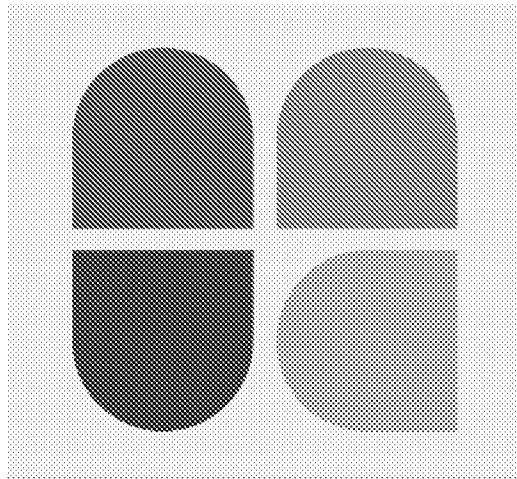




BRIGHT PLAN CIVILS

**SUNNYMEAD FARM, NORTH END
ROAD, YAPTON BN18 0DL**

PROPOSED RESIDENTIAL DEVELOPMENT

Drainage Strategy Report

Prepared on Behalf of

Roy Daniells

D1958/DS1.0

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1 INTRODUCTION

1.1 Background

- 1.1.1 Bright Plan Civils is instructed by Roy Daniells to prepare a Drainage Strategy Report to support a planning application for a Proposed Residential Development at the Sunnymead Farm, North End Road, Yapton BN18 0DL.
- 1.1.2 This report has been undertaken in accordance with National Planning Policy Framework (NPPF) and The Planning Practice Guidance on the use of SuDS for achieving sustainable development.
- 1.1.3 The proposed development will involve the demolition of an existing property and construction of a 5 residential properties - as demonstrated within the preliminary site layout, contained within **Appendix A** of this report.
- 1.1.4 In preparing this report, Bright Plan Civils has referred to the following documents and information:
- Environment Agency Flood Maps for Planning
 - Long Term Flood Risk Information; Flood Risk Maps
 - Southern Water and Local Authority Drainage Records
 - British Geological Survey & Records
- 1.1.5 This document has been prepared to propose assess drainage constraints and propose a drainage strategy that is appropriate for the design life of the development, without causing offsite impacts from runoff in a design event.
- 1.1.6 This report has been prepared for the benefit of the named Client only.

1.2 Site Location and Description

- 1.2.1 The site location is at the existing property of Sunnymead Farm. Much of the north of the site is overgrown and there are a number of large established trees on site.
- 1.2.2 The site is bounded to the north by the Ford to Barnham railway line. It is situated in the north east of the North End residential area of Yapton and is also bounded by a horse field to the east, an access track to the field between the neighbouring Apple Tree Cottage to the south and North End Road to the west. The preliminary site layout is provided in **Appendix A**.
- 1.2.3 The site is 2,792m² in size and lies between 3.02m and 5.37m AOD, falling towards the centre of the site, as can be seen in **Drawing 101**.
- 1.2.4 The pre-development impermeable area is approximately 415m², as demonstrated in **Drawing 102**.
- 1.2.5 A tributary to the River Arun becomes a designated Main River at North End Road and passes the site approximately 40m from the north boundary, running east.

1.3 Ground Conditions

- 1.3.1 Southern Testing Laboratories Ltd undertook soakage testing in October 2018 at the site, with a report provided to present the exploratory hole logs and test results, with indicative infiltration rates for the site

as a result of the test results – as seen in **Appendix C**.

- 1.3.2 The soils encountered comprised of topsoil over sandy clay, with a layer of gravelly sand over weathered Chalk bedrock below.
- 1.3.3 Testing was carried out in windowless sampler boreholes rather than pits due to access constraints. Three successful soakage tests at pits WLS02, WLS03 and WLS04 recorded infiltration at 4.19×10^{-7} , 8.75×10^{-5} and 1.69×10^{-4} respectively. WLS02 collapsed during testing to 1.34m bgl.
- 1.3.4 The findings of WLS03 are proposed as the design soakage rate given the location of the proposed infiltration features.
- 1.3.5 Analysis of the BGS website data within the local area confirms underlying strata to be as follows:

Bedrock Geology:

The underlying bedrock is indicated as 'Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation (undifferentiated) – Chalk'

Beyond the north west corner of the site the bedrock is indicated as 'Lambeth Group - Clay, Silt and Sand'

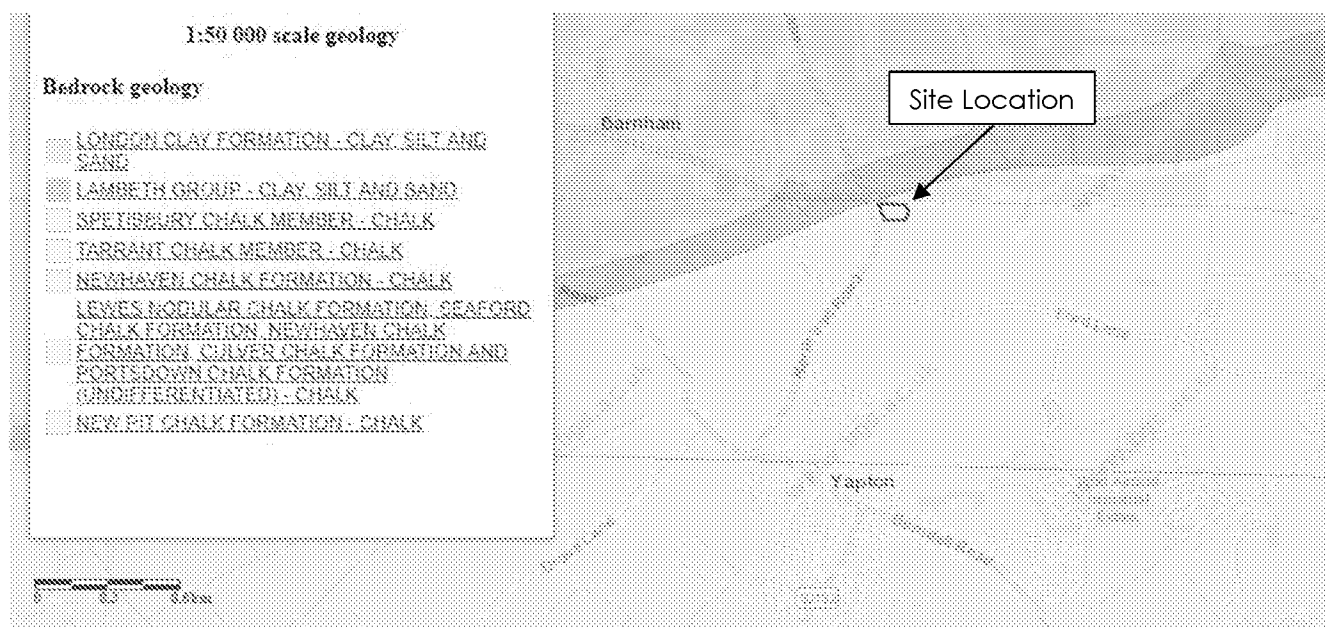


Figure 1. Bedrock geology by the BGS website

Superficial Deposits:

The superficial deposits indicated to be present at the site are 'Raised Beach Deposits, 1 - Sand and Gravel', as well as 'River Terrace Deposits (undifferentiated) - Sand, Silt And Clay' to the south of the site.

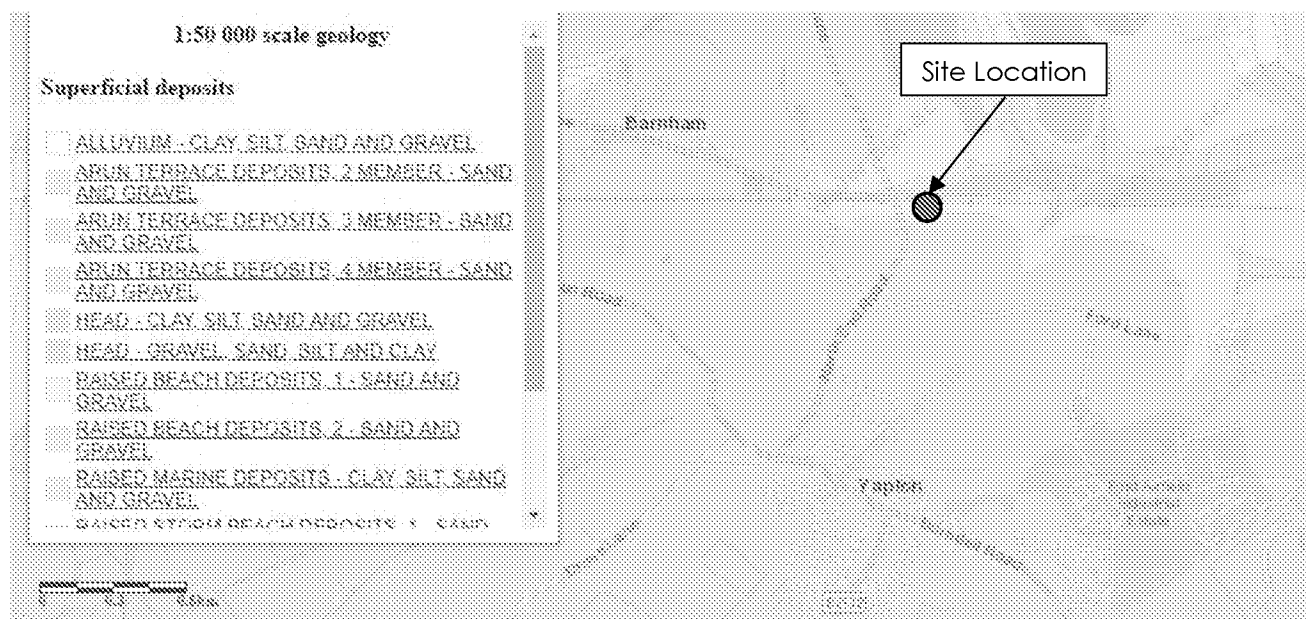


Figure 2. Superficial deposits by the BGS website

- 1.3.6 Analysis of the Magic Map Application (magic.defra.gov.uk/magicmap.aspx) indicates underlying aquifers, groundwater vulnerability and designated protection zones.
- 1.3.7 The site is within a Principal Aquifer (Bedrock) and a Secondary A Aquifer (Superficial Deposits).

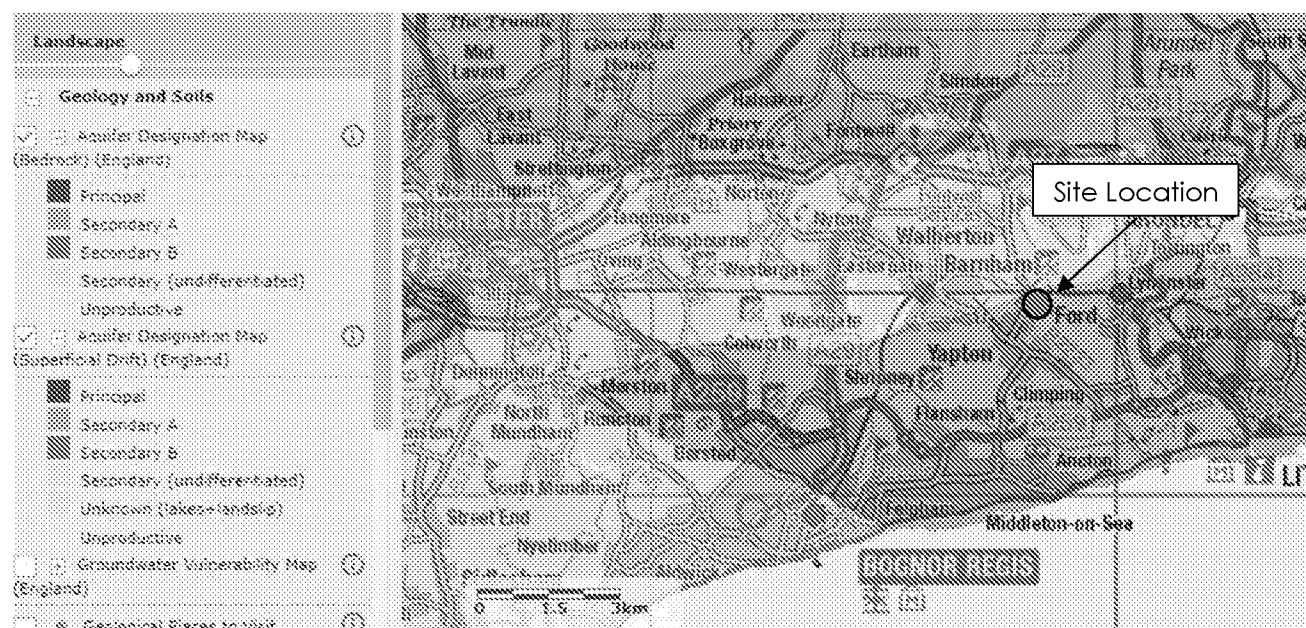


Figure 3. DEFRA Aquifer Designation Mapping

- 1.3.8 In addition, the site is located within a 'Medium' groundwater vulnerability zone (referring to leaching potential of pollutants to groundwater), and classified as an area of soluble rock risk. Mapping however shows that the site is not located within a groundwater source protection zone.

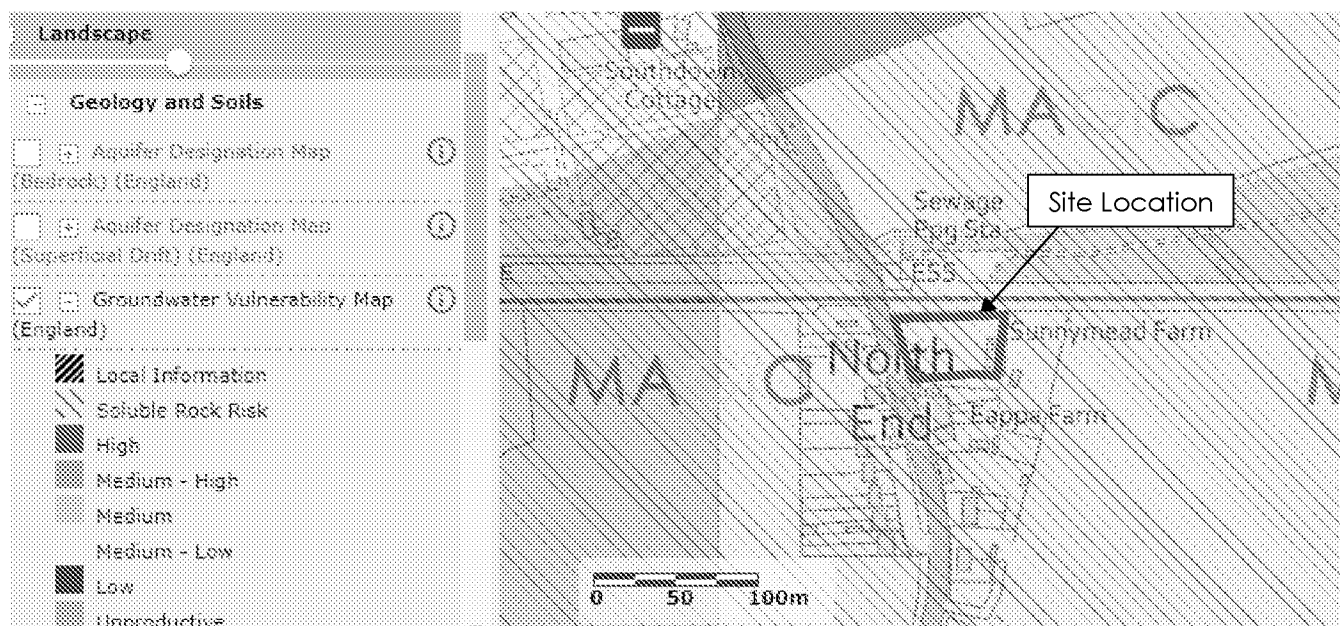


Figure 4. DEFRA Groundwater Vulnerability Zone Mapping

1.4 Groundwater

- 1.4.1 The Soakage Test Report by Southern testing recorded groundwater levels in two of the boreholes. WLS03 and WLS04 groundwater was found to rest at 2.34m and 1.87m bgl respectively.
- 1.4.2 It is likely that groundwater levels vary due to wet and winter weather and will rise above the measured levels seasonally. Any SuDS features utilizing attenuation storage should therefore be kept close to the surface so that there is freeboard between the attenuated surface water and groundwater levels.
- 1.4.3 Groundwater monitoring over winter months would provide peak groundwater levels to confirm detailed drainage design, and therefore should be undertaken prior to discharge of planning conditions and detailed design.

1.5 Existing Drainage

- 1.5.1 The local Water Authority is Southern Water, who provide sewerage services within the area. Public sewer records have been obtained from Southern Water, as contained within this report in **Appendix D**.
- 1.5.2 Surface Water:
- The Southern Water public sewer records (**Appendix D**) show no public surface water sewers within the vicinity of the site.
 - The existing building is drained by rainwater pipes. The connection route of this drainage is presumed to be via a combined manhole to the foul sewer.
 - In the absence of confirmation of any existing formal drainage, it is believed that surface water run-off generated by the site currently discharges to the ground via infiltration. Noting natural overland flow is routed northly this would be compounded within the confines of the site by the Network Rail embankment. This may be regulated by NR culverts which exist in strategic locations and shall be investigated at detailed design stage.

- The nearest surface water feature is a pond 65m northwest of the site.
- The nearest watercourse is a tributary to the River Arun, which becomes a designated Main River at North End Road and passes the site approximately 40m from the north boundary, running east.
- Greenfield runoff rate (Qbar) has been calculated to be 0.55l/s, using HR Wallingford drainage calculator.
- However, a consideration of the existing site layout shows that a proportion of the site is impermeable due to previous development. Using the 'Rational' (Lloyd-Davies) formula to approximate the predevelopment runoff rate for the brownfield site with a predicted mean annual maximum rainfall intensity of 50mm/hr, the existing average peak annual runoff from the previous development is 5.8l/s.

1.5.3 Foul Water:

- The Southern Water public sewer records (**Appendix D**) show a public 175mm foul water sewer passes through the centre of the site from south to north, under the rail tracks, to the North End Yapton Waste Pumping Station approximately 25m north of the site. The sewer manhole on site has an invert of 2.13m AOD.
- The existing building is presumed to connect to the public foul sewer.

1.5.4 Highway Drainage:

- North End Road appears to be drained by highway gullies.

2 FLOOD RISK

2.1 Flood Risk from Rivers and Sea

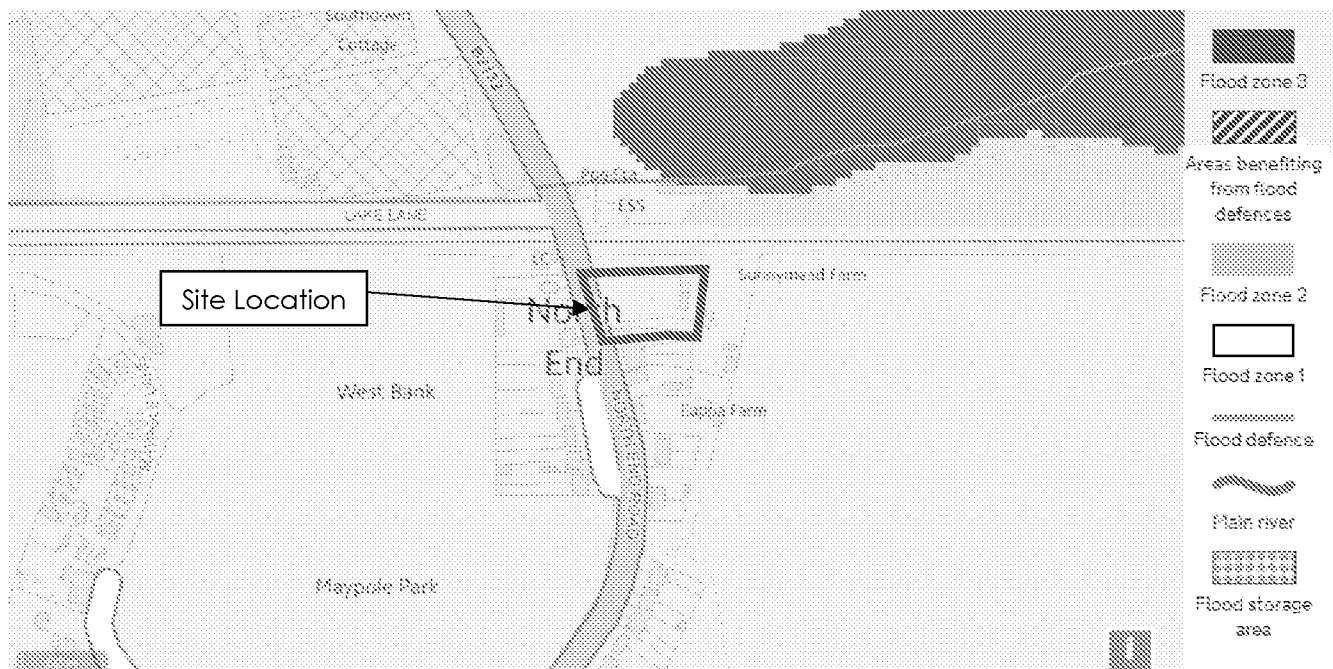


Figure 5. Environment Agency Flood Map for Planning

- 2.1.1 The Environment Agency's on-line Flood Maps for Planning (rivers and sea) show that the site is located within Flood Zone 1, with Flood Zone 3 to the north of the site, opposite the railway.
- 2.1.2 Flood Zone 1 is defined as land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	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. (Not separately distinguished from Zone 3a on the Flood Map)

2.1.3 **Figure 6** also shows that the site is at very low risk of flooding from rivers or sea.

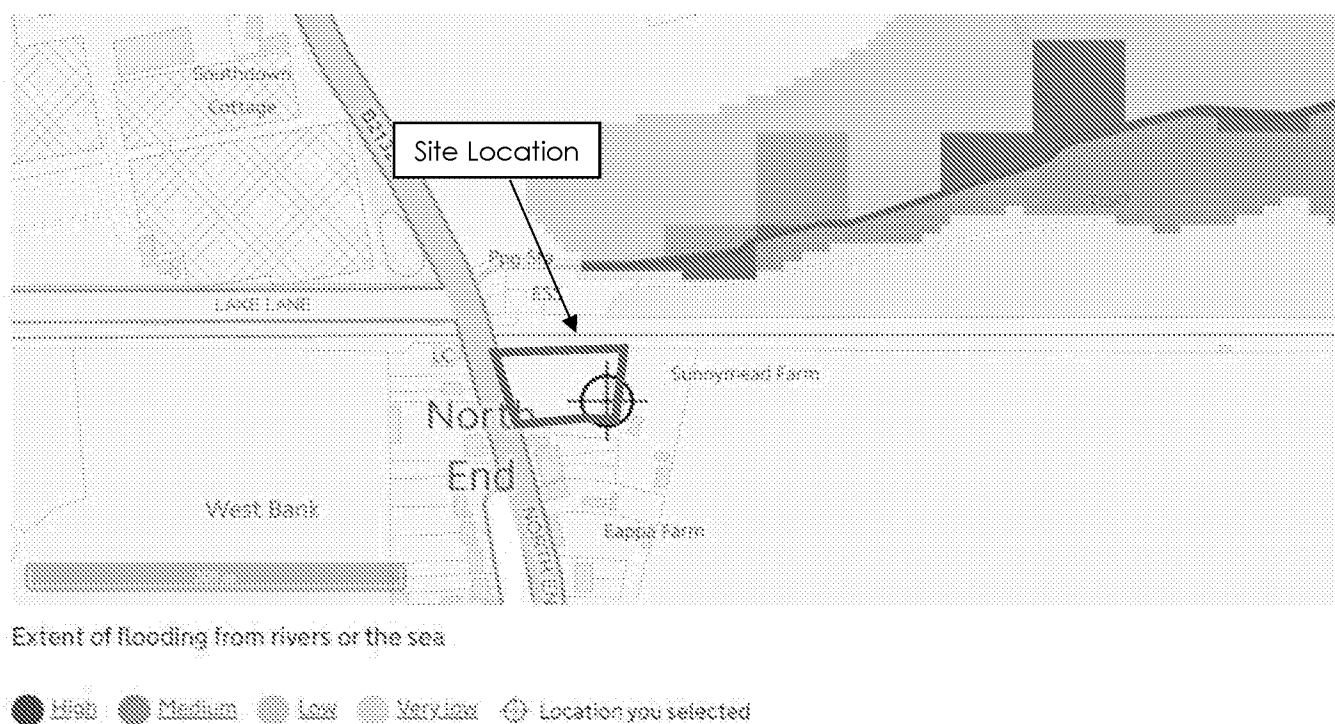
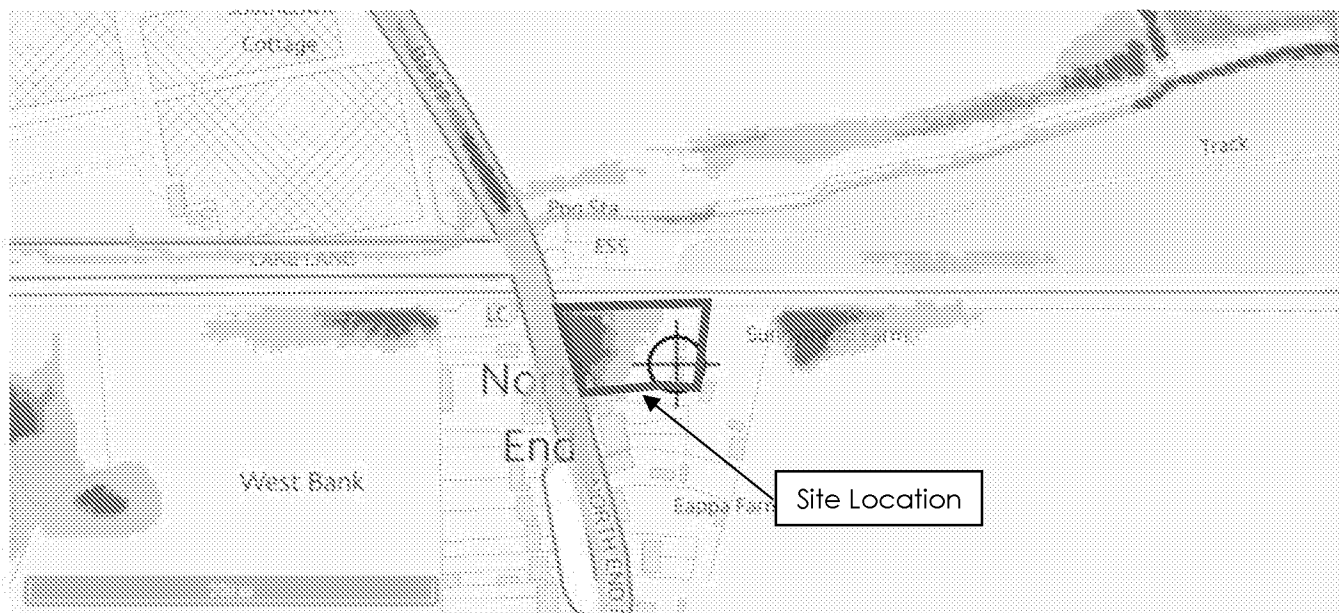


Figure 6. Long Term Flood Risk Map; Flood risk from rivers or the sea

2.2 Surface Water Flood Risk

- 2.2.1 **Figure 7** shows that the site at 'very low' to 'high' risk of surface water flooding. The northwest of the site is shown to be at high risk of surface water flooding, with depths of over 900mm in a low risk storm event scenario.
- 2.2.2 The east of the site and the highway are shown to be at 'very low' to 'low' risk of surface water flooding, although in a low risk flood event scenario flood depths of up to 900mm are shown in the adjacent highway.
- 2.2.3 As noted by previous consultation with Arun District Council (ADC) (**Appendix E**), this is shown as an area of surface water flooding in a 1 in 30 event and greater and is further evidenced in the topographical survey. ADC have no evidence that this area currently floods beyond the anecdotal evidence of the current resident. There is no historic mapping of any pond here.
- 2.2.4 As discussed with ADC, the proposed development and design of levels and drainage will need to take into account the area of surface water flooding, ensuring the site is safe from flooding without causing an increase in flood risk elsewhere.
- 2.2.5 Any displacement of potential surface water ponding will need to be within the site, without causing an increase in surface water flood risk off site and ensuring safe access and egress from the site.
- 2.2.6 Level and drainage design should ensure that exceedance flows would pond within the site as currently.
- 2.2.7 Review of runoff from the adjacent road and railway via site information and topographic survey indicates that surface water would not drain to the site, as there is a road kerb, highway drainage and gullies, and a railway embankment that steers runoff away from the site boundary.

- 2.2.8 Nevertheless, the design should consider that exceedance may enter the site due to flooding off-site, and therefore consider exceedance via level design



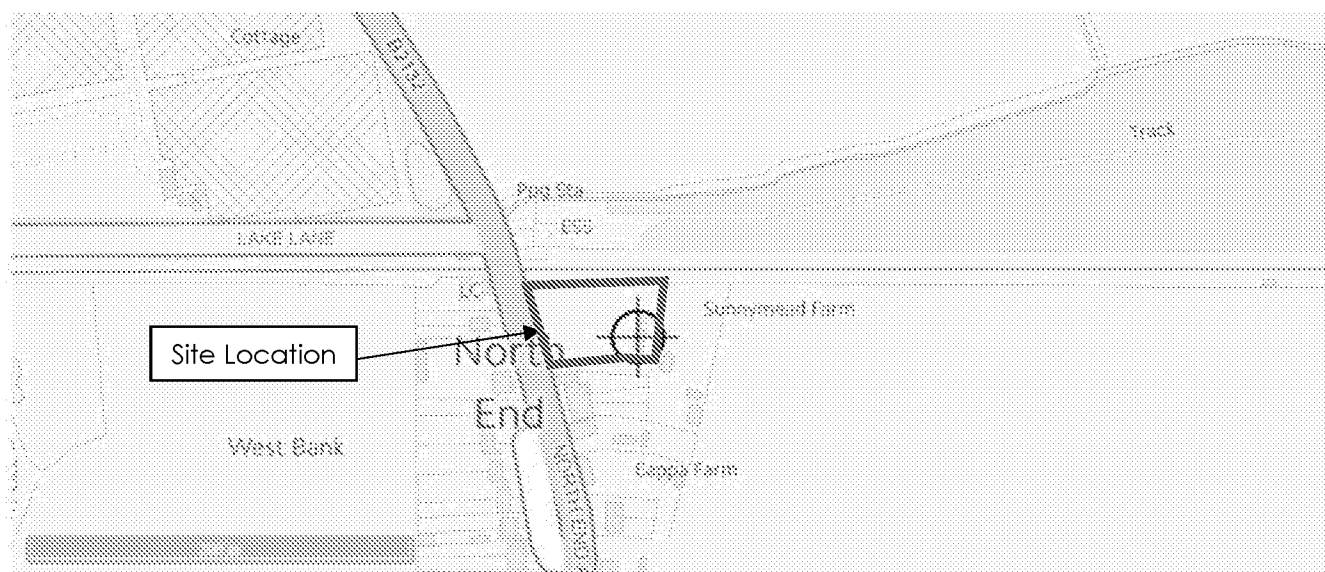
Extent of flooding from surface water

● High ● Medium ● Low ○ Very low ⊕ Location you selected

Figure 7. Long Term Flood Risk Map; Flood risk from surface water

2.3 Artificial Flood Risk

- 2.3.1 **Figure 8** shows that the site is not at risk of flooding from reservoirs.



Extent of flooding from reservoirs

● Maximum extent of flooding ⊕ Location you selected

Figure 8. Long Term Flood Risk Map; Flood risk from reservoirs

2.4 Summary of Flood Risk

2.4.1 The potential sources of flooding are:

Source of Flooding	Level of Risk
Rivers and Coastal	Very Low The site is within Flood Zone 1 not shown to be at risk of flooding from rivers or sea.
Surface Water	High The long-term flood risk for surface water is classified as 'very low' to 'High' at the site. Surface water flood depths are shown to exceed 900mm in the northwest corner. Design of levels and drainage will need to ensure the site is safe without causing flood risk elsewhere, and ensure safe access or egress.
Groundwater	Medium BGS records found the site to be situated above variable permeability strata, and boreholes found groundwater between 1.87-2.34mbgl. Further winter groundwater monitoring would indicate maximum groundwater levels to account for in the detailed level and drainage design.
Sewers	Low There are no surface water sewers within the area, and no reports of sewer flooding have been found. In view of this information the risk of flooding from this source is deemed to be 'Low'.
Artificial Sources	None The site is not shown to be at risk of flooding due to artificial sources.

2.4.2 The site is considered to be vulnerable to surface water flood risk, however the proposed level and drainage design for the proposed development will be designed in order to provide capacity up to the design event and provide consideration of potential exceedance routes, so as to not increase the risk of surface water flooding on or off the site.

3 PROPOSED DEVELOPMENT

3.1 Description of Development

3.1.1 The proposed development will involve the the demolition of an existing building, and the construction of 5 residential properties, with associated landscaping as demonstrated within **Appendix A**.

3.1.2 The type of development falls within the 'More Vulnerable' classification (Flood Risk and Coastal Change Table 2) and is appropriate in Flood Zone 1 (Flood Risk and Coastal Change Table 3).

Flood Zones	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone 1	✓	✓	✓	✓	✓
Flood Zone 2	✓	Exception Test Required	✓	✓	✓
Flood Zone 3a†	Exception Test Required †	✗	Exception Test Required	✓	✓
Flood Zone 3b*	Exceptions Test Required *	✗	✗	✗	✗
✓ = Development is appropriate ✗ = Development should not be permitted					

3.1.3 The proposed development will increase the hardstanding area of the site; however SuDS measures will be used in order to prevent any increase in the rate of run-off generated by the site.

3.1.4 The post-development impermeable/hardstanding area has been determined to be 1,057m² (0.106Ha).

3.1.5 The use of Sustainable Drainage System (SuDS) methods and techniques (where site conditions and constraints allow) within the bounds of the site (whilst adhering to the SuDS hierarchy as stated within Building Regulations (Part H) and The CIRIA SuDS Manual C753) will be used to provide a betterment of surface water run-off compared to the existing site.

3.1.6 The specific Surface Water and Foul Water drainage proposals are detailed in **Section 4** of this report.

4 PROPOSED DRAINAGE STRATEGY

4.1 Surface Water

4.1.1 The SUDS manual and Building Regulations set out a hierarchy of drainage methods to ensure that developments maximise the use of sustainable drainage techniques. The hierarchy favours infiltration methods of disposal over other methods such as watercourse and sewers, as detailed below;

- i. Utilise infiltration techniques
- ii. Attenuate rainwater in ponds or open water features for gradual release
- iii. Attenuate rainwater by storing in tanks or sealed water features for gradual release
- iv. Discharge rainwater direct to a watercourse
- v. Discharge rainwater to a surface water sewer/drain
- vi. Discharge rainwater to a combined sewer

SUDS Technique	Suitable	Comments
Living Roof	No	Architect proposals are not conducive to green roof proposals.
Basins and Ponds (such as Wetlands, Balancing Ponds, Detention Basins, Retention Ponds)	No	Not viable - lack of available space due to proposed site layout and existing trees.
Filter strips and swales	Yes	Viable, however limited by possible high groundwater levels.
Infiltration Devices - Soakaways - Infiltration trenches and basins	Yes	Viable, however limited by possible high groundwater levels.
Permeable surfaces and filter drains (such as gravelled areas and porous block paving)	Yes	As above, and permeable surfaces would also provide a source of treatment and shallow attenuation.
Tanked systems (such as oversized pipes or cellular tanks)	Yes	Viable, however limited by possible high groundwater levels should they be used for infiltration and would require mitigation against possible flotation affects should they be used for attenuated runoff storage.

4.1.2 Site specific geotechnical testing indicates infiltration measures into the underlying bedrock are viable, with a design soakage rate of 8.8×10^{-5} m/s used for the design of the surface water drainage system.

- 4.1.3 Infiltration into the Clay deposits is not viable, given site findings by Southern Testing. Therefore, it is proposed that tanked permeable surfacing will capture and attenuate runoff at a shallow level that will be discharged to the underlying permeable bedrock via ring soakaways.
- 4.1.4 The proposed drainage system will utilize 260m² of permeable block paving with a minimum sub-base thickness of 450mm, with 2 No. ring soakaways infiltrating into the underlying bedrock, as detailed in Drawing **PL200**. This will ensure that runoff is attenuated at shallow depths at least 1.0m above groundwater in the underlying bedrock, and infiltrated below the site.
- 4.1.5 Due to the presence of an area of surface water flood risk, level design has also been considered in conjunction with the drainage design, to ensure that runoff does not drain off the site as a result of the development, and that highway runoff cannot drain into the site drainage system. In addition, exceedance will be directed to the north of the parking area and to the north-centre of the site, to be drained via infiltration. This will not impact on the proposed development, access or egress, or off-site.
- 4.1.6 The strategy above will ensure that there is no increase in the rate of run-off leaving the site, therefore no increase in the risk of flooding from this source.

4.2 Treatment

- 4.2.1 The use of permeable paving will ensure that run-off from the site receives a level of treatment required by the SuDS manual, with hydrocarbons being filtered by the aggregate and geotextile layers.
- 4.2.2 In accordance with the CIRIA SuDS Manual C753 regarding methods for managing pollution risks, the risk posed by surface water runoff to the receiving environment depends on the pollution hazard at the site (the source), SuDS treatment techniques (the pathway), and the sensitivity of the environment (the receptor).
- 4.2.3 The simple index approach considers whether SuDS techniques are appropriate for the site. The states that for SuDS components to deliver adequate treatment, the total pollution mitigation index for each contaminant type should equal or exceed the pollution hazard index.
- 4.2.4 The SuDS Manual outlines three categories of pollution hazard identification, which vary depending on proposed land use, which are as follows:
- Total Suspended Solids (TSS).
 - Metals (M).
 - Hydrocarbons (H).
- 4.2.5 In accordance with C753 Table 26.2, the proposed land uses at the site are categorised as follows:
- Residential Roofs and non-trafficked areas – very low/TSS=0.2/M=0.2/H=0.05
 - Low traffic roads and residential parking areas – low/TSS=0.5/M=0.4/H=0.4
- 4.2.6 In accordance with C753 Table 26.3, the values of SuDS Mitigation indices are provided for permeable paving:
- Permeable Pavement – TSS=0.7/M=0.6/H=0.7

- 4.2.7 As the pollution hazard index does not exceed any pollution mitigation index for any contaminant type, the proposed SuDS methods will provide sufficient treatment for the proposed development.

4.3 Foul Water Drainage

- 4.3.1 An existing 175mm foul water sewer runs through the site. Investigation is required into the existing site connection in order to ascertain the proposed connection arrangement for the proposed development, however it is considered that a gravity connection to the existing public foul manhole within the site is viable. Post development, there will be an estimated increase in peak foul water flows to 0.25 l/s (based on Sewers for Adoption).
- 4.3.2 The infrastructure and connection charges (OFWAT Charging Rules) place the onus on the sewerage undertaker to reinforce their network should there no longer be sufficient capacity to serve the new development. Funding for this is provided by revised charging arrangements for infrastructure and connection charges for each dwelling constructed comprising a Network Reinforcement Charge and Site-Specific Charges. The revised charging arrangement (funded by the developer) covers alterations to the Existing Sewer Network and the sewerage undertaker remains responsible for the cost of reinforcing their Strategic Assets. The developer is responsible for connecting the development to the public sewer network.

4.4 Climate Change

- 4.4.1 In July 2020 the Environment Agency updates the latest climate change allowances (available online at <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>), which supports the NPPF in making an allowance for climate change within flood risk assessment. The allowances provide predictions of anticipated change for peak river flow by river basin district and peak rainfall intensity.
- 4.4.2 The table below shows the anticipated changes in extreme rainfall intensity. For flood risk assessments, both the central and upper end allowances should be assessed to understand the range of impact.

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper End	10%	20%	40%
Central	5%	10%	20%

- 4.4.3 Based on the latest allowances, an increase of 20% should be applied to peak rainfall to this development, with a review undertaken to determine the impact of a 40% increase.

4.5 Urban Creep

- 4.5.1 The effect of urban creep has been considered for the surface water drainage design. An urban creep allowance of 10% on the proposed drainage strategy would result in minimal exceedance in the low point of the site, but would not affect the development, existing or proposed buildings, or access and egress.

5 MAINTENANCE

5.1 Proposed Maintenance Regime

- 5.1.1 Maintenance is required to ensure the long-term operational performance of the proposed surface water drainage system.
- 5.1.2 The drainage system has been designed to minimise maintenance requirements; however a number of key tasks will need to be undertaken so that the system remains in optimal condition. These operations are summarised in the table below, along with the required frequency of works.

Drainage System feature	Proposed maintenance / remedial works	Required frequency of works
Permeable Paving	Surface sweeping to reduce silt and debris accumulation.	Every 8 to 12 weeks
	Removal / management of weed growth	At least once a year
	Silt removal from permeable surfaces, possibly involving raking out of joints, redressing, removal and remedial works.	As required / to be specified by manufacturer
Ring Soakaway	Monitoring of silt traps	Monthly for one year, then annually
	Inspection of components, rings and soakaway. Cleaning as necessary	Annually
	Remedial reconstruction including replacement of geotextiles	As required
Diffuser units & catch pits, gully sumps and drains	Inspection and additional cleansing as required.	Annual
	Desilting	Year 1, Year 3, then every 5 years
Pipework	Jetting to clear blockages	As required

- 5.1.3 The responsibility of maintenance regime will be determined by the Developer, by agreed appointment.

5.2 Permeable Paving / Diffuser Units

- 5.2.1 The areas of permeable paving are designed to allow infiltration of surface water run-off through the joints in the block paving surface course and into the subbase below. The water is then collected and discharged into the positive drainage system.
- 5.2.2 As part of the permeable paving system, diffuser units are used to discharge surface water run-off from roof areas into the sub-base, as well as forming links between areas of permeable paving. These diffuser units are small heavy-duty cellular units which allow more efficient discharge of surface water into the sub-base base of the permeable paved areas.
- 5.2.3 The areas of permeable paving will require additional maintenance measures to ensure they operate as designed. Failure in carrying out this maintenance, could increase the risk of flooding. The additional measures are as follows:

- Periodic surface sweeping to reduce silt and debris accumulation. The permeable surfaces should be swept at least every 8 to 12 weeks with additional sweeps in the autumn to clear fallen leaves
- Removal / management of weed growth, as required. Typically, once or twice a year for regularly used areas
- Periodic silt removal from permeable surfaces as described by the manufacturer. If any areas are showing signs of ponding, they shall be dealt with by raking out the joints and redressing. The entire surface shall be monitored and when there are signs of excessive siltation resulting in poor drainage over the whole area, the blocks shall be taken up and a replacement of bedding layer and geotextile shall be undertaken
- Redressing of joints on the block paving as required
- Catchpits upstream of diffuser units, should be emptied and inspected on the same regime as all catchpits specified previously set out in this document

5.3 Ring Soakaway

- 5.3.1 Infiltration systems will require regular maintenance in order to ensure continued full operation of the system. The design should include monitoring points where the water level can be observed, as well as the infiltration surface.
- 5.3.2 The life cycle and operation of the features will depend on the frequency of maintenance and the risk of sediment entering the system.
- 5.3.3 The lined infiltration features will require additional maintenance measures to ensure it operates as designed. The additional measures are as follows:
- Monitoring of silt traps and rate of sediment accumulation, monthly in the first year and then annually.
 - Annual monitoring of soakaway to ensure emptying is occurring.
 - Annual inspection for sediment and debris in pre-treatment components, and inside of concrete manhole rings. Removal of sediment and debris as required.
 - Annual (or as required based on inspections) cleaning of gutters and any filters on downpipes.
 - Remedial works to reconstruct soakaway if performance deteriorates or failure occurs, including replacement of clogged geotextiles.

5.4 Remedial/Repair Actions

- 5.4.1 Significant storm events may cause considerable damage to SuDS and their associated components. As such, it may be necessary to inspect and carry out essential recovery works to return the feature to

full working order.

- 5.4.2 Resetting of uneven blocks by lifting block area, removing bedding material and relaying to match original design are all actions which may need to be undertaken.

5.5 Accidental Spillages

- 5.5.1 It is not envisaged that any materials are to be stored onsite once the development has been completed, which could cause major spills and potential pollution issues within the drainage system. If this situation alters in the future consultation with a specialist will be required in order to confirm if any upgrades to the existing system are necessary.
- 5.5.2 Minor spillages of fuels and oils will be dealt with by the permeable paving and deep trapped gullies, by bio-degrading and collecting the hydrocarbons respectively.

5.6 Future Alterations to the Development

- 5.6.1 Any future alterations to the permeable paving should be confirmed by a specialist. Where possible any future services are to avoid being located through areas of permeable paving. If new services are required to run through areas of permeable paving, services should be installed below the depth of permeable paving with the permeable system reinstalled above.

6 OFFSITE IMPACTS

- 6.1.1 The proposed development will not result in any increase in runoff from the site, and therefore will not cause an increase in flood risk offsite.
- 6.1.2 Post development foul water flows will contribute an increase to the sewer network compared to the previous use – it is expected that the foul sewer flow will be 0.25l/s.
- 6.1.3 The effects of climate change have been considered in the design of the proposed surface water drainage system, to ensure there is no off-site impact.

7 SUMMARY

- 7.1.1 This site-specific drainage strategy report is based on Flood Maps, Public Sewer Records, BGS records, site-specific geotechnical information, and consultation with the Lead Local Flood Authority.
- 7.1.2 The existing site consists of a rear garden and side entrance for the existing property.
- 7.1.3 The site slopes between 3.02m and 5.37m AOD, falling towards the centre of the site.
- 7.1.4 The site area is 0.279Ha and has an impermeable area of 0.042Ha, which will increase to 0.106Ha as a result of the development.
- 7.1.5 The proposed development comprises the construction of 5 residential properties with associated landscaping, access and parking.
- 7.1.6 The development lies within Flood Zone 1, however is at high risk of surface water flooding, associated with a localised low point within the site location, which will be addressed by a combination of the proposed levels and drainage design to mitigate the risk of surface water flooding to the proposed development.
- 7.1.7 The existing run-off from the site is assumed to drain via the foul sewer upon preliminary assessment of the existing drainage infrastructure.
- 7.1.8 Post-development surface water run-off will be managed through sustainable drainage measures, with the installation of permeable paving and 2 No. ring soakaways to infiltrate runoff from the proposed development.
- 7.1.9 The wastewater from the proposed development will discharge to the public foul sewer network, with connection arrangement to be confirmed subject to site investigation. A gravity connection to the existing foul sewer manhole on site is considered to be viable.
- 7.1.10 The completion of the development will not increase flood risk on or off the site.
- 7.1.11 In conclusion, this development is suitable with regards to flood risk and surface water drainage.

DRAWINGS

- 100** Site Location Plan
- 101** Existing Topography & Overland Flow Routes
- 102** Impermeable Areas Comparison
- 200** Conceptual Drainage Strategy



NOTES

1. This drawing is to be read in conjunction with all other Bright Plan Civils drawings, and with all relevant Architect's and Engineer's drawings and specification. Any discrepancies found are to be reported immediately to the Engineer.

2. Bright Plan Civils accepts no responsibility for inaccuracies in data provided by third parties such as topographic surveys or Ordnance Survey mapping.

3. Do not scale, work to figured dimensions only. All dimensions are in millimeters unless noted otherwise and all levels are in metres from the topographic survey datum.

4. Any information given regarding existing underground services is given in good faith after consultation with the relevant authority, however accuracy is not certain.

-SITE LOCATION LEGEND-

Site Boundary - 2,792 m² (0.28 Ha.)

Site Grid Reference: SU 98129 04367

PLANNING

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Rev.	Amendments	Date

BRIGHT PLAN CIVILS

Transport Planning and Infrastructure Design Consultants

2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF

Tel 01243 210418

www.bpcivils.co.uk enquires@bpcivils.co.uk

Drawing Status

PLANNING

Client

Roy Daniells

Project

Site Location Plan

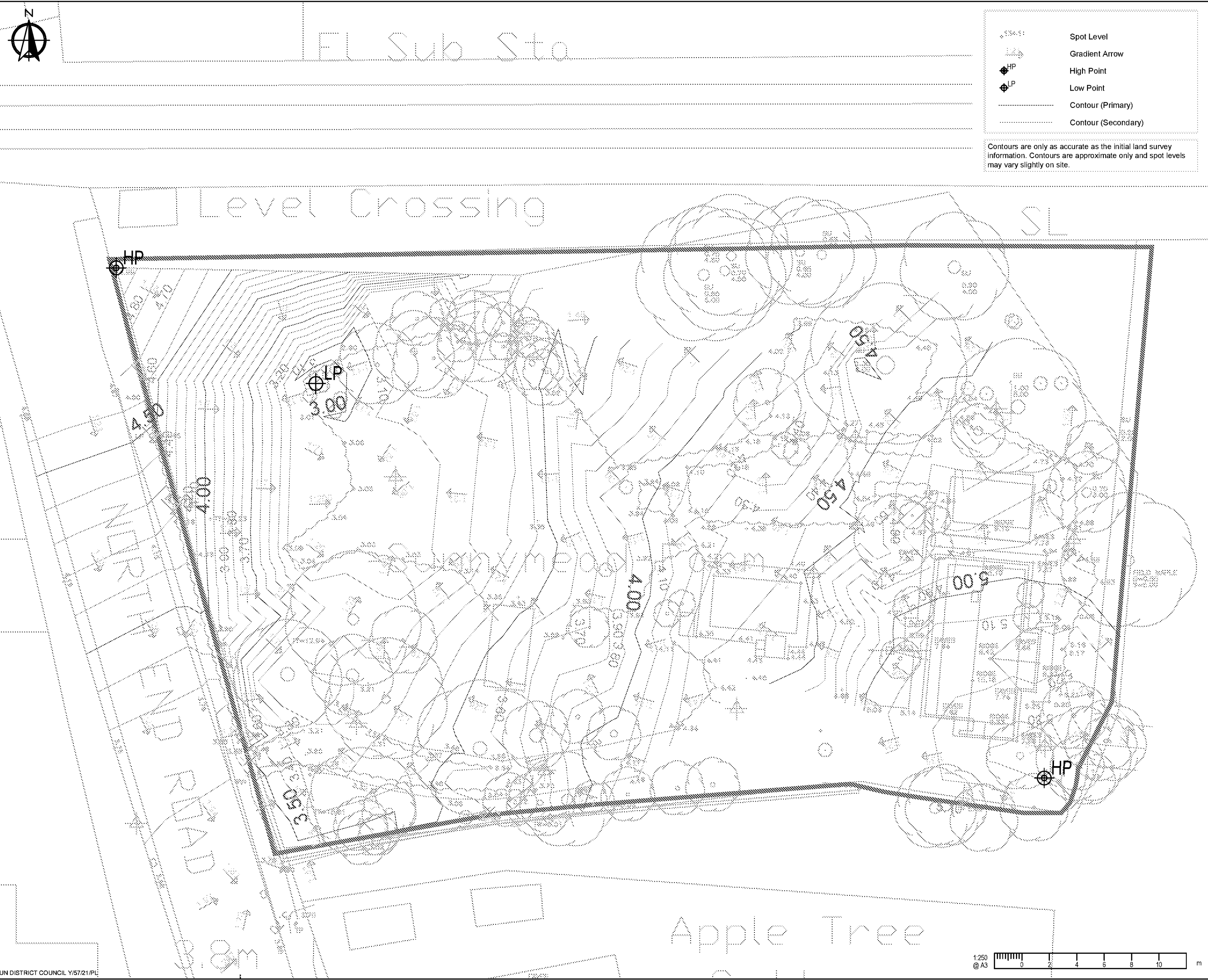
Drawing Title

Sunnymead Farm, North End Road

Yapton BN18 0DL

Scale	Date	Drawn By	Checked By
1:750	Feb 2021	DJL	MJA

Drawing No.	Rev.
D1958-100	-



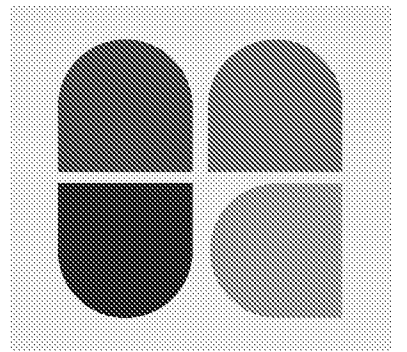
1. This drawing is to be read in conjunction with all other Bright Plan Civils drawings, and with all relevant Architect's and Engineer's drawings and specification. Any discrepancies found are to be reported immediately to the Engineer.
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PLANNING

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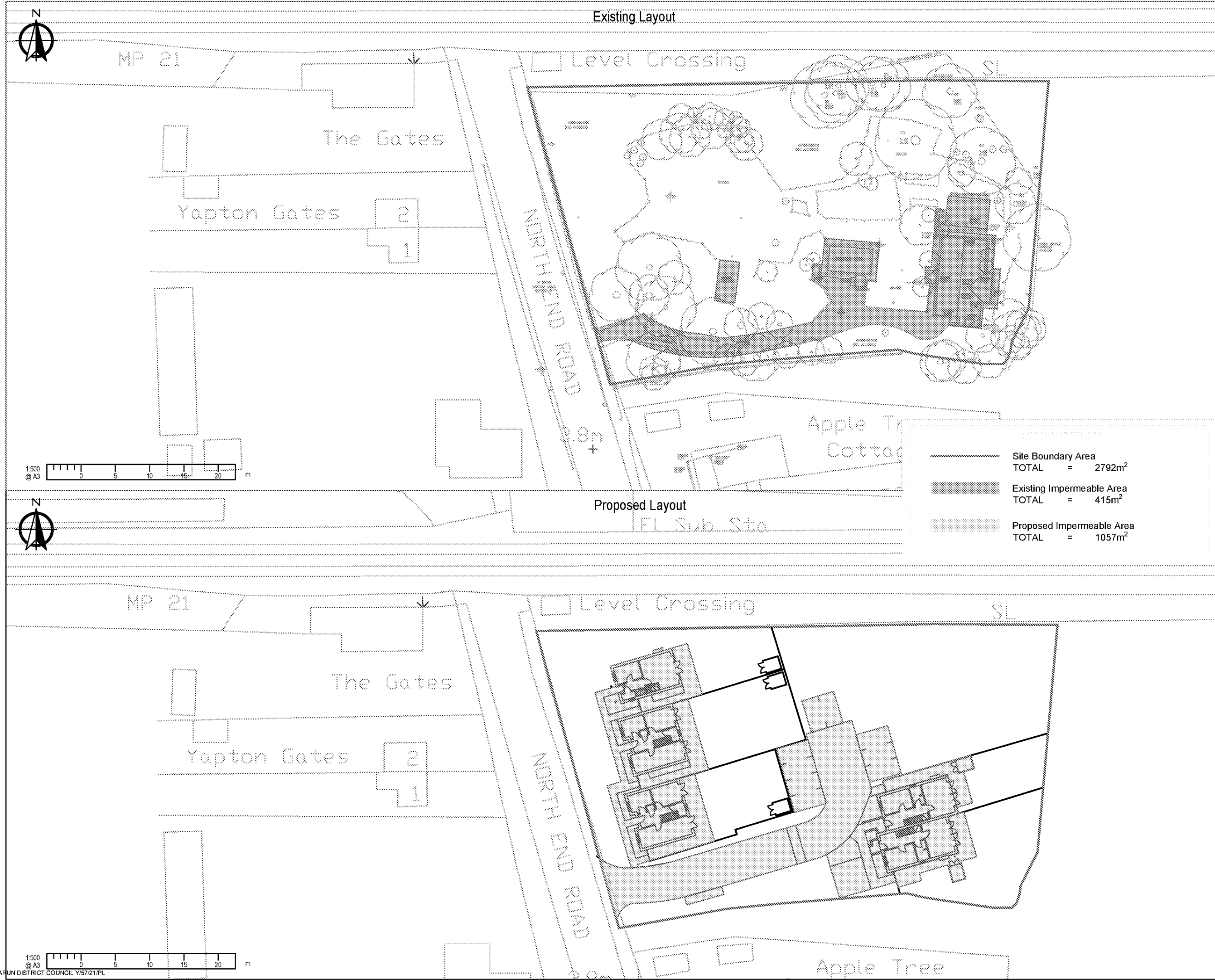
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Drawing Status	PLANNING		
Client	Roy Daniells		
Project	Overland Flow Routes		
Drawing Title	Sunnymead Farm North End Road, Yapton BN18 0DL		
Scale	1:250	Date	Mar 2021
Drawn By	DJL	Checked By	LDF
Drawing No.	D1958-101		Rev.
		-	



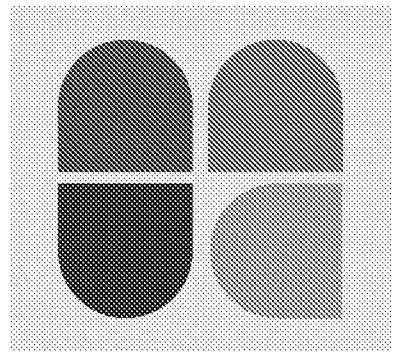
1. This drawing is to be read in conjunction with all other Bright Plan Civils drawings, and with all relevant Architect's and Engineer's drawings and specification. Any discrepancies found are to be reported immediately to the Engineer.
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Rev.	Amendments	Date
-	-	-



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Drawing Status **PLANNING**

Client **Roy Daniells**

Project **Impermeable Areas**

Drawing Title **Sunnymead Farm
North End Road, Yapton BN18 0DL**

Scale 1:500	Date Mar 2021	Drawn By DJL	Checked By LDF
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Drawing No. D1958-102	Rev. -
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NOTES

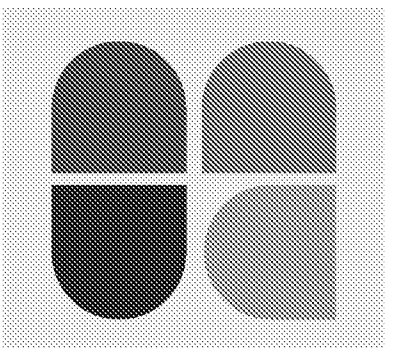
- This drawing is to be read in conjunction with all other Bright Plan Civils drawings, and with all relevant Architect's and Engineer's drawings and specification. Any discrepancies found are to be reported immediately to the Engineer.
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Rev	Amendments	Date
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Drawing Status **PLANNING**

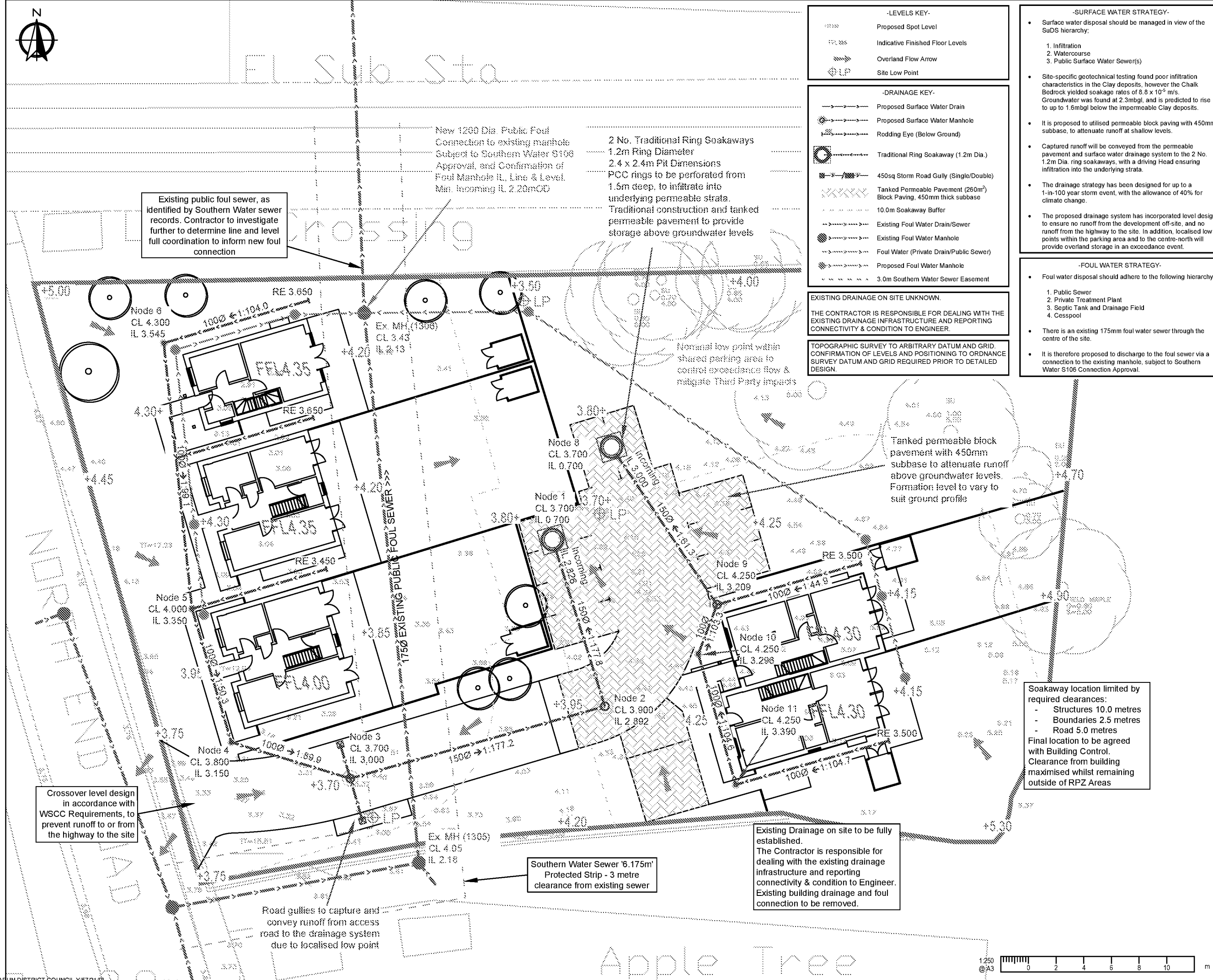
Client **Roy Daniells**

Project **Conceptual Drainage Strategy**

Drawing Title **Sunnymead Farm
North End Road, Yapton BN18 0DL**

Scale 1:250	Date Apr 2021	Drawn By DJL	Checked By MJA
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Drawing No. D1958-200	Rev. -
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APPENDICES

Appendix A Preliminary Site Layout

SUNNYMEAD FARM, YAPTON WEST SUSSEX
PROPOSED

NOTES:

Dimensions to be checked on site before commencing work. Any discrepancies shall be reported to the architect immediately.

Do not scale from these drawings except for planning purposes.

Use figured dimensions only.

Where applicable this drawing is to be read in conjunction with other consultants' drawings.

All drawings to be read in conjunction with specification and all other drawings including structural engineer and mechanical and electrical drawings / specification



SITE LOCATION PLAN

1:100	
REV	DATE
1	10/09/2020



hda
architects

www.hdarchitects.co.uk mail@hdarchitects.co.uk

Helyer Davies Architects Ltd
1 The Old Flour Mill,
Emsworth, PO10 7BT
01243 370 715

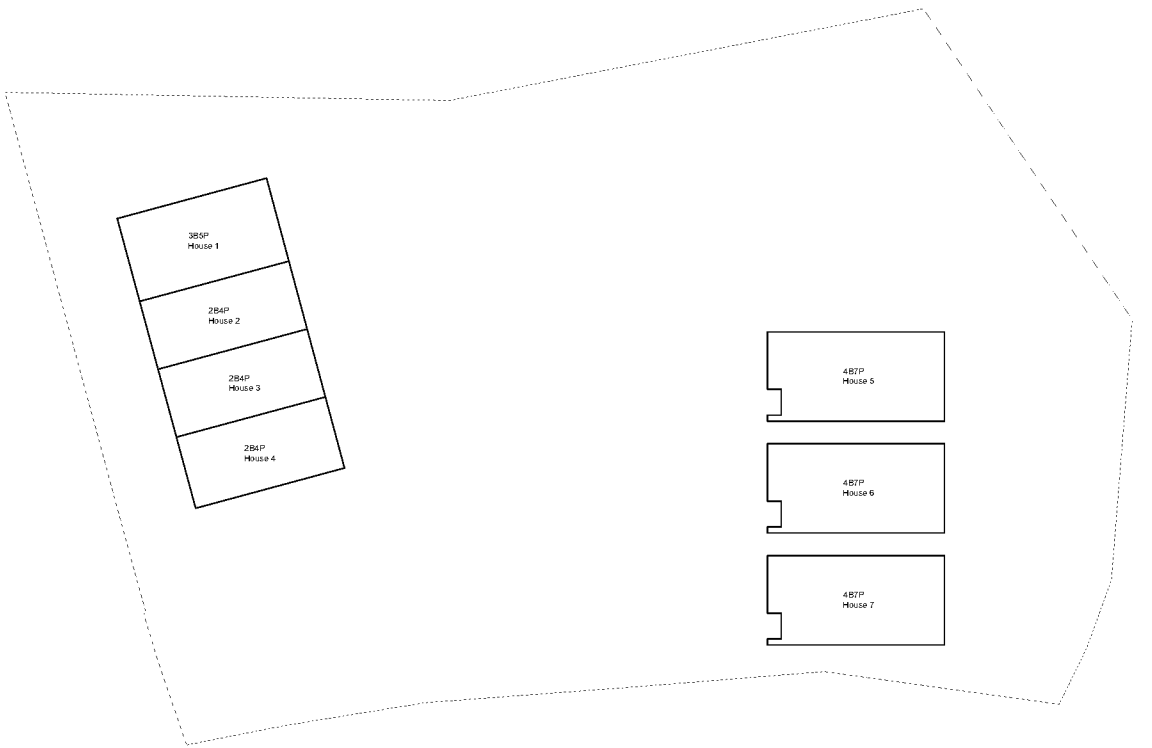
PROJECT

SUNNYMEAD FARM,
YAPTON
WEST SUSSEX

DRAWING	SCALE
Site Plan	1:100 @A1

DATE	September 2020	DRAWN	MH
DRAWING NUMBER	20148-03	REVISION	B

Appendix B Topographic Survey



key:

- Boundary Treatments:**
- 1.8m high venetian timber fence between dwellings with matching timber gate, hedgehog holes to be provided
 - 1.1m high timber picket gate

- ### Garden Furniture:

- 200 litres min.
collection and
average of 300

- | Services: | |
|-----------|----------------|
| 00.00 | Existing level |
| +00.00 | Proposed level |

- Show Colegate Land & Building Surveyors Topographic Survey 06018_Topo, June 2018
- Terrafirma Landscape Design and Ecology, Tree Constraints Plan LD1445-ARB-DWG-001, Preliminary Ecological Appraisal LD1445-ECO-REP-001, Site Habitat Plan LD1445-ARB-DWG-001
- rsg Transport Planning and Infrastructure Design Consultants, Visibility Splays and Vehicle Sweep Path Analysis dwg. 2018-4297-501
- RfE Environment-rtal, Noise Impact Assessment Technical RFE-0205-18-01 July 2018

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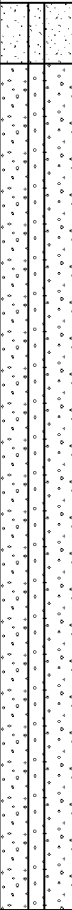
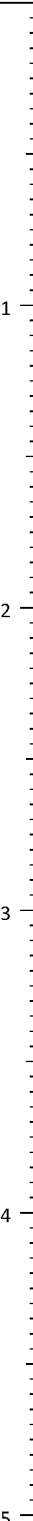
Cover Storey Architects LLP
Tel. 02392 006266

The Studio, 18 St Georges Avenue, Havant
info@coverstorey.co.uk

PO9 2RX
www.coverstorey.co.uk

Appendix C Geotechnical Information

 Southern Testing ST Consult					Start - End Date 07/11/2018		Project ID: J13840		Hole Type: WLS		WLS03 Sheet 1 of 1	
Project Name: Sunny Mead Farm					Remarks:		Co-ordinates:		Level:		Logger: NH	
Location: Sunny Mead Farm, North End Road, Yapton, Arundel, BN18 0DL					Groundwater encountered. Preliminary BRE 365 Test performed in exploratory hole.							
Client: Mr. Roy Daniells												

Well	Water Strikes	Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description	
		Depth (m bgl)	Type	Results						
							0.20	Grass over dark brown fine sandy clayey TOPSOIL with rare roots and brick fragments.		
							0.20	Firm, friable, desiccated, mid brown, fine sandy CLAY with occasional roots and rare flint gravel.		
							1.40	From 1.10m - Becoming less friable with depth		
							1.60	WEATHERED CHALK recovered as cream silty clayey GRAVEL. Gravel is fine to medium, extremely weak to very weak, subrounded to subangular CHALK with rare flint.		
							1.40			
							3.00	End of Borehole at 3.00m		

Hole Details		Casing Details		Waterstrike (m bgl)						Standing/Chiselling (m bgl)			
Depth (m bgl)	Dia. (mm)	Depth (m bgl)	Dia. (mm)	Date	Depth Strike	Depth Casing	Depth Sealed	Rose to:	Time (mins)	From	To	Time	Remarks
3.00	150				2.60			2.34	30				

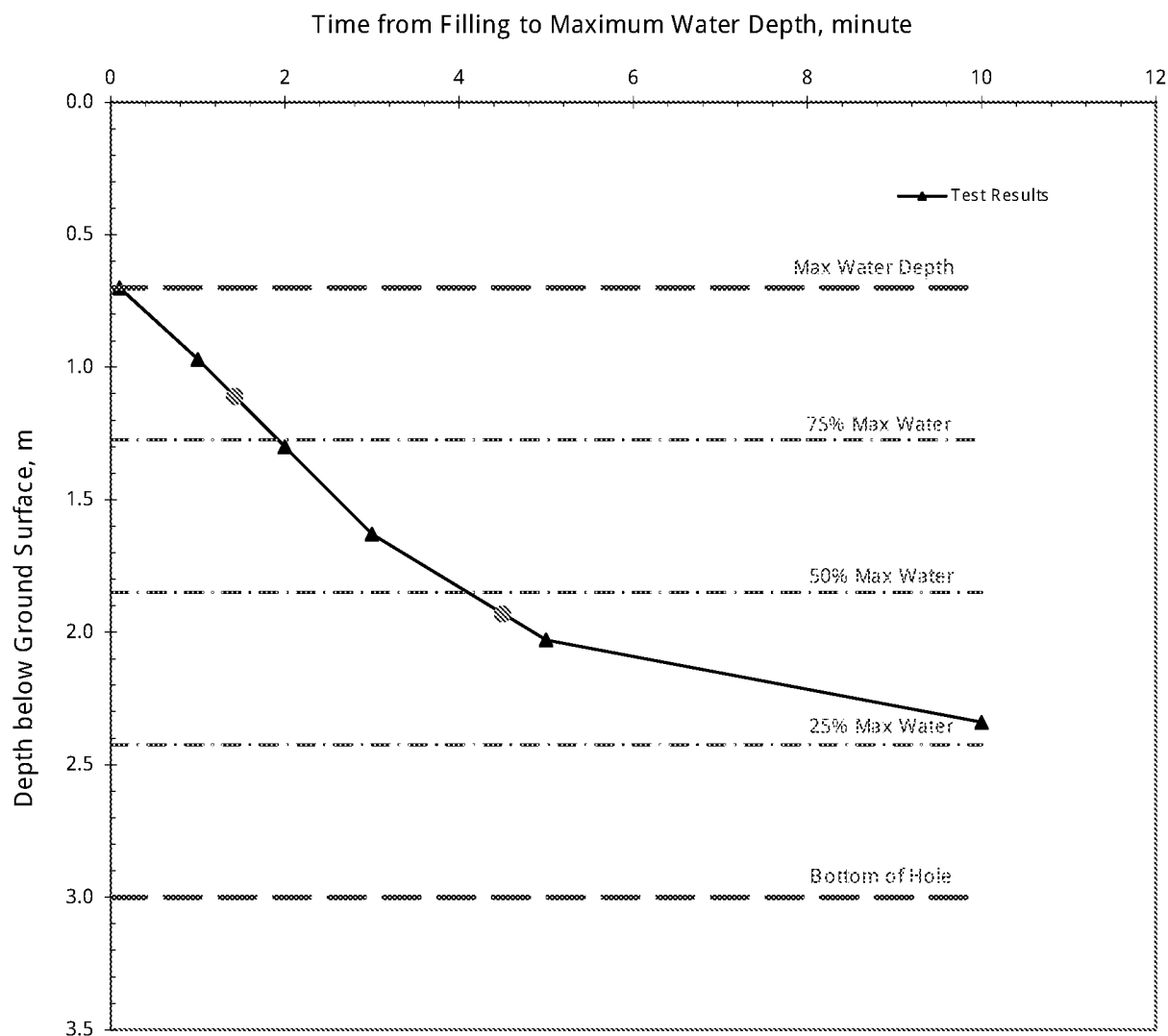
Summary Sheet

Results of Preliminary Falling-Head Soakage Tests

Site : Sunny Mead Farm, North End Road, Yapton, Aru					J ob No : J 13840		
Client : Roy Daniells					O S Reference : SU 98191 04366		
Tested By : AA/RA				Engineer: NH		Test Date : 07/Nov/2018	
Hole No	Test No	Hole Depth m	Soakage Rate for Each Test litre/m ² /min	Soakage Rate for Each Hole litre/m ² /min m/sec		Water Level at Finish of Test	Remarks
WLS02	No 1	3.00	0.025	0.025	4.19E-7	Pit was not emptied; Non compliant value was calculated.	Exploratory hole collapsed during 2 and 3 hour reading.
WLS03	No 1	3.00	6.59	5.25	8.75E-5	Pit was not emptied; Non compliant value was calculated.	Depth to existing ground water level was 2.34m.
WLS03	No 2	3.00	5.89			Pit was not emptied; Non compliant value was calculated.	
WLS03	No 3	3.00	5.25			Pit was not emptied; Non compliant value was calculated.	
WLS04	No 1	3.00	19.82	10.13	1.69E-4	Pit was not emptied; Non compliant value was calculated.	Depth to existing ground water level was 1.87m.
WLS04	No 2	3.00	11.63			Pit was not emptied; Non compliant value was calculated.	
WLS04	No 3	3.00	10.13			Pit was not emptied; Non compliant value was calculated.	
Mean Value of All Calculated Soakage Rates :				5.13 litre/m ² /min	8.56E-5 m/sec		

Preliminary Falling-Head Soakage Test

Test Hole No: WLS03
Test No: Test No 1 (Initial)



Diameter of Borehole, m	0.150	Depth to Water at Start of Test, m	0.700
Depth to End of Borehole Casing, m		Max Water Dropdown during Test, m	1.640
Depth to Borehole Base, m	3.000	Total Soakage Test Time, min	10.0
Depth to Top of Permeable Soils, m		Mean Internal Discharge Area, m ²	0.715
Depth to Groundwater Surface, m	2.340	Discharge Rate, litre/min	4.711
Depth to Top of Granular Fill, m		Soakage Rate, litre/m ² /min	6.59
Voids Assumed within Borehole, %	100%	BRE Soil Infiltration Rate, m/sec	1.10E-04

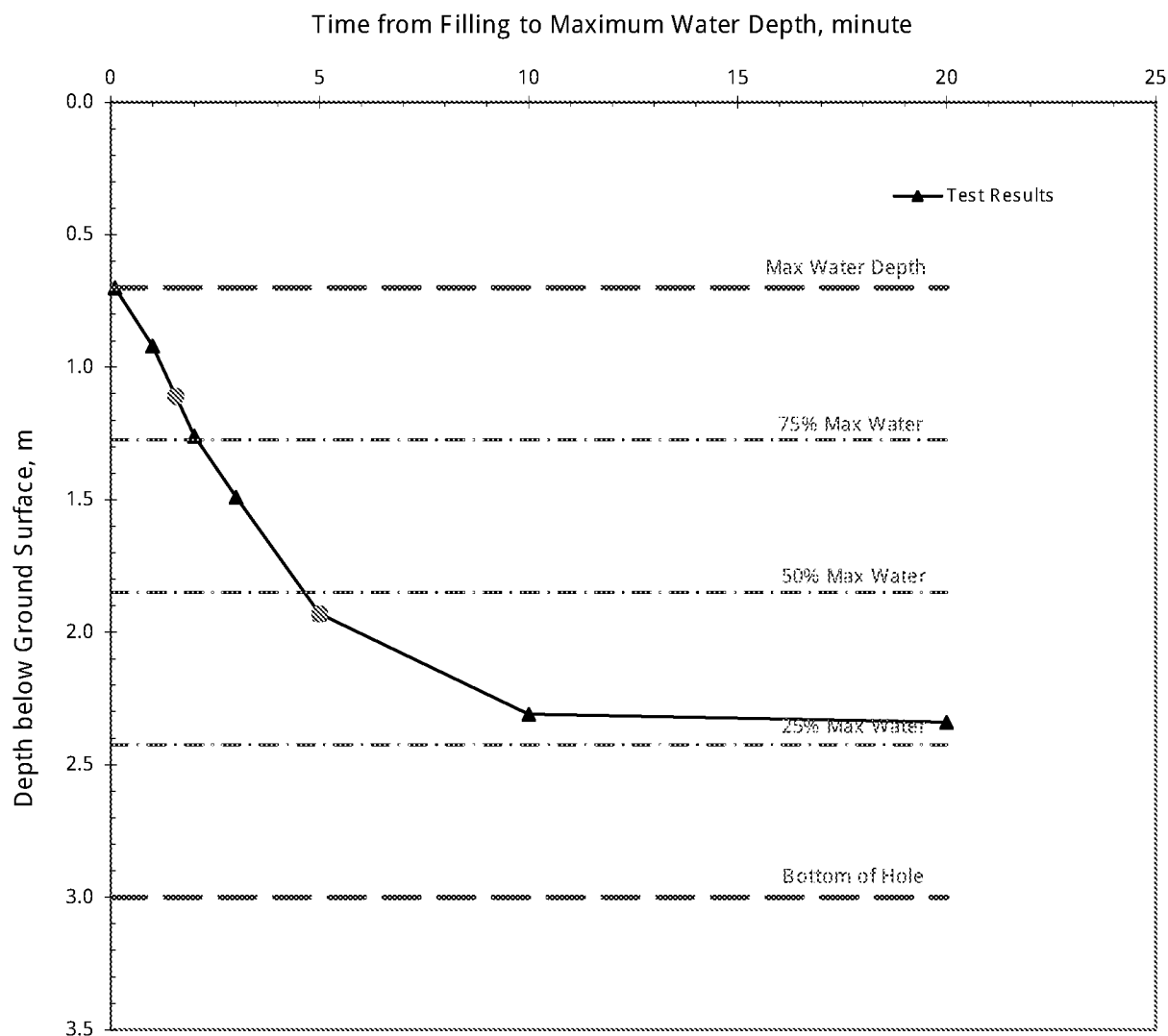
Comments:

Water level fell to 50% -- 25% max water depth, calculations were based on actual fall of water level achieved.
Result not compliant with BRE365 requirement since water did not fall to 25% max water depth.

Client: Roy Daniells	Job No: J 13840	Test Date: 07/Nov/2018
Site: Sunny Mead Farm, North End Road, Yapton	Tested By: AA/RA	Engineer: NH Fig. S2

Preliminary Falling-Head Soakage Test

Test Hole No: WLS03
Test No: Test No 2 (Repeated)



Diameter of Borehole, m	0.150	Depth to Water at Start of Test, m	0.700
Depth to End of Borehole Casing, m		Max Water Dropdown during Test, m	1.640
Depth to Borehole Base, m	3.000	Total Soakage Test Time, min	20.0
Depth to Top of Permeable Soils, m		Mean Internal Discharge Area, m ²	0.715
Depth to Groundwater Surface, m	2.340	Discharge Rate, litre/min	4.211
Depth to Top of Granular Fill, m		Soakage Rate, litre/m ² /min	5.89
Voids Assumed within Borehole, %	100%	BRE Soil Infiltration Rate, m/sec	9.81E-05

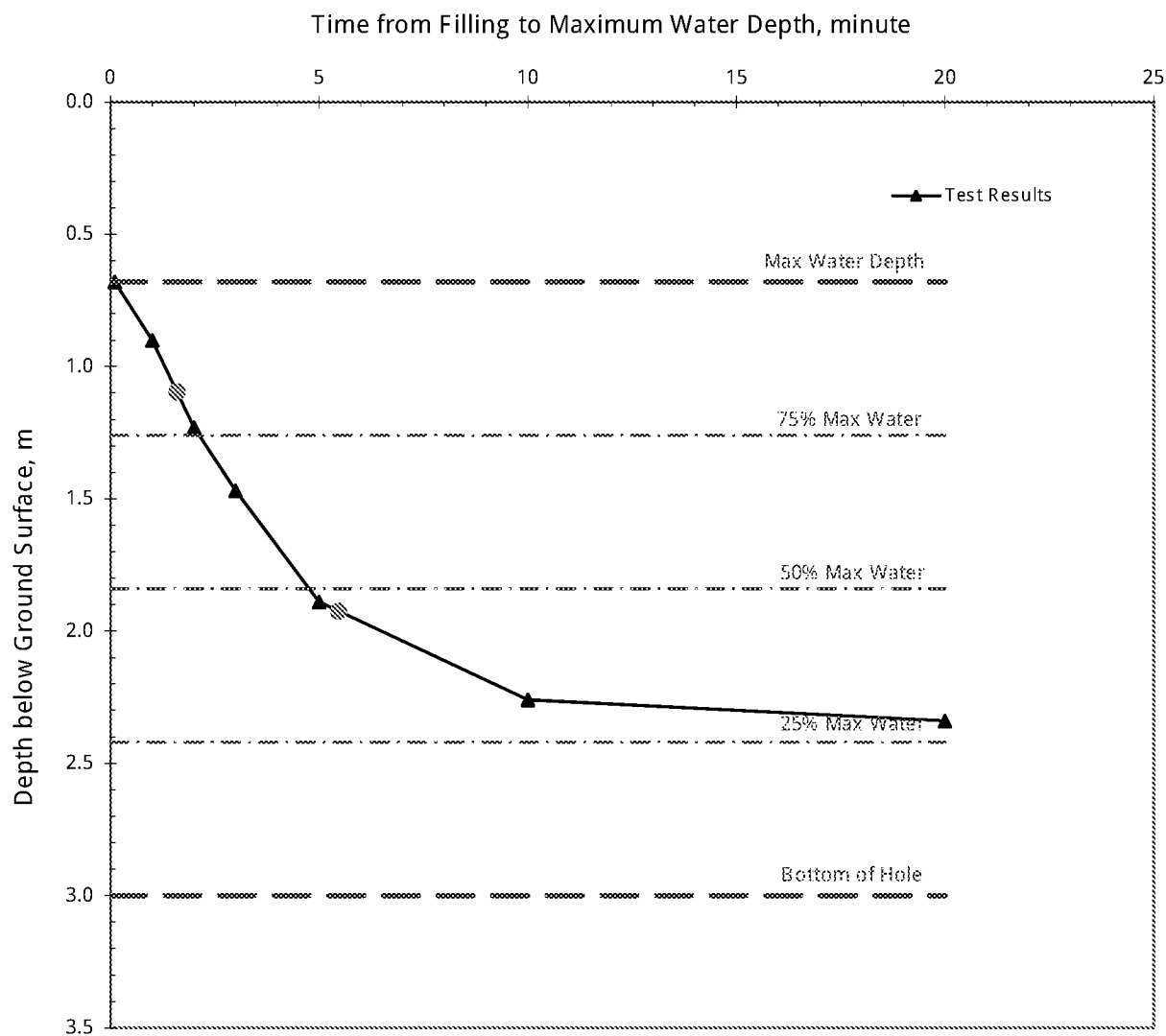
Comments:

Water level fell to 50% -- 25% max water depth, calculations were based on actual fall of water level achieved.
Result not compliant with BRE365 requirement since water did not fall to 25% max water depth.

Client: Roy Daniells	Job No: J 13840	Test Date: 07/Nov/2018
Site: Sunny Mead Farm, North End Road, Yapton	Tested By: AA/RA	Engineer: NH Fig. S3

Preliminary Falling-Head Soakage Test

Test Hole No: WLS03
Test No: Test No 3 (Repeated)



Diameter of Borehole, m	0.150	Depth to Water at Start of Test, m	0.680
Depth to End of Borehole Casing, m		Max Water Dropdown during Test, m	1.660
Depth to Borehole Base, m	3.000	Total Soakage Test Time, min	20.0
Depth to Top of Permeable Soils, m		Mean Internal Discharge Area, m ²	0.720
Depth to Groundwater Surface, m	2.340	Discharge Rate, litre/min	3.778
Depth to Top of Granular Fill, m		Soakage Rate, litre/m ² /min	5.25
Voids Assumed within Borehole, %	100%	BRE Soil Infiltration Rate, m/sec	8.75E-05

Comments:

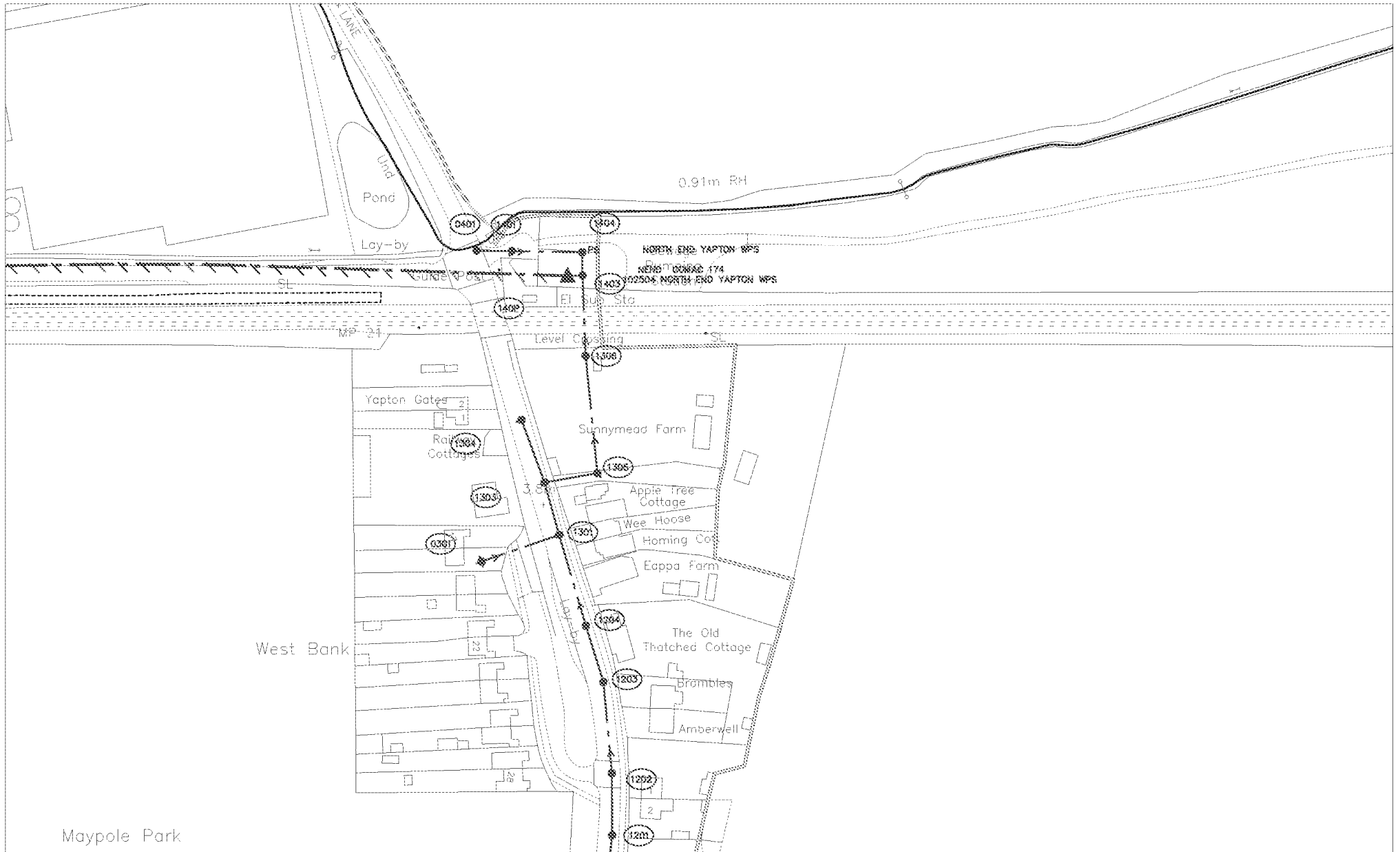
Water level fell to 50% -- 25% max water depth, calculations were based on actual fall of water level achieved.
Result not compliant with BRE365 requirement since water did not fall to 25% max water depth.

Client: Roy Daniells	Job No: J 13840	Test Date: 07/Nov/2018
Site: Sunny Mead Farm, North End Road, Yapton	Tested By: AA/RA	Engineer: NH Fig. S4

Appendix D Public Sewer Records

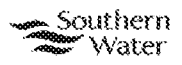
SEWER RECORDS PAGE 1 OF 2

104498



104210

497933

O.S. REF. SU9804SW	Drawn by: rohandas	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. WARNING: SHAG poles are associated of Shared Accessible Cane WARNING: Unknown Poles may include Shared Accessible Cane		
	Scale: 1:1250			
Title: 310572__Sunny Mead Farm, North	Date: 27/09/2018	Based upon Ordnance Survey Digital Data with the permission of the controller of H.M.S.O. Crown Copyright Reserved Licence No. WU 298530.		

SEWER RECORDS PAGE 2 OF 2

Node	Cover	Invert	Size	Material	Shape
0301X	8.45	4.73	150	VC	CIRC
0401K	4.56	2.6	175	VC	CIRC
1201X	5.75	3.32	175	VC	CIRC
1202K	5.59	3.13	175	VC	CIRC
1203X	4.98	2.99	175	VC	CIRC
1204K	4.53	2.75	175	VC	CIRC
1301K	3.94	2.48	175	VC	CIRC
1303X	3.67	2.23	175	VC	CIRC
1304K	3.92	2.48	175	VC	CIRC
1305X	4.05	2.18	175	VC	CIRC
1306X	3.43	2.13	175	VC	CIRC
1401K	3.97	2.3	175	VC	CIRC
1403X	3.5	1.9	175	VC	CIRC
1404K	3.46	2.06	175	VC	CIRC
140PX	3.91	3.9	100	CI	CIRC

[illegible]

Drawn by: rohandas	
Title: 310572_Sunny Mead Farm, North	
Date: 27/09/2018	

Appendix E ADC Consultation

YAPTON LANE

El Sub Sta

Yapton Gates

2
1

Railway
Cottages

Sunnymead Farm

Cottage
Wee Hoose

Homing Cott

Eappa Farm

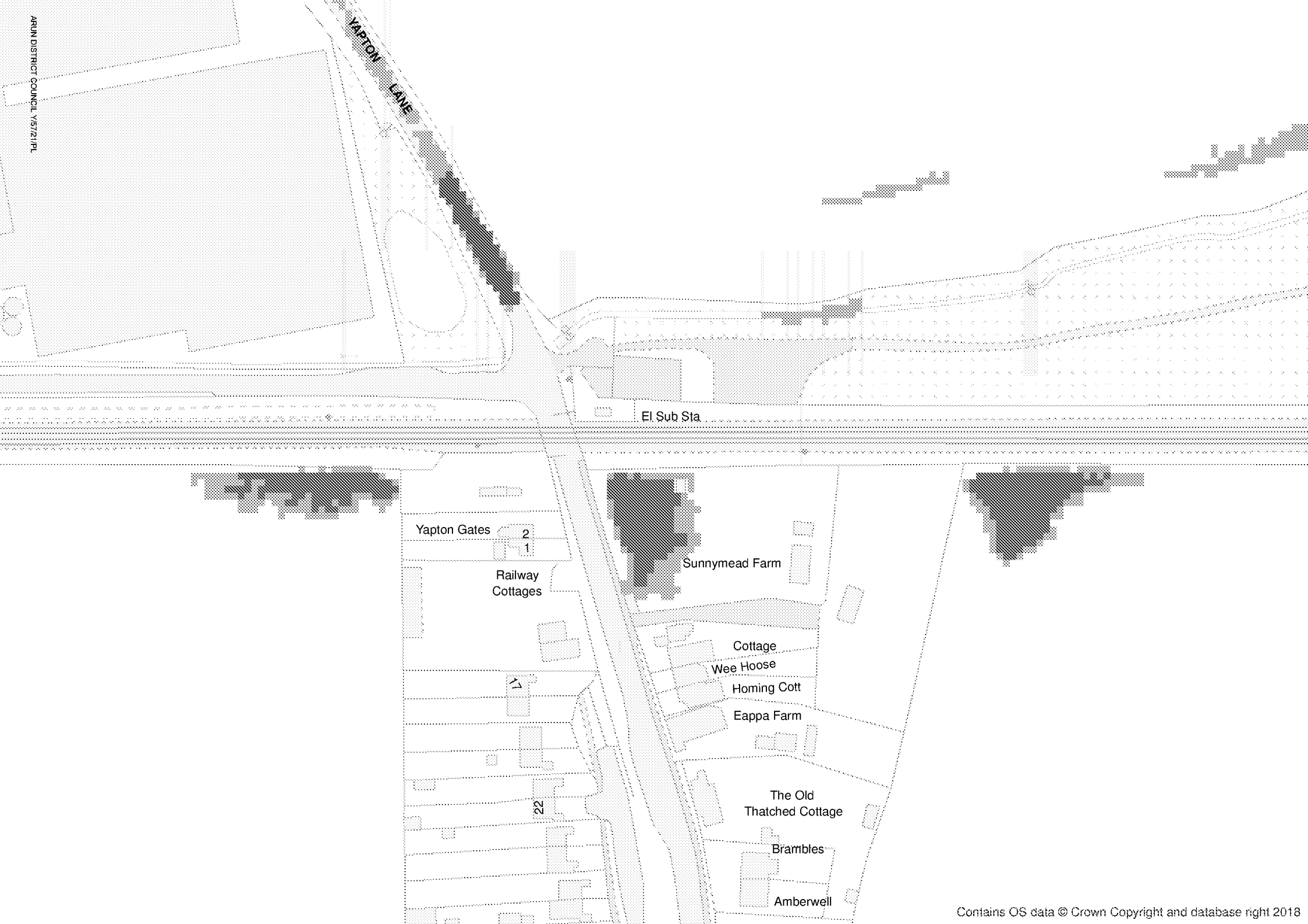
The Old
Thatched Cottage

Brambles

Amberwell

2

22



YAPTON LANE

El Sub Sta

Yapton Gates 2
1
Railway
Cottages

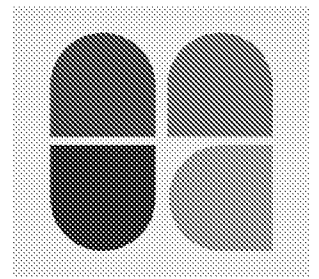
Sunnymead Farm

Cottage
Wea Hoose
Homing Cott
Eappa Farm

The Old
Thatched Cottage

Brambles

Amberwell



RGP DESIGN LIMITED

Drainage Officer
Arun District Council
Application No. Y/33/20/PL

22 May 2020
Our Ref: NSTP/18/D1511

RE: SUNNYMEAD FARM, NORTH END ROAD, YAPTON BN18 0DL

Consultant Response to Engineers Comments Regarding Surface Water Drainage (In Red)

1. As noted by the applicant, a public foul sewer crosses the site. It would appear that the proposal will attempt to divert this sewer. Please consult Southern water if this has not been done already. Discussion with Arun Drainage Engineer clarified that this was mistaken. The Proposal will not attempt to divert any existing sewer. It is requested that it is clarified that this has been reviewed again.
2. Infiltration testing was completed in October and not in accordance with BRE365. The applicant will need to carry out winter infiltration tests in strict accordance with BRE365, in the locations and at the depths of any proposed infiltration structures. It is expected that this will include both shallow and deeper tests to account for the permeable paving and the proposed soakaways. The testing should be undertaken in the months of January/February when the ground is most saturated and above the recorded highest groundwater level (see point 3). This is understood and we agree with Arun Policy on this matter, it is requested that this is conditioned, and full testing would inform detailed design with initial design utilising the preliminary test results. It is viable that the design could be amended should final infiltration rates require additional storage volume.
3. No groundwater monitoring data has been supplied; a full winters groundwater monitoring is required to demonstrate the level at which groundwater peaks on the site. Infiltration testing and by default, all infiltration structures must have their base above this level. This is understood and we agree with Arun Policy on this matter, it is requested that this is conditioned, and full testing would inform detailed design with initial design utilising the preliminary test results. Should groundwater levels be high, it is viable that SuDs volume could be increased at shallow depths, for instance through the use of permeable block paving with a geocellular sub-base alternative (i.e. Permavoid).
4. There is a large low area to the north west of the site, this is shown as an area of surface water flooding in a 1 in 30 event and greater on our mapping and is further evidenced in the topographical survey. We have no evidence that this area currently floods beyond the anecdotal evidence of the current resident. There is no historic mapping of any pond here. The four house terrace is proposed to be built in this area. There are no clear references to ground raising, however the location of these properties is problematic either way.
 - a. If the intention is to build the properties in the low area with no ground raising (ground floor FFL specified as +2.925 – is this AOD?) then the properties themselves will displace any potential water

storage that could occur here. In addition, there is a risk that the properties could be flooded due to exceedance events of the proposed SuDS system. The proposed level design of the site shows the houses raised to a minimum of 4.00mAOD, with the design low point of the site to the rear. The drainage system has been designed to capture all runoff, and in addition it can be seen that the low points of the SuDS system are at 3.45mAOD and 3.25mAOD. This means that exceedance would pond the rear parking area and the visitor parking bay but would not significantly inhibit access or egress, or risk flooding of the proposed buildings or off-site.

- b. If the intention is to raise the ground levels (which appears to be the case from the elevations of the buildings and the street elevation sheet), then the ground level may be being raised by up to 1.85m. This could remove a large area of flood storage; however the properties would be less likely to be flooded themselves but could increase flood risk elsewhere. As above, Exceedance storage is still provided within the site, where SuDS are situated. Sufficient capacity to capture runoff, and exceedance limited to within parking areas, or at worst also driveways and rear gardens. Consideration of proposed level design was incorporated in the development of the proposed drainage strategy and is indicated within the drainage strategy drawing;
- It is not considered that runoff from the road and railway would not drain to the site, as there is a road kerb and railway embankment that steers runoff away from the site boundary. The design of the proposed drainage system provides sufficient storage for the surface water runoff from the development.
 - Nevertheless, the design has considered that runoff may enter the site due to flooding off-site, and therefore considered exceedance via level design. The FFLs of the proposed buildings are at least 750mm above the adjacent low point.
 - As can be seen in Drawing SK300 dated 21/11/2018, proposed levels fall towards the centre of the site from all four (north, south, east and west) boundaries, so with buildings raised and the low points within the intended drainage locations any exceedance due to an event above the design event or excessive highway runoff onto the site will not result in flooding to the proposed buildings or off-site.

On the basis of point 4 we currently **object** to the proposed scheme. In order to overcome our objection, the applicant will need to fully assess the points raised above and provide evidence that there will be no detriment to the new properties or existing infrastructure/properties as a result of this development.

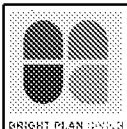
If the applicant is able to overcome our objection, or if you are minded to approve the application despite the objection, then please apply the following standard conditions: PCENGD2 and PCENGD4.

We hope that the design and the additional clarification satisfies the Drainage Officer that the site has dealt with all proposed site runoff, without increasing flood risk on or off site and provided sufficient level assessment that access and egress will not be unacceptably impeded. We do not believe that there is a requirement to make an assessment of 'storage volume' as runoff from the railway and highway are not designed to enter the site, nevertheless we have included an assessment of this for the safety of the proposed development.

Kind Regards,

Dan Lytton
Engineer, RGP Design Ltd

Appendix F Causeway Flow Drainage Calculations



Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	250.0
Additional Flow (%)	10	Minimum Velocity (m/s)	0.75
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	0.550
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
✓ 13	0.006	5.00	4.150	1200	0.650
✓ 12	0.006	5.00	4.150	1200	0.650
✓ 11	0.006	5.00	4.250	1200	0.860
✓ 10	0.006	5.00	4.250	1200	0.954
✓ 9	0.021	5.00	4.250	1200	1.041
✓ 8			3.700	1200	0.700
✓ 7	0.003	5.00	4.300	1200	0.650
✓ 6	0.004	5.00	4.300	1200	0.755
✓ 5	0.007	5.00	4.000	1200	0.650
✓ 4	0.007	5.00	3.800	1200	0.650
✓ 3	0.013	5.00	3.700	1200	0.700
✓ 2	0.014	5.00	3.900	1200	1.008
✓ 1			3.700	1200	0.874

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.005	11.737	177.8	150	3.900	2.892	0.858	3.700	2.826	0.724
1.004	19.140	177.2	150	3.700	3.000	0.550	3.900	2.892	0.858
1.003	8.987	89.9	100	3.800	3.150	0.550	3.700	3.050	0.550
1.002	10.069	50.3	100	4.000	3.350	0.550	3.800	3.150	0.550
1.001	19.320	99.1	100	4.300	3.545	0.655	4.000	3.350	0.550
1.000	10.919	104.0	100	4.300	3.650	0.550	4.300	3.545	0.655
2.003	12.821	61.3	150	4.250	3.209	0.891	3.700	3.000	0.550
3.000	10.819	44.9	100	4.150	3.500	0.550	4.250	3.259	0.891
2.002	3.320	103.3	100	4.250	3.296	0.854	4.250	3.259	0.891
2.001	9.833	104.6	100	4.250	3.390	0.760	4.250	3.296	0.854

Link	US Node	DS Node
1.005	2	1
1.004	3	2
1.003	4	3
1.002	5	4
1.001	6	5
1.000	7	6
2.003	9	8
3.000	13	9
2.002	10	9
2.001	11	10



Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
2.000	11.519	104.7	100	4.150	3.500	0.550	4.250	3.390	0.760

Link	US Node	DS Node
2.000	12	11

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
13	4.150	0.650	1200					
				0	3.000	3.500	100	
12	4.150	0.650	1200					
				0	2.000	3.500	100	
11	4.250	0.860	1200		1	2.000	3.390	100
				0	2.001	3.390	100	
10	4.250	0.954	1200		1	2.001	3.296	100
				0	2.002	3.296	100	
9	4.250	1.041	1200		1	3.000	3.259	100
				2	2.002	3.259	100	
				0	2.003	3.209	150	
8	3.700	0.700	1200		1	2.003	3.000	150
7	4.300	0.650	1200					
				0	1.000	3.650	100	
6	4.300	0.755	1200		1	1.000	3.545	100
				0	1.001	3.545	100	
5	4.000	0.650	1200		1	1.001	3.350	100
				0	1.002	3.350	100	
4	3.800	0.650	1200		1	1.002	3.150	100
				0	1.003	3.150	100	



Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
3	3.700	0.700	1200		1	1.003	3.050 100
2	3.900	1.008	1200		0	1.004	3.000 150
1	3.700	0.874	1200		1	1.005	2.892 150

Node 1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	3.140	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.450
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	0.450
Porosity	0.32	Length (m)	13.000		

Node 8 Carpark Storage Structure

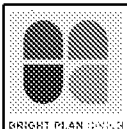
Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	3.140	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.450
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	0.450
Porosity	0.32	Length (m)	13.000		

Node 1 Lined Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.32000	Invert Level (m)	0.700	Pit Length (m)	1.800
Side Inf Coefficient (m/hr)	0.32000	Time to half empty (mins)	60	Depth (m)	
Safety Factor	2.0	Ring Diameter (m)	1.200	Inf Depth (m)	1.500
Porosity	0.32	Pit Width (m)	1.800	Number Required	1

Node 8 Lined Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.32000	Invert Level (m)	0.700	Pit Length (m)	1.800
Side Inf Coefficient (m/hr)	0.32000	Time to half empty (mins)	60	Depth (m)	
Safety Factor	2.0	Ring Diameter (m)	1.200	Inf Depth (m)	1.500
Porosity	0.32	Pit Width (m)	1.800	Number Required	1



Results for 1 year Critical Storm Duration. Lowest mass balance: 99.69%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	13	11	3.520	0.020	0.8	0.0269	0.0000	OK
15 minute winter	12	11	3.525	0.025	0.8	0.0327	0.0000	OK
15 minute winter	11	11	3.425	0.035	1.6	0.0451	0.0000	OK
15 minute winter	10	11	3.344	0.048	2.4	0.0599	0.0000	OK
15 minute winter	9	11	3.264	0.055	6.1	0.0842	0.0000	OK
120 minute winter	8	94	2.832	-0.168	2.2	3.4245	0.0000	OK
15 minute winter	7	11	3.668	0.018	0.4	0.0215	0.0000	OK
15 minute winter	6	11	3.571	0.026	1.0	0.0326	0.0000	OK
15 minute winter	5	11	3.382	0.032	1.9	0.0426	0.0000	OK
15 minute winter	4	11	3.198	0.048	2.8	0.0649	0.0000	OK
15 minute winter	3	11	3.060	0.060	4.5	0.0895	0.0000	OK
15 minute winter	2	11	2.968	0.076	6.4	0.1075	0.0000	OK
60 minute winter	1	59	2.913	0.087	3.5	3.6138	0.0000	OK

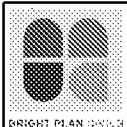
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute winter	13	3.000	9	0.8	0.705	0.088	0.0123
15 minute winter	12	2.000	11	0.8	0.403	0.136	0.0230
15 minute winter	11	2.001	10	1.6	0.519	0.270	0.0303
15 minute winter	10	2.002	9	2.4	0.682	0.401	0.0134
15 minute winter	9	2.003	8	6.0	1.062	0.265	0.0728
120 minute winter	8	Infiltration		0.6			
15 minute winter	7	1.000	6	0.4	0.313	0.067	0.0140
15 minute winter	6	1.001	5	0.9	0.491	0.152	0.0364
15 minute winter	5	1.002	4	1.9	0.635	0.217	0.0295
15 minute winter	4	1.003	3	2.8	0.764	0.434	0.0326
15 minute winter	3	1.004	2	4.5	0.575	0.336	0.1484
15 minute winter	2	1.005	1	6.2	0.720	0.471	0.1018
60 minute winter	1	Infiltration		0.6			



Results for 30 year Critical Storm Duration. Lowest mass balance: 99.69%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	13	10	3.533	0.033	2.1	0.0429	0.0000	OK
15 minute winter	12	10	3.541	0.041	2.1	0.0536	0.0000	OK
15 minute winter	11	11	3.451	0.061	4.2	0.0775	0.0000	OK
15 minute winter	10	11	3.397	0.101	6.2	0.1269	0.0000	SURCHARGED
180 minute winter	9	176	3.344	0.135	3.7	0.2067	0.0000	OK
180 minute winter	8	176	3.344	0.344	3.7	10.1652	0.0000	OK
15 minute winter	7	11	3.678	0.028	1.0	0.0340	0.0000	OK
15 minute winter	6	11	3.588	0.043	2.4	0.0531	0.0000	OK
15 minute winter	5	11	3.403	0.053	4.7	0.0709	0.0000	OK
120 minute winter	4	118	3.326	0.176	2.3	0.2375	0.0000	SURCHARGED
120 minute winter	3	118	3.326	0.326	3.5	0.4898	0.0000	SURCHARGED
120 minute winter	2	118	3.326	0.434	4.5	0.6114	0.0000	SURCHARGED
120 minute winter	1	120	3.326	0.500	4.4	9.5775	0.0000	OK

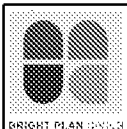
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute winter	13	3.000	9	2.1	0.829	0.229	0.0308
15 minute winter	12	2.000	11	2.1	0.516	0.349	0.0460
15 minute winter	11	2.001	10	4.1	0.625	0.692	0.0631
15 minute winter	10	2.002	9	6.0	0.812	1.016	0.0277
180 minute winter	9	2.003	8	3.7	0.877	0.163	0.2198
180 minute winter	8	Infiltration		0.6			
15 minute winter	7	1.000	6	1.0	0.404	0.169	0.0272
15 minute winter	6	1.001	5	2.3	0.631	0.384	0.0714
15 minute winter	5	1.002	4	4.7	0.756	0.546	0.0605
120 minute winter	4	1.003	3	2.1	0.712	0.331	0.0703
120 minute winter	3	1.004	2	3.1	0.514	0.236	0.3370
120 minute winter	2	1.005	1	4.4	0.648	0.328	0.2066
120 minute winter	1	Infiltration		0.6			



Results for 100 year Critical Storm Duration. Lowest mass balance: 99.69%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	13	10	3.537	0.037	2.7	0.0489	0.0000	OK
15 minute winter	12	10	3.547	0.047	2.7	0.0615	0.0000	OK
15 minute winter	11	11	3.495	0.105	5.3	0.1339	0.0000	SURCHARGED
180 minute winter	10	176	3.433	0.137	1.8	0.1718	0.0000	SURCHARGED
180 minute winter	9	176	3.433	0.224	4.6	0.3429	0.0000	SURCHARGED
180 minute winter	8	176	3.432	0.432	4.4	14.0537	0.0000	OK
15 minute winter	7	11	3.682	0.032	1.3	0.0389	0.0000	OK
15 minute winter	6	11	3.595	0.050	3.1	0.0617	0.0000	OK
15 minute winter	5	13	3.494	0.144	6.1	0.1936	0.0000	SURCHARGED
30 minute winter	4	22	3.446	0.296	7.0	0.3988	0.0000	SURCHARGED
180 minute winter	3	176	3.419	0.419	3.4	0.6290	0.0000	FLOOD RISK
180 minute winter	2	176	3.419	0.527	4.7	0.7420	0.0000	SURCHARGED
180 minute winter	1	176	3.418	0.592	4.6	13.6416	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute winter	13	3.000	9	2.7	0.812	0.293	0.0504
15 minute winter	12	2.000	11	2.6	0.533	0.447	0.0653
15 minute winter	11	2.001	10	4.8	0.631	0.807	0.0769
180 minute winter	10	2.002	9	1.8	0.636	0.306	0.0299
180 minute winter	9	2.003	8	4.4	0.877	0.192	0.2257
180 minute winter	8	Infiltration		0.6			
15 minute winter	7	1.000	6	1.3	0.437	0.220	0.0330
15 minute winter	6	1.001	5	3.0	0.648	0.500	0.1106
15 minute winter	5	1.002	4	5.5	0.762	0.641	0.0788
30 minute winter	4	1.003	3	6.5	0.881	1.023	0.0703
180 minute winter	3	1.004	2	3.2	0.490	0.242	0.3370
180 minute winter	2	1.005	1	4.6	0.601	0.346	0.2066
180 minute winter	1	Infiltration		0.6			



Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.69%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	13	180	3.617	0.117	0.9	0.1533	0.0000	SURCHARGED
15 minute winter	12	13	3.707	0.207	3.8	0.2719	0.0000	SURCHARGED
15 minute winter	11	12	3.682	0.292	7.0	0.3707	0.0000	SURCHARGED
180 minute winter	10	180	3.617	0.321	2.7	0.4032	0.0000	SURCHARGED
180 minute winter	9	180	3.617	0.408	6.5	0.6253	0.0000	SURCHARGED
180 minute winter	8	180	3.617	0.617	6.3	21.0527	0.0000	OK
15 minute winter	7	14	3.751	0.101	1.9	0.1229	0.0000	SURCHARGED
15 minute winter	6	14	3.746	0.201	4.4	0.2484	0.0000	SURCHARGED
15 minute winter	5	13	3.723	0.373	8.0	0.5015	0.0000	FLOOD RISK
15 minute winter	4	13	3.662	0.512	9.5	0.6892	0.0000	FLOOD RISK
240 minute winter	3	236	3.587	0.587	3.7	0.8811	0.0000	FLOOD RISK
240 minute winter	2	236	3.587	0.695	5.1	0.9786	0.0000	SURCHARGED
240 minute winter	1	236	3.586	0.760	5.0	21.0115	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
180 minute winter	13	3.000	9	0.9	0.674	0.099	0.0847
15 minute winter	12	2.000	11	3.4	0.541	0.570	0.0901
15 minute winter	11	2.001	10	5.3	0.680	0.902	0.0769
180 minute winter	10	2.002	9	2.5	0.655	0.422	0.0299
180 minute winter	9	2.003	8	6.3	0.848	0.276	0.2257
180 minute winter	8	Infiltration		0.6			
15 minute winter	7	1.000	6	1.9	0.471	0.315	0.0854
15 minute winter	6	1.001	5	3.8	0.660	0.624	0.1512
15 minute winter	5	1.002	4	5.7	0.807	0.670	0.0788
15 minute winter	4	1.003	3	7.2	0.922	1.131	0.0703
240 minute winter	3	1.004	2	3.5	0.456	0.267	0.3370
240 minute winter	2	1.005	1	5.0	0.548	0.377	0.2066
240 minute winter	1	Infiltration		0.6			