception storage (m^3)
Interception storage is required in order to ensure that no run-off passes directly to the river for rainfall depths of 5mm or less. This is aimed at trying to replicate greenfield runoff response when no runoff is likely to take place for most small events. This type of storage is principally aimed at river water quality protection - polluted water is prevented from entering the water course for all small rainfall events. A 5mm rainfall threshold will reduce the number of runoff events into a receiving water body by at least 50%.

Interception of 5mm requires the use of vegetation based drainage systems, infiltration units or rainwater harvesting systems.

Attenuation storage with/without Long Term Storage (m^3)
Attenuation storage is provided to enable the rate of runoff from the site into the receiving water to be limited to an acceptable rate to protect against erosion and flooding downstream. The attenuation storage volume is a function of the degree of development relative to the greenfield discharge rate.

Attenuation storage should preferably avoid using underground storage tanks which do not provide any form of treatment and have higher safety risks associated with any maintenance.

Long term storage (m^3)
Long term storage is similar to Attenuation storage, but aims to specifically address the additional volume of runoff caused by the development compared to pre-development runoff. Long-Term storage is specifically aimed at runoff from extreme events to limit flood impact downstream.

This volume difference should be infiltrated to the ground or, if this is not possible, discharged to the receiving water at very low flow rates (less than 2 l/s/ha) so as to minimise the risk of exacerbating river flooding. In this situation, the normal attenuation discharge limit should be adjusted (reduced) to take account of any discharge rate taking place from the Long Term Storage system.

Long Term Storage is calculated based on the difference between greenfield and development runoff volumes using the 100 year 6 hours rainfall event. This is a pragmatic criterion and avoids the need for complex analysis of extreme rainfall series.

Long Term Storage can be provided using a number of techniques:
- infrequent flooding of public open spaces- a minimum of 1 in 5 to 1 in 10 year frequency;
- flooding of an area adjacent to the pond which cannot drain back through the pond outfall;
- providing an equivalent volume in the form of infiltration units or rainwater harvesting where this is designed for stormwater control.
- storage with a very small outflow control orifice (2 L/s/ha), where there is minimal risk of blockage.

This methodology has been applied in order to determine the estimated surface water storage requirements for the post development site.

A copy of the preliminary Surface Water Drainage Strategy Plan and associated drainage calculations can been found within the appendices.

Water Quality

Reference to the CIRIA C753, The SuDS Manual (2015), section 26.7, details the method to determine the SuDS pollution mitigation indices.

To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type)

Land Use	Pollution Hazard Levels	Total suspended solids (TSS)	Metals	Hydrocarbons
Other roofs (typically commercial)	Low	0.3	0.4*	0.05
Non residential car parking with infrequent change	Low	0.5	0.4	0.4

Figure 9 - Pollution hazard indices for different land use classifications

Types of SuDS Component	TSS	Metals	Hydrocarbons
Bioretention System	0.8	0.8	0.8

Figure 10 - Indicative SuDS Mitigation indices for discharges to surface waters (suitable components)

Reference to the Surface Water Drainage strategy will indicate that a combination of a pond and swale has been selected as an appropriate compliant treatment train. In addition this combination of components can be utilised to provide the attenuation requirements.

SuDS Maintenance

A copy of the preliminary SuDS Maintenance responsibilities schedule has been provided within the appendices.

6. Occupants & Users of the Development

Pre Development site users

The current pre development site is greenfield and as such has no occupants. Site users would include the general public.

Post Development site users

As a result of the development an increase in occupants will occur.

Flood Risk management/evacuation plan

Due to the low risk of flooding to the site (from any source) there is unlikely to be any restrictions placed on the site design. (i.e. restrictions to accommodation on ground floor etc), similarly no specific restrictions will be imposed for the requirement of a dedicated flood evacuation route or plan.

Reference to the site plan indicates that the buildings are located at a higher elevation than the proposed SuDS features and that in the event of a critical event access to/from the development would not be restricted.

Emergency access is freely available from Tursdale Road, which itself does not suffer from any flooding issues in the locality.

7. Exception Test

In this instance as the proposed development is solely within Flood Zone 1 the exception test is not required.

8. Residual Risk

The only residual risks associated with flood risk relate the risk of blockage/damage to the proposed drainage network. To mitigate this risk all components will be specified and designed to current building regulations and guidance. A maintenance schedule has/will be produced to cover the SuDS features.

Foul Water Drainage Strategy

The nearest suitable outfall for the foul drainage from the proposed development has been identified as the existing combined sewerage system within Salcombe Avenue the east of the site.

The developer has submitted a Pre Development Enquiry to NWL. A pre development enquiry was submitted to NWL in December 2016.

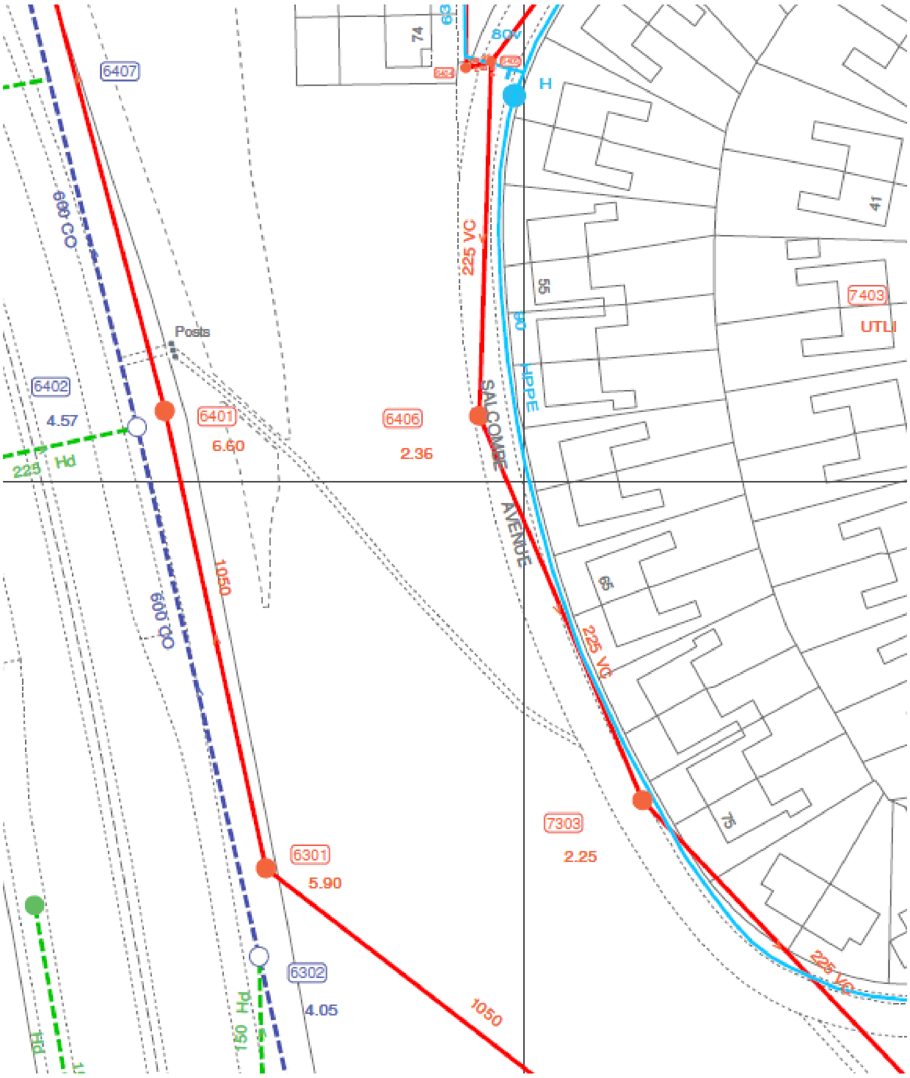


Figure 11 - Extract from NWL Sewer/Water Plan

Appendix A

Proposed Site Layout

Do Not Scale from Drawing. Any discrepencies to be reported to the Architect prior to fabrication or ordering.

REVISION	DATE	DESCRIPTION	CHECKED

CEAD
Community | Environment | Architecture | Delivery

JOB / CLIENT South Tyneside Homes
Porlock Green

DWG TITLE Proposed Site Plan

PROJECT NO.	DRAWING NO.	REVISION	STATUS
16.28	PG SP02	A	D

DRAWN	CHECKED	SCALE	DATE
PM	RM	1:250	Dec 16

STATUS: D=Draft R=Review P=Planning T=Tender C=Construction B=As-Built

Appendix B

Greenfield Runoff Calculations

Greenfield runoff estimation for sites

HR Wallingford
Working with water

Site name:	Salcombe Avenue
Site location:	Jarrow

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the CIRIA SUDS Manual (2007). It is not to be used for detailed design of drainage systems. It is recommended that every drainage scheme uses hydraulic modelling software to finalise volume requirements and design details before drawings are produced.

Site coordinates

Latitude:	54.97210° N
Longitude:	1.47505° W
Reference:	gcybwrmgsy5j / 0.38
Date:	22 Dec 2016

Site characteristics

Total site area	0.38	ha
Significant public open space	0.16	ha
Area positively drained	0.22	ha

Methodology

Greenfield runoff method	IH124

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type
SOIL type	4
HOST class	N/A
SPR	0.47

Hydrological characteristics

	Default	Edited	
SAAR	638	638	mm
M5-60 Rainfall Depth	17	17	mm
'r' Ratio M5-60/M5-2 day	0.3	0.3	
FEH/FSR conversion factor	0.92	0.92	
Hydrological region	3	3	
Growth curve factor: 1 year	0.86	0.86	
Growth curve factor: 10 year	1.45	1.45	
Growth curve factor: 30 year	1.75	1.75	
Growth curve factor: 100 year	2.08	2.08	

Greenfield runoff rates

	Default	Edited	
Qbar	0.95	0.95	l/s
1 in 1 year	0.82	0.82	l/s
1 in 30 years	1.67	1.67	l/s
1 in 100 years	1.98	1.98	l/s

Please note that a minimum flow of 5 l/s applies to any site

Appendix C

Surface Water Attenuation Calculations

Surface water storage requirements for sites

HR Wallingford
Working with water

Site name:	Salcombe Avenue
Site location:	Jarrow

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance “Preliminary rainfall runoff management for developments”, W5-074/A/TR1/1 rev. E (2012) and the CIRIA SUDS Manual (2007). It is not to be used for detailed design of drainage systems. It is recommended that every drainage scheme uses hydraulic modelling software to finalise volume requirements and design details before drawings are produced.

Site coordinates

Latitude:	54.97198° N
Longitude:	1.47511° W
Reference:	gcybwrmfgry3 / 0.22
Date:	22 Dec 2016

Site characteristics

Total site area	0.38	ha
Significant public open space	0.16	ha
Area positively drained	0.22	ha
Impermeable area	0.22	ha
Percentage of drained area that is impermeable	100	%
Impervious area drained via infiltration	0	ha
Return period for infiltration system design	10	year
Impervious area drained to rainwater harvesting systems	0	ha
Return period for rainwater harvesting system design	10	year
Compliance factor for rainwater harvesting system design	66	%
Net site area for storage volume design	0.22	ha

Methodology

Greenfield runoff method	IH124
Volume control approach	Use Long Term Storage

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type
SOIL type	4
HOST class	N/A
SPR	0.47

Hydrological characteristics

	Default	Edited	
SAAR	638	638	mm
M5-60 Rainfall Depth	17	17	mm
‘r’ Ratio M5-60/M5-2 day	0.3	0.3	
FEH/FSR conversion factor	0.92	0.92	
Hydrological region	3	3	
Growth curve factor: 1 year	0.86	0.86	
Growth curve factor: 10 year	1.45	1.45	
Growth curve factor: 30 year	1.75	1.75	
Growth curve factor: 100 year	2.08	2.08	

Design criteria

Climate change allowance factor	1.3	
Urban creep allowance factor	1.1	
Interception rainfall depth	5	mm

Greenfield runoff rates

	Default	Edited	
Qbar	0.95	0.95	l/s
1 in 1 year	5.00	5.00	l/s
1 in 30 years	5.00	5.00	l/s
1 in 100 years	5.00	5.00	l/s

Please note that a minimum flow of 5 l/s applies to any site

Estimated storage volumes

	Default	Edited	
Interception storage	8.80	8.80	m^3
Attenuation storage	91.85	91.85	m^3
Long term storage	0.00	0.00	m^3
Treatment storage	26.40	26.40	m^3
Total storage	100.65	100.65	m^3

Appendix D

Proposed Drainage Strategy Plan

A1

Standard Notes

DO NOT USE THIS DRAWING IN ISOLATION

A. This drawing has been prepared as part of a set, and must therefore be read in conjunction with all other drawings. Any discrepancies or design queries must be reported to the engineer prior to completion of tender and commencement of works. Following completion of tender it is assumed that developer and contractor are in full agreement with the design drawings (with the exception of pre tender queries only).

B. Third party information is used to prepare the engineering design (including, architectural layout, ground investigation, existing utilities records, and specialist design items). The engineering design must therefore be read in conjunction with all third party information prior to commencing work. CK21 Ltd are not responsible for any third party information or details.

C. House type working drawings are to be used in conjunction with the plot setting out drawing.

D. Drawing status will remain preliminary until full technical approval is received from local authority and sewerage undertaker. Works commenced prior to technical approval are done so at risk and may be subject to change.

E. The contractor is expected to prepare appropriate construction method statements for all aspects of appointed work. This should include any temporary protection / works.

F. Land drainage is not permitted to discharge into the public sewer network. Any need for land drainage should be assessed by the ground worker and landscaper during construction and placement of gardens on an individual plot basis. If land drainage designs are required, they should be appointed prior to plot completion.

G. The contractor is expected to cross check all drainage inverts prior to commencing work, this may involve completion of trial holes if invert levels have been interpolated.

H. The contractor must monitor the “as build” progress of each construction stage (roads/sewers/plot works/to enable the next stages of construction to be checked before installation.

Highways

1. All highway works to be carried out in accordance with the current local authority design guide and specification.
2. All excavations below proposed and existing highways to be back filled with granular Type 1 sub base and well compacted in layers not exceeding 150mm, unless otherwise agreed.
3. Highway authority to be notified by the contractor prior to the commencement of works.

Adoptable Drainage

1. All adoptable drainage works to be in accordance with the water authorities publication "Sewers For Adoption 7th Edition" aswell as the approved drawings.
2. Precast concrete manhole rings to comply with the relevant provisions of BS5911: Part 200.
3. All brickwork to be Class B engineering complying with the relevant provisions of BS 3921. Concrete bricks maybe used if their specification is the same as Class B engineering bricks. Please seek approval from relevant water authority before using.
4. Manhole covers and frames shall comply with the relevant provisions of BS EN 124 and be of a non-rocking, non-ventilating design.
5. Ladders that are required in Type 1 manholes are to comply with "Sewers For Adoption 7th Edition".
6. Concrete must be either C20 sulphate resistant portland cement with high strength concrete topping to the benching or C35 ordinary portland cement.
7. 150mm Concrete surround is required around pipes where the depth from finished surface to soffit of pipe is less than 1200mm. This may be reduced to 900mm within open space.
8. The location of existing drainage that is within close proximity to the proposed site works, which is not to be diverted, should be confirmed by the contractor and reported to the developer to ensure it corresponds to that shown on the engineering layout and that no proposed works are affected. The position, line and diameter of all existing drainage apparatus should be confirmed on site prior to the commencement of the works. Any discrepancies must be reported to the engineer immediately. The connection of foul and surface water drainage to the existing public sewer system shall be subject to the approval of the local sewerage undertaker. The contractor is expected to apply for relevant permits prior to commencing the work.
9. Roads and sewers contractor must inform water authority prior to works commencing

Existing Services

Any existing services which may be affected by the proposed works should be located by means of a hand dig in close liaison with the statutory service authorities. The contractor shall inform the developer of any services that may affect the proposed design.

Contractor to notify statutory service authorities prior to commencement of work.

As Constructed Information

Refer to note H above. It is the contractors responsibility to provide the following as constructed drawings to the developer upon the completion of the works covered by the contract :

1. Position/coordinates of all adoptable manholes.
2. Invert and cover levels of all adoptable manholes.
3. New gully positions and connections.
4. Position and depth of service ducts for water, gas, electric, BT, cable and street lighting, stating size and number of ducts.

Drawing Specific Notes

1. General levels prepared for planning submission. Levels may be subject to some minor alteration during design development.
2. Topographic Survey shown in background in feint.

Discharge Rates

1. The pre development site is a greenfield site, measuring 0.38ha, with no obvious natural surface water outfall. the existing topography falls North/South and East/West. Existing overland flows are likely to run east into the wooded area and be blocked by the embankment of the adjacent A19.

2. Consideration of the surface water hierarchy has been undertaken.
   - Review of the Site Investigation report, produced by Dunelm, Dec 16, confirms that the underlying strata is not suitable to accept infiltration.
   - The closest natural watercourse is approx 300m to the north of the site, which considering the topography and existing built environment, is considered an unacceptable distance/level to connect to directly.
   - A Pre development enquiry has been submitted to NWL, applying for consent to discharge into the surface water sewer that runs SOUTH/NORTH within the western boundary of the site.

3. It is proposed that the surface water run off generated by the proposed development will be attenuated on site and released to the receiving watercourse at equivalent greenfield runoff rates. The existing greenfield run off rates from the development area (excluding the non contributing soft landscaping areas) have been calculated as follows:

   Methodology (IH124):
   QBar = 0.95 l/s
   1 in 1 year = 0.82 l/s
   1 in 30 year = 1.67 l/s
   1 in 100 year = 1.98 l/s

   In accordance with best practice a minimum flow rate of 5 l/s will be applies to any site.Greenfield runoff calculations have been provided separately.

4. It is proposed to utilize SuDS in combination with a suitable flow control device to restrict and attenuate flows from site to the above rates.
   A Bio-Retention basin has been selected as an appropriate method of SuDS to treat the proposed flows. Bioretention systems are shallow landscaped areas that can reduce runoff rates and volumes, and treat pollution through the use of engineered soils and vegetation. They are particularly effective in delivering interception and can also provide;
   - attractive landscape features that are self irrigating and fertilizing
   - habitat and biodiversity.

5. The system including the SuDS has been designed to accommodate the 100yr 360min storm event,without flooding, whilst ensuring that any flood volume from the critical 100 year event or as a result of system failure remains within the development boundary.

6. The SuDS Feature(s) will be maintained by the client (or management company) to ensure the performance of the drainage system is maintained throughout the design life of the development. A maintenance schedule will be provided separately.

7. The actual (at planning stage) calculated discharge rates into the receiving watercourse are as follows.

   1 in 1 year = 4.2 l/s
   1 in 30 year = 4.5 l/s
   1 in 100 year = 4.5 l/s

   These rates are derived from the Windes software model and include an allowance for 40% climate change. The windes calculations have been provided separately.

Treatment

Reference to the CIRIA C753, The SUDS Manual (2015), section 26.7, details the method to determine the SUDS pollution mitigation indices.

To deliver adequate treatment, the selected SUDS components should have a total pollution mitigation index (for each containment type) that equals or exceeds the pollution hazard index (for each containment type)

Total SuDS mitigation index ≥ pollution hazard index

Table 1				
Land Use	Pollution Hazard Leve	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential Roofs	Very Low	0.2000	0.2000	0.0500
Individual Property Driveways, residential car parks, low traffic roads	Very Low	0.5000	0.4000	0.4000

Table 1 - based on Table 26.2 - Pollution hazard indices for different land use classifications

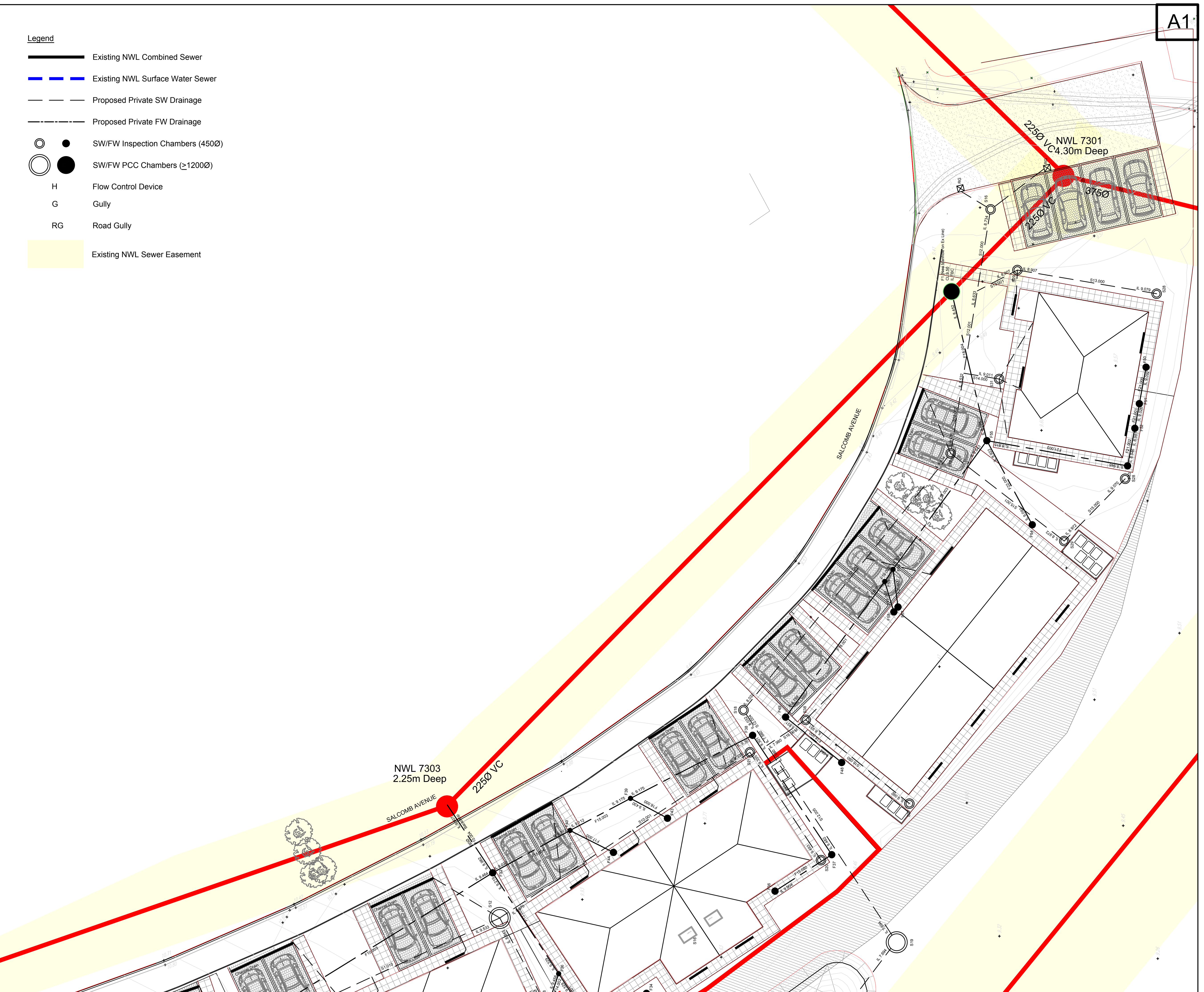
Table 2 Mitigation Indices			
Types of SUDS Component	TSS	Metals	Hydrocarbons
Bio-retention Basin	0.8	0.800	0.800
Total	0.8	0.800	0.800

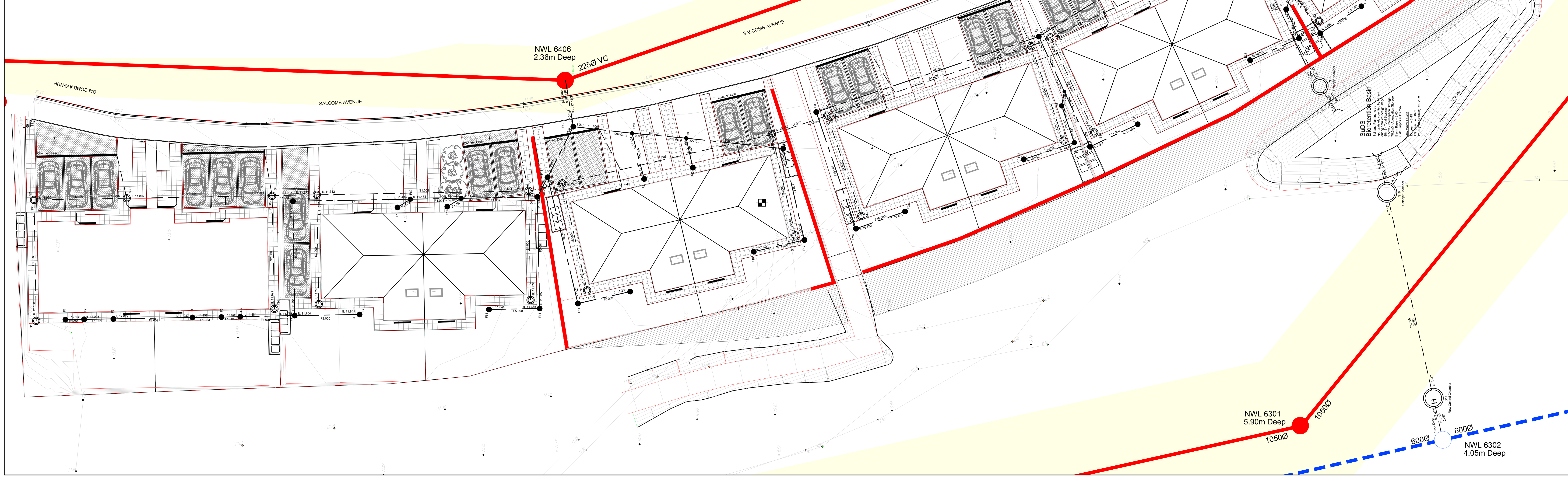
Table 2 - based on Table 26.3 - Indicative SuDS mitigation indices for discharge to surface waters

Conclusion:
Reference to the above criteria confirms that the BIO-RETENTION BASIN alone provides sufficient SUDS mitigation from the new build residential scheme. Treating all sources in compliance with the requirements of CIRIA C753, The SUDS Manual (2016), section 26.7.

Legend

Solid thick black line	Existing NWL Combined Sewer
Blue dashed line	Existing NWL Surface Water Sewer
Dashed line	Proposed Private SW Drainage
Dash-dot line	Proposed Private FW Drainage
◎ ●	SW/FW Inspection Chambers (450Ø)
◯ ●	SW/FW PCC Chambers (≥1200Ø)
H	Flow Control Device
G	Gully
RG	Road Gully
Pale yellow area	Existing NWL Sewer Easement





Rev	Date	Description	Drawn	Chkd

Project	SALCOMBE AVENUE, JARROW RESIDENTIAL DEVELOPMENT
Client	South Tyneside Homes
Architect	CEAD
Title	DRAINAGE ARRANGEMENT OVERVIEW

Scale	Drawn	Date
1:200	DW	DEC 16

Job Number	Drawing Number	Rev.
16124	C-GA-201	P1

CK21
CK21 Ltd.
Shakespeare House,
18 Shakespeare St,
Newcastle upon Tyne,
NE1 6AQ.
www.ck21.co.uk initial.surname@ck21.co.uk Telephone: (0191) 261 6312

Status
PRELIMINARY

Appendix E

Surface Water Drainage Calculations

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)	2	Add Flow / Climate Change (%)	0
M5-60 (mm)	17.100	Minimum Backdrop Height (m)	0.000
Ratio R	0.346	Maximum Backdrop Height (m)	4.000
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	0.600
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

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)	Auto Design
S1.000	10.973	0.188	58.5	0.004	1.00	0.0	0.600	o	100	
S1.001	8.413	0.144	58.5	0.004	0.00	0.0	0.600	o	100	
S1.002	13.174	0.225	58.5	0.008	0.00	0.0	0.600	o	100	
S2.000	10.657	0.182	58.5	0.005	1.00	0.0	0.600	o	100	
S1.003	4.039	0.069	58.5	0.011	0.00	0.0	0.600	o	100	
S3.000	9.884	0.169	58.5	0.004	1.00	0.0	0.600	o	100	
S1.004	19.193	0.328	58.5	0.007	0.00	0.0	0.600	o	100	
S4.000	9.862	0.175	56.4	0.004	1.00	0.0	0.600	o	100	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	1.18	12.138	0.004	0.0	0.0	0.0	1.01	7.9	0.6
S1.001	50.00	1.32	11.950	0.009	0.0	0.0	0.0	1.01	7.9	1.2
S1.002	50.00	1.54	11.807	0.016	0.0	0.0	0.0	1.01	7.9	2.2
S2.000	50.00	1.18	11.991	0.005	0.0	0.0	0.0	1.01	7.9	0.6
S1.003	50.00	1.60	11.581	0.032	0.0	0.0	0.0	1.01	7.9	4.3
S3.000	50.00	1.16	11.746	0.004	0.0	0.0	0.0	1.01	7.9	0.6
S1.004	50.00	1.92	11.512	0.043	0.0	0.0	0.0	1.01	7.9	5.9
S4.000	50.00	1.16	11.718	0.004	0.0	0.0	0.0	1.03	8.1	0.6

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)	Auto Design
S1.005	3.115	0.055	56.4	0.008	0.00	0.0	0.600	o	100	
S5.000	9.896	0.169	58.5	0.004	1.00	0.0	0.600	o	100	
S1.006	19.524	0.197	99.3	0.009	0.00	0.0	0.600	o	150	
S6.000	9.927	0.170	58.5	0.004	1.00	0.0	0.600	o	100	
S1.007	5.268	0.239	22.1	0.008	0.00	0.0	0.600	o	150	
S7.000	9.576	0.164	58.5	0.004	1.00	0.0	0.600	o	100	
S1.008	19.540	0.197	99.2	0.008	0.00	0.0	0.600	o	150	
S8.000	9.519	0.163	58.5	0.004	1.00	0.0	0.600	o	100	
S1.009	1.890	0.271	7.0	0.008	0.00	0.0	0.600	o	150	
S9.000	9.454	0.162	58.5	0.004	1.00	0.0	0.600	o	100	
S1.010	19.547	0.197	99.0	0.008	0.00	0.0	0.600	o	150	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.005	50.00	1.97	11.184	0.056	0.0	0.0	0.0	1.03	8.1	7.6
S5.000	50.00	1.16	11.146	0.004	0.0	0.0	0.0	1.01	7.9	0.6
S1.006	50.00	2.29	10.927	0.069	0.0	0.0	0.0	1.01	17.8	9.4
S6.000	50.00	1.16	10.951	0.004	0.0	0.0	0.0	1.01	7.9	0.6
S1.007	50.00	2.34	10.730	0.081	0.0	0.0	0.0	2.15	38.0	11.0
S7.000	50.00	1.16	10.544	0.004	0.0	0.0	0.0	1.01	7.9	0.6
S1.008	50.00	2.66	10.331	0.094	0.0	0.0	0.0	1.01	17.8	12.7
S8.000	50.00	1.16	10.500	0.004	0.0	0.0	0.0	1.01	7.9	0.6
S1.009	50.00	2.67	10.134	0.106	0.0	0.0	0.0	3.84	67.8	14.4
S9.000	50.00	1.16	9.942	0.004	0.0	0.0	0.0	1.01	7.9	0.6
S1.010	50.00	2.99	9.730	0.119	0.0	0.0	0.0	1.01	17.8	16.1

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)	Auto Design
S10.000	9.236	0.158	58.5	0.004	1.00	0.0	0.600	o	100	
S10.001	21.354	0.365	58.5	0.008	0.00	0.0	0.600	o	100	
S1.011	10.912	0.073	150.0	0.016	0.00	0.0	0.600	o	225	
S11.000	3.440	0.070	48.8	0.004	1.00	0.0	0.600	o	100	
S1.012	3.168	0.021	150.0	0.004	0.00	0.0	0.600	o	225	
S1.013	6.685	0.051	131.1	0.000	0.00	0.0	0.600	o	225	
S1.014	4.851	0.029	168.4	0.000	0.00	0.0	0.600	o	225	
S12.000	5.925	0.101	58.5	0.017	1.00	0.0	0.600	o	100	
S13.000	10.069	0.172	58.5	0.002	1.00	0.0	0.600	o	100	
S13.001	3.184	0.054	58.5	0.003	0.00	0.0	0.600	o	100	
S12.001	5.925	0.101	58.5	0.000	0.00	0.0	0.600	o	100	
S14.000	2.525	0.132	19.2	0.001	1.00	0.0	0.600	o	100	
S12.002	5.739	0.098	58.7	0.000	0.00	0.0	0.600	o	100	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S10.000	50.00	1.15	9.493	0.004	0.0	0.0	0.0	1.01	7.9	0.6
S10.001	50.00	1.51	9.335	0.012	0.0	0.0	0.0	1.01	7.9	1.7
S1.011	50.00	3.16	8.845	0.148	0.0	0.0	0.0	1.07	42.4	20.0
S11.000	50.00	1.05	9.500	0.004	0.0	0.0	0.0	1.11	8.7	0.6
S1.012	50.00	3.21	8.772	0.157	0.0	0.0	0.0	1.07	42.4	21.2
S1.013	50.00	3.31	8.751	0.157	0.0	0.0	0.0	1.14	45.3	21.2
S1.014	50.00	3.39	8.400	0.157	0.0	0.0	0.0	1.00	39.9	21.2
S12.000	50.00	1.10	8.734	0.017	0.0	0.0	0.0	1.01	7.9	2.4
S13.000	50.00	1.17	9.079	0.002	0.0	0.0	0.0	1.01	7.9	0.3
S13.001	50.00	1.22	8.907	0.005	0.0	0.0	0.0	1.01	7.9	0.7
S12.001	50.00	1.32	8.633	0.023	0.0	0.0	0.0	1.01	7.9	3.0
S14.000	50.00	1.02	9.011	0.001	0.0	0.0	0.0	1.77	13.9	0.2
S12.002	50.00	1.41	8.532	0.024	0.0	0.0	0.0	1.01	7.9	3.2

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)	Auto Design
S15.000	5.694	0.097	58.5	0.004	1.00	0.0	0.600	o	100	
S15.001	10.212	0.175	58.5	0.004	0.00	0.0	0.600	o	100	
S12.003	23.511	0.402	58.5	0.007	0.00	0.0	0.600	o	100	
S12.004	3.033	0.052	58.5	0.011	0.00	0.0	0.600	o	100	
S16.000	9.442	0.161	58.5	0.004	1.00	0.0	0.600	o	100	
S16.001	3.323	0.057	58.5	0.004	0.00	0.0	0.600	o	100	
S12.005	16.724	0.286	58.5	0.000	0.00	0.0	0.600	o	100	
S12.006	25.636	0.438	58.5	0.000	0.00	0.0	0.600	o	100	
S1.015	19.075	0.113	168.4	0.000	0.00	0.0	0.600	o	225	
S1.016	3.173	0.019	168.4	0.000	0.00	0.0	0.600	o	225	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S15.000	50.00	1.09	9.070	0.004	0.0	0.0	0.0	1.01	7.9	0.6
S15.001	50.00	1.26	8.972	0.008	0.0	0.0	0.0	1.01	7.9	1.1
S12.003	50.00	1.80	8.434	0.039	0.0	0.0	0.0	1.01	7.9	5.3
S12.004	50.00	1.85	8.032	0.050	0.0	0.0	0.0	1.01	7.9	6.8
S16.000	50.00	1.16	9.092	0.004	0.0	0.0	0.0	1.01	7.9	0.6
S16.001	50.00	1.21	8.931	0.008	0.0	0.0	0.0	1.01	7.9	1.1
S12.005	50.00	2.13	7.980	0.058	0.0	0.0	0.0	1.01	7.9	7.8
S12.006	50.00	2.55	7.694	0.058	0.0	0.0	0.0	1.01	7.9	7.8
S1.015	50.00	3.70	7.131	0.214	0.0	0.0	0.0	1.00	39.9	29.0
S1.016	50.00	3.76	7.017	0.214	0.0	0.0	0.0	1.00	39.9	29.0

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1	12.838	0.700	Open Manhole	450	S1.000	12.138	100				
S2	12.806	0.856	Open Manhole	450	S1.001	11.950	100	S1.000	11.950	100	
S3	12.833	1.026	Open Manhole	450	S1.002	11.807	100	S1.001	11.807	100	
S4	12.691	0.700	Open Manhole	450	S2.000	11.991	100				
S4	12.662	1.080	Open Manhole	450	S1.003	11.581	100	S1.002	11.581	100	
								S2.000	11.808	100	227
S6	12.446	0.700	Open Manhole	450	S3.000	11.746	100				
S5	12.443	0.931	Open Manhole	450	S1.004	11.512	100	S1.003	11.512	100	
								S3.000	11.577	100	65
S8	12.418	0.700	Open Manhole	450	S4.000	11.718	100				
S6	12.243	1.059	Open Manhole	450	S1.005	11.184	100	S1.004	11.184	100	
								S4.000	11.543	100	359
S10	11.846	0.700	Open Manhole	450	S5.000	11.146	100				
S7	11.852	0.926	Open Manhole	450	S1.006	10.927	150	S1.005	11.129	100	152
								S5.000	10.977	100	
S12	11.651	0.700	Open Manhole	450	S6.000	10.951	100				
S8	11.612	0.882	Open Manhole	450	S1.007	10.730	150	S1.006	10.730	150	
								S6.000	10.782	100	1
S14	11.244	0.700	Open Manhole	450	S7.000	10.544	100				
S9	11.242	0.911	Open Manhole	450	S1.008	10.331	150	S1.007	10.492	150	161
								S7.000	10.381	100	
S16	11.200	0.700	Open Manhole	450	S8.000	10.500	100				
S10	11.152	1.019	Open Manhole	450	S1.009	10.134	150	S1.008	10.134	150	
								S8.000	10.337	100	154
S18	10.642	0.700	Open Manhole	450	S9.000	9.942	100				
S11	10.613	0.883	Open Manhole	450	S1.010	9.730	150	S1.009	9.863	150	133
								S9.000	9.780	100	
S20	10.193	0.700	Open Manhole	450	S10.000	9.493	100				
S21	10.073	0.739	Open Manhole	450	S10.001	9.335	100	S10.000	9.335	100	
S12	10.398	1.554	Open Manhole		S1.011	8.845	225	S1.010	9.533	150	613
								S10.001	8.970	100	
S21	10.200	0.700	Open Manhole		S11.000	9.500	100				
S13	10.647	1.875	Junction	0	S1.012	8.772	225	S1.011	8.772	225	
								S11.000	9.430	100	533
S14	9.590	0.839	Open Manhole	1200	S1.013	8.751	225	S1.012	8.751	225	
S15	9.100	0.700	Open Manhole	450	S1.014	8.400	225	S1.013	8.700	225	300
S16	9.434	0.700	Open Manhole		S12.000	8.734	100				
S28	9.779	0.700	Open Manhole	450	S13.000	9.079	100				

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 (mm)
S29	9.714	0.807	Open Manhole		S13.001	8.907	100	S13.000	8.907	100	
S28	9.661	1.028	Junction		S12.001	8.633	100	S12.000	8.633	100	
								S13.001	8.853	100	220
S31	9.711	0.700	Open Manhole		S14.000	9.011	100				
S32	9.579	1.047	Junction	0	S12.002	8.532	100	S12.001	8.532	100	
								S14.000	8.879	100	347
S33	9.770	0.700	Open Manhole	450	S15.000	9.070	100				
S34	9.786	0.813	Open Manhole	450	S15.001	8.972	100	S15.000	8.972	100	
S35	9.674	1.240	Open Manhole	450	S12.003	8.434	100	S12.002	8.434	100	
								S15.001	8.798	100	364
S36	9.890	1.858	Open Manhole		S12.004	8.032	100	S12.003	8.032	100	
S37	9.792	0.700	Open Manhole	450	S16.000	9.092	100				
S38	9.791	0.860	Open Manhole		S16.001	8.931	100	S16.000	8.931	100	
S39	9.962	1.982	Junction	0	S12.005	7.980	100	S12.004	7.980	100	
								S16.001	8.874	100	894
S40	9.375	1.681	Open Manhole	1200	S12.006	7.694	100	S12.005	7.694	100	
S41	9.205	2.074	Open Manhole	1200	S1.015	7.131	225	S1.014	8.371	225	1241
								S12.006	7.256	100	
S42	9.500	2.483	Open Manhole	1200	S1.016	7.017	225	S1.015	7.017	225	
S6406	9.913	2.915	Open Manhole	1200		OUTFALL		S1.016	6.999	225	

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)
S1.000	o	100	S1	12.838	12.138	0.600	Open Manhole	450
S1.001	o	100	S2	12.806	11.950	0.756	Open Manhole	450
S1.002	o	100	S3	12.833	11.807	0.926	Open Manhole	450
S2.000	o	100	S4	12.691	11.991	0.600	Open Manhole	450
S1.003	o	100	S4	12.662	11.581	0.980	Open Manhole	450
S3.000	o	100	S6	12.446	11.746	0.600	Open Manhole	450
S1.004	o	100	S5	12.443	11.512	0.831	Open Manhole	450
S4.000	o	100	S8	12.418	11.718	0.600	Open Manhole	450
S1.005	o	100	S6	12.243	11.184	0.959	Open Manhole	450
S5.000	o	100	S10	11.846	11.146	0.600	Open Manhole	450
S1.006	o	150	S7	11.852	10.927	0.776	Open Manhole	450
S6.000	o	100	S12	11.651	10.951	0.600	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)
S1.000	10.973	58.5	S2	12.806	11.950	0.756	Open Manhole	450
S1.001	8.413	58.5	S3	12.833	11.807	0.926	Open Manhole	450
S1.002	13.174	58.5	S4	12.662	11.581	0.980	Open Manhole	450
S2.000	10.657	58.5	S4	12.662	11.808	0.753	Open Manhole	450
S1.003	4.039	58.5	S5	12.443	11.512	0.831	Open Manhole	450
S3.000	9.884	58.5	S5	12.443	11.577	0.766	Open Manhole	450
S1.004	19.193	58.5	S6	12.243	11.184	0.959	Open Manhole	450
S4.000	9.862	56.4	S6	12.243	11.543	0.600	Open Manhole	450
S1.005	3.115	56.4	S7	11.852	11.129	0.624	Open Manhole	450
S5.000	9.896	58.5	S7	11.852	10.977	0.776	Open Manhole	450
S1.006	19.524	99.3	S8	11.612	10.730	0.732	Open Manhole	450
S6.000	9.927	58.5	S8	11.612	10.782	0.731	Open Manhole	450

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)
S1.007	o	150	S8	11.612	10.730	0.732	Open Manhole	450
S7.000	o	100	S14	11.244	10.544	0.600	Open Manhole	450
S1.008	o	150	S9	11.242	10.331	0.761	Open Manhole	450
S8.000	o	100	S16	11.200	10.500	0.600	Open Manhole	450
S1.009	o	150	S10	11.152	10.134	0.869	Open Manhole	450
S9.000	o	100	S18	10.642	9.942	0.600	Open Manhole	450
S1.010	o	150	S11	10.613	9.730	0.733	Open Manhole	450
S10.000	o	100	S20	10.193	9.493	0.600	Open Manhole	450
S10.001	o	100	S21	10.073	9.335	0.639	Open Manhole	450
S1.011	o	225	S12	10.398	8.845	1.329	Open Manhole	1200
S11.000	o	100	S21	10.200	9.500	0.600	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)
S1.007	5.268	22.1	S9	11.242	10.492	0.600	Open Manhole	450
S7.000	9.576	58.5	S9	11.242	10.381	0.761	Open Manhole	450
S1.008	19.540	99.2	S10	11.152	10.134	0.869	Open Manhole	450
S8.000	9.519	58.5	S10	11.152	10.337	0.715	Open Manhole	450
S1.009	1.890	7.0	S11	10.613	9.863	0.600	Open Manhole	450
S9.000	9.454	58.5	S11	10.613	9.780	0.733	Open Manhole	450
S1.010	19.547	99.0	S12	10.398	9.533	0.715	Open Manhole	1200
S10.000	9.236	58.5	S21	10.073	9.335	0.639	Open Manhole	450
S10.001	21.354	58.5	S12	10.398	8.970	1.329	Open Manhole	1200
S1.011	10.912	150.0	S13	10.647	8.772	1.650	Junction	
S11.000	3.440	48.8	S13	10.647	9.430	1.117	Junction	

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)
S1.012	o	225	S13	10.647	8.772	1.650	Junction	
S1.013	o	225	S14	9.590	8.751	0.614	Open Manhole	1200
S1.014	o	225	S15	9.100	8.400	0.475	Open Manhole	450
S12.000	o	100	S16	9.434	8.734	0.600	Open Manhole	450
S13.000	o	100	S28	9.779	9.079	0.600	Open Manhole	450
S13.001	o	100	S29	9.714	8.907	0.707	Open Manhole	450
S12.001	o	100	S28	9.661	8.633	0.928	Junction	
S14.000	o	100	S31	9.711	9.011	0.600	Open Manhole	450
S12.002	o	100	S32	9.579	8.532	0.947	Junction	
S15.000	o	100	S33	9.770	9.070	0.600	Open Manhole	450
S15.001	o	100	S34	9.786	8.972	0.713	Open Manhole	450
S12.003	o	100	S35	9.674	8.434	1.140	Open Manhole	450
S12.004	o	100	S36	9.890	8.032	1.758	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)
S1.012	3.168	150.0	S14	9.590	8.751	0.614	Open Manhole	1200
S1.013	6.685	131.1	S15	9.100	8.700	0.175	Open Manhole	450
S1.014	4.851	168.4	S41	9.205	8.371	0.609	Open Manhole	1200
S12.000	5.925	58.5	S28	9.661	8.633	0.928	Junction	
S13.000	10.069	58.5	S29	9.714	8.907	0.707	Open Manhole	450
S13.001	3.184	58.5	S28	9.661	8.853	0.709	Junction	
S12.001	5.925	58.5	S32	9.579	8.532	0.947	Junction	
S14.000	2.525	19.2	S32	9.579	8.879	0.600	Junction	
S12.002	5.739	58.7	S35	9.674	8.434	1.140	Open Manhole	450
S15.000	5.694	58.5	S34	9.786	8.972	0.713	Open Manhole	450
S15.001	10.212	58.5	S35	9.674	8.798	0.776	Open Manhole	450
S12.003	23.511	58.5	S36	9.890	8.032	1.758	Open Manhole	450
S12.004	3.033	58.5	S39	9.962	7.980	1.882	Junction	

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)
S16.000	o	100	S37	9.792	9.092	0.600	Open Manhole	450
S16.001	o	100	S38	9.791	8.931	0.760	Open Manhole	450
S12.005	o	100	S39	9.962	7.980	1.882	Junction	
S12.006	o	100	S40	9.375	7.694	1.581	Open Manhole	1200
S1.015	o	225	S41	9.205	7.131	1.849	Open Manhole	1200
S1.016	o	225	S42	9.500	7.017	2.258	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)
S16.000	9.442	58.5	S38	9.791	8.931	0.760	Open Manhole	450
S16.001	3.323	58.5	S39	9.962	8.874	0.988	Junction	
S12.005	16.724	58.5	S40	9.375	7.694	1.581	Open Manhole	1200
S12.006	25.636	58.5	S41	9.205	7.256	1.849	Open Manhole	1200
S1.015	19.075	168.4	S42	9.500	7.017	2.258	Open Manhole	1200
S1.016	3.173	168.4	S6406	9.913	6.999	2.690	Open Manhole	1200

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.004	0.004	0.004
1.001	User	-	100	0.004	0.004	0.004
1.002	User	-	100	0.008	0.008	0.008
2.000	User	-	100	0.005	0.005	0.005
1.003	User	-	100	0.011	0.011	0.011
3.000	User	-	100	0.004	0.004	0.004
1.004	User	-	100	0.004	0.004	0.004
	User	-	100	0.004	0.004	0.007
4.000	User	-	100	0.004	0.004	0.004
1.005	User	-	100	0.008	0.008	0.008
5.000	User	-	100	0.004	0.004	0.004
1.006	User	-	100	0.009	0.009	0.009
6.000	User	-	100	0.004	0.004	0.004
1.007	User	-	100	0.008	0.008	0.008
7.000	User	-	100	0.004	0.004	0.004
1.008	User	-	100	0.008	0.008	0.008
8.000	User	-	100	0.004	0.004	0.004
1.009	User	-	100	0.008	0.008	0.008
9.000	User	-	100	0.004	0.004	0.004
1.010	User	-	100	0.008	0.008	0.008
10.000	User	-	100	0.004	0.004	0.004
10.001	User	-	100	0.008	0.008	0.008
1.011	User	-	100	0.009	0.009	0.009
	User	-	100	0.008	0.008	0.016
11.000	User	-	100	0.004	0.004	0.004
1.012	User	-	100	0.004	0.004	0.004
1.013	-	-	100	0.000	0.000	0.000
1.014	-	-	100	0.000	0.000	0.000
12.000	User	-	100	0.017	0.017	0.017
13.000	User	-	100	0.002	0.002	0.002
13.001	User	-	100	0.003	0.003	0.003
12.001	-	-	100	0.000	0.000	0.000
14.000	User	-	100	0.001	0.001	0.001
12.002	-	-	100	0.000	0.000	0.000
15.000	User	-	100	0.004	0.004	0.004
15.001	User	-	100	0.004	0.004	0.004
12.003	User	-	100	0.003	0.003	0.003
	User	-	100	0.004	0.004	0.007
12.004	User	-	100	0.006	0.006	0.006
	User	-	100	0.004	0.004	0.011
16.000	User	-	100	0.004	0.004	0.004
16.001	User	-	100	0.004	0.004	0.004
12.005	-	-	100	0.000	0.000	0.000
12.006	-	-	100	0.000	0.000	0.000
1.015	-	-	100	0.000	0.000	0.000
1.016	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.214	0.214	0.214

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.016	S6406	9.913	6.999	0.000	1200	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	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 Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.100	Storm Duration (mins)	15
Ratio R	0.346		

Online Controls for Storm

Hydro-Brake Optimum® Manhole: S42, DS/PN: S1.016, Volume (m^3): 3.5

Unit Reference	MD-SHE-0090-5000-2100-5000
Design Head (m)	2.100
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	90
Invert Level (m)	7.017
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.100	5.0
Flush-Flo™	0.397	4.0
Kick-Flo®	0.808	3.2
Mean Flow over Head Range	-	3.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.8	1.200	3.8	3.000	5.9	7.000	8.8
0.200	3.7	1.400	4.1	3.500	6.3	7.500	9.1
0.300	4.0	1.600	4.4	4.000	6.8	8.000	9.4
0.400	4.0	1.800	4.6	4.500	7.1	8.500	9.6
0.500	4.0	2.000	4.9	5.000	7.5	9.000	9.9
0.600	3.9	2.200	5.1	5.500	7.8	9.500	10.2
0.800	3.3	2.400	5.3	6.000	8.2		
1.000	3.5	2.600	5.5	6.500	8.5		

Storage Structures for Storm

Tank or Pond Manhole: S15, DS/PN: S1.014

Invert Level (m) 8.400

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	64.2	0.300	120.1	0.600	157.5
0.100	97.8	0.400	132.0	0.700	171.1
0.200	108.6	0.500	144.5	0.701	171.3

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 * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 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 Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.345
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.200 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status ON
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	15 Summer	1	+0%	100/15 Summer			
S1.001	S2	15 Summer	1	+0%	30/15 Summer			
S1.002	S3	15 Summer	1	+0%	30/15 Summer			
S2.000	S4	15 Summer	1	+0%	100/15 Summer			
S1.003	S4	15 Summer	1	+0%	30/15 Summer	100/15 Summer		
S3.000	S6	15 Summer	1	+0%	30/15 Summer	100/15 Summer		
S1.004	S5	15 Summer	1	+0%	30/15 Summer	100/15 Winter		
S4.000	S8	15 Summer	1	+0%	100/15 Summer			
S1.005	S6	15 Summer	1	+0%	30/15 Summer			
S5.000	S10	15 Summer	1	+0%	100/15 Summer			
S1.006	S7	15 Summer	1	+0%	100/15 Summer			
S6.000	S12	15 Summer	1	+0%	100/15 Summer			
S1.007	S8	15 Summer	1	+0%	100/15 Summer			
S7.000	S14	15 Summer	1	+0%	30/15 Summer	100/15 Summer		
S1.008	S9	15 Summer	1	+0%	30/15 Summer			
S8.000	S16	15 Summer	1	+0%	100/15 Summer			
S1.009	S10	15 Winter	1	+0%	30/15 Summer			
S9.000	S18	15 Summer	1	+0%	30/15 Summer			
S1.010	S11	15 Winter	1	+0%	30/15 Summer			
S10.000	S20	15 Summer	1	+0%				
S10.001	S21	15 Summer	1	+0%	100/15 Summer			

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	12.160	-0.078	0.000	0.10		0.8	OK	
S1.001	S2	11.977	-0.074	0.000	0.14		1.0	OK	
S1.002	S3	11.839	-0.068	0.000	0.23		1.7	OK	
S2.000	S4	12.013	-0.077	0.000	0.11		0.8	OK	
S1.003	S4	11.631	-0.050	0.000	0.50		3.4	OK	2
S3.000	S6	11.768	-0.078	0.000	0.10		0.7	OK	4
S1.004	S5	11.568	-0.044	0.000	0.60		4.5	OK	1
S4.000	S8	11.739	-0.078	0.000	0.10		0.7	OK	
S1.005	S6	11.257	-0.027	0.000	0.88		5.8	OK	
S5.000	S10	11.168	-0.078	0.000	0.10		0.7	OK	
S1.006	S7	10.995	-0.082	0.000	0.41		6.9	OK	
S6.000	S12	10.973	-0.078	0.000	0.10		0.7	OK	
S1.007	S8	10.783	-0.097	0.000	0.27		8.1	OK	
S7.000	S14	10.566	-0.078	0.000	0.10		0.7	OK	2
S1.008	S9	10.412	-0.069	0.000	0.56		9.3	OK	
S8.000	S16	10.522	-0.078	0.000	0.10		0.7	OK	
S1.009	S10	10.192	-0.091	0.000	0.32		10.5	OK	
S9.000	S18	9.964	-0.078	0.000	0.10		0.7	OK	
S1.010	S11	9.824	-0.057	0.000	0.69		11.6	OK	
S10.000	S20	9.515	-0.078	0.000	0.10		0.7	OK	
S10.001	S21	9.364	-0.071	0.000	0.18		1.4	OK	

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) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.011	S12	15 Winter	1	+0%	30/15 Summer			
S11.000	S21	15 Summer	1	+0%				
S1.012	S13	15 Winter	1	+0%	30/15 Summer			
S1.013	S14	15 Winter	1	+0%	30/15 Summer			
S1.014	S15	30 Winter	1	+0%	30/30 Winter			
S12.000	S16	15 Summer	1	+0%	30/15 Summer	100/15 Summer		
S13.000	S28	15 Summer	1	+0%	100/15 Summer			
S13.001	S29	15 Summer	1	+0%	100/15 Summer			
S12.001	S28	15 Summer	1	+0%	30/15 Summer			
S14.000	S31	15 Summer	1	+0%	100/15 Summer			
S12.002	S32	15 Summer	1	+0%	30/15 Summer			
S15.000	S33	15 Summer	1	+0%	100/15 Summer			
S15.001	S34	15 Summer	1	+0%	100/15 Summer			
S12.003	S35	15 Summer	1	+0%	30/15 Summer			
S12.004	S36	60 Winter	1	+0%	1/30 Summer			
S16.000	S37	15 Summer	1	+0%	100/15 Winter			
S16.001	S38	15 Summer	1	+0%	100/15 Summer			
S12.005	S39	60 Winter	1	+0%	1/30 Summer			
S12.006	S40	60 Winter	1	+0%	1/15 Summer			
S1.015	S41	60 Winter	1	+0%	1/15 Summer	100/120 Winter		
S1.016	S42	60 Winter	1	+0%	1/15 Summer	100/180 Summer		

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.011	S12	8.945	-0.125	0.000	0.40		14.5	OK	
S11.000	S21	9.522	-0.078	0.000	0.10		0.8	OK	
S1.012	S13	8.887	-0.110	0.000	0.51		15.3	OK*	
S1.013	S14	8.860	-0.116	0.000	0.48		15.3	OK	
S1.014	S15	8.475	-0.150	0.000	0.25		7.1	OK	
S12.000	S16	8.782	-0.053	0.000	0.42		2.9	OK	10
S13.000	S28	9.094	-0.085	0.000	0.05		0.4	OK	
S13.001	S29	8.928	-0.079	0.000	0.09		0.6	OK	
S12.001	S28	8.683	-0.050	0.000	0.43		3.4	OK*	
S14.000	S31	9.020	-0.090	0.000	0.02		0.2	OK	
S12.002	S32	8.582	-0.050	0.000	0.48		3.8	OK*	
S15.000	S33	9.092	-0.078	0.000	0.10		0.7	OK	
S15.001	S34	8.998	-0.075	0.000	0.13		1.0	OK	
S12.003	S35	8.493	-0.041	0.000	0.67		5.1	OK	
S12.004	S36	8.470	0.339	0.000	0.48		3.0	SURCHARGED	
S16.000	S37	9.114	-0.078	0.000	0.10		0.7	OK	
S16.001	S38	8.958	-0.073	0.000	0.15		1.0	OK	
S12.005	S39	8.468	0.388	0.000	0.44		3.5	SURCHARGED*	
S12.006	S40	8.461	0.667	0.000	0.46		3.5	SURCHARGED	
S1.015	S41	8.453	1.097	0.000	0.17		6.2	SURCHARGED	7
S1.016	S42	8.444	1.202	0.000	0.16		4.2	SURCHARGED	7

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 * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 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 Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.345
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.200 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status ON
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	15 Summer	30	+0%	100/15 Summer			
S1.001	S2	15 Winter	30	+0%	30/15 Summer			
S1.002	S3	15 Winter	30	+0%	30/15 Summer			
S2.000	S4	15 Winter	30	+0%	100/15 Summer			
S1.003	S4	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
S3.000	S6	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
S1.004	S5	15 Winter	30	+0%	30/15 Summer	100/15 Winter		
S4.000	S8	15 Summer	30	+0%	100/15 Summer			
S1.005	S6	15 Winter	30	+0%	30/15 Summer			
S5.000	S10	15 Summer	30	+0%	100/15 Summer			
S1.006	S7	15 Winter	30	+0%	100/15 Summer			
S6.000	S12	15 Summer	30	+0%	100/15 Summer			
S1.007	S8	15 Winter	30	+0%	100/15 Summer			
S7.000	S14	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
S1.008	S9	15 Winter	30	+0%	30/15 Summer			
S8.000	S16	15 Summer	30	+0%	100/15 Summer			
S1.009	S10	15 Winter	30	+0%	30/15 Summer			
S9.000	S18	15 Winter	30	+0%	30/15 Summer			
S1.010	S11	15 Winter	30	+0%	30/15 Summer			
S10.000	S20	15 Summer	30	+0%				
S10.001	S21	15 Summer	30	+0%	100/15 Summer			

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	12.173	-0.065	0.000	0.25		1.9	OK	
S1.001	S2	12.094	0.044	0.000	0.34		2.5	SURCHARGED	
S1.002	S3	12.081	0.175	0.000	0.53		3.9	SURCHARGED	
S2.000	S4	12.037	-0.053	0.000	0.22		1.6	OK	
S1.003	S4	12.031	0.350	0.000	1.06		7.2	SURCHARGED	2
S3.000	S6	11.963	0.116	0.000	0.20		1.4	SURCHARGED	4
S1.004	S5	11.957	0.344	0.000	1.26		9.6	SURCHARGED	1
S4.000	S8	11.752	-0.066	0.000	0.24		1.8	OK	
S1.005	S6	11.434	0.150	0.000	1.93		12.6	SURCHARGED	
S5.000	S10	11.180	-0.066	0.000	0.24		1.8	OK	
S1.006	S7	11.044	-0.033	0.000	0.96		16.1	OK	
S6.000	S12	10.986	-0.065	0.000	0.25		1.8	OK	
S1.007	S8	10.817	-0.063	0.000	0.64		19.4	OK	
S7.000	S14	10.680	0.035	0.000	0.20		1.5	SURCHARGED	2
S1.008	S9	10.674	0.194	0.000	1.30		21.8	SURCHARGED	
S8.000	S16	10.535	-0.065	0.000	0.25		1.8	OK	
S1.009	S10	10.341	0.057	0.000	0.75		24.3	SURCHARGED	
S9.000	S18	10.195	0.153	0.000	0.17		1.2	SURCHARGED	
S1.010	S11	10.190	0.310	0.000	1.61		26.9	SURCHARGED	
S10.000	S20	9.528	-0.065	0.000	0.25		1.8	OK	
S10.001	S21	9.386	-0.049	0.000	0.51		3.9	OK	

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) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.011	S12	15 Winter	30	+0%	30/15 Summer			
S11.000	S21	15 Summer	30	+0%				
S1.012	S13	15 Winter	30	+0%	30/15 Summer			
S1.013	S14	15 Summer	30	+0%	30/15 Summer			
S1.014	S15	120 Winter	30	+0%	30/30 Winter			
S12.000	S16	60 Winter	30	+0%	30/15 Summer	100/15 Summer		
S13.000	S28	15 Summer	30	+0%	100/15 Summer			
S13.001	S29	60 Winter	30	+0%	100/15 Summer			
S12.001	S28	30 Winter	30	+0%	30/15 Summer			
S14.000	S31	15 Summer	30	+0%	100/15 Summer			
S12.002	S32	60 Winter	30	+0%	30/15 Summer			
S15.000	S33	15 Summer	30	+0%	100/15 Summer			
S15.001	S34	15 Summer	30	+0%	100/15 Summer			
S12.003	S35	60 Winter	30	+0%	30/15 Summer			
S12.004	S36	60 Winter	30	+0%	1/30 Summer			
S16.000	S37	15 Summer	30	+0%	100/15 Winter			
S16.001	S38	15 Summer	30	+0%	100/15 Summer			
S12.005	S39	60 Winter	30	+0%	1/30 Summer			
S12.006	S40	60 Winter	30	+0%	1/15 Summer			
S1.015	S41	180 Winter	30	+0%	1/15 Summer	100/120 Winter		
S1.016	S42	180 Winter	30	+0%	1/15 Summer	100/180 Summer		

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.011	S12	9.114	0.045	0.000	0.96		34.2	SURCHARGED	
S11.000	S21	9.536	-0.064	0.000	0.26		1.9	OK	
S1.012	S13	9.049	0.052	0.000	1.21		36.0	SURCHARGED*	
S1.013	S14	8.981	0.005	0.000	1.10		34.9	SURCHARGED	
S1.014	S15	8.684	0.059	0.000	0.26		7.7	SURCHARGED	
S12.000	S16	9.008	0.174	0.000	0.37		2.6	SURCHARGED	10
S13.000	S28	9.104	-0.075	0.000	0.13		0.9	OK	
S13.001	S29	9.001	-0.006	0.000	0.12		0.8	OK	
S12.001	S28	8.953	0.220	0.000	0.63		5.0	SURCHARGED*	
S14.000	S31	9.025	-0.086	0.000	0.05		0.5	OK	
S12.002	S32	8.979	0.347	0.000	0.39		3.1	SURCHARGED*	
S15.000	S33	9.105	-0.065	0.000	0.25		1.7	OK	
S15.001	S34	9.016	-0.057	0.000	0.36		2.7	OK	
S12.003	S35	8.979	0.446	0.000	0.65		5.0	SURCHARGED	
S12.004	S36	8.910	0.779	0.000	0.89		5.6	SURCHARGED	
S16.000	S37	9.127	-0.066	0.000	0.24		1.8	OK	
S16.001	S38	8.977	-0.054	0.000	0.40		2.6	OK	
S12.005	S39	8.888	0.808	0.000	0.76		6.0	SURCHARGED*	
S12.006	S40	8.801	1.007	0.000	0.65		5.0	SURCHARGED	
S1.015	S41	8.844	1.488	0.000	0.26		9.4	SURCHARGED	7
S1.016	S42	8.974	1.731	0.000	0.17		4.5	SURCHARGED	7

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 * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 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 Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.345
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.200 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status ON
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	15 Winter	100	+40%	100/15 Summer			
S1.001	S2	15 Winter	100	+40%	30/15 Summer			
S1.002	S3	15 Summer	100	+40%	30/15 Summer			
S2.000	S4	15 Winter	100	+40%	100/15 Summer			
S1.003	S4	15 Winter	100	+40%	30/15 Summer	100/15 Summer		
S3.000	S6	15 Winter	100	+40%	30/15 Summer	100/15 Summer		
S1.004	S5	15 Winter	100	+40%	30/15 Summer	100/15 Winter		
S4.000	S8	15 Winter	100	+40%	100/15 Summer			
S1.005	S6	15 Winter	100	+40%	30/15 Summer			
S5.000	S10	15 Winter	100	+40%	100/15 Summer			
S1.006	S7	15 Winter	100	+40%	100/15 Summer			
S6.000	S12	15 Winter	100	+40%	100/15 Summer			
S1.007	S8	15 Winter	100	+40%	100/15 Summer			
S7.000	S14	15 Winter	100	+40%	30/15 Summer	100/15 Summer		
S1.008	S9	15 Winter	100	+40%	30/15 Summer			
S8.000	S16	15 Winter	100	+40%	100/15 Summer			
S1.009	S10	15 Winter	100	+40%	30/15 Summer			
S9.000	S18	15 Winter	100	+40%	30/15 Summer			
S1.010	S11	15 Winter	100	+40%	30/15 Summer			
S10.000	S20	15 Summer	100	+40%				
S10.001	S21	15 Winter	100	+40%	100/15 Summer			

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	12.816	0.578	0.000	0.31		2.3	FLOOD RISK	
S1.001	S2	12.801	0.750	0.000	0.51		3.7	FLOOD RISK	
S1.002	S3	12.793	0.887	0.000	0.77		5.8	FLOOD RISK	
S2.000	S4	12.677	0.587	0.000	0.33		2.4	FLOOD RISK	
S1.003	S4	12.662	0.981	0.041	1.78		12.0	FLOOD	2
S3.000	S6	12.447	0.600	0.153	0.44		3.2	FLOOD	4
S1.004	S5	12.443	0.831	0.153	1.68		12.8	FLOOD	1
S4.000	S8	11.975	0.157	0.000	0.35		2.7	SURCHARGED	
S1.005	S6	11.964	0.680	0.000	2.34		15.3	FLOOD RISK	
S5.000	S10	11.700	0.454	0.000	0.34		2.5	FLOOD RISK	
S1.006	S7	11.689	0.612	0.000	1.19		19.8	FLOOD RISK	
S6.000	S12	11.420	0.369	0.000	0.37		2.7	FLOOD RISK	
S1.007	S8	11.407	0.526	0.000	0.81		24.7	FLOOD RISK	
S7.000	S14	11.245	0.600	0.094	0.38		2.8	FLOOD	2
S1.008	S9	11.241	0.760	0.000	1.65		27.6	FLOOD RISK	
S8.000	S16	10.831	0.231	0.000	0.37		2.7	SURCHARGED	
S1.009	S10	10.817	0.534	0.000	0.93		30.4	SURCHARGED	
S9.000	S18	10.591	0.549	0.000	0.26		1.9	FLOOD RISK	
S1.010	S11	10.580	0.699	0.000	2.13		35.6	FLOOD RISK	
S10.000	S20	9.542	-0.051	0.000	0.46		3.3	OK	
S10.001	S21	9.522	0.087	0.000	0.77		5.9	SURCHARGED	

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) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.011	S12	15 Winter	100	+40%	30/15 Summer			
S11.000	S21	15 Summer	100	+40%				
S1.012	S13	15 Winter	100	+40%	30/15 Summer			
S1.013	S14	15 Winter	100	+40%	30/15 Summer			
S1.014	S15	180 Winter	100	+40%	30/30 Winter			
S12.000	S16	60 Winter	100	+40%	30/15 Summer	100/15 Summer		
S13.000	S28	30 Winter	100	+40%	100/15 Summer			
S13.001	S29	30 Winter	100	+40%	100/15 Summer			
S12.001	S28	60 Winter	100	+40%	30/15 Summer			
S14.000	S31	30 Winter	100	+40%	100/15 Summer			
S12.002	S32	60 Winter	100	+40%	30/15 Summer			
S15.000	S33	30 Winter	100	+40%	100/15 Summer			
S15.001	S34	30 Winter	100	+40%	100/15 Summer			
S12.003	S35	30 Winter	100	+40%	30/15 Summer			
S12.004	S36	30 Winter	100	+40%	1/30 Summer			
S16.000	S37	30 Winter	100	+40%	100/15 Winter			
S16.001	S38	30 Winter	100	+40%	100/15 Summer			
S12.005	S39	60 Winter	100	+40%	1/30 Summer			
S12.006	S40	180 Winter	100	+40%	1/15 Summer			
S1.015	S41	480 Winter	100	+40%	1/15 Summer	100/120 Winter		
S1.016	S42	480 Winter	100	+40%	1/15 Summer	100/180 Summer		

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.011	S12	9.327	0.257	0.000	1.37		48.9	SURCHARGED	
S11.000	S21	9.550	-0.050	0.000	0.47		3.4	OK	
S1.012	S13	9.189	0.192	0.000	1.74		52.1	SURCHARGED*	
S1.013	S14	9.050	0.074	0.000	1.63		52.0	SURCHARGED	
S1.014	S15	8.995	0.370	0.000	0.69		20.0	FLOOD RISK	
S12.000	S16	9.437	0.603	2.634	0.52		3.7	FLOOD	10
S13.000	S28	9.492	0.312	0.000	0.13		1.0	FLOOD RISK	
S13.001	S29	9.487	0.480	0.000	0.26		1.7	FLOOD RISK	
S12.001	S28	8.953	0.220	0.000	0.49		3.9	SURCHARGED*	
S14.000	S31	9.501	0.390	0.000	0.04		0.5	FLOOD RISK	
S12.002	S32	8.979	0.347	0.000	0.51		4.0	SURCHARGED*	
S15.000	S33	9.543	0.374	0.000	0.25		1.8	FLOOD RISK	
S15.001	S34	9.537	0.464	0.000	0.41		3.1	FLOOD RISK	
S12.003	S35	9.517	0.983	0.000	0.93		7.2	FLOOD RISK	
S12.004	S36	9.437	1.305	0.000	1.44		9.1	SURCHARGED	
S16.000	S37	9.392	0.200	0.000	0.25		1.8	SURCHARGED	
S16.001	S38	9.387	0.356	0.000	0.51		3.3	SURCHARGED	
S12.005	S39	8.974	0.894	0.000	0.96		7.6	SURCHARGED*	
S12.006	S40	9.275	1.481	0.000	0.71		5.4	FLOOD RISK	
S1.015	S41	9.207	1.851	2.526	0.22		7.8	FLOOD	7
S1.016	S42	9.500	2.258	0.748	0.18		4.7	FLOOD	7