FLOOD RISK UK

FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

LAND EAST OF YAPTON LANE, WALBERTON

OUTLINE PLANNING APPLICATION FOR PROPOSED RESIDENTIAL DEVELOPMENT

DATE: OCT 2020

ARUN DISTRICT COUNCIL WA/80/21/OUT

Table of Contents

1.0 Introduction 3

2.0 Site Context 4

3.0 Development Proposal 11

4.0 Flood Risk Assessment 12

5.0 Climate Change 15

6.0 Surface Water Drainage Strategy 16

7.0 Foul Water Drainage Strategy 29

8.0 Conclusion 30

APPENDIX A: TOPOGRAPHIC SURVEY

APPENDIX B: INDICATIVE PROPOSED SITE LAYOUT AND SUDS PLAN

APPENDIX C: SURFACE WATER DRAINAGE CALCULATIONS

APPENDIX D: SOUTHERN WATER SEWERAGE INFORMATION

1.0 Introduction

1.1 Flood Risk UK have undertaken a Flood Risk Assessment (FRA) and Drainage Strategy (DS) in support of a proposed residential development on land east of Yapton Lane, in the village of Walberton in West Sussex. The site is under the administrative area of Arun District Council, the Local Planning Authority (LPA), West Sussex County Council, the Lead Local Flood Authority (LLFA), and Southern Water, the Water Authority and Drainage Undertaker.

1.2 The National Planning Policy Framework (NPPF) requires FRA for new development proposed on the floodplains of rivers, at risk of coastal flooding, over one hectare or in critical drainage areas. To comply with the NPPF, FRA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere and where possible reducing overall flood risk. The application site comprises 7.6 hectares of residential development and open space in Flood Zone 1, an area which is not at significant risk of river or coastal flooding. The proposed residential use is classified as 'more vulnerable' to flooding by the National Planning Practice Guide (NPPG), whereas the proposed open space areas are 'water-compatible'. Opportunities for the provision of Sustainable Drainage Systems (SuDS) within open space are described in later sections of this report.

1.3 The information within the FRA relating to site layout design and drainage strategy is subject to change due to the indicative nature of the outline planning consent that is sought from the LPA. The final site layout and design, including drainage information, will be fixed by the approval of reserved matters application, subject to the grant of outline planning consent. For the purposes of planning, a preliminary drainage strategy has been prepared to demonstrate that the site can be sustainably drained in principle, although this will continue to be refined until the design reaches fruition.

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2.0 Site Context

Topography

2.1 Walberton is a village located 7 km to the north east of Bognor Regis, on the southern edge of the South Downs. As shown in **Figure 1**, the site is located on the eastern edge of the existing village and is bordered by a golf course to the north and east, farmland to the south, and the B2132 Yapton Lane to the west.

Figure 1: Site Location, Grid Reference SU977060, nearest postcode BN18 0AR

2.2 The site comprises 7.6 ha of land which is currently a large field used for agriculture, bounded by a mixture of hedgerows and trees. There is a Public Right of Way (PRoW) along the southern boundary, which continues through the golf course to a watercourse east of the site.

2.3 As shown by the topographic survey contained in Appendix A, ground levels fall from a high point in the northern part of the site at 19.3 mAOD to low points of 16.2 mAOD at the south west corner and 15.2 mAOD at the south east corner. The majority of the site slopes at a gradient of approximately 1 in 80 towards the south, except for an area sloping towards the eastern boundary at approximately 1 in 50. There are no discernible surface water drainage features or ditches within or around the boundary of the site.

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Geology

2.4 The bedrock geology, according to BGS 1:10,000 scale mapping is the *London Clay Formation – Clay, Silt and Sand*. The superficial geology is shown in **Figure 2** and summarised below:

- *River Terrace Deposits (undifferentiated) – Silt* (grey);
- *Head – Gravel, Sand, Silt and Clay* (salmon);

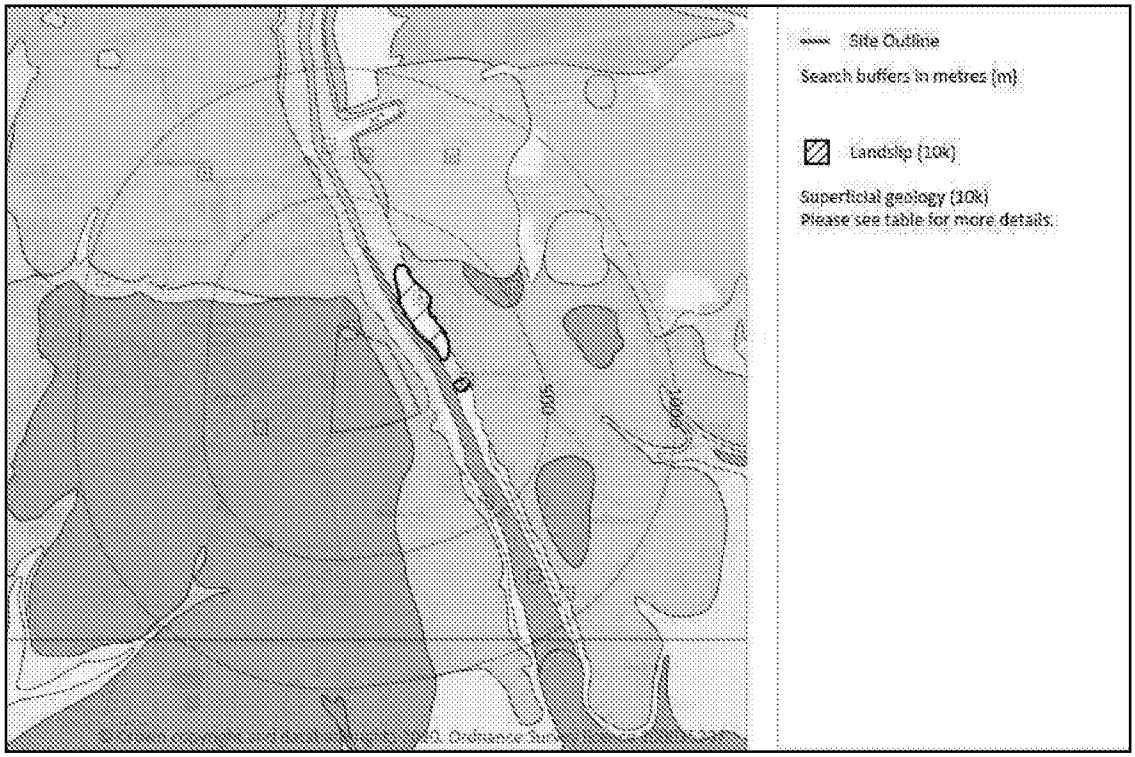

Figure 2: Superficial Geology (Groundsure map)

2.5 There is a soluble rock risk shown for the northern half of the site as shown in Figure 3.

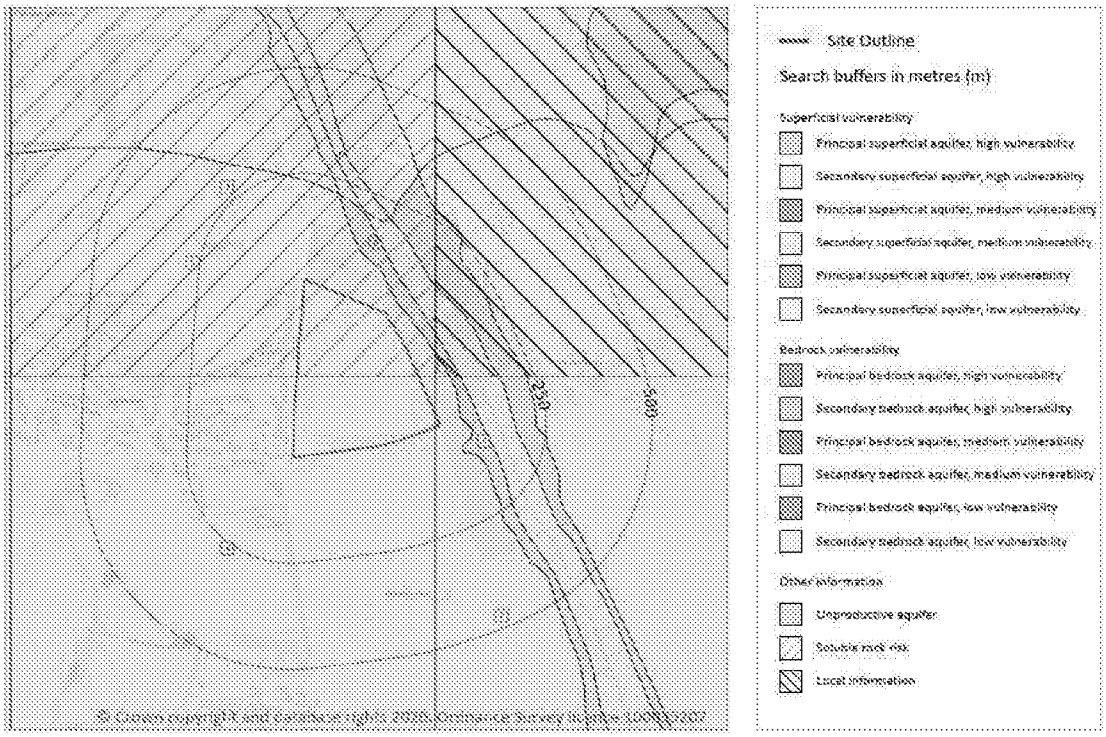

Figure 3: Indicated soluble rock risk

2.6 On site and nearby borehole records suggest the presence of clay, sand and gravel at shallow depth but in varying proportions. Superficial geology is anticipated to be variable across the site.

2.7 The Cranfield Soil and Agrifood Institute Soilscapes mapping indicates freely draining slightly acid loamy soils, as shown in **Figure 4**.

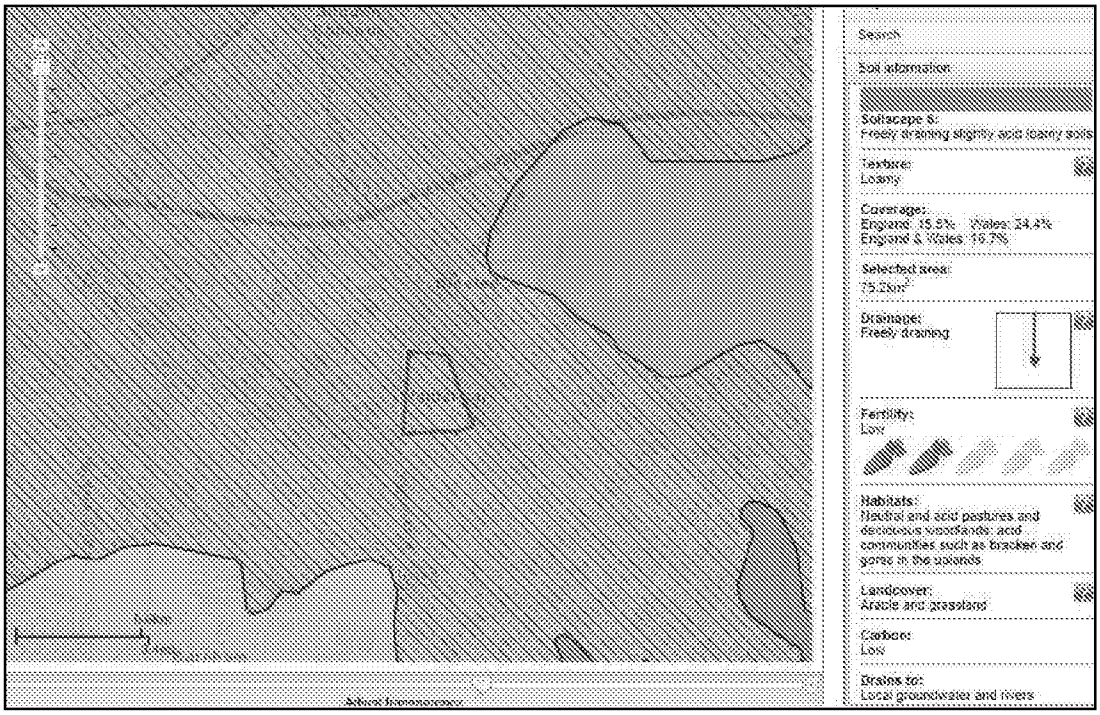

Figure 4: Soilscapes map

2.8 The geology and soil types across the site indicate that the ground conditions are likely to be of moderate to high permeability.

Hydrogeology

2.9 The site is within a Secondary A superficial aquifer area, and is underlain by unproductive bedrock aquifer. According to Groundsure data, the superficial aquifer comprises *permeable layers capable of supporting water supplies at a local scale, and in some cases potentially forming an important source of base flow to rivers*.

2.10 The secondary aquifer has a medium groundwater vulnerability classification, whereas the bedrock aquifer has a low classification. This is combined with a soil / surface recorded as intermediate leaching class and high infiltration value.

2.11 The site is not within any source protection zones and there are no active or historic groundwater or surface water abstractions within 500 m of the site boundary.

Hydrology

2.12 At the time of the site visit on 15th September 2020 there were no signs of surface water drainage features, standing water or flowing water within the site boundary.

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2.13 There is a mapped watercourse 110 m to the east, as shown in **Figure 5**. This flows towards the south and is designated as an Environment Agency main river, although it is not named on OS mapping. As shown by the topographic survey (Appendix A) the level of watercourse is more than 10 m lower than the ground levels across site, due to its location within a valley.

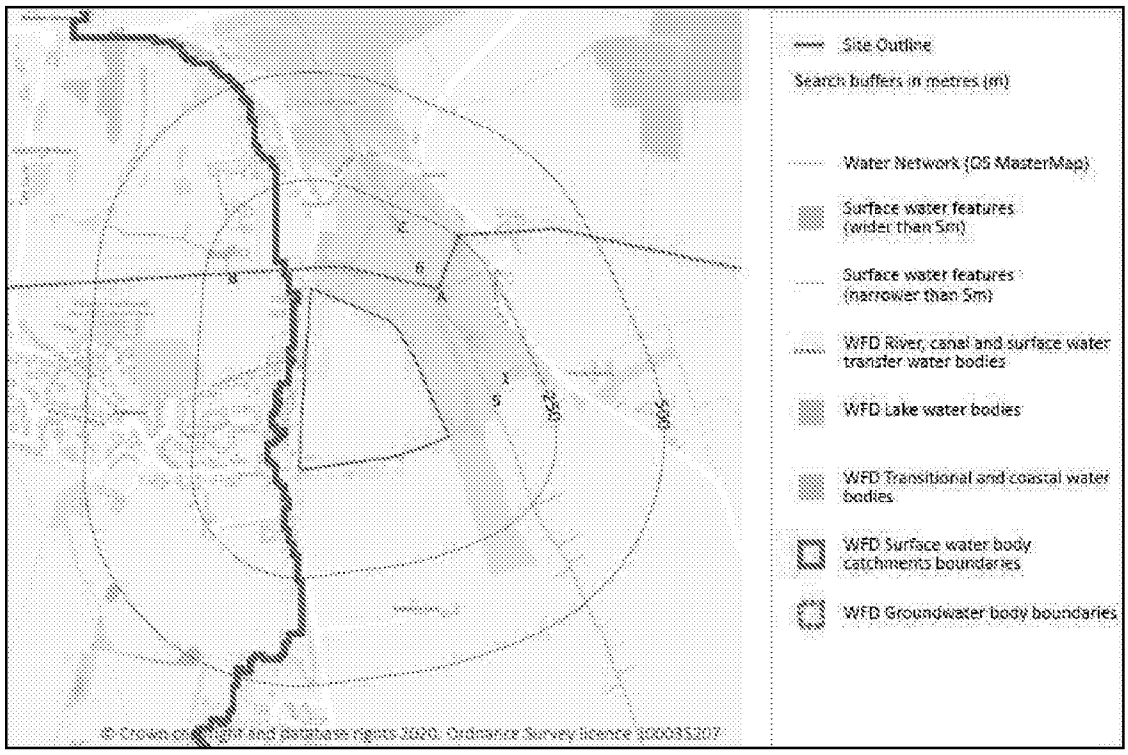

Figure 5: Watercourse network (Groundsure map)

2.14 The site lies within the Lower Arun and Western Streams surface water body catchment of the Water Framework Directive (WFD), which is detailed in **Table 1**. This is a coastal catchment so is not associated with a river.

Table 1: WFD Surface-water data (Groundsure tables)

ID	Location	Type	Water body catchment	Water body ID	Operational catchment	Management catchment
1	On site	Coastal Catchment	Not part of a river WB catchment	194	Lower Arun	Arun and Western Streams

Environmentally Sensitive Sites

2.15 There are two Ancient & Semi-Natural Woodlands including Hundredhouse Copse 320-330 m to the north of the site, and a number of other woodlands of this type within 1 km to the

ARUN DISTRICT COUNCIL WA/80/21/OUT

north and east, as indicated by **Figure 6**. The site lies within two SSSI Impact Risk Zones, for SSSI sites which are 2-3 km to the north and north east, as shown in **Figure 7**.

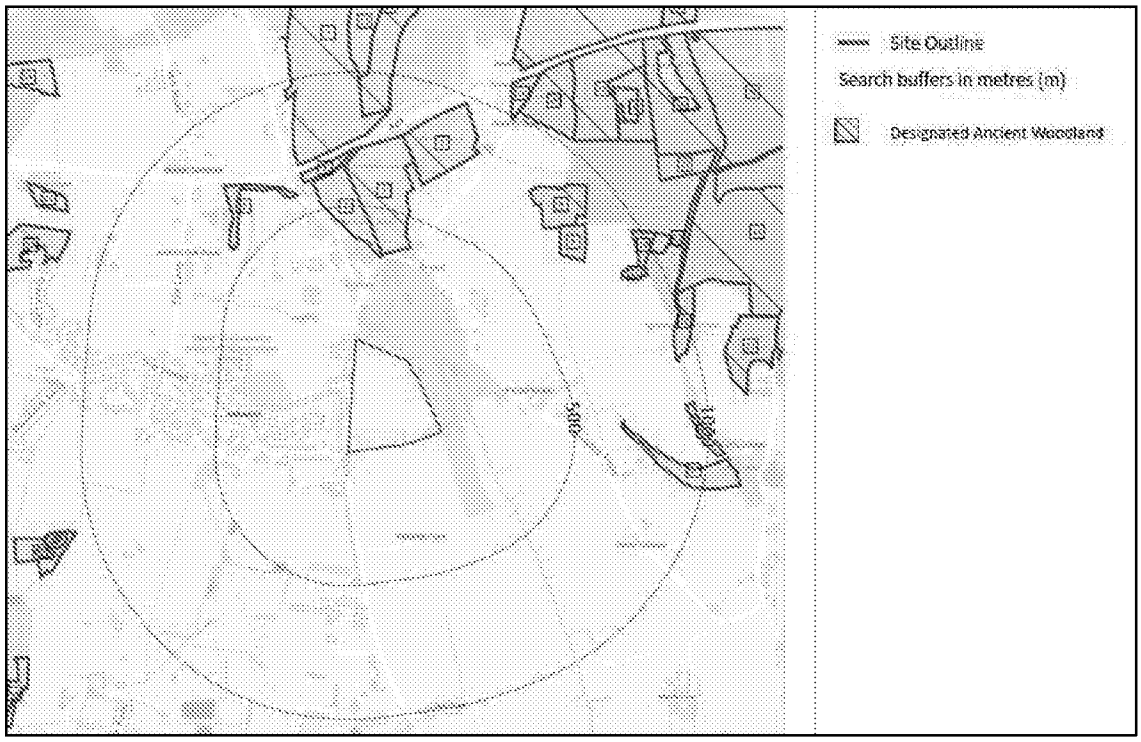

Figure 6: Environmental designations (Groundsure map)

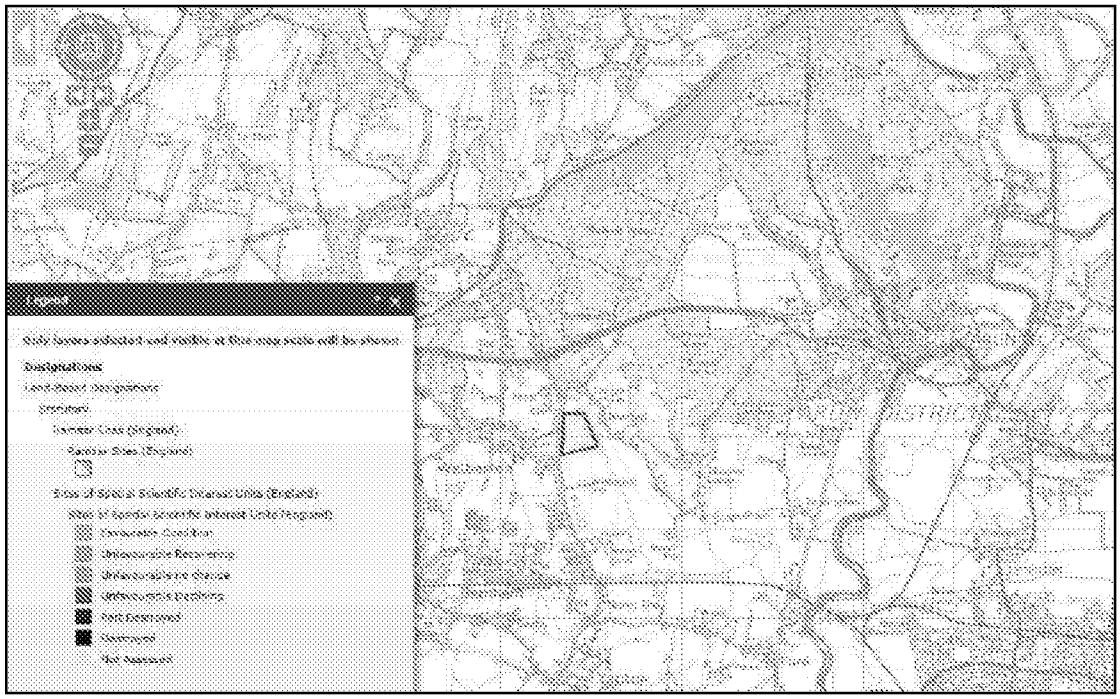

Figure 7: DEFRA Magic Map extract showing site boundary and SSSI sites

2.16 Surface water and groundwater are assumed to flow towards the valley and watercourse to the east, which itself flows to the coast to the south. As this is in the opposite direction from the woodlands and SSSIs, there would not be any impact from development runoff.

3.0 Development Proposal

3.1 The proposal is to develop the site with residential properties in a spacious arrangement, including areas of community open space through the centre and around the western and eastern edges. The indicative proposed site layout is included in Appendix B. The housing styles are not yet fixed, but an appraisal of surrounding housing types would suggest that a mixture of 2-4 bedroom, two-storey dwellings in detached and semi-detached arrangement, would form the basis of the development. Open space areas within the development offer opportunities for sustainable drainage features to enhance amenity and biodiversity.

3.2 The development is accessed from Yapton Lane midway along the western boundary. Since most of the proposed roads will be adoptable highway, it is anticipated that these will primarily be of traditional, impermeable construction. Private driveways and courtyards could be formed from permeable surfacing.

4.0 Flood Risk Assessment

Fluvial Flooding

4.1 The Environment Agency (EA) flood map for planning, included in **Figure 8** below, identifies areas at risk of flooding by rivers and the sea. This shows that the proposed site is within Flood Zone 1, of low risk (less than 1 in 1,000 or 0.1% average probability in a given year). The closest area at medium or high risk of flooding is the valley over 100 m to the east, which is more than 10 m below the ground levels on the site.

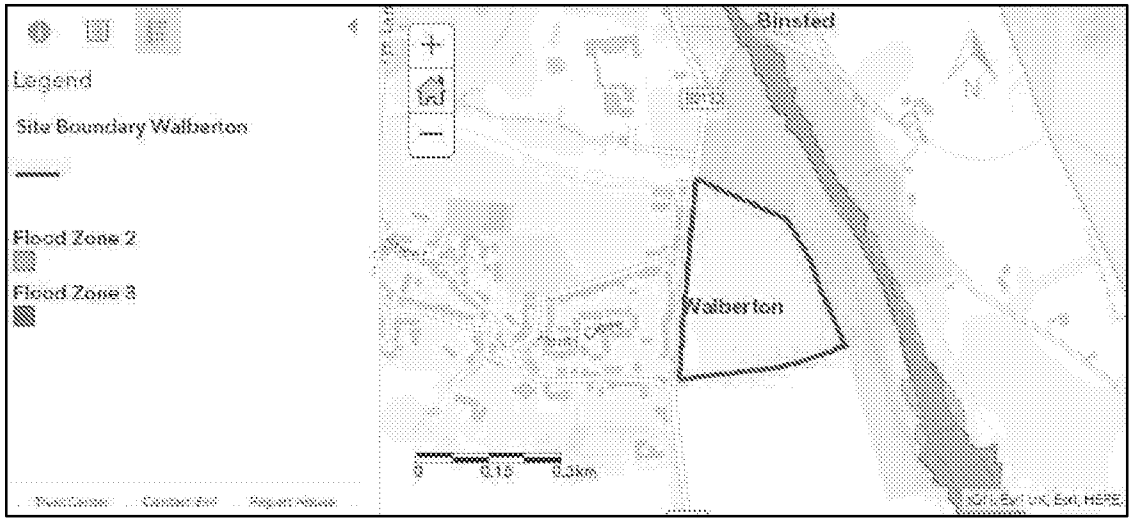

Figure 8: Environment Agency Flood Map for Planning

Pluvial Flooding

4.2 Intense rainfall, particularly in urban areas, can create runoff which temporarily overwhelms the capacity of the drainage system. Under these conditions, localised 'flash' flooding can occur. In addition, surface water sewers can flood into foul sewers and overload both the surface water and combined sewer networks, which can be especially problematic.

4.3 The updated Flood Map for Surface Water (uFMfSW) provides information about surface water flooding including multiple risk categories, as follows:

- **Very low;** has a chance of flooding on average of less than 1 in 1000 (0.1%).
- **Low;** has a chance of flooding on average between 1 in 1000 (0.1%) - 1 in 100 (1%),
- **Medium;** has a chance of flooding on average between 1 in 100 (1%) - 1 in 30 (3.3%)
- **High;** has a chance of flooding on average greater than 1 in 30 (3.3%).

ARUN DISTRICT COUNCIL WA/80/21/OUT

4.4 In general terms, the uFMfSW alone should not be used to assess flood risk at individual site level. Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the probability and severity of flooding. When used to consider catchment-wide surface water or pluvial flows, the maps are a useful tool in determining generalised flood risk to an area.

4.5 An extract from the uFMfSW is shown in **Figure 9**, indicating that there is a small strip of pluvial flood risk along the low-lying southern boundary. There are no apparent surface water flow corridors entering the site from the surrounding area. The proposed surface water drainage strategy, described in the following section, would direct runoff into conveyance and storage features such as swales and basins in order to manage the risk of pluvial flooding. This approach will attenuate and discharge surface water without flooding of adjacent property.

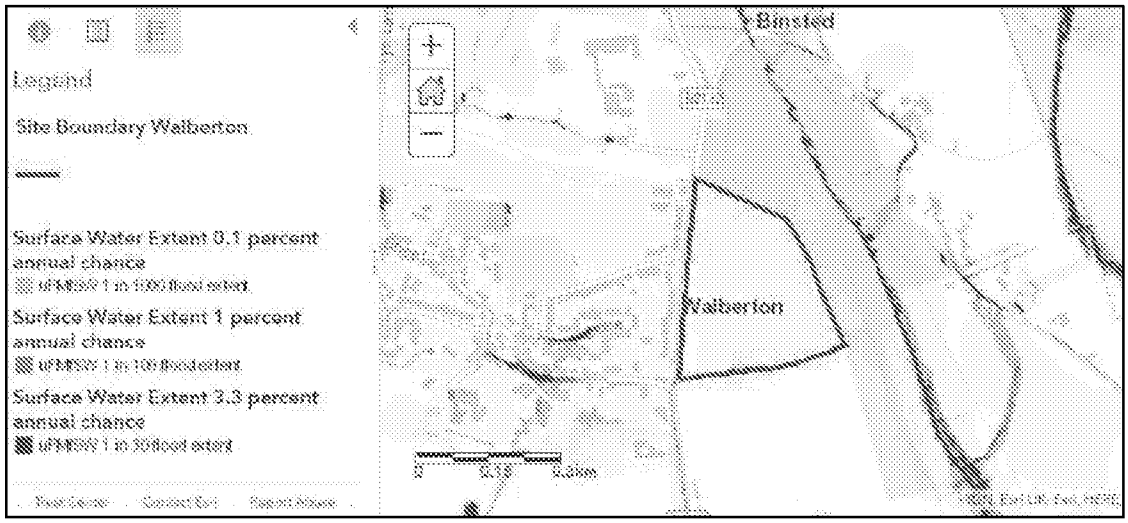

Figure 9: updated Flood Map for Surface Water (uFMfSW) extract

Groundwater Flooding

4.6 Groundwater flooding is most commonly caused by rainfall which causes the groundwater table beneath a site to rise and to eventually exceed ground level. Groundwater flooding can also occur where the water table is sufficiently close to the site surface that it inundates subterranean development. Like other sources of flooding, groundwater flooding will be affected by increased rainfall attributable to climate change.

4.7 Groundsure data (**Figure 10**) shows the site to be within an area of moderate susceptibility to groundwater flooding. There are patches of moderate to high susceptibility in the southern half of the site, which is assumed to correlate to the lowest ground levels. Based

ARUN DISTRICT COUNCIL WA/80/21/OUT

on the topography, geology and soil type described in Section 2, it is assumed that the water table is linked with the eastern valley and watercourse. The proposed drainage strategy will have a role in controlling the potential for groundwater rise, hence the risk to property will be managed by surface drainage features which would have capacity to convey flows away.

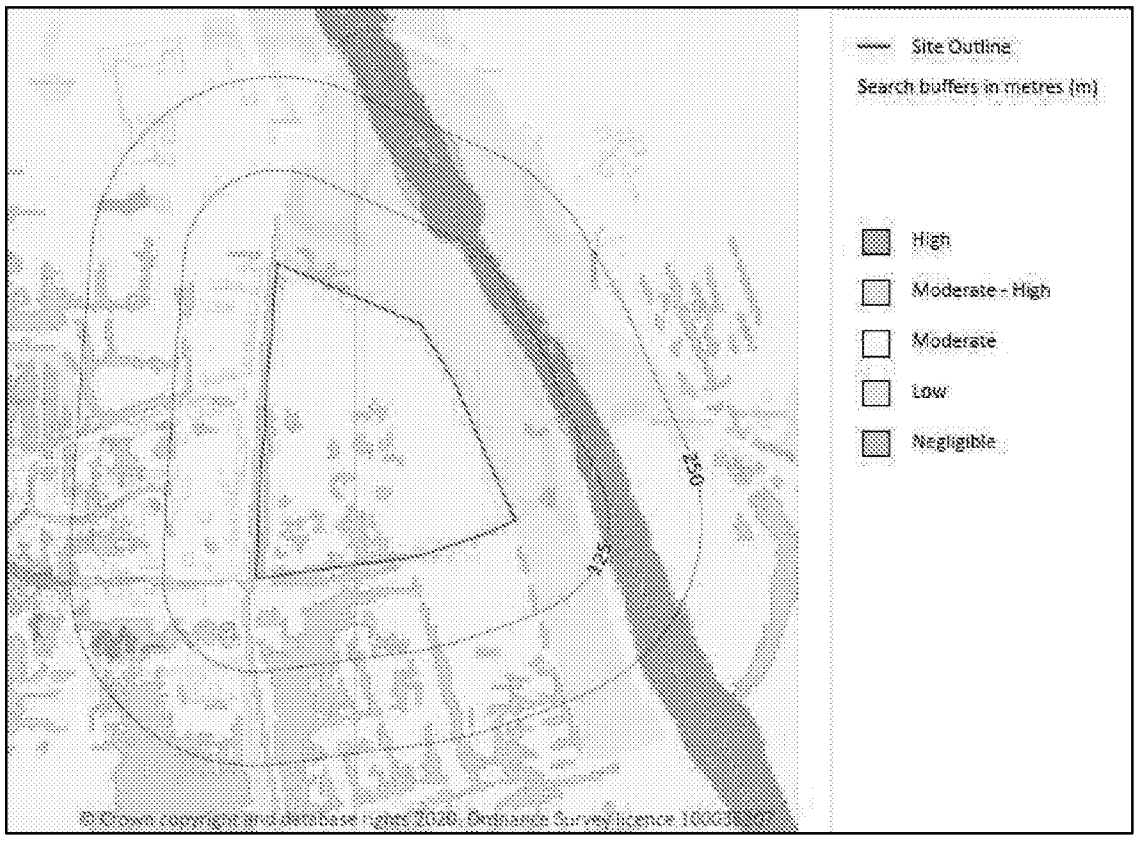

Figure 10: Susceptibility to groundwater flooding (Groundsure map)

Reservoir Flooding

4.8 The Environment Agency 'Risk of Flooding from Reservoirs' map, which relates to flood risk from an uncontrolled release of water from a reservoir, shows that the site is not at risk from this type of flooding. Since dams in England are regulated by the Reservoirs Act 1975 and monitored for compliance by the Environment Agency, the probability of a reservoir breach is generally very low. The risk from reservoir flooding is deemed to be negligible.

5.0 Climate Change

5.1 Allowances for the flood risk related impacts of climate change are determined from the site's location based on NPPG which references Environment Agency guidance and UK climate change projections. Due to the substantial distance and elevation separating the site from rivers and the sea, the increased river flow or sea-level rise allowances do not have any impact on the proposed development. The range of increases in peak rainfall intensity applicable to the proposed development is summarised in **Table 2** below.

Table 2: Climate change allowances

Development type and allowance lifetime:	Residential	100 years
Allowance	**Category**	**Total potential change anticipated**
Peak rainfall intensity	Upper end	40%
	Central	20%

5.2 Planning practice guidance recommends that flood risk assessments consider the Upper End and Central estimates of peak rainfall intensity changes. In line with current industry practice, the drainage system is to be designed to prevent flooding from a storm of 1 in 100 year (1%) average annual probability, with 40% allowance for increased rainfall intensity due to climate change (denoted CCA in the following drainage strategy tables).

6.0 Surface Water Drainage Strategy

Guiding Principles

6.1 In accordance with Local and National Planning Policy requirements the sustainable management of surface water from new development is a fundamental area for consideration within any planning application, achieved through the use of Sustainable Drainage Systems (SuDS). Current best practice, CIRIA's SuDS Manual, Version 2 (C753) and the Non-Statutory Technical Standards for SuDS, highlights that the main principle behind SuDS is to replicate natural drainage wherever possible. This can be achieved by increasing infiltration, attenuating water runoff and reducing the rate and volume of surface water flows. SuDS also provide opportunities to use rainwater as a resource, improve water quality by removing sediment and pollutants throughout the system prior to discharge, and enhance amenity and biodiversity value in the form of attractive natural systems alongside community open space. The SuDS strategy prioritises interventions as close as possible to the source, as follows:

1. Prevention – prevent rainwater runoff and pollution
2. Source control – capture and use rainwater close to where it falls
3. Site control – manage surface water on site
4. Regional control – manage water from a number of areas in a single location

6.2 As part of the identification and development of options for final discharge from the proposed system, the sustainable drainage hierarchy is followed. This helps to avoid impacts on and in some cases alleviate flooding downstream, by promoting discharge of surface water to the most suitable receptor. Surface water discharge options are assessed in the following order of preference:

1. Infiltration into the ground
2. Outfall to watercourse or river
3. Connection to surface water sewer
4. Connection to combined sewer

6.3 Whichever discharge option is ultimately selected, the incorporation of infiltration, treatment, gradual conveyance and flow control throughout the SuDS strategy provides the most efficient and effective approach.

ARUN DISTRICT COUNCIL WA/80/21/OUT

SuDS Components Appraisal

An appraisal of the most suitable SuDS features for the proposed development is provided in the following sections.

Rainwater Harvesting Systems

6.4 Although the sustainable benefit of rainwater harvesting in water usage terms is not disputed, the very nature of such systems is that the internal storage tanks are full or partially full in perpetuity, meaning that they are often of limited benefit when used to control the rate and volume of surface water discharged from a given rainfall event. Therefore, although such systems may be viable, and are beneficial for using rainwater as a resource thereby preventing runoff, they are not relied on as part of the proposed surface water management strategy.

Pervious Pavements

6.5 Pervious hardstanding is a form of runoff prevention and source control, involving percolation of surface water through the surface and into the underlying sub-base which provides interception storage within the voids of granular material. This percolation can aid in the removal of sediment and helps to reduce the flow rate if the pavement layer is connected to the drainage system (usually via a perforated pipe or fin drain). When pervious pavements are installed with permeable geotextile around the granular material, infiltration can occur which provides a partial reduction in runoff volume. With a sufficiently high infiltration rate, there may be no need for a piped connection to the drainage network. Pervious pavements are suitable for private domestic and shared parking areas and unadopted highway spurs where present. It is improbable that pervious pavements could be used for the entire internal road network which will be subject to adoption by the Local Highway Authority.

Bioretention Tree Pits and Rain Gardens

6.6 With a combination of runoff prevention, treatment and source control, tree pits and rain gardens assist with limiting the rate and volume of surface water discharge from the site through interception of rainfall, transpiration, void storage, and increased infiltration. Engineered soils of high sand and gravel content, potentially mixed with nutrient-retaining organic material (such as biochar or compost), could be used to improve the capacity and water treatment of these systems. Where tree pits or rain gardens are used to intercept impervious surface runoff, initial storage is provided within each feature, and a connection

ARUN DISTRICT COUNCIL WA/80/21/OUT

or overflow to the site control SuDS is usually required. Tree pits and rain gardens are suitable as upstream SuDS components, interspersed throughout the site within open amenity space or traffic calming measures along the residential streetscape.

Green Roofs

6.7 Green roofs provide multiple benefits, such as insulation and biodiversity, in addition to reducing the rate and volume of runoff discharged from developed areas. The viability of green roofs depends upon the suitability of their appearance within the street scene and surrounding area; a point to be determined by the Urban Design and Local Planning Authority. Matching traditionally designed local dwellings is likely to require roof designs that will inhibit the use of green roofs.

Swales, Filter Drains and Filter Strips

6.8 There are a variety of linear features which are typically used as the middle stage of treatment in a SuDS scheme, as follows:

- Swales – a natural channel which may be wide, gently sloping and grassed, or relatively narrow and vegetated;
- Filter Drains – trenches containing granular material up to the surface, often used as a narrow linear feature, or at the base of a swale;
- Filter Strips – gently sloping areas of varying width, usually falling towards a swale or filter drain;

6.9 All of these systems can be used for source control, infiltration, treatment, gradual conveyance and as part of the site control storage. Where vegetation is incorporated, this helps with nutrient uptake and sediment removal. For sloping areas, some form of check dam (i.e. timber board) or below ground separation may be required to attenuate surface water upstream. These linear features are well suited to green corridors, which promote sustainable travel (walking, cycling) and enable biodiverse links between habitats.

6.10 For the outline drainage strategy, conveyance and storage swales are proposed throughout the site within open space, as shown on the SuDS Plan in Appendix B. This involves a network of swales sloping towards the south east corner of the site. Check dams or other intermediate controls such as footpath/road crossings could be used to encourage infiltration throughout the network.

ARUN DISTRICT COUNCIL WA/80/21/OUT

Ponds and Basins

6.11 Ponds and basins can provide multiple benefits including community amenity value, habitat creation to enhance biodiversity, bioretention for water quality treatment, and various aspects of surface water storage. These SuDS components are positioned at lower-lying parts points of the site and are often the final stage of treatment. Where off-site piped discharge is proposed, the flow control is usually adjacent to the pond or basin, which provides the main storage area downstream in the network.

6.12 As shown on the SuDS Plan in Appendix B, a multi-functional pond/basin feature is proposed at the south eastern corner of the site, being closest to the nearby watercourse and likely outfall. When surface water arrives from the upstream SuDS, having been attenuated, treated and conveyed gradually, the pond will begin to fill. The edges of the pond will be formed within a dry basin having gently sloping sides; this permits infiltration, enables varying amounts of surface water storage, and will be landscaped appropriately within the community open space.

Attenuation Storage

6.13 There are two potential scenarios for the final discharge of surface water from the site, and these have been addressed via the following options, in order of preference:

- Option A – Infiltration of surface water into the ground; this is dependent on suitable soil permeability and groundwater depth;
- Option B – Discharge to the watercourse to the east via a piped outfall, at an agreed flow rate, potentially with volume control; this would be required if infiltration is not feasible.

Option A – Infiltration

6.14 The underlying geology, as described in Section 2.0, indicates that infiltration may be viable. Soilscapes mapping indicates freely draining soil, however this is contradicted by legacy borehole records available through BGS, which indicate predominantly clay soils at shallow depth on the site.

6.15 Furthermore, a soluble rock risk within the northern half of the site suggests that infiltration of surface water could lead to undue settlement, subsidence or even collapse within the site. BGS records illustrate a landslip to the east of the site on the opposite side of the watercourse, which is further indication of the potential for settlement, subsidence or collapse of ground.

6.15 Soakaway testing in accordance with BRE Digest 365 should be progressed to confirm the permeability of the soil, which is a fundamental parameter for system design, however, this information is not available for the outline drainage strategy. Soakaway testing should be included as part of a wider intrusive ground investigation to provide a sequential approach to the siting of infiltration systems to minimise the soluble rock risk.

6.15 The proposed SuDS strategy allows for infiltration at various stages, from source control to the final pond/basin storage, which can be incorporated into the final design following an intrusive site investigation. It is anticipated that the optimal areas for infiltration will be at higher elevation within the freely draining soils or at the eastern boundary within gravel & sand Head strata as shown on the superficial geology mapping. As such, upstream components such as permeable paving, treepits or rain gardens, and linear SuDS including swales and filter strips/drains where practical, can provide cascading infiltration storage. The south eastern corner provides the opportunity for an infiltration basin as the final stage in the network.

6.16 At this stage, the required theoretical infiltration storage volume has been calculated assuming a typical sandy loam (slightly clayey sand) infiltration coefficient of $1x10^{-5}$ m/s (0.036 m/hr) based on Table 25.1 of the CIRIA SuDS Manual 2015 Part E Supporting Guidance. The calculation is conservative since it does not account for the upstream SuDS. The resulting volumes are summarised in **Table 3**. Storage would be distributed throughout the SuDs network, as close to the source as possible.

Table 3: Infiltration storage volume requirements

Return Period + CCA	Assumed Infiltration Coefficient (m/hr)	Storage Volume (m^3)
30 year	0.036	211 to 730
100 year + 40%	0.036	388 to 1273

Option B – Discharge to watercourse

6.17 Since the land ownership extends to the edge of the watercourse in several locations, and this is at a lower level than the developable area, a piped outfall is expected to be a feasible option. This would be subject to an Environmental Permit (formally Flood Defence Consent) from the EA, or alternatively, the developer may register for FRA12 exemption for an outfall less than 300mm diameter provided that the EA headwall works conditions are met. The outfall is likely to require a flap valve, and the effects of downstream water levels due to

ARUN DISTRICT COUNCIL WA/80/21/OUT

river flooding may need to be taken into account by detailed hydraulic modelling as part of the drainage design.

6.18 In accordance with the Non-statutory Technical Standards for Sustainable Drainage Systems, greenfield development is required to restrict the proposed peak discharge rates to the equivalent peak greenfield runoff rates for the 1 in 1 year and 1 in 100-year rainfall events. The greenfield runoff rates have been calculated based on the Institute of Hydrology Report 124 (IH124) method, and are contained in Appendix C and **Table** 4 below.

6.19 It is envisaged that the proposed landscaping in the eastern area will lead to a natural runoff reduction from the open space, however, this has not been quantified since these areas do not form part of the proposed drainage strategy.

6.20 In accordance with the Sewerage Sector Guidance Appendix C, Section C7.12, Clause 3c, static flow controls may have a minimum opening size of 50mm if the upstream system will prevent debris from entering the system. Where the upstream system cannot prevent debris from entering the system, the guidance states that the minimum opening size at the flow control for a static device should be 100mm.

6.21 Although permeable paving is suggested in private drives and shared surfaces, it is likely that the estate roads will be constructed to an impermeable specification to enable adoption by the local highway authority. As such, the use of traditional gullies to drain the estate roads provides a pathway for the ingress of gross solids and debris into the below ground drainage system.

6.22 As discussed further in the report, the strategy for maintenance of the below ground drainage system is to offer the system for adoption by Southern Water. Southern Water are very likely to request that the below ground drainage system adheres to the Sewerage Sector Guidance Appendix C and, therefore, a 100mm opening at the flow control device has been suggested for use in this surface water drainage system, with estimated discharge rates as **Table** 4 below.

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Table 4: Summary of greenfield runoff rates and proposed discharge rates

Return Period + CCA	Existing Greenfield Rate (l/s/ha)	Equivalent Greenfield Discharge Rate based on 1.32ha contributing area (l/s)	Discharge Rate based on 100mm minimum flow control opening
1 year	1.76	2.32	5.2
Q_{BAR}	2.07	2.73	
30 year	4.76	6.28	5.7
100 year	6.60	8.71	6.0
100 year + 40%			6.4

6.23 The estimated discharge rate from the surface water drainage system exceeds the equivalent greenfield rate for 1 in 1 year and Q_{BAR} storm events, however it is less than the equivalent 1 in 30 year, 1 in 100 year and 1 in 100 year + 40% climate change storm events.

6.24 Using the proposed discharge rates associated with a minimum 100mm opening at the flow control device, the attenuation storage volumes shown in **Table 5** have been calculated to provide peak flow restriction, with calculations provided in Appendix C.

Table 5: Attenuation storage volume requirements

Return Period + CCA	Storage Volume (m^2)
30 year	495 to 740
100 year + 40%	1038 to 1379

Treatment and Long Term Storage Volumes

6.25 In accordance with SuDS best practice, treatment storage is provided for the 'first flush' of runoff since this initial portion of surface water carries the highest pollutant load from impervious surfaces. Long term storage is provided where the change in land use and surface type would otherwise result in a significant increase in runoff volume, and is required to meet the Non-statutory Technical Standards for Sustainable Drainage Systems relating to volume control. The volume requirements for both types of storage have been calculated based on the EA Rainfall Runoff Management for Developments report, as summarised in **Table 6**, with calculations given in Appendix C. Treatment storage will be provided throughout SuDS components, with a focus on source control and vegetation uptake during detailed design, whereas long term storage will predominantly be contained behind swales check dams and within the pond below the outfall level.

ARUN DISTRICT COUNCIL WA/80/21/OUT

Table 6; Treatment and Long Term storage volume requirements

Type of Storage	Storage Volume (m^2)
Treatment	20
Long Term	468

Site Control Volume Allocation

6.26 The required storage volumes identified in the preceding sections have been allocated between the site control SuDS, to determine suitable footprints within the masterplan. As shown on the SuDS Plan in Appendix B, this would be focussed predominantly within several large open space areas. At this stage the masterplan is not sufficiently developed to define the storage available in the upstream SuDS source control strategy, hence the site control schematic design proposed.

6.27 Compared to the existing site levels, a balanced approach to earthworks would be utilised to form appropriate levels of attenuation storage, with buildings and roads set at levels above the adjacent SuDS features.

6.28 Development of the drainage design should incorporate detailed modelling of the cascading linkages between SuDS storage components to refine the volume provision throughout the network, leading to a more efficient overall solution. Suitable freeboard will need to be incorporated into the design of major storage components.

Exceedance Flows

6.29 In the event that the drainage system is inundated by a storm of greater magnitude than the design rainfall, the capacity of the system could be exceeded. The uncertainties posed by climate change place further importance on this aspect of the design. Routes for exceedance flows are ultimately determined by the site layout and levels, particularly features such as road gradients, kerbs or slopes.

6.30 Indicative exceedance flow routes are shown on the SuDS Plan in Appendix B. This provides guidance for the site design to provide surface falls and direct flows away from properties. It is expected that roads and open space will direct exceedance flow towards low points in the SuDS storage network. Proposed dwellings should be slightly elevated above exceedance flow routes to provide protection; this is typically achieved by footpaths and driveways falling away from thresholds towards the road kerb.

ARUN DISTRICT COUNCIL WA/80/21/OUT

Water Quality

6.31 The proposed SuDS will provide treatment for potential runoff pollutants prior to discharge. The level of treatment required is dependent on the pollution hazard level of the development and the sensitivity of the receiving waters.

6.32 The site does not lie within any Source Protection Zones or Nitrate Vulnerable Zones, therefore, does not require any particular water quality treatment measures. The water quality treatment criteria have been determined based on the CIRIA SuDS Manual. The appraisal of the site's characteristics and relevant SuDS components is presented below, demonstrating that the hazard indices have been met by the proposed mitigation indices.

Minimum water quality management requirements for discharges to receiving surface waters and groundwater (SuDS Manual, 2015, Table 4.3)

Land use	**Pollution hazard level**	**Requirement for discharge to surface waters and groundwater**
Residential roofs	Very low	Removal of gross solids and sediments only
Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, home zones, general access roads)	Low	Simple index approach

Steps in the simple index approach (SuDS Manual, 2015, Box 26.2):

1. *Allocate suitable pollution hazard indices for the proposed land use*
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*

Pollution hazard indices for different land use classifications (SuDS Manual, 2015, Table 4.3)

Land use	**Pollution hazard level**	**Total suspended solids TSS**	**Metals**	**Hydrocarbons**
Residential roofs	Very low	0.2	0.2	0.05
Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, home zones, general access roads)	Low	0.5	0.4	0.4

Indicative SuDS mitigation indices for discharges to surface waters (SuDS Manual, 2015, Table 26.3)

Type of SuDS component	**TSS**	**Metals**	**Hydrocarbons**
Swale	0.5	0.6	0.6
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5

Indicative SuDS mitigation indices for discharges to groundwater (SuDS Manual, 2015, Table 26.4)

Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates	**TSS**	**Metals**	**Hydrocarbons**
A layer of dense vegetation underlain by a soil	0.6	0.5	0.6

with good contaminant attenuation potential of at least 300 mm in depth (i.e. existing soils below partial infiltration SuDS features)			

Maintenance Plan

6.33 It is prudent as part of the planning application to consider the future maintenance and operation of SuDS, including the continued realisation of any non-drainage related benefits such as visual amenity, habitat and biodiversity. This section outlines the maintenance arrangements and the requirements for key SuDS components.

Management Arrangements

6.34 **Developer Maintenance**; because the proposals are for residential dwellings which it is anticipated would be sold on a freehold basis, it is improbable that the developer/site owner will be in a position to undertake maintenance of SuDS in perpetuity. Should the developer wish to retain responsibility for the maintenance of SuDS, the Local Authority would require details of how this future maintenance is to be funded without imposing unfair charges on owners/occupiers in the associated planning application.

6.35 **Service Management Companies;** Responsibility for maintenance of drainage systems could be subcontracted and included within the responsibilities of a service management company, as is often the case for the management of public spaces within new developments. Funding for SuDS maintenance would be included within the regular maintenance fees payable by the owners/occupiers. The developer is responsible for demonstrating that there is a binding requirement on owners/occupiers to pay the required fee, common for provision of an agreement to be secured by planning condition. It is proposed that use of a service management company would be most suitable for this development.

6.36 **Local Authority**; The LLFA may be open to adopting SuDS basins in open spaces. This could enable more economical and consistent maintenance of landscape and surface drainage features across the administrative area compared to individual development arrangements. For this reason, it is recommended that the developer engage with the local authority to explore this option at the earliest opportunity following outline planning consent.

6.37 **Water and Sewage Companies;** Were the developer to enter into agreement with Southern Water to adopt drainage assets in their capacity as drainage undertaker, these would become water company assets and maintenance costs would be covered by the surface

ARUN DISTRICT COUNCIL WA/80/21/OUT

water charge element of water bills. This could also involve the water company building the drainage system or elements of it, funded by the developer. It is envisaged that this approach is more likely to include pipes, chambers and headwalls, rather than open, landscaped SuDS features.

6.38 **The preferred adoption strategy** is for above ground 'green' SuDS in open space to be adopted by the local authority or placed under the responsibility of a service management company, and for below ground pipework and chambers to be adopted by Southern Water. If permeable paving is incorporated into the scheme this may need to be part of a service management company maintenance agreement since it is unlikely to be unacceptable for adoption by the Highways Authority.

Key Component Requirements

6.39 To ensure that SuDS components operate efficiently over the lifetime of the development it is fundamental that routine maintenance duties are undertaken. The areas of the site drainage system which require regular maintenance are those where silt and debris accumulate, limiting the storage or conveyance function of individual components, which in turn exacerbates the probability of drainage system failure. Regular maintenance requirements broadly relate to the following components:

- Swales
- Permeable Paving
- Detention Basin
- Pond
- Flow Control

6.40 The provision of the final maintenance schedule will in the first instance be reliant on the type of SuDS ultimately incorporated into the scheme, and subsequently matters such as a legal agreement for maintenance funding in perpetuity. While the provision of a detailed SuDS management/maintenance schedule should be secured through planning condition, a typical example is outlined below (including **Table 7**, **Table 8** and **Table 9**) for each of the key components. Ultimately, the developer is responsible for ensuring that full instructions for maintenance, along with the details of any parts that may need to be replaced, are provided to the appropriate person(s).

ARUN DISTRICT COUNCIL WA/80/21/OUT

Table 7: Permeable Paving Maintenance Requirements

Maintenance Schedule	Required Action	Typical frequency
Regular Maintenance	Remove litter and debris	Monthly (or as required)
	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this is most likely to collect the most sediment
Occasional Maintenance	Stabilise and mow contributing adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required, once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving.	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 hours after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Table 8: Basin Maintenance Requirements

Maintenance Schedule	Required Action	Typical frequency
Regular Maintenance	Inspect areas operating incorrectly and remedy	Monthly for three months, then annually
	Remove debris from the catchment	Monthly
	For infiltration systems, check filter surface for blockage and remove/replace as necessary	Annually
	Remove sediment from pre-treatment structures	Annually or as required
Remedial Action	Repair or rehabilitate inlets, outlets and overflows	Annually or as required
Monitoring	Inspect all inlets, outlets and over-flows	Annually
	Survey basin for sediment build-up and remove	Every 5 years or as required

Table 9: Swales Maintenance Requirements

Type	Required Action	Typical frequency
Routine maintenance	Litter and debris removal	Monthly
	Grass cutting	Monthly or as required
	Other vegetation/weeds	Monthly or as required
Infrequent maintenance	Check for poor growth or leaf litter	Annually
	Reseed and replant where required	Annually
Corrective maintenance	Repair erosion or other damage by re-turfing or re-seeding	As required
	Level uneven surfaces and reinstate design levels.	As required
	Remove build-up of sediments where hydraulic performance is affected.	As required
	Scarify and spike topsoil layer to improve infiltration, break up silt deposits and prevent compaction of soil surface.	As required

6.41 For the flow control chamber, it is recommended that one month after construction the chamber should be inspected, preferably after a period of rainfall. This will involve removing the cover and secondary cover and checking that water flows through the device. A visual check will be carried out on the debris guard or trash screen, with any debris removed. Thereafter inspections should be carried out monthly for three months and then annually, with cleaning if required.

7.0 Foul Water Drainage Strategy

7.1 Existing foul water infrastructure is present within Walberton and, in particular, in Yapton Lane to the west of the site. Cover levels of the manholes at the junction of Yapton Lane and The Street have been provided by Southern Water and are shown on the topographic survey. There is a discrepancy between the recorded and surveyed manhole cover levels, therefore the surveyed levels have been presumed to be more accurate. It is assumed that the invert levels provided by Southern Water relate to a depth below ground level, therefore the depths have been calculated from the Southern Water records and relayed to the surveyed cover levels to ascertain approximate invert levels at the proposed point of location.

7.2 Manhole invert levels at the southwest corner of the site (at the junction of Yapton Lane and The Street) are approximately 13.25mAOD to 13.30mAOD.

7.3 Based on the existing site levels and the elevated nature of the site from the receiving manholes at the junction of Yapton Lane and The Street it is strongly anticipated that a connection can be made by gravity to the public sewer network and no pumping of foul water will be required.

7.4 Southern Water have confirmed that foul water from the site would be directed to Lidsey Wastewater Treatment Works. Treated effluent from Lidsey Wastewater Treatment Works discharges to Lidsey Rife, which is a tributary of Adlingbourne Rife and reaches a confluence with the English Channel at Bognor Regis. Foul water from the site will not be directed towards the Chichester Harbour Nutrient Neutrality Zone.

7.5 Following planning approval, foul water drainage design should be based on the hydraulic requirements of the Sewerage Sector Guidance Appendix C and be offered for adoption by Southern Water.

ARUN DISTRICT COUNCIL WA/80/21/OUT

8.0 Conclusion

8.1 Residential development is proposed on the 7.6 ha on the edge of Walberton in West Sussex. Due to the nature of the residential land allocations process, the site layout and the number of dwelling houses are not yet fixed.

8.2 The proposed development is within Flood Zone 1, the low fluvial and tidal flood risk area. Following an appraisal of topographic and geological records, and additional flood mapping resources, the development site is also considered to have a low risk of flooding from surface water, sewers, groundwater and reservoirs. The proposed development is classified as 'More Vulnerable', and is therefore appropriate within Flood Zone 1.

8.3 The proposed SuDS strategy favours runoff interception and storage as close to the source as possible. The geology indicates that high permeability surface soils and moderate permeability superficial deposits are likely to be present on the site. Options for surface water disposal therefore include infiltration systems as well as an outfall to a watercourse east of the development, which could also act as an overflow with the SuDS providing partial infiltration of runoff. The watercourse outfall would be restricted to greenfield runoff rates, with the necessary swale and basin attenuation footprints allocated within the proposed indicative site plan.

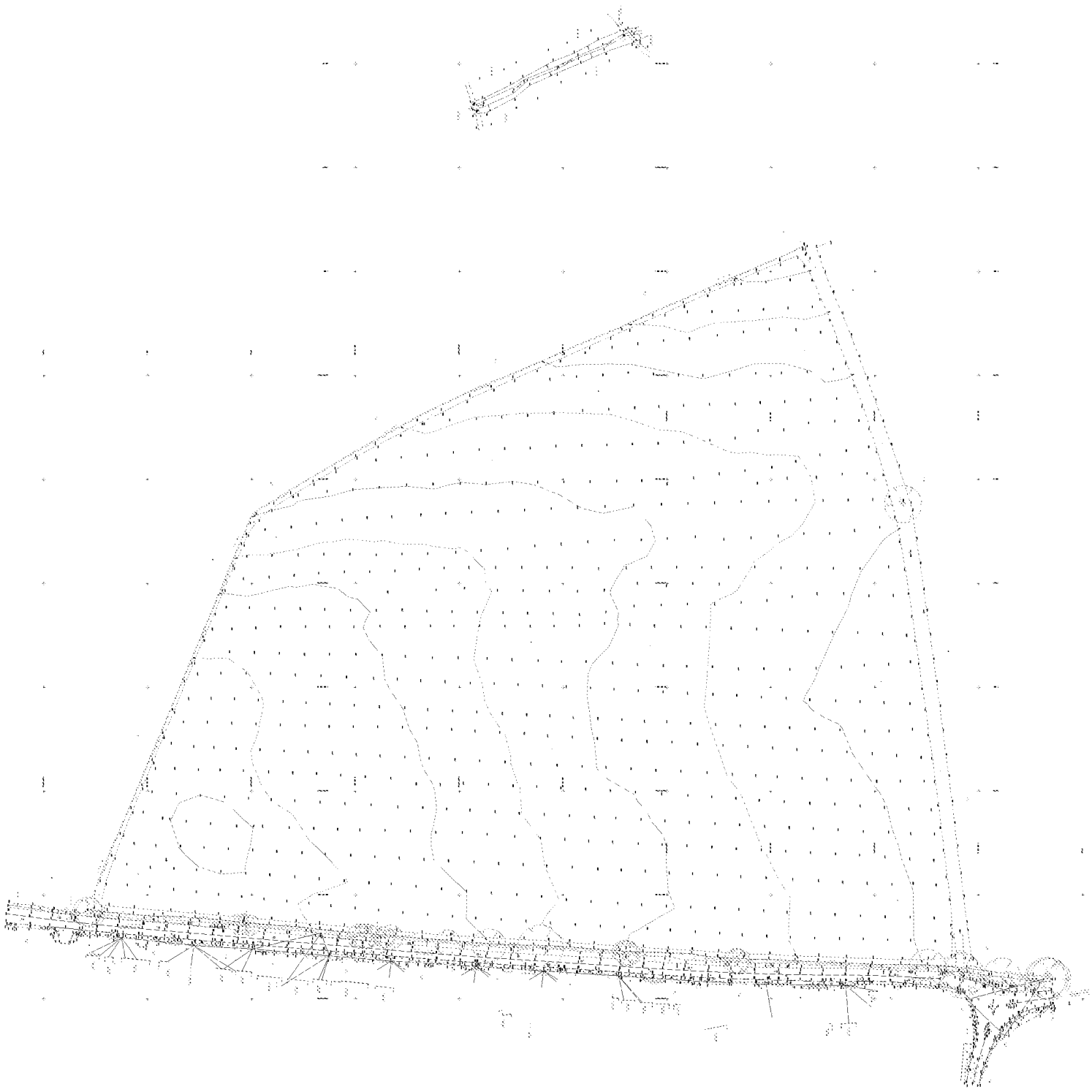
8.4 The preliminary drainage strategy presented for outline planning demonstrates that appropriate SuDS measures have been incorporated into the scheme and sets out how these will be developed prior to the reserved matters application. At this stage of the planning process, it is envisaged that the detailed drainage design of the final scheme would be secured by a planning condition attached to any planning permission granted and agreed with West Sussex County Council Lead Local Flood Authority, the Environment Agency, Southern Water and the LPA. This FRA demonstrates that a scheme can be developed that does not increase the risk of flooding to adjacent properties and development further downstream.

8.5 Foul water should be discharged to the public foul sewer in Yapton Lane. Foul sewerage would be directed to Lidsey Wastewater Treatment Works, from where treated effluent would be directed towards the English Channel and away from the Chichester Harbour Nutrient Neutrality Zone. Based on existing site levels and approximate existing public sewer invert levels, pumping of foul water should not be required.

ARUN DISTRICT COUNCIL WA/80/21/OUT

APPENDIX A:

TOPOGRAPHIC SURVEY



APPENDIX B:

INDICATIVE PROPOSED SITE LAYOUT AND SUDS PLAN

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INDICATIVE SITE LAYOUT

The scaling of this drawing cannot be assured

Revision		Date	Drn	Ckd
A	Layout amended	23.07.2021	AS	JC

- SITE BOUNDARY
  Area = 7.6 Hectares
- PROPOSED SITE ACCESS
- INDICATIVE DWELLINGS
- INDICATIVE PRIMARY STREET
- TRANSITION ZONE
- PRIVATE DRIVE
- PEDESTRIAN ROUTE
- EXISTING PLANTING
- PROPOSED PLANTING
- INFORMAL OPEN SPACE
- CENTRAL OPEN SPACE
- LEAP
- LAP
- HEALTH AND FITNESS SPACE
- INDICATIVE SUDS FEATURES
- REFUSE COLLECTION POINT

Project
Walberton
Sussex

Drawing Title
Indicative Site Layout

Date	Scale	Drawn by	Check by
28.10.2020	1:1250@A2	AS	JC

Project No	Drawing No	Revision
CAL020920	MP-05	A

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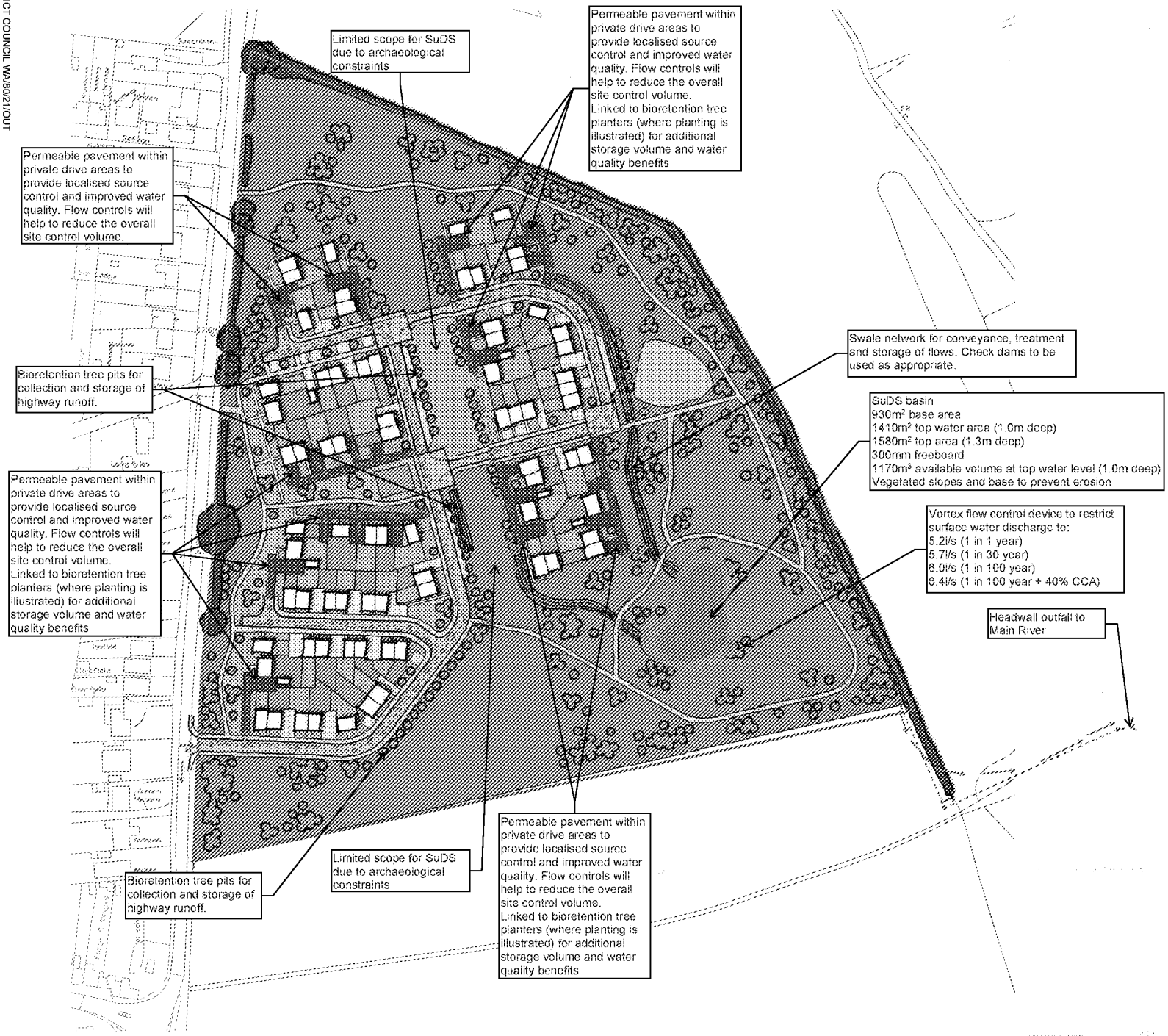

SuDS Basin

Permeable Pavement

Swale

Surface Water Piped Drainage

Exceedance Route

INDICATIVE SITE LAYOUT

FLOOD RISK UK

54 Blossom St
York YO24 1AP

Office: +44 (0)1904 628 258

Drawing Title:
SuDS Plan

Reference:
FRUK-WAL-SUDS-01-V1

Scale:
1:1250 @ A2

Date:
02/05/2021

Drawn:
MF

APPENDIX C:

SURFACE WATER DRAINAGE CALCULATIONS

HR Wallingford
Working with water

Greenfield runoff estimation for sites

Calculated by:	Matthew Freeman
Site name:	Land East of Yapton Lane
Site location:	Walberton

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 SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site coordinates

Latitude:	50.84553° N
Longitude:	0.61248° W

Reference:	Walberton
Date:	2021-07-21 12:59

Methodology	IH124

Site characteristics

Total site area (ha)	1.0

Methodology

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type

	Default	Edited
SOIL type	2	2
HOST class	---	---
SPR/SPRHOST	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm)	780	780
Hydrological region	7	7
Growth curve factor: 1 year	0.85	0.85
Growth curve factor: 30 year	2.3	2.3
Growth curve factor: 100 year	3.19	3.19

Notes:

(1) Is Q_{BAR} < 2.0 l/s/ha?

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consents are usually set at 5.0l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite may be a requirement for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Qbar (l/s)	2.07	2.07
1 in 1 year (l/s)	1.76	1.76
1 in 30 years (l/s)	4.76	4.76
1 in 100 years (l/s)	6.6	6.6

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool have been used to estimate storage volume requirements. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for use of the data in the design or operational characteristics of any drainage scheme.

4.3 Initial sizing of long term storage volume

Long term storage is to be provided to cater for the additional runoff caused by the development compared to the volume that would be contributed from the site in its greenfield state. This volume must be catered for as either infiltration storage or in storage with the ability to be discharged at a rate of less than 2 l/s/ha. Designing the drainage system with Long Term storage will result in less total storage being required than not providing LTS.

Discussion on the equation and practical provision of Long Term storage is provided in Chapter 7.

1.	Development area	(A)	1.32	ha	Excluding public open space which is not modified by the development
2.	Estimate of PIMP (percentage impermeable area)	(PIMP)	100	%	
3.	Impermeable area (A · PIMP/100)	(AP)		ha	All hard surfaces in the development
4.	Long Term storage factor	(LTF)	5		Storage volume per unit area per mm of rainfall (see Figure A10.1 or A10.2) see note 3.
5.	Rainfall depth	(RD)	70	mm	Rainfall depth for 100 year 6 hour event (Appendix 1 Figure A3.1).
6.	Long Term storage volume (RD · LTF · AP)	($LTVol_{100yr\ 6hr}$)	462	M^3	See note 2

Note 1 *Where Long Term storage is being discharged directly to the receiving water at 2 l/s/ha, the values for Q_{30} and Q_{100} for attenuation storage discharge rate should be reduced accordingly. If this is the case, the calculation for Attenuation storage should be based on (Q_{BAR}/A – 0.5) l/s/ha unless this reduces below a value of 1.0 l/s/ha, in which case 1.0 l/s/ha should be used.*

2 *LTF is defined such that the equation of item 6 uses rainfall depth in millimetres and area in hectares.*

3 *There is a choice of LTF factor based on the assumption as to whether the pervious area contributes to the 100 year runoff based on its SPR value. The conservative assumption would be to assume it does (Figure A10.1) unless the site is designed to minimise the runoff from green areas (Figure A10.2). 80% runoff is assumed to occur from pervious surfaces. Other options can be assumed working from first principles using the formulae in Chapter 7.*

ARUN DISTRICT COUNCIL WA/80/21/OUT

4.4 Initial sizing of Treatment storage volume

1. Development area	(A)	1.32	ha	Excluding public open space which is not modified by the development
2. Estimate of PIMP percentage impermeable area	(PIMP)	100	%	
3. Proportion of impervious area requiring Treatment storage	(β)	N/A		(see note 2)
4. Soil runoff coefficient	(SPR)	N/A		From the Wallingford Procedure WRAP map or FSR SOIL maps (Appendix 1, Figure A12.1)
5. 5 year / 60 minute rainfall depth	($M_5$60)		mm	5 year 60 min rainfall depth. From the Wallingford Procedure $M_5$60 map or FSR rainfall maps (Appendix 1, Figure A2.1).
6. Treatment volume 6.1 Treatment volume (England and Wales) T Vol = A.15.PIMP/100	(Tv)	19.8	m^3	Treatment volume is calculated using the formula See note 1
6.2 Treatment storage volume (Scotland and N. Ireland) T Vol = 9A.$M_5$60·(SPR/2 + (1 – SPR/2). β PIMP/100)	(Tv)		m^3	Treatment volume is calculated using the formula See note 1

Note 1 *The concept of treatment volume is to provide sufficient volume to provide partial treatment of the stormwater effluent. There are no specified water quality discharge criteria to comply with. Accepted best practice in Scotland is based on (CIRIA report C522, 2000) requiring 1 times Tv except in certain circumstances when up to 4 times Tv is needed. See SEPA guidance. Elsewhere in UK the volume equivalent to 15mm of rainfall is used.*
It should be noted that the emphasis on the importance of ponds to provide treatment has changed to some degree in favour of emphasising the need to use vegetative units to provide treatment or pre-treatment. This therefore has implications on treatment volume requirements and the need for flexibility in pond sizing.

2 *Compliance with the SuDS Manual or the National SuDS Standards, if different, in terms of providing a treatment sequence of 1, 2 or 3 treatment units, makes any rule of thumb for modifying the sizing of the treatment volume difficult. It is unlikely that a Tv of less than 10mm of rainfall runoff from impermeable areas draining to the pond would be acceptable.*

ARUN DISTRICT COUNCIL WA/80/21/OUT

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Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	40	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
1	0.174	5.00	18.400	79.950	-83.211	1.425
2	0.143	5.00	18.350	135.181	-68.591	1.831
3	0.143	5.00	17.500	158.053	-152.466	1.561
9	0.037	5.00	16.950	170.040	-200.163	3.100
4	0.110	5.00	16.700	51.025	-257.647	1.425
5	0.063	5.00	16.500	123.682	-260.011	1.952
6	0.144	5.00	17.200	71.725	-202.000	1.425
7	0.010	5.00	16.900	143.227	-205.708	1.602
8			16.800	159.293	-216.124	2.704
13	0.163	5.00	18.300	166.400	-60.941	1.425
14	0.012	5.00	18.250	211.264	-48.349	1.686
15	0.108	5.00	18.000	228.085	-58.628	1.642
16	0.050	5.00	17.600	246.060	-114.310	1.632
19			17.400	266.049	-182.606	1.931
10	0.064	5.00	17.100	195.589	-168.433	1.350
17	0.072	5.00	17.250	245.859	-170.505	1.350
18			17.250	254.007	-168.847	1.724
11			17.000	200.729	-189.648	1.468
12			17.000	250.477	-210.308	3.555
20			16.000	275.541	-207.562	2.639
21			15.200	366.157	-238.962	2.004

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ARUN DISTRICT COUNCIL WA/80/21/OUT

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
22			14.600	390.476	-288.858	2.337
22_OUT			2.100	466.369	-255.105	1.100

Links (Input)

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	57.133	0.600	16.975	16.594	0.381	150.0	225	5.89	50.0
1.001	2	3	86.938	0.600	16.519	15.939	0.580	150.0	300	7.03	50.0
1.002	3	9	49.180	0.600	15.939	15.447	0.492	100.0	300	7.55	50.0
2.000	4	5	72.695	0.600	15.275	14.548	0.727	100.0	225	5.93	50.0
2.001	5	8	56.517	0.600	14.548	14.171	0.377	150.0	225	6.81	50.0
2.002	8	9	19.242	0.600	14.096	14.000	0.096	200.0	300	7.10	50.0
3.000	6	7	71.598	0.600	15.775	15.298	0.477	150.0	225	6.12	50.0
3.001	7	8	19.147	0.600	15.298	14.897	0.401	47.7	225	6.29	50.0
1.003	9	12	81.074	0.600	13.850	13.445	0.405	200.0	450	8.49	50.0
4.000	10	11	21.829	0.600	15.750	15.532	0.218	100.0	150	5.36	50.0
4.001	11	12	53.867	0.600	15.532	14.993	0.539	100.0	150	6.26	50.0
5.000	13	14	46.508	0.600	16.875	16.564	0.311	150.0	225	5.73	50.0
5.001	14	15	19.713	0.600	16.564	16.433	0.131	150.0	225	6.04	50.0
5.002	15	16	58.511	0.600	16.358	15.968	0.390	150.0	300	6.80	50.0
5.003	16	18	55.113	0.600	15.968	15.601	0.367	150.0	300	7.52	50.0
6.000	17	18	8.315	0.600	15.900	15.751	0.149	55.8	150	5.10	50.0
5.004	18	19	18.284	0.600	15.526	15.469	0.057	320.8	375	7.82	50.0
5.005	19	20	26.700	0.600	15.469	15.020	0.449	59.5	375	8.01	50.0
1.004	12	20	25.214	0.600	13.445	13.361	0.084	300.0	450	8.85	50.0
1.005	20	21	96.902	0.600	13.361	13.196	0.165	581.2	150	12.75	50.0
1.006	21	22	55.507	0.600	13.196	12.263	0.933	59.5	150	13.46	50.0
1.007	22	22_OUT	83.060	0.600	12.263	1.000	11.263	7.4	150	13.83	50.0

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ARUN DISTRICT COUNCIL WA/80/21/OUT

Simulation Settings

Rainfall Methodology	FSR	Summer CV	0.750	Drain Down Time (mins)	240
FSR Region	England and Wales	Winter CV	0.840	Additional Storage (m³/ha)	20.0
M5-60 (mm)	20.000	Analysis Speed	Normal	Check Discharge Rate(s)	x
Ratio-R	0.300	Skip Steady State	x	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	10	0	100	0	10	0
30	0	10	0	100	40	10	0

Node 20 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	13.361	Product Number	CTL-SHE-0100-6400-2350-6400
Design Depth (m)	2.350	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	6.4	Min Node Diameter (mm)	1200

Node 20 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	14.700
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	930.0	0.0	1.300	1577.1	0.0

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ARUN DISTRICT COUNCIL WA/80/21/OUT

Results for 1 year +10% A Critical Storm Duration. Lowest mass balance: 63.76%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	11	17.094	0.119	24.6	0.3199	0.0000	OK
15 minute winter	2	11	16.662	0.143	43.0	0.2457	0.0000	OK
15 minute winter	3	11	16.096	0.157	61.8	0.3150	0.0000	OK
15 minute winter	9	11	14.984	1.134	128.0	0.2983	0.0000	SURCHARGED
15 minute winter	4	10	15.357	0.082	15.5	0.1395	0.0000	OK
15 minute winter	5	12	15.038	0.490	51.1	0.3454	0.0000	SURCHARGED
15 minute winter	6	10	15.887	0.112	20.3	0.2476	0.0000	OK
15 minute winter	7	11	15.379	0.081	21.0	0.0109	0.0000	OK
15 minute winter	8	11	15.100	1.004	42.6	0.0000	0.0000	SURCHARGED
15 minute winter	13	10	16.991	0.116	23.0	0.2925	0.0000	OK
15 minute winter	14	11	16.684	0.120	24.3	0.0188	0.0000	OK
15 minute winter	15	11	16.493	0.135	38.4	0.1953	0.0000	OK
15 minute winter	16	11	16.116	0.148	45.2	0.0995	0.0000	OK
15 minute winter	5.003:50%	11	15.933	0.149	46.6	0.3378	0.0000	OK
15 minute winter	19	12	15.585	0.116	56.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	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	23.7	1.114	0.561	1.2184	
15 minute winter	2	1.001	3	42.9	1.222	0.474	3.0637	
15 minute winter	3	1.002	9	60.6	1.637	0.546	1.8262	
15 minute winter	9	1.003	12	95.1	0.994	0.417	12.8456	
15 minute winter	4	2.000	5	15.0	0.934	0.288	1.8775	
15 minute winter	5	2.001	8	-27.9	1.058	-0.658	2.2477	
15 minute winter	6	3.000	7	19.7	1.226	0.466	1.1544	
15 minute winter	7	3.001	8	21.2	1.614	0.280	0.4852	
15 minute winter	8	2.002	9	40.5	1.050	0.517	1.3550	
15 minute winter	13	5.000	14	22.6	1.079	0.533	0.9752	
15 minute winter	14	5.001	15	24.1	1.116	0.570	0.4265	
15 minute winter	15	5.002	16	38.6	1.179	0.426	1.9149	
15 minute winter	16	5.003	5.003:50%	45.1	1.297	0.498	0.9587	
15 minute winter	16	5.003	18	46.0	1.316	0.507	0.9622	
15 minute winter	19	5.005	20	55.2	1.911	0.212	0.7708	

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ARUN DISTRICT COUNCIL WA/80/21/OUT

Results for 1 year +10% A Critical Storm Duration. Lowest mass balance: 63.76%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	10	10	15.826	0.076	9.1	0.0793	0.0000	OK
15 minute winter	17	10	15.968	0.068	10.2	0.0803	0.0000	OK
15 minute winter	18	11	15.703	0.177	54.8	0.0000	0.0000	OK
15 minute winter	11	11	15.606	0.074	9.0	0.0000	0.0000	OK
15 minute winter	4.001:50%	11	15.343	0.080	10.0	0.0000	0.0000	OK
600 minute winter	12	480	14.881	1.436	17.4	0.0000	0.0000	SURCHARGED
600 minute winter	20	480	14.881	1.520	25.4	176.6270	0.0000	SURCHARGED
600 minute winter	21	480	13.249	0.053	5.2	0.0000	0.0000	OK
600 minute winter	22	480	12.292	0.029	5.2	0.0000	0.0000	OK
600 minute winter	22_OUT	480	1.029	0.029	5.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	10	4.000	11	9.0	1.021	0.505	0.1919	
15 minute winter	17	6.000	18	10.1	1.299	0.424	0.0647	
15 minute winter	18	5.004	19	56.7	1.437	0.511	0.7257	
15 minute winter	11	4.001	4.001:50%	8.8	0.976	0.496	0.2469	
15 minute winter	11	4.001	12	10.1	1.045	0.566	0.2592	
600 minute winter	12	1.004	20	17.3	0.171	0.093	3.9950	
600 minute winter	20	Hydro-Brake®	21	5.2				
600 minute winter	21	1.006	22	5.2	1.350	0.226	0.2192	
600 minute winter	22	1.007	22_OUT	5.2	2.235	0.079	0.1943	239.3

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ARUN DISTRICT COUNCIL WA/80/21/OUT

Results for 30 year +10% A Critical Storm Duration. Lowest mass balance: 63.76%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	12	17.562	0.587	60.1	1.5778	0.0000	SURCHARGED
15 minute winter	2	11	17.005	0.486	100.3	0.8321	0.0000	SURCHARGED
15 minute winter	3	11	16.399	0.460	143.8	0.9243	0.0000	SURCHARGED
15 minute winter	9	12	15.394	1.544	234.8	0.4060	0.0000	SURCHARGED
15 minute winter	4	12	16.316	1.041	38.0	1.7669	0.0000	SURCHARGED
15 minute winter	5	12	16.045	1.497	59.0	1.0556	0.0000	SURCHARGED
15 minute winter	6	12	16.121	0.346	49.6	0.7688	0.0000	SURCHARGED
15 minute winter	7	12	15.672	0.374	49.6	0.0505	0.0000	SURCHARGED
15 minute winter	8	12	15.532	1.436	91.7	0.0000	0.0000	SURCHARGED
15 minute winter	13	11	17.344	0.469	56.4	1.1814	0.0000	SURCHARGED
15 minute winter	14	11	16.847	0.283	56.2	0.0441	0.0000	SURCHARGED
15 minute winter	15	11	16.599	0.241	91.0	0.3479	0.0000	OK
15 minute winter	16	12	16.293	0.325	106.8	0.2183	0.0000	SURCHARGED
15 minute winter	5.003:50%	12	16.067	0.283	106.6	1.2186	0.0000	OK
15 minute winter	19	11	15.650	0.181	134.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	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	51.1	1.312	1.206	2.2722	
15 minute winter	2	1.001	3	94.5	1.417	1.044	6.1221	
15 minute winter	3	1.002	9	132.8	1.887	1.195	3.3860	
15 minute winter	9	1.003	12	235.1	1.484	1.031	12.8456	
15 minute winter	4	2.000	5	30.9	1.114	0.595	2.8912	
15 minute winter	5	2.001	8	48.5	1.219	1.144	2.2477	
15 minute winter	6	3.000	7	46.2	1.419	1.091	2.8475	
15 minute winter	7	3.001	8	44.6	1.814	0.591	0.7615	
15 minute winter	8	2.002	9	92.0	1.306	1.174	1.3550	
15 minute winter	13	5.000	14	52.3	1.316	1.236	1.8533	
15 minute winter	14	5.001	15	56.0	1.413	1.322	0.7524	
15 minute winter	15	5.002	16	90.7	1.387	1.001	3.8305	
15 minute winter	16	5.003	5.003:50%	103.0	1.528	1.137	1.9188	
15 minute winter	16	5.003	18	104.5	1.585	1.153	1.8132	
15 minute winter	19	5.005	20	126.0	2.397	0.485	1.4108	

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ARUN DISTRICT COUNCIL WA/80/21/OUT

Results for 30 year +10% A Critical Storm Duration. Lowest mass balance: 63.76%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	10	11	16.098	0.348	22.2	0.3648	0.0000	SURCHARGED
15 minute winter	17	10	16.031	0.131	24.9	0.1541	0.0000	OK
15 minute winter	18	11	15.814	0.288	126.3	0.0000	0.0000	OK
15 minute winter	11	12	15.826	0.294	19.9	0.0000	0.0000	SURCHARGED
15 minute winter	4.001:50%	12	15.496	0.233	21.8	0.0000	0.0000	SURCHARGED
720 minute winter	12	705	15.219	1.774	31.6	0.0000	0.0000	SURCHARGED
720 minute winter	20	705	15.219	1.858	46.3	550.2306	0.0000	SURCHARGED
720 minute winter	21	705	13.252	0.056	5.7	0.0000	0.0000	OK
720 minute winter	22	705	12.293	0.030	5.7	0.0000	0.0000	OK
720 minute winter	22_OUT	705	1.030	0.030	5.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	10	4.000	11	19.9	1.170	1.121	0.3843	
15 minute winter	17	6.000	18	24.6	1.537	1.033	0.1385	
15 minute winter	18	5.004	19	134.2	1.859	1.208	1.3104	
15 minute winter	11	4.001	4.001:50%	19.0	1.127	1.070	0.4742	
15 minute winter	11	4.001	12	21.4	1.218	1.206	0.4589	
720 minute winter	12	1.004	20	31.5	0.199	0.170	3.9950	
720 minute winter	20	Hydro-Brake®	21	5.7				
720 minute winter	21	1.006	22	5.7	1.386	0.249	0.2343	
720 minute winter	22	1.007	22_OUT	5.7	2.299	0.087	0.2074	301.2

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Results for 100 year +10% A Critical Storm Duration. Lowest mass balance: 63.76%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	12	18.400	1.425	73.9	4.0325	0.0000	FLOOD RISK
15 minute winter	2	12	17.853	1.334	117.5	2.2858	0.0000	SURCHARGED
15 minute winter	3	12	16.898	0.959	172.0	1.9283	0.0000	SURCHARGED
15 minute winter	9	12	15.769	1.919	294.7	0.5048	0.0000	SURCHARGED
15 minute summer	4	11	16.700	1.425	46.6	2.9036	0.0000	FLOOD RISK
15 minute summer	5	12	16.500	1.952	60.1	1.4461	0.0000	FLOOD RISK
15 minute winter	6	12	16.944	1.169	64.1	2.5950	0.0000	FLOOD RISK
15 minute winter	7	12	16.212	0.914	54.8	0.1234	0.0000	SURCHARGED
15 minute winter	8	12	15.989	1.893	115.8	0.0000	0.0000	SURCHARGED
15 minute winter	13	12	18.107	1.232	72.8	3.1047	0.0000	FLOOD RISK
15 minute winter	14	12	17.437	0.873	65.1	0.1362	0.0000	SURCHARGED
15 minute winter	15	12	17.101	0.743	107.9	1.0745	0.0000	SURCHARGED
15 minute winter	16	12	16.555	0.587	126.3	0.3937	0.0000	SURCHARGED
15 minute winter	5.003:50%	12	16.204	0.419	129.9	2.6745	0.0000	SURCHARGED
15 minute winter	19	12	15.674	0.205	165.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	61.5	1.545	1.451	2.2722	
15 minute winter	2	1.001	3	114.1	1.621	1.260	6.1221	
15 minute winter	3	1.002	9	169.2	2.403	1.523	3.4632	
15 minute winter	9	1.003	12	294.8	1.861	1.293	12.8456	
15 minute summer	4	2.000	5	37.0	1.177	0.711	2.8912	
15 minute summer	5	2.001	8	58.0	1.459	1.370	2.2477	
15 minute winter	6	3.000	7	51.4	1.401	1.215	2.8475	
15 minute winter	7	3.001	8	54.8	1.765	0.726	0.7615	
15 minute winter	8	2.002	9	115.8	1.645	1.479	1.3550	
15 minute winter	13	5.000	14	60.9	1.533	1.439	1.8533	
15 minute winter	14	5.001	15	66.2	1.665	1.564	0.7840	
15 minute winter	15	5.002	16	105.6	1.500	1.166	4.1203	
15 minute winter	16	5.003	5.003:50%	125.2	1.778	1.383	1.9405	
15 minute winter	16	5.003	18	124.7	1.772	1.377	1.8841	
15 minute winter	19	5.005	20	151.8	2.507	0.584	1.6303	

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ARUN DISTRICT COUNCIL WA/80/21/OUT

Results for 100 year +10% A Critical Storm Duration. Lowest mass balance: 63.76%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	10	12	16.615	0.865	28.6	0.9070	0.0000	SURCHARGED
15 minute winter	17	10	16.166	0.266	32.1	0.3132	0.0000	SURCHARGED
15 minute winter	18	10	15.840	0.314	151.4	0.0000	0.0000	OK
15 minute winter	11	12	16.213	0.681	24.8	0.0000	0.0000	SURCHARGED
15 minute winter	4.001:50%	12	15.719	0.457	26.3	0.0000	0.0000	SURCHARGED
960 minute winter	12	930	15.388	1.943	32.4	0.0000	0.0000	SURCHARGED
960 minute winter	20	930	15.388	2.027	47.4	757.5073	0.0000	SURCHARGED
960 minute winter	21	930	13.253	0.057	6.0	0.0000	0.0000	OK
960 minute winter	22	930	12.294	0.031	6.0	0.0000	0.0000	OK
960 minute winter	22_OUT	930	1.031	0.031	6.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	10	4.000	11	24.8	1.406	1.394	0.3843	
15 minute winter	17	6.000	18	31.6	1.792	1.323	0.1449	
15 minute winter	18	5.004	19	165.4	2.083	1.489	1.4545	
15 minute winter	11	4.001	4.001:50%	23.2	1.317	1.305	0.4742	
15 minute winter	11	4.001	12	26.0	1.476	1.464	0.4674	
960 minute winter	12	1.004	20	32.3	0.204	0.174	3.9950	
960 minute winter	20	Hydro-Brake®	21	6.0				
960 minute winter	21	1.006	22	6.0	1.402	0.259	0.2412	
960 minute winter	22	1.007	22_OUT	6.0	2.326	0.091	0.2135	387.7

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ARUN DISTRICT COUNCIL WA/80/21/OUT

Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 63.76%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	18.400	1.425	103.5	9.8196	0.0000	FLOOD RISK
15 minute summer	2	10	18.350	1.831	147.4	5.0031	0.0000	FLOOD RISK
15 minute summer	3	11	17.500	1.561	213.2	4.2025	0.0000	FLOOD RISK
15 minute winter	9	12	16.440	2.590	383.2	0.6812	0.0000	SURCHARGED
15 minute summer	4	10	16.700	1.425	65.3	5.7222	0.0000	FLOOD RISK
15 minute summer	5	10	16.500	1.952	82.2	2.4039	0.0000	FLOOD RISK
15 minute summer	6	10	17.200	1.425	85.4	5.3634	0.0000	FLOOD RISK
15 minute summer	7	12	16.900	1.602	70.4	0.2288	0.0000	FLOOD RISK
15 minute winter	8	12	16.800	2.704	153.3	0.0000	0.0000	FLOOD RISK
15 minute summer	13	10	18.300	1.425	97.0	6.5381	0.0000	FLOOD RISK
15 minute summer	14	11	18.250	1.686	82.7	0.2856	0.0000	FLOOD RISK
15 minute winter	15	12	18.000	1.642	143.3	2.4295	0.0000	FLOOD RISK
15 minute winter	16	12	17.067	1.098	167.5	0.7371	0.0000	SURCHARGED
15 minute winter	5.003:50%	13	16.454	0.670	172.0	6.8349	0.0000	SURCHARGED
15 minute winter	19	12	15.707	0.238	195.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	76.8	1.930	1.813	2.2722	
15 minute summer	2	1.001	3	138.2	1.963	1.526	6.1221	
15 minute summer	3	1.002	9	204.9	2.910	1.844	3.4632	
15 minute winter	9	1.003	12	382.6	2.415	1.678	12.8456	
15 minute summer	4	2.000	5	49.3	1.241	0.949	2.8912	
15 minute summer	5	2.001	8	77.6	1.952	1.833	2.2477	
15 minute summer	6	3.000	7	65.8	1.654	1.554	2.8475	
15 minute summer	7	3.001	8	69.1	1.787	0.916	0.7615	
15 minute winter	8	2.002	9	153.6	2.181	1.961	1.3550	
15 minute summer	13	5.000	14	77.1	1.938	1.820	1.8533	
15 minute summer	14	5.001	15	84.6	2.127	1.998	0.7840	
15 minute winter	15	5.002	16	140.4	1.994	1.551	4.1203	
15 minute winter	16	5.003	5.003:50%	165.5	2.350	1.827	1.9405	
15 minute winter	16	5.003	18	159.9	2.272	1.766	1.9208	
15 minute winter	19	5.005	20	195.2	2.645	0.751	1.9710	

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ARUN DISTRICT COUNCIL WA/80/21/OUT

Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 63.76%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	10	11	17.100	1.350	38.3	1.8460	0.0000	FLOOD RISK
15 minute winter	17	10	16.419	0.519	45.1	0.6098	0.0000	SURCHARGED
15 minute winter	18	12	15.871	0.345	195.0	0.0000	0.0000	OK
15 minute winter	11	12	17.000	1.468	32.9	0.0000	0.0000	FLOOD RISK
15 minute winter	4.001:50%	13	16.266	1.003	33.7	0.0000	0.0000	SURCHARGED
1440 minute winter	12	1380	15.699	2.254	33.4	0.0000	0.0000	SURCHARGED
1440 minute winter	20	1380	15.699	2.338	49.1	1177.8130	0.0000	SURCHARGED
1440 minute winter	21	1380	13.255	0.059	6.4	0.0000	0.0000	OK
1440 minute winter	22	1380	12.295	0.032	6.4	0.0000	0.0000	OK
1440 minute winter	22_OUT	1380	1.032	0.032	6.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	10	4.000	11	31.7	1.802	1.787	0.3843	
15 minute winter	17	6.000	18	43.8	2.487	1.837	0.1449	
15 minute winter	18	5.004	19	195.2	2.121	1.757	1.6460	
15 minute winter	11	4.001	4.001:50%	29.3	1.664	1.650	0.4742	
15 minute winter	11	4.001	12	32.5	1.844	1.828	0.4742	
1440 minute winter	12	1.004	20	33.4	0.211	0.180	3.9950	
1440 minute winter	20	Hydro-Brake®	21	6.4				
1440 minute winter	21	1.006	22	6.4	1.428	0.277	0.2531	
1440 minute winter	22	1.007	22_OUT	6.4	2.372	0.097	0.2238	565.9

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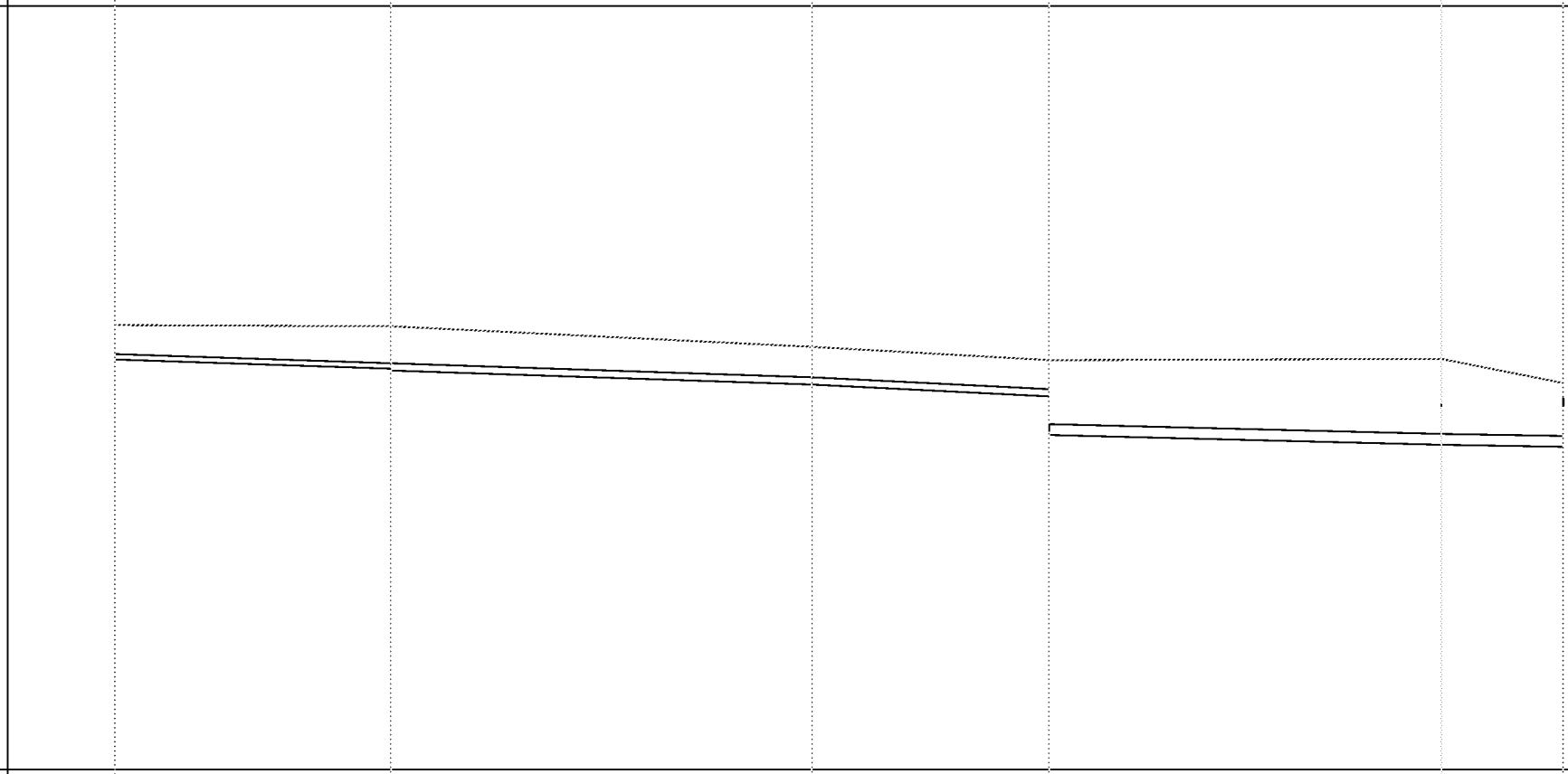
ARUN DISTRICT COUNCIL WORKING COPY



Node Name	1		2		3		9		12	20
Link Name	1.000		1.001		1.002		1.003		1.004	
Section Type	225mm		300mm		300mm		450mm		450mm	
Slope (1:X)	150.0		150.0		100.0		200.0		300.0	
Cover Level (m)	18.400		18.350		17.500		16.950		17.000	16.000
Invert Level (m)	16.975	16.594	16.519	15.939	15.939	15.447	13.850	13.445	13.445	13.361
Length (m)	57.133		86.938		49.180		81.074		25.214	

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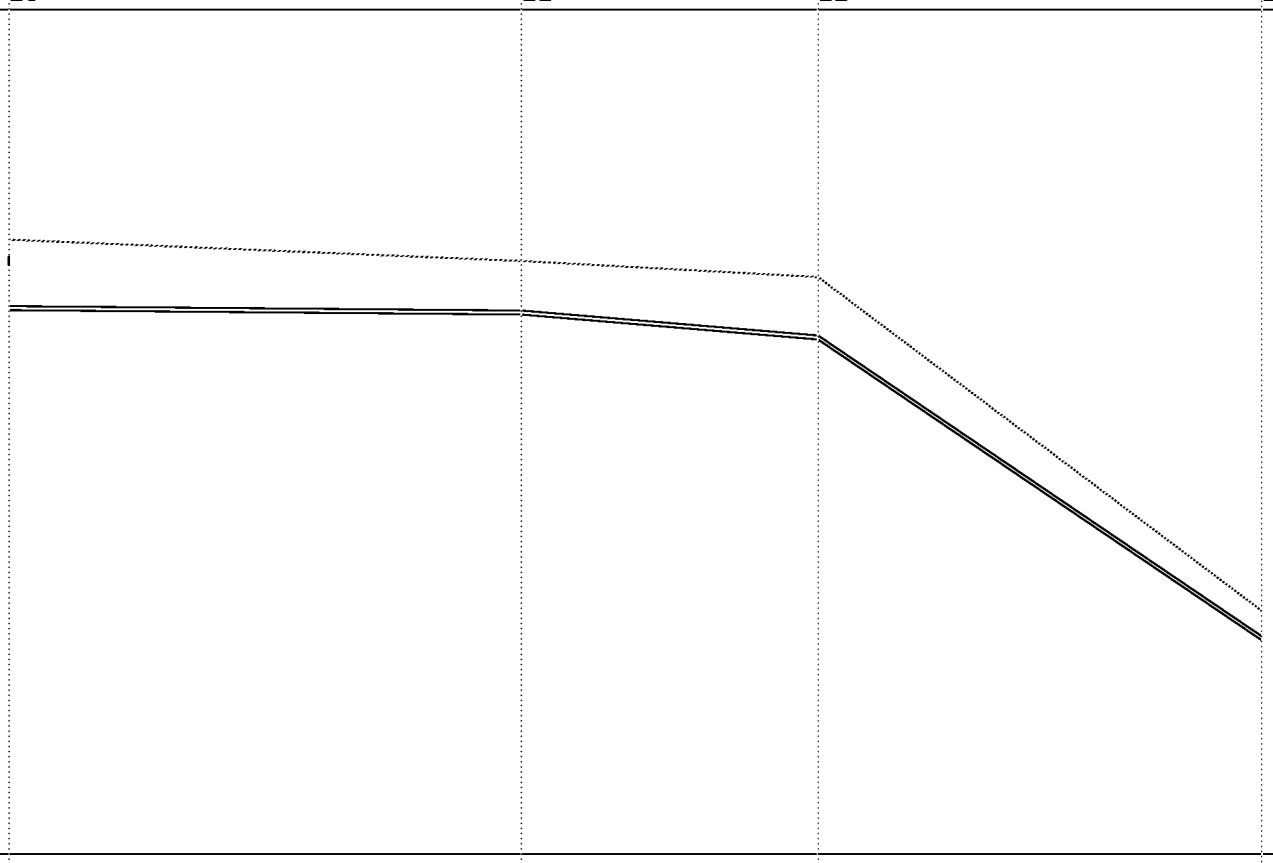
Node Name	20	21	22	22_OUT
A3 drawing Hor Scale 1000 Ver Scale 200 Datum (m) -7.000				
Link Name	1.005	1.006	1.007	
Section Type	150mm	150mm	150mm	
Slope (1:X)	581.2	59.5	7.4	
Cover Level (m)	16.000	15.200	14.600	2.100
Invert Level (m)	13.361	13.196 / 13.196	12.263 / 12.263	1.000
Length (m)	95.902	55.507	83.060	

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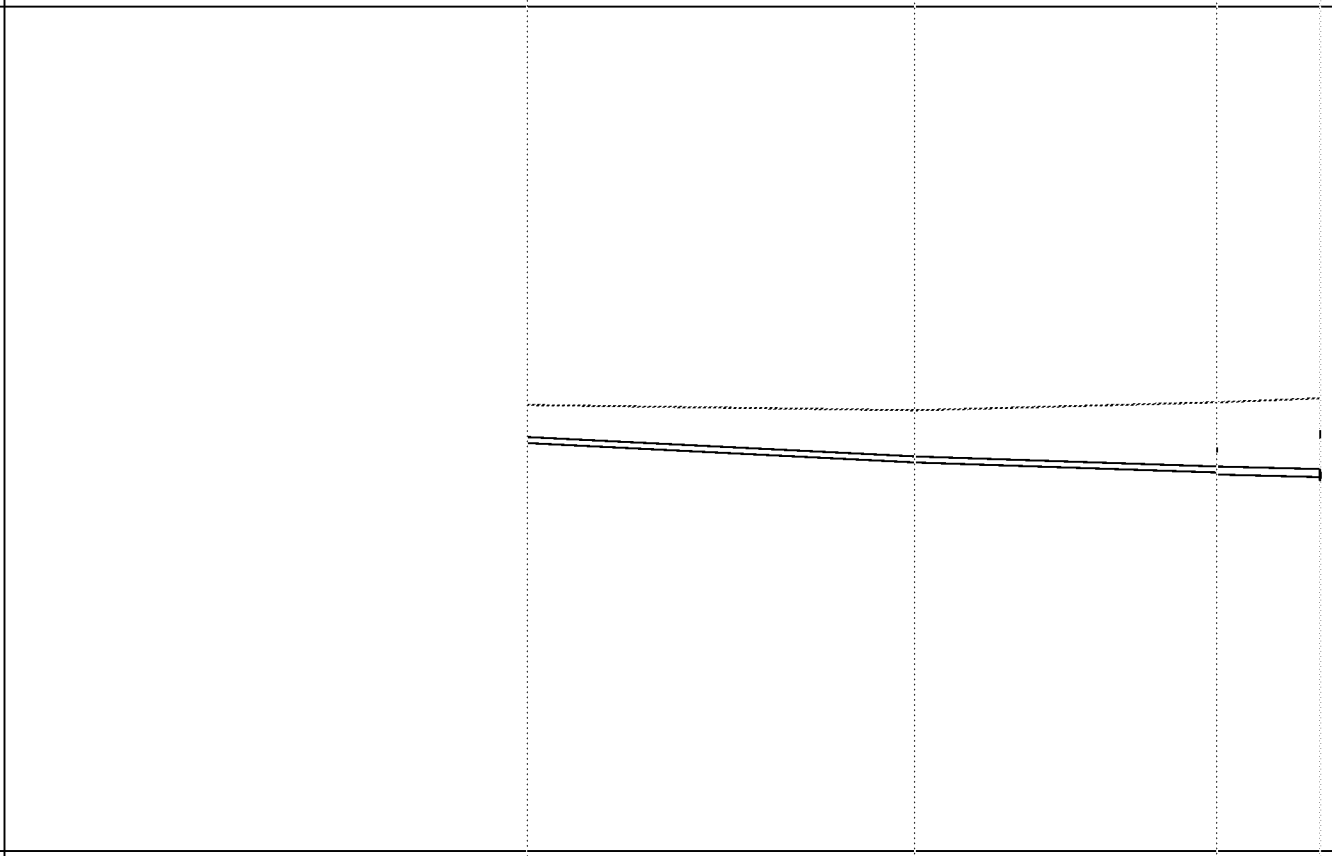
ARUN DISTRICT COUNCIL WA/80/21/OUT

Node Name		4		5		8	9
A3 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 0.000							
Link Name			2.000		2.001	2.002	
Section Type			225mm		225mm	300mm	
Slope (1:X)			100.0		150.0	200.0	
Cover Level (m)		16.700		16.500		16.800	16.950
Invert Level (m)		15.275	14.548	14.548	14.171	14.096	14.000
Length (m)			72.695		56.517	19.242	

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Node Name		6		7	8
A3 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 0.000					
Link Name			3.000	3.001	
Section Type			225mm	225mm	
Slope (1:X)			150.0	47.7	
Cover Level (m)		17.200		16.900	16.800
Invert Level (m)		15.775	15.298	15.298	14.897
Length (m)			71.598	19.147	

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Node Name		10	11	12
A3 drawing Hor Scale 1000 Ver Scale 200 Datum (m) -1.000				
Link Name		4.000	4.001	
Section Type		150mm	150mm	
Slope (1:X)		100.0	100.0	
Cover Level (m)		17.100	17.000	17.000
Invert Level (m)		15.750 / 15.532	15.532	14.993
Length (m)		21.829	53.867	

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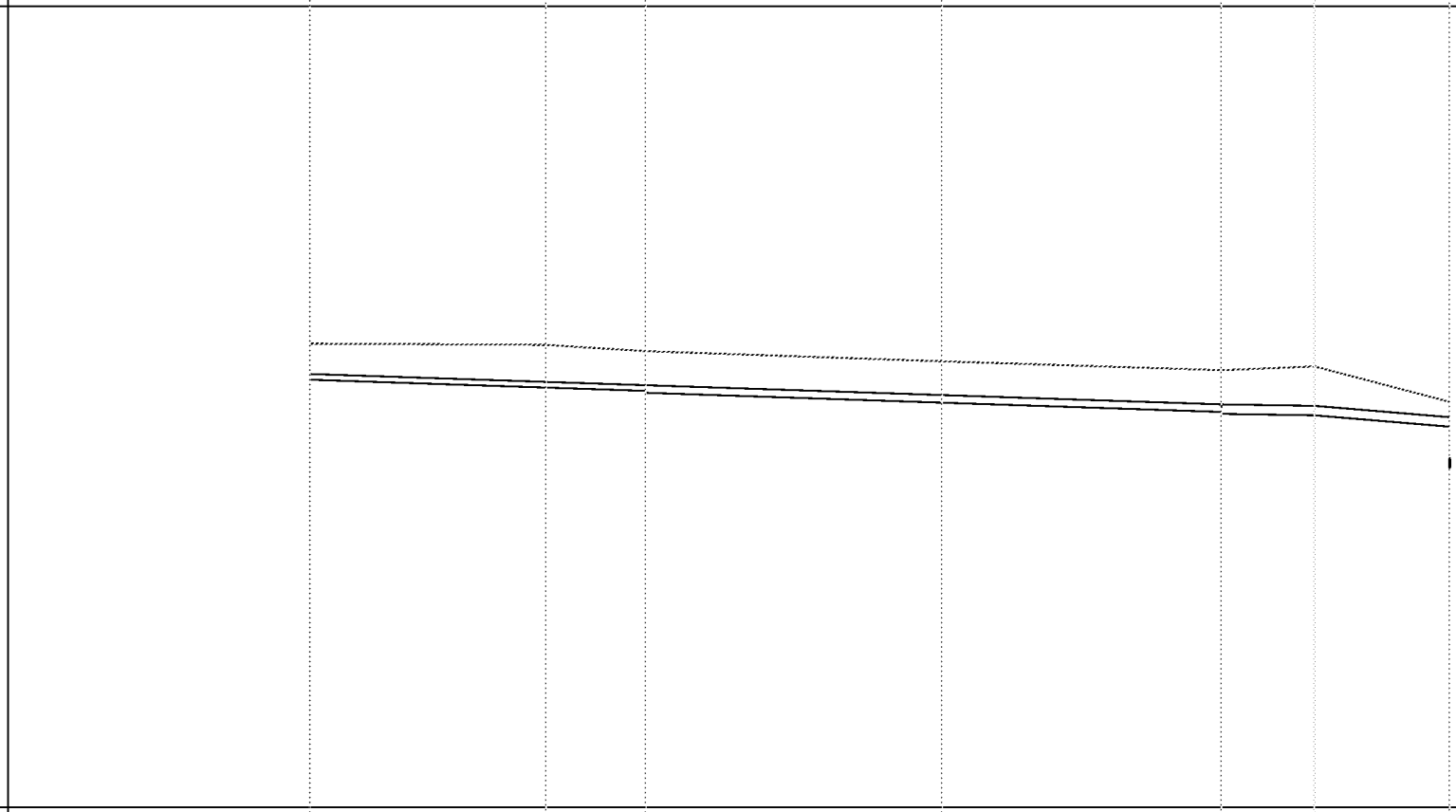
Node Name		13	14	15	16	18	19	20
A3 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 0.000								
Link Name		5.000	5.001	5.002	5.003	5.004	5.005	
Section Type		225mm	225mm	300mm	300mm	375mm	375mm	
Slope (1:X)		150.0	150.0	150.0	150.0	320.8	59.5	
Cover Level (m)		18.300	18.250	18.000	17.600	17.250	17.400	16.000
Invert Level (m)		16.875	16.564 / 16.564	16.433 / 16.358	15.968 / 15.968	15.601 / 15.526	15.469 / 15.469	15.020
Length (m)		46.598	19.713	58.511	55.113	18.284	26.700	

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Node Name		17	18
A3 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 1.000			
Link Name		6.0	
Section Type		150	
Slope (1:X)		55.8	
Cover Level (m)		17.250	17.250
Invert Level (m)		15.900	
Length (m)		8.3	

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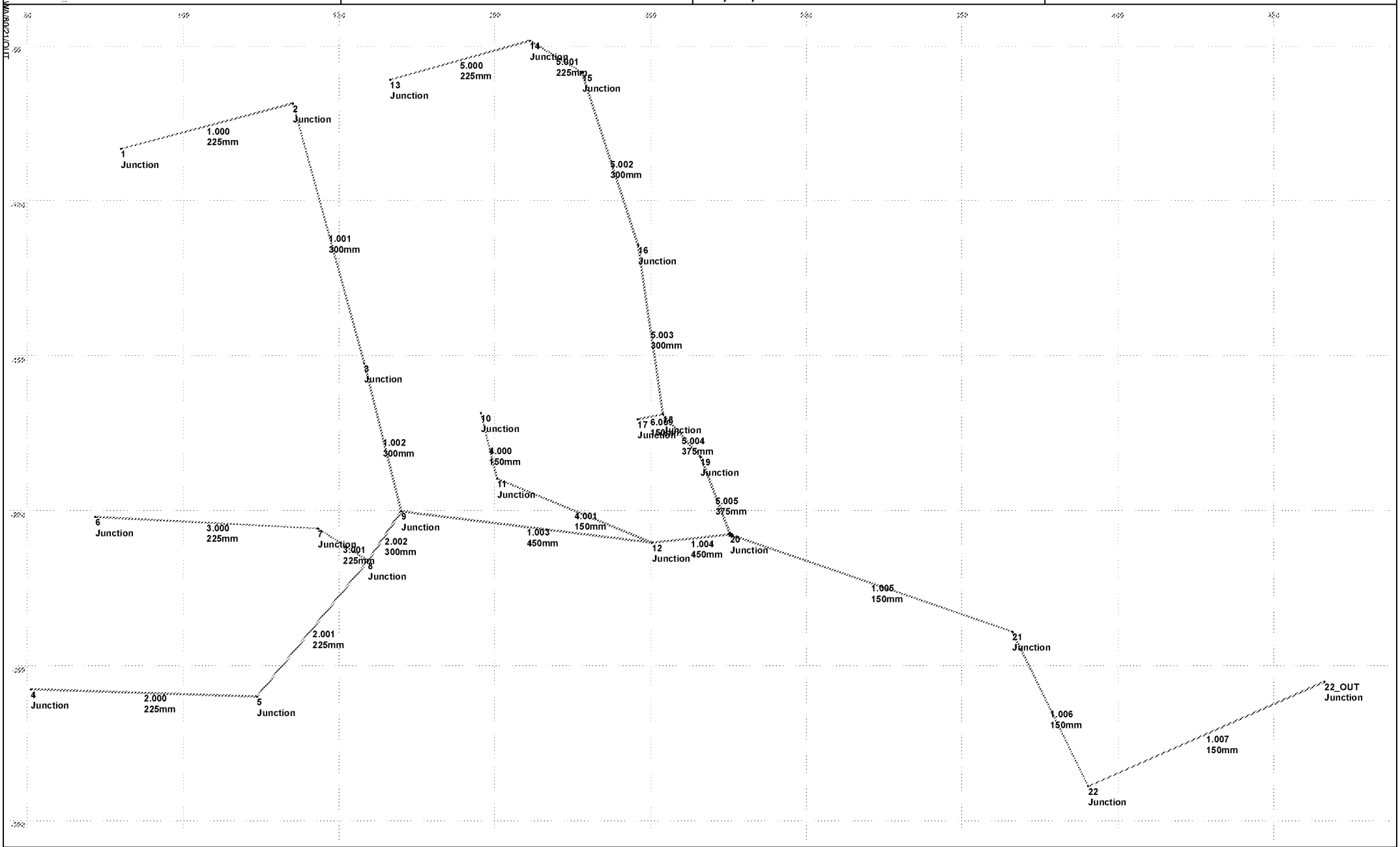

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APPENDIX D:

SOUTHERN WATER SEWERAGE INFORMATION

ARUN DISTRICT COUNCIL WA/80/21/OUT

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.

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Southern Water

O.S. REF: SU9706SE

Scale: 1:5000

N

Printed By: AS

Date: 2-10-2020

Sewer Plot

Land East of Yapton Lane

22/24

WARNING: BAC pipes are constructed of Bonded Asbestos Cement

Requested By:

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

Southern Water

Land Searches Map Legend — Sewer

Pipe Line Styles/Colours

- Foul Sewer
- Foul Rising Main
- Foul Syphon Sewer
- Foul Vacuum Sewer
- Foul Trunk Sewer
- Foul Tank Sewer
- Surface Water Sewer
- Surface Water Rising Main
- Surface Water Syphon Sewer
- Surface Water Trunk Sewer
- Surface Water Tank Sewer
- Culverted Watercourse
- Combined Sewer
- Combined Rising Main
- Combined Syphon Sewer
- Combined Trunk Sewer
- Combined Tank Sewer
- Treated Effluent
- Treated Effluent Rising Main
- Sludge Rising Main
- Flow Direction Arrows (All Styles)
- As above line styles but decommissioned
- (Yellow) As above line styles but private
- Access Shaft -- Personnel Only

Boundary Line Styles/Colours

- Catchment Boundary
- Sub-Catchment Boundary
- Section 104 Agreement Area
- Building Over Agreement Area

Materials

AK	Alkathene	GRP	Glass Reinforced Plastic
BAC	Bonded Asbestos Cement *	MAC	Masonry in regular courses
BRE	Brick (Engineering)	MAR	Masonry in random courses
BRC	Brick (Common)	PE	Polyethyelene
CC	Concrete Box Culvert	PF	Pitch Fibre
CI	Cast Iron	PP	Polypropylene
CO	Concrete (In-Situ)	PVC	Polyvinyl Chloride
CP	Concrete (Pre-Cast)	RPM	Reinforced Plastic Matrix
CSB	Concrete Segments (Bolted)	SI	Spun Iron
CSU	Concrete Segments (Un-Bolted)	ST	Steel
DI	Ductile Iron	VC	Vitrified Clay
GRC	Glass Reinforced Concrete	UNK	Unknown*

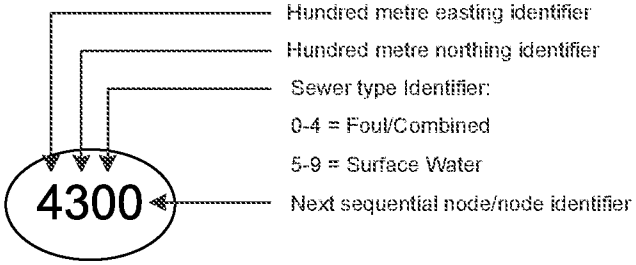
*Warning
BAC Pipes are constructed of Bonded Asbestos Cement
UNK Pipes are may be constructed of Bonded Asbestos Cement

Symbols

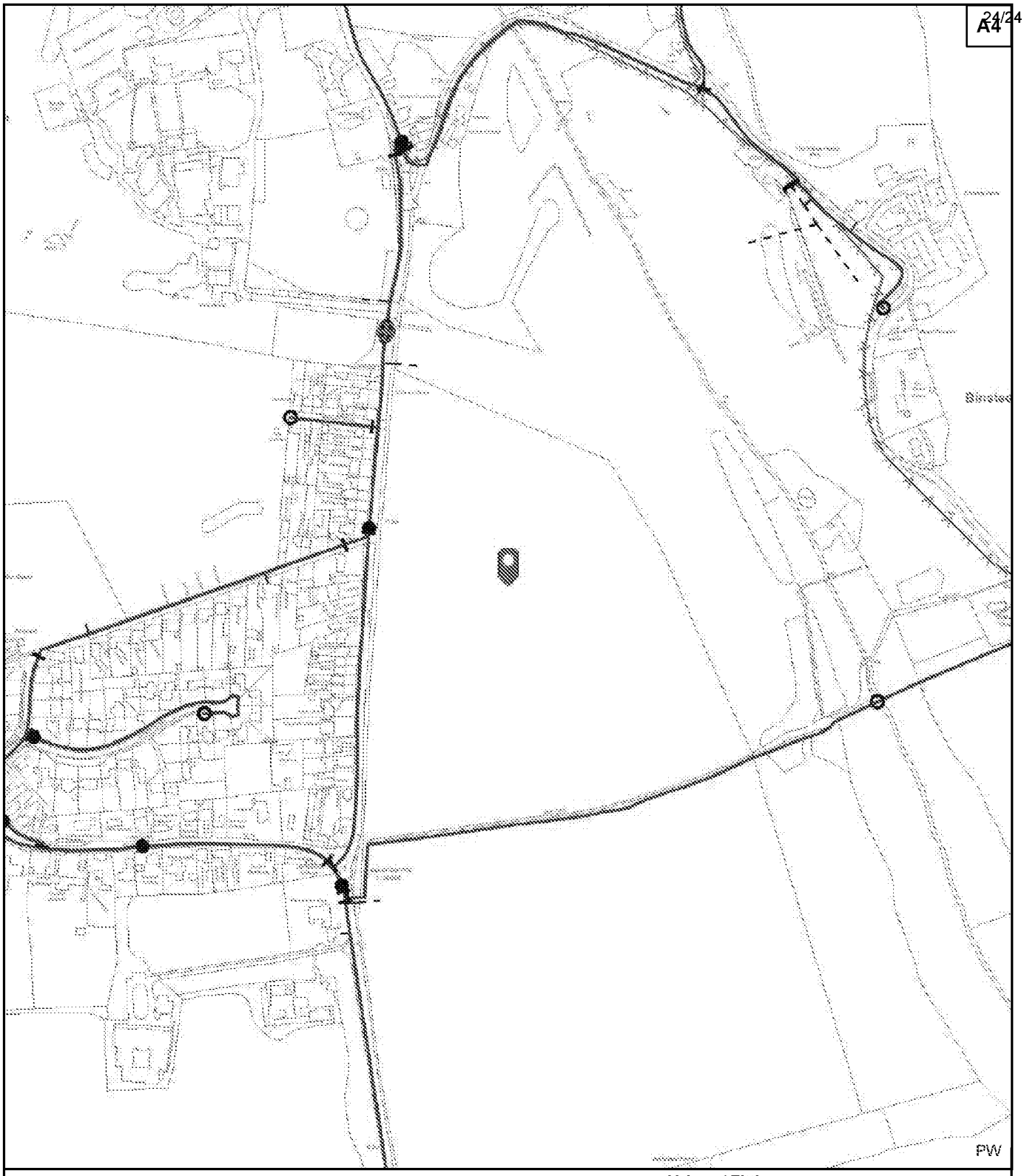
Surface	Foul	Combined	
4300	4300	4300	Label Ellipse
			Manhole
			Dummy/S.24 Manhole
			Manhole Backdrop
CP	n/a	n/a	Catchpit
SA	n/a	n/a	Soakaway
BP	n/a	n/a	Balancing Pond
RE	PE	RE	Rodding Eye
WO	WO	WO	Washout
HB	HB	HB	Flushing Chamber Mn-E
FC	FC	FC	Flushing Chamber No-E
HC	FC	HC	Hatch Box
LH	LH	LH	Lamphole
IC	IC	IC	Interceptor Chamber
BS	BS	BS	Blind Shaft
ST	ST	ST	Storm Tank
VC	VC	VC	Vortex Chamber
VT	VT	VT	Vent
VE	VE	VE	Vent Column
?	?	?	Other/Unknown
PK	PK	PK	Penstock
CC	n/a	CC	Cascade
			Change Node
PS	PS	PS	Pumping Station
n/a	PS	PS	Micro Pumping Station
AV	AV	AV	Air Valve
			Valve
n/a			Reflux Valve
n/a	AFD	AFD	Anti-Flood Device
			Blank End
			Head of Public Sewer
	n/a	n/a	Inlet
			Outfall
n/a	CSO	CSO	Storm Overflow
n/a	WWTW	WWTW	Treatment Works

Other symbols or text may be visible which are not shown here.
These are used for Southern Water operational guidance only.

Node Referencing System



A4



Water Supply

- Distribution Main
- Communication Pipe
- Fire Main
- Private Main
- Raw Water Main
- Trunk Main
- Abandoned Main

Hydrant

- Company Washout Hydrant(Single)
- Fire Brigade Hydrant(Single)
- Fire Brigade Washout Hydrant

Valves / Fittings

- CappedEnd
- StopCock
- ButterflyValve
- Pressure Flow Valve
- RefluxValve
- Air Valve
- Open Valve
- Closed Valve

The information supplied is given in good faith as a guide to locating underground apparatus. Its accuracy cannot be guaranteed, nor does it include comprehensive information about the existence or location of service pipes or cables to individual premises. The responsibility for locating and avoiding damage to apparatus on site shall be that of the person proposing to excavate in the street who shall be liable to the apparatus owner and any third party who may be affected in any way for any loss or damage caused by their failure to do so.

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U1538538

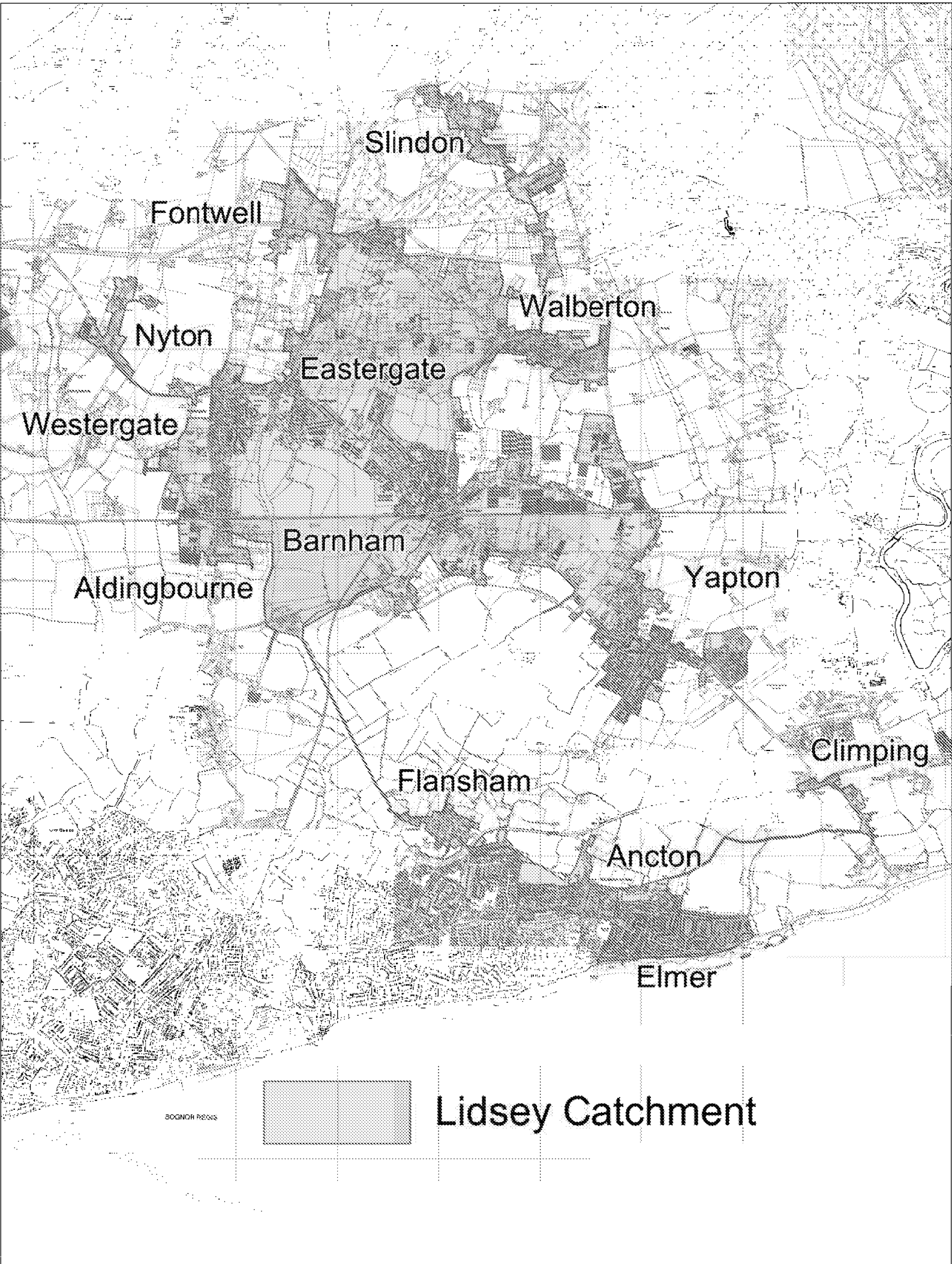
Easting/Northing: **497,794 106,036**

Scale: **1:5,000**

Date: **30/09/2020**

Portsmouth Water

Registered Office
P.O. BOX NO. 8, West Street, Havant,
Hampshire. PO9 1LG.
Registered in England No. 2536455
Telephone: (023) 9249 9888
Fax: (023) 9245 3632
Website: www.portsmouthwater.co.uk


Slindon
Fontwell
Walberton
Nyton
Eastergate
Westergate
Barnham
Aldingbourne
Yapton
Climping
Flansham
Ancton
Elmer
BOGNOR REGIS
Lidsey Catchment