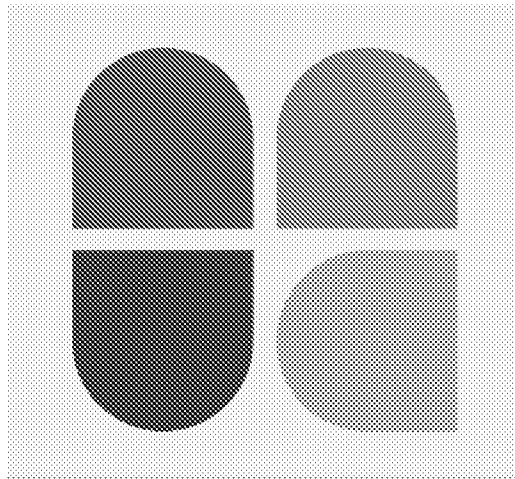




BRIGHT PLAN CIVILS

**LAND AT BROOKVIEW NURSERY,
EASTERGATE LANE, WALBERTON BN18
0BA**

**PROPOSED COMMERCIAL
DEVELOPMENT**

Flood Risk Assessment and Drainage
Strategy

Prepared on Behalf of

Philip Sowden

D1963/FRA1.0

07 June 2021

DOCUMENT CONTROL

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1 INTRODUCTION

1.1 Background

- 1.1.1 Bright Plan Civils (BPC) is instructed by Philip Sowden to prepare a site-specific Flood Risk Assessment (FRA) and Drainage Strategy to support a planning application for a proposed commercial development at Brookview Nursery, Eastergate Lane, Walberton BN18 0BA.
- 1.1.2 This FRA and Drainage Strategy has been undertaken in accordance with Planning Practice Guidance: Flood Risk and Coastal Change and National Planning Policy Framework Section 14.
- 1.1.3 The proposed development will involve a mixed development building consisting of 4 office units and a 3 warehouse units - as demonstrated within the preliminary site layout, contained within **Appendix A** of this report.
- 1.1.4 In preparing this report, BPC has referred to the following documents and information:
- Environment Agency Flood Maps for Planning
 - Long Term Flood Risk Information; Flood Risk Maps
 - Local Authorities Strategic Flood Risk Assessment
 - Generic Water Company and Local Authority Drainage Records
 - Site-specific Environmental Investigation Report
 - British Geological Survey & Records
- 1.1.5 This document has been prepared to assess if the proposed development is suitable for the site and confirms if mitigation is required to ensure that flood risk is not increased, and that the proposed development remains safe during its design life.
- 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 is an existing nursery with offices, polytunnels and hardstanding area.
- 1.2.2 The site has a total area of 6604 m² (0.66 Ha) – as seen in Drawing **100**.
- 1.2.3 A topographical survey of the site has been undertaken by Maltby Surveys Ltd. A copy of this survey is included in **Appendix B** of this report.
- 1.2.4 The topographical survey shows that the site is between 12.1m AOD in the northeast corner to 10.6mAOD along the watercourse boundary to the south of the site. The site generally falls gently southwards. This influences the existing overland flow routes – as detailed in Drawing **100**.

- 1.2.5 The site drains into the boundary ditch along the western and southern boundary, with a road gully collecting runoff from the concreted catchment area and discharged to the ditch along the western boundary via a 150m diameter pipe.
- 1.2.6 The existing site consists of 1838m² of hardstanding and buildings that discharge to the watercourse via the existing drainage system, as well as 644m² of impermeable areas draining via overland runoff and a further 2176m² of porous hardstanding surfacing – as seen in Drawing 100.

1.3 Ground Conditions

- 1.3.1 In the absence of a site-specific investigation, reference has been made to the British Geological Survey (BGS) website.
- 1.3.2 The BGS geology viewer states that the bedrock geology consists of 'London Clay Formation', as seen in Figure 1.

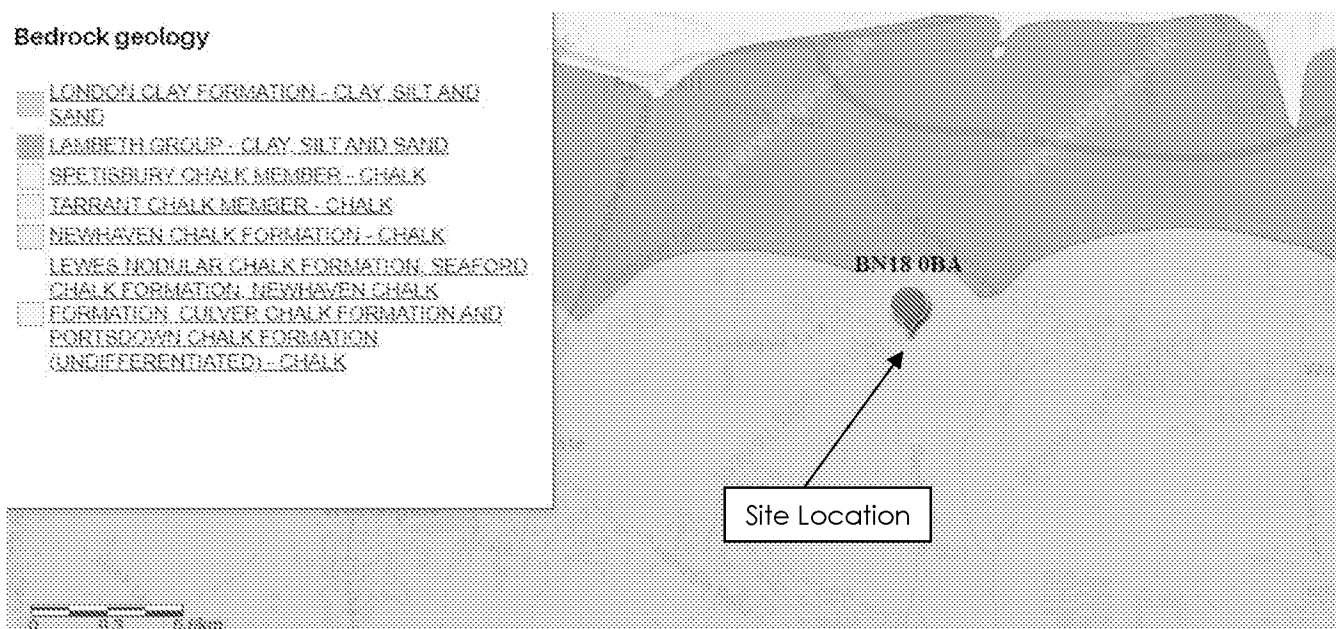


Figure 1. BGS website Bedrock geology

- 1.3.3 Superficial Deposits located at the site area are recorded as 'River Terrace Deposits (undifferentiated) - Sand, Silt And Clay' and 'Head - Gravel, Sand, Silt And Clay', as seen in Figure 2.

Superficial deposits

- ALLUVIUM - CLAY, SILT, SAND AND GRAVEL
- HEAD - CLAY, SILT, SAND AND GRAVEL
- HEAD - GRAVEL, SAND, SILT AND CLAY
- RAISED BEACH DEPOSITS 1 - SAND AND GRAVEL
- RAISED BEACH DEPOSITS 2 - SAND AND GRAVEL
- RAISED MARINE DEPOSITS - CLAY, SILT, SAND AND GRAVEL
- RAISED STORM BEACH DEPOSITS 1 - SAND AND GRAVEL
- RAISED STORM BEACH DEPOSITS 2 - GRAVEL
- RIVER TERRACE DEPOSITS (UNDIFFERENTIATED) - SAND, SILT AND CLAY

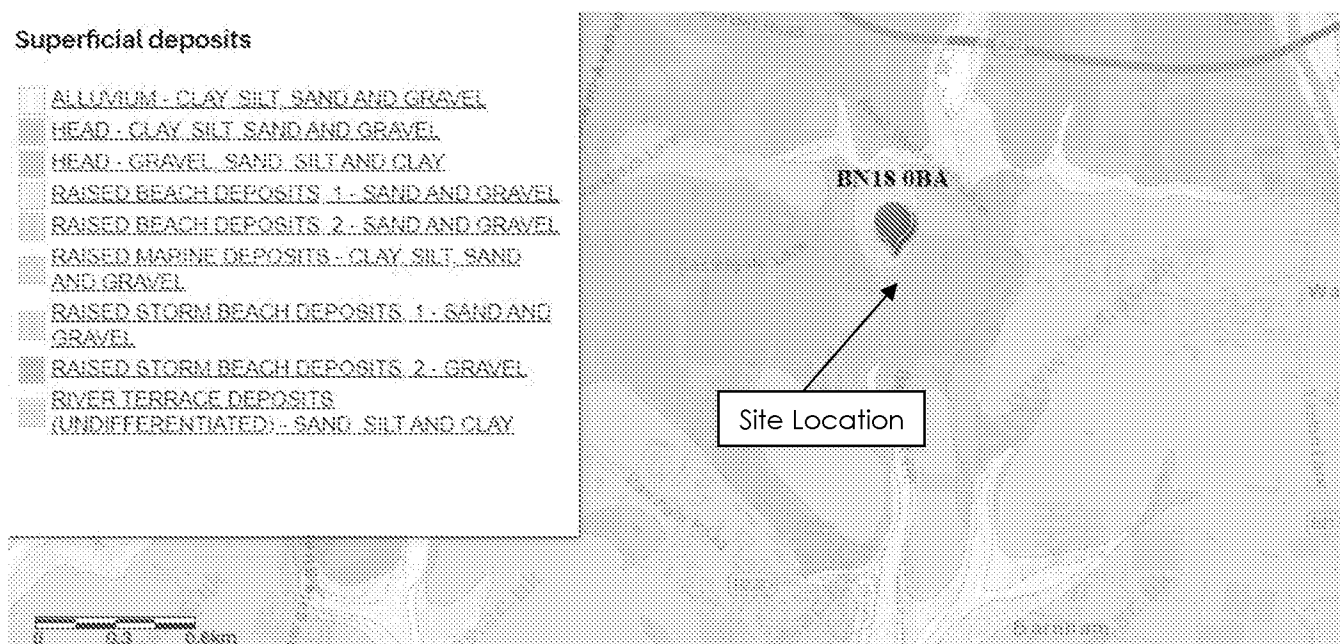


Figure 2. BGS website superficial deposits

- 1.3.4 Historic borehole records from the Single Onshore Boreholes Index (SOBI) on the BGS website have also been reviewed in the absence of a site-specific geotechnical investigation, as depicted in **Figure 3**.

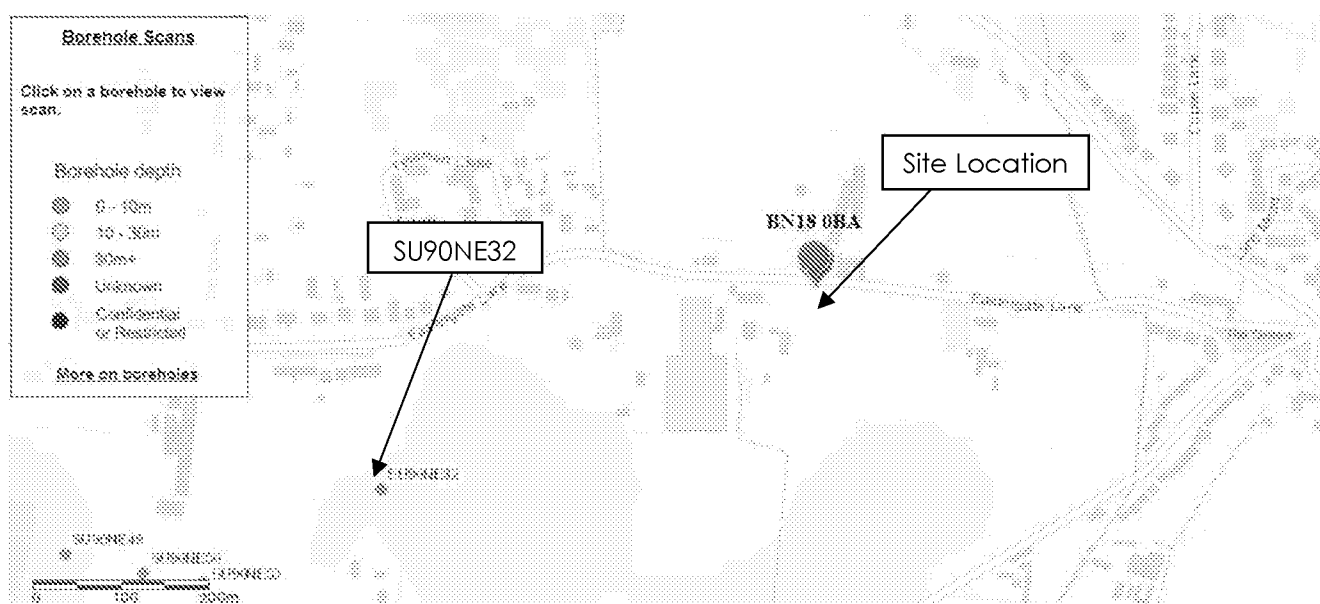


Figure 3. BGS website borehole locations

- 1.3.5 Two boreholes in relation to the site are a borehole located at Stoneyfields Nursery (SU90NE32) 600m to the southwest, as seen in **Figure 3**. The borehole has a similar geotechnical strata to the site according to the BGS online mapping.
- 1.3.6 The log at Stoneyfields Nursery states that the geological composition encountered within the borehole consisted of 'Head Gravel' (gravel and clay) to a depth of 5.79mbgl (metres below ground level), followed by 'London Clay' up to a depth of 56.23mbglm.
- 1.3.7 A copy of the BGS records reviewed can be found within **Appendix C** of this report.

1.4 Groundwater

- 1.4.1 The Environment Agency have provided commentary with respect to groundwater in their Product 4 Information Request response. It is noted that London Clay bedrock geology at this site is characterised as unproductive. An unproductive aquifer does not have the ability to yield or store water. Over this bedrock are superficial river terrace deposits which are secondary aquifers which may store or yield small amounts of water.
- 1.4.2 The EA had no documented or anecdotal evidence of groundwater flooding in this area, which suggests that there's a little or no risk of flooding but that any works or structures beneath the ground surface could be affected by groundwater. The EA do not have any groundwater level monitoring data relevant to this site.
- 1.4.3 Consideration of 10 shallow boreholes at West Barnham Farm and Choller Farm to the southwest of the site found rest water levels of 1.2mbgl to 3.0mbgl. The boreholes were undertaken at a similar elevation and geological composition as the site.
- 1.4.4 Mapping managed by MAGIC (magic.defra.gov.uk) provides geographic information concerning the natural environment from across government. This mapping tool has been referred to in order to confirm whether the site is located within either any groundwater source protection zones or groundwater vulnerability zones. The site is situated within an 'Unproductive' bedrock strata, as seen in **Figure 4**.

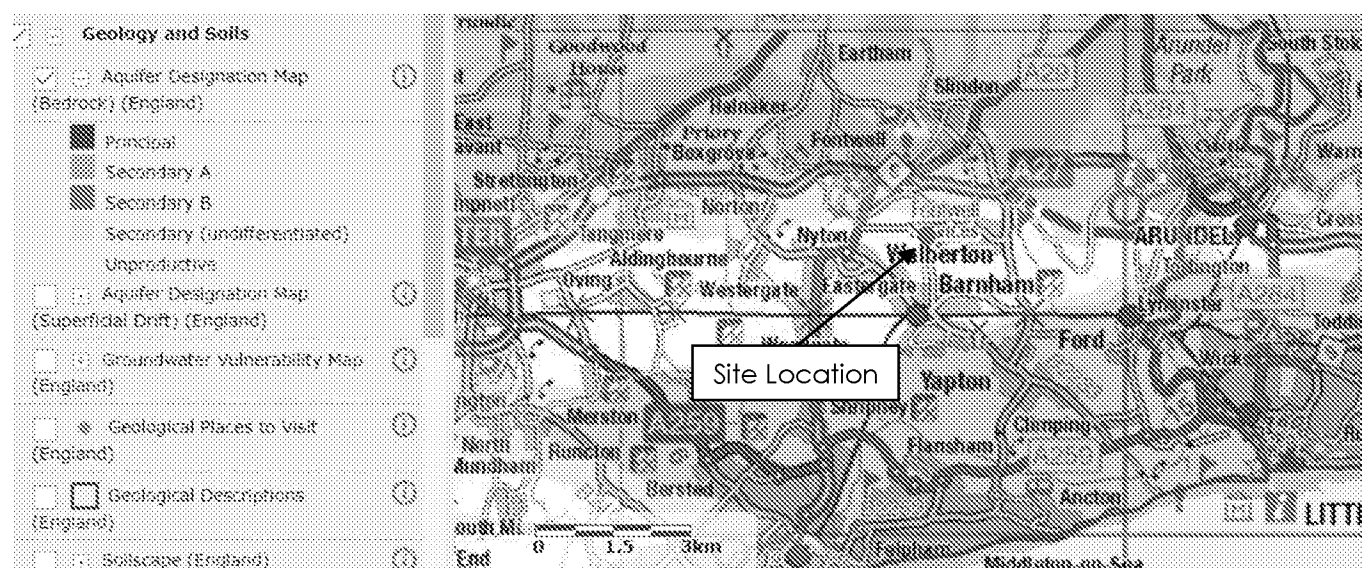


Figure 4. DEFRA Bedrock Aquifer Designation Map

- 1.4.5 This refers to bedrock geology that exhibits high permeability and/or provides a high level of water storage. The bedrock may support water supply and/or river base flow on a strategic scale. The site is also within a 'Secondary A' superficial drift aquifer, as seen in **Figure 5**.

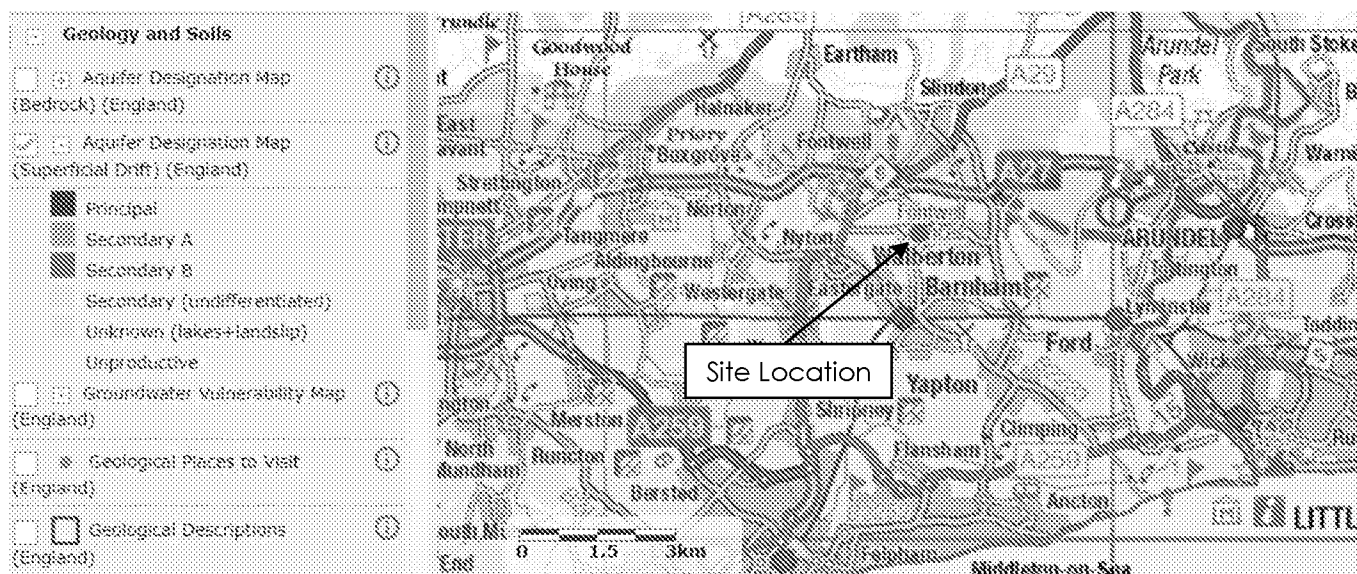


Figure 5. DEFA Superficial Drifts Aquifer Designation Map

- 1.4.6 The Groundwater Vulnerability Map (**Figure 6**) confirms that the site falls within a 'Low' groundwater vulnerability zone. This refers to typically low permeability ground, with low leaching potential.



Figure 6. DEFA Groundwater Vulnerability Map

- 1.4.7 The site is not recorded as within a Source Protection Zone or a Drinking Water Safeguard Zone, referring to non-statutory designations with respect to groundwater protections.

1.5 Existing Drainage

1.5.1 The site falls within the administration of West Sussex County Council and Arun District Council who have been consulted in view of the existing drainage infrastructure local to the site.

1.5.2 The local Water Authority is Southern Water, who provide sewerage services within the area. Public sewer records have been obtained, as contained within this report in **Appendix E**.

1.5.3 Surface Water:

- The Southern Water public sewer records (**Appendix E**) demonstrate that there are no public surface water sewers located within the boundaries of the site.
- The nearest water feature is the ordinary watercourse boundary ditch along the western and southern boundary. This conveys the ditch from the northwest and the highway drainage along Eastergate Lane to the north of the site, and runs east and south away from the site.
- As the existing site is Brownfield (developed), the runoff from the existing impermeable areas is expected to be approximately 34.5l/s (2482m² impermeable area x 50mm/hr rainfall / 3600s).

1.5.4 Foul Water:

- The public sewer records (**Appendix E**) demonstrate that there is a 175mm clay pipe foul sewer that runs east along Eastergate Lane, to the north of the site.

1.5.5 Highway Drainage:

- Information provided by Arun District Council shows existing road gullies along Eastergate Lane, which is shown to discharge into the culverted section of watercourse from the road to the western boundary of Brookview Nursery (the site).

2 PROBABILITY

2.1 Sources of Information

- 2.1.1 The NPPF requires that all sources of flooding are considered being Tidal, Fluvial, Pluvial, Groundwater, Sewers and Man-made reservoirs/canals.
- 2.1.2 The likelihood of the site flooding has been established by reviewing the following information:
- Environment Agency Flood Maps for Planning
 - Long Term Flood Risk Assessment Surface Water Flood Risk Maps
 - Long Term Flood Risk Assessment Reservoir Flood Risk Maps
 - Local Authorities Strategic Flood Risk Assessment
 - Consultation with Local Authority/Lead Local Flood Authority

2.2 Flood Maps and Modelling

- 2.2.1 The Environment Agency's Product 4 Response indicated that the site is within Flood Zone 1, as seen in **Appendix F**.
- 2.2.2 This refers to land assessed as having less than 0.1% annual chance of flooding from rivers or the sea. The site is 270 metres away from Flood Zone 3 and no detailed site flood levels are available for the location.
- 2.2.3 The flood zones are also confirmed by information and mapping obtained from the Flood Map for Planning, and is consistent within other flood risk mapping reviewed.

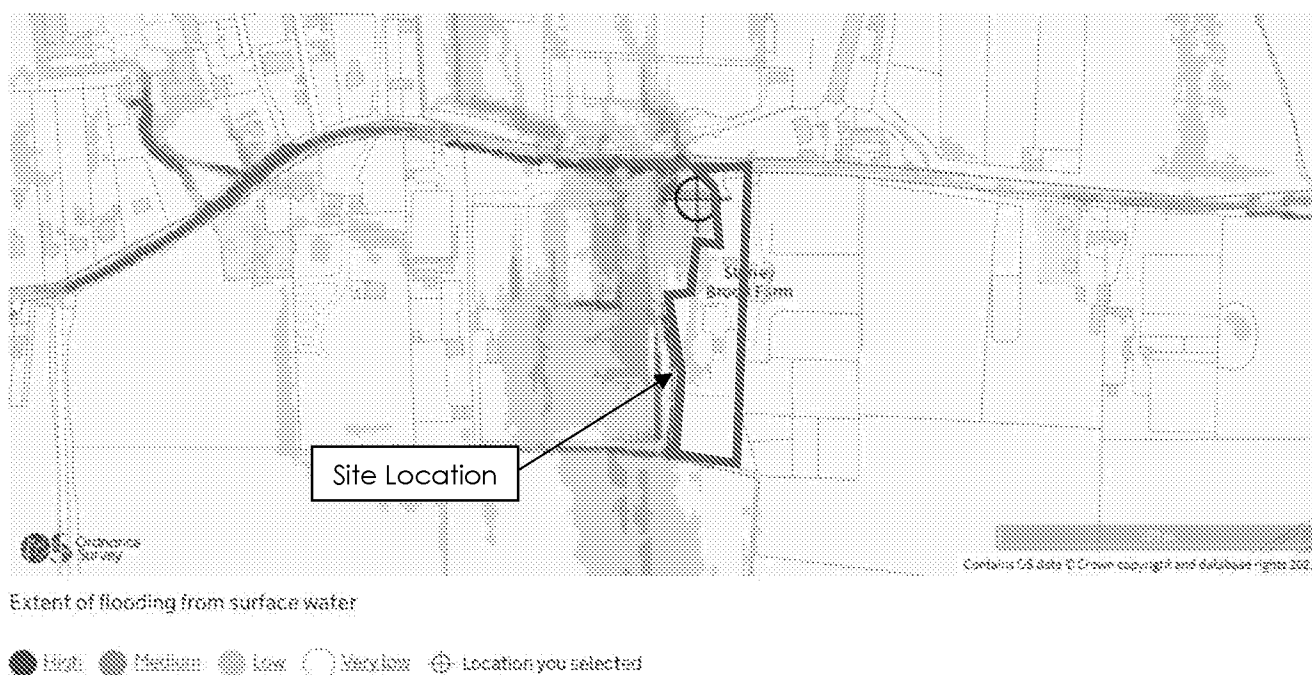
Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; 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)

2.2.4 **Figure 7** also shows that the site is at very low risk of flooding from rivers or sea.



2.2.5 **Figure 8** shows that the site at very low to low risk of surface water flooding, with depths limited to less than 300mm.

2.2.6 Eastergate lane along the northern boundary is at low to high risk of flooding, with depths between 300mm to 900mm to the north west of the site entrance.



2.2.7 **Figure 9** shows that the site is not at risk of flooding from reservoirs.



Figure 9. Long Term Flood Risk Map; Flood risk from reservoirs

2.3 Strategic Flood Risk Assessment

- 2.3.1 The Arun District Council SFRA identified Walberton as having suffered surface water flooding in the past, as recently as 2009. The SFRA does not have any records of flooding incidents or historic flood outlines in the vicinity of the site however.
- 2.3.2 The site is not shown as affected by the increase in flood risk as a result of climate change or within a flood warning area, but is within an area identified as typically susceptible to groundwater.

2.4 Historic Flooding

- 2.4.1 Consultation with Arun District Council confirmed historic flooding of the highway at the convergence of the highway drainage and watercourse with the culverted section to the south, emerging along the western boundary of the site.
- 2.4.2 This was attributed to run off from the land to the north. Some landowners have undertaken works to minimise this but there still may be an issue due to suspected issues with the culvert(s).

2.5 Summary of Flood Risk

- 2.5.1 The potential sources of flooding are:

Source of Flooding	Level of Risk
Rivers and Coastal	Very Low The site is within Flood Zone 1 with no significant risk of flooding from rivers or the sea identified.
Surface Water	Low The long-term flood risk for surface water varies from 'Very Low' to 'Low' at the site location. There is low to high risk along Eastergate Lane, so access/egress will need to be considered.
Groundwater	Medium Review of BGS records found the site to be situated above an Unproductive Aquifer with low groundwater vulnerability. Borehole records show groundwater at 1.2-3.0m below ground level. It is considered that the low lying groundwater is likely due to perched groundwater within the deposits, above the impermeable Clay strata. The use of infiltration SuDS will be limited by the presence of perched groundwater, however some infiltration may contribute to discharge in shallow SuDS subject to testing.
Sewers	Very Low No records of sewer flooding have been identified within the vicinity of the site, and no other records of sewer flooding have been found. In view of this information the risk of flooding from this source is deemed to be 'Very Low'.
Artificial Sources	None The site is not shown to be at risk of flooding in the event of a breach of a reservoir.

3 PROPOSED DEVELOPMENT

3.1 Description of Development

3.1.1 The proposed development will involve retaining 2 commercial units, and the construction of 7 commercial units as demonstrated within **Appendix A**.

3.1.2 The type of development falls within the 'Less 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 post-development hardstanding area has been determined to be reduced from 4,658m² (0.47Ha) to 3,986m² (0.40Ha), as seen in Drawing **200**. This includes porous surfaces such as gravel at both the existing and proposed sites.

3.1.4 The proposed development will not increase the impermeable area of the site or increase the rate of run-off generated by the site.

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	Yes	No initial constraints but not suitable due to client construction specification.
Basins and Ponds		No initial constraints, suitable within the proposed layout.
- Constructed Wetlands	Yes	
- Balancing Ponds	Yes	
- Detention Basins	Yes	
- Retention Ponds	Yes	
Filter strips and swales	No	Shallow groundwater and Clay bedrock limits the use of infiltration techniques, subject to testing.
Infiltration Devices	No	Shallow groundwater and Clay bedrock limits the use of infiltration techniques, subject to testing.
- Soakaways		
- Infiltration trenches and basins		
Permeable surfaces and filter drains		Shallow groundwater and Clay bedrock limits the use of infiltration techniques, however this could be

- Gravelled areas	Yes	considered to capture and attenuate flows.
- Solid paving blocks	Yes	
- Porous pavers	Yes	
Tanked systems		SuDS systems would be depth limited due to cover levels required, ditch levels for discharge and possible presence of shallow groundwater.
- Oversized pipes	Yes	
- Cellular tanks	Yes	

- 4.1.2 Runoff from the 6 no. buildings to the north and centre of the site will be discharged to a proposed open pond, that will discharge to the boundary ditch to the west of the site at a controlled flow rate of 2.0l/s.
- 4.1.3 In addition, it is proposed that permeable surfacing will be introduced across the site for the access road and shared parking areas, totalling 2218m². A minimum subbase thickness of 300mm is proposed, with a porous surfacing proposed. This may however be increased at detailed design stage for vehicular loading. The permeable surfacing will be conveyed via a filter trench with a 225mm perforated pipe to a open pond to the south of the site, along with runoff from 3 no. buildings to the south of the site. This will discharge to the boundary ditch to the south of the site at a controlled rate of 5.0l/s. The proposed drainage layout is set out in Drawing **300**.
- 4.1.4 Drainage calculations, as seen in **Appendix G**, demonstrate that the proposed drainage system will attenuate runoff without exceedance up to the design event of 1 in-100 years, including an allowance of climate change.
- 4.1.5 Proposed runoff from the site represents a 80% betterment compared to the average peak annual runoff of the existing Brownfield site, as detailed in **Section 1.5**.
- 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 – very low/TSS=0.2/M=0.2/H=0.05
- Driveways and low traffic roads – 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
- Pond - TSS=0.7/M=0.7/H=0.5

4.2.7 As the pollution hazard index does not exceed any pollution mitigation index for any contaminant type, for any proposed land use, the proposed SuDS methods will provide sufficient treatment for the residential areas.

4.3 Foul Water Drainage

- 4.3.1 It is understood there is an existing connection to the public foul sewer via a Third Party site. It is proposed that a new foul water connection is provided for the proposed development. Connections to the public sewer network can be established by the developer, subject to approval.
- 4.3.2 Recent changes to 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.
- 4.3.3 The topography of the site, as well as the location and depth of the existing foul sewers located within Eastergate Lane, means that a gravity-based connection to the public foul sewer network is not viable. A proposed foul pumping station is proposed within the site. The proposed points of connection are shown on Drawing **300** (Drainage Strategy).
- 4.3.4 Based on the based on Water UK Design & Construction Guidance (4000l/day) for 9 No. units, the proposed foul flow to the public foul sewer will be 0.45 l/s.

4.4 Climate Change

- 4.4.1 NPPF sets out percentage increases to be applied to the peak rainfall intensity values used in the design of a surface water drainage system to allow for the effects of climate change.
- 4.4.2 In accordance with NPPF 'climate change allowances' update 22 July 2020, an increase of 20% should be applied for this development and a review should be undertaken to determine the impact of an increase of 40%.
- 4.4.3 A 40% level of climate change has been accounted for within the overall drainage strategy for the site.

4.5 Urban Creep

- 4.5.1 In accordance with West Sussex LLFA Policy for the Management of surface water, an allowance for urban creep has not been considered as the site is not residential.
- 4.5.2 It should be noted however that the southern pond has additional capacity to support minor changes in catchment area, as well as excess runoff to the porous pavement in the event of overland flows or exceedance from the roof areas, in accordance with SuDS Policy 5 to provide greater flexibility and maximise resilience.

5 RESIDUAL RISK AND MITIGATION

5.1 Residual Risk

5.1.1 The following residual risks have been identified in relation to the proposed development:

- i. Blockage of watercourses as a result of debris or otherwise, causing flooding to the site.
- ii. Extreme rainfall events that exceed the design criteria used for the drainage system causing surface water flooding.
- iii. Blockage/failure of the proposed drainage system causing flooding to the site.
- iv. Groundwater flooding to the site caused by groundwater levels exceeding the ground surface level.
- v. Surface water flooding of proposed buildings

5.2 Mitigation

5.2.1 Consideration has been taken to the residual risks stated in Section 5.1, and the following mitigation measures are proposed:

- i. Recent remedial works identified by Arun District Council have improved the watercourse system in the vicinity. In addition, maintenance measures for the boundary watercourse as a riparian owner will be included within the maintenance schedule.
- ii. The drainage strategy has been developed to capture runoff up to a 1 in 100-year critical rainfall event, with 40% allowance for climate change. However, should a more extreme rainfall event occur, there is the potential for the drainage system to be exceeded. The existing topography of the site has been reviewed and the existing overland flow routes assessed. Flows currently following the existing topography – falling to the south and west towards the watercourse. Existing and proposed drainage infrastructure should also be considered which can intercept run-off in an exceedance event, including gullies and channel drains.
- iii. The proposed drainage system will attenuate and store runoff up to the design event. Blockage of the drainage system has the potential to cause flooding on the site. Surcharged flows will likely travel overland to the ponds and watercourse, however maintenance measures proposed in Chapter 8 will mitigate the risk of the system becoming blocked.

- iv. Due to the underlying ground conditions of the site and the presence of groundwater in the upper layers, there is a risk of groundwater exceeding the surface level and emerging on the site. There are no records of previous groundwater flooding, however. If groundwater flooding were to occur, it would flow away from the proposed buildings into the ponds and the watercourse, or via the proposed drainage system.
- v. The risk of surface water flooding will be mitigated by raised finished floor levels to provide freeboard and design of levels to convey overland flow away from buildings.

6 SEQUENTIAL AND EXCEPTION TESTS

6.1 Sequential Test

- 6.1.1 The site is located within Flood Zone 1 and therefore does not require a Sequential Test.

FLOOD RISK MANAGEMENT

6.2 Safe Access and Egress

- 6.2.1 Eastergate Lane to the north of the proposed development is at low to high risk of surface water flooding.
- 6.2.2 Surface water flood maps show flood depths of 300mm to 900mm to the northwest of the access, however depths are limited to less than 300mm to the north east of the development.
- 6.2.3 It is presumed that the localised area of higher surface water flood risk is associated with the local topography and runoff to the watercourse culvert to the northwest of the site, and that in the event of surface water flooding access and egress eastwards along Eastergate Lane would remain safe.

6.3 Flood Warning

- 6.3.1 The site is not at risk of fluvial flooding, and is at low risk of surface water flooding with site depths limited to less than 300mm, therefore there is no need for a Flood Evacuation Plan (FEP).

7 MAINTENANCE

7.1 Proposed Maintenance Regime

7.1.1 Maintenance is required to ensure the long-term operational performance of the proposed surface water drainage system.

7.1.2 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
Porous Surfacing	Removal / management of weed growth	At least once a year
	Remedial works	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
Hydrobrake	As specified by manufacturer	As specified by manufacturer
Inlet, Outfall and Existing Watercourses	Inspection, vegetation clearance and additional clearing/cleansing of potential outfall blockages	At least once a year
	Desilting	Year 1, Year 3, then every 5 years

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

Porous Surfacing

7.1.4 The areas of porous surfacing are designed to allow infiltration of surface water run-off through the paving surface course and into the subbase below. The water is then collected and discharged into the positive drainage system.

7.1.5 A filter trench is used to discharge surface water run-off from the subbase to the drainage system.

7.1.6 The areas of porous surfacing 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
- The entire surface shall be monitored and when there are signs of excessive damage resulting in poor drainage over the whole area, the surface course and subbase could will have remedial measures as required
- Catchpits upstream and downstream of the filter trench should be emptied and inspected on the same regime as all catchpits specified previously set out in this document

HydroBrake (Flow Control Chamber)

- 7.1.7 The HydroBrake flow control system is self-activating, relying on upstream hydraulic head to generate an air-filled vortex within the centre of the casing. Once the vortex is initiated water drains down through a small opening in the back of the device at the designed restricted flow rate.
- 7.1.8 The flow control device has two measures encase of emergency (i.e. blockage). The first is a door situated in the front of the unit itself, this can be operated from the surface by a release cable situated just under the manhole cover which closes under its own weight and does not require any mechanism to operate. The second is a high-level overflow pipe situated with the flow control manhole. Both measures allow the system to drain down freely, until the blockage can be cleared.
- 7.1.9 The HydroBrake flow control chamber will require additional maintenance measures to ensure it operates as designed. The additional measures are as follow:
- The sump within the flow control chamber should be monitored for build-up of silts and should be emptied, as a minimum, on the same regime as specified for catchpits previously within this document
 - The drain down door located on the centre of the unit will require inspection and opening annually, to ensure it is operating as intended

Dry Pond

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris	Monthly
	Cut grass in and around pond	Monthly (during growing season) or as required
	Manage other vegetation and remove nuisance plants	Monthly at start and then as required
	Inspect inlets and outlets for blockages and clear as required	Monthly

	Inspect banks for damage and repair as required	Monthly
	Inspect inlets and pond surface for silt accumulation. Establish silt removal frequency	Monthly for first year then annually or as required
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlet	Annually or as required
Occasional Maintenance	Reseed areas of poor growth	As required
	Trim overhanging trees and remove cuttings	Every 2 years
Remedial Actions	Repair erosion or other damage by reseedling or returfing	As required
	Repair inlets and outlets	As required
	Relevel uneven surfaces and reinstate design levels	As required

Remedial/Repair Actions

- 7.1.10 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.
- 7.1.11 Remedial works to porous surfacing course, removing bedding material and relaying to match original design are all actions which may need to be undertaken.

Accidental Spillages

- 7.1.12 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.
- 7.1.13 Minor spillages of fuels and oils from motor vehicles will be dealt with by the porous surfacing and catchpits, by bio-degrading and collecting the hydrocarbons respectively.

Future Alterations to the Development

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

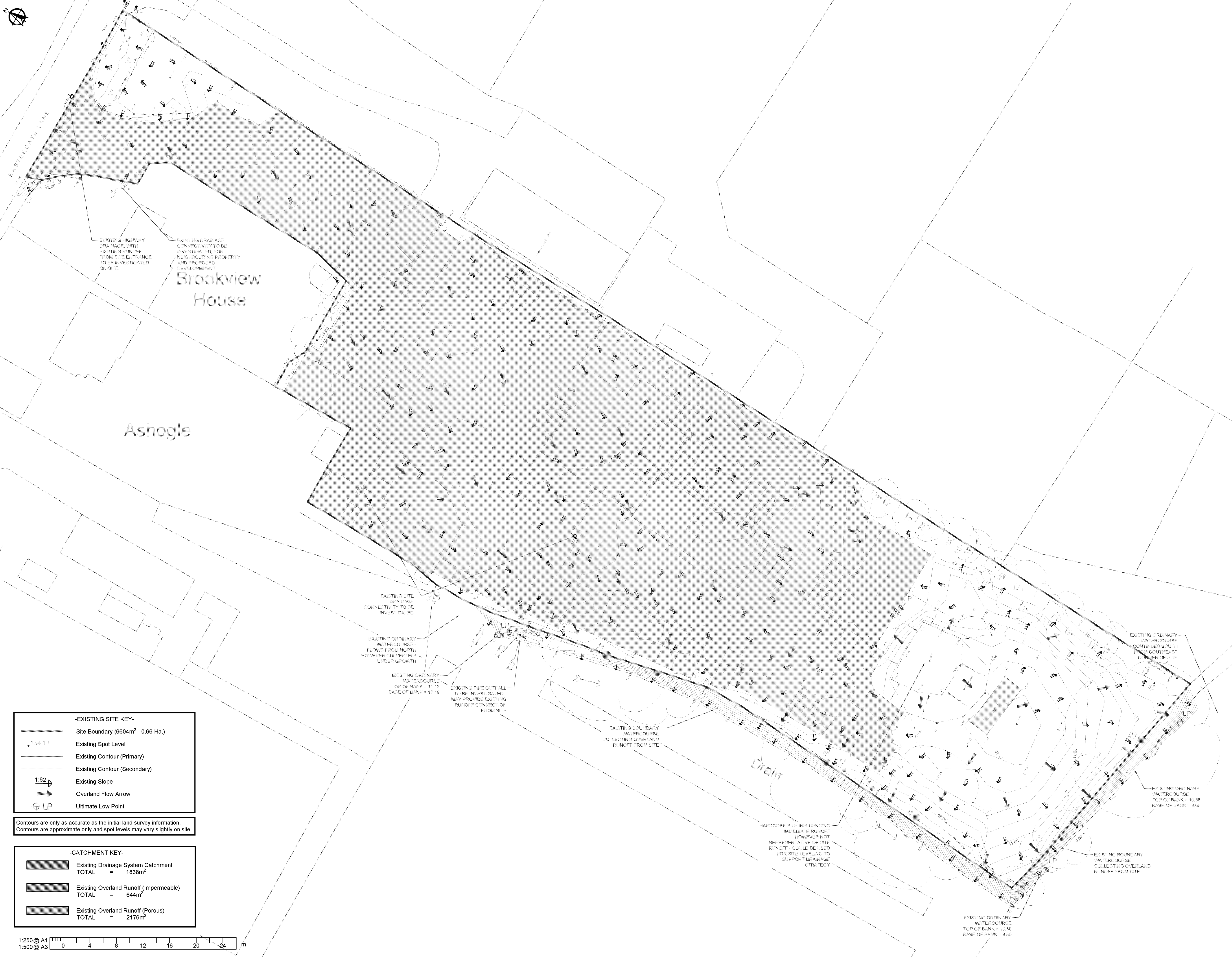
8 OFFSITE IMPACTS

- 8.1.1 The proposed development will have a positive impact on flooding issues off-site by reducing run-off rates and discharge to the watercourse via attenuation within sustainable drainage systems.
- 8.1.2 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 0.45l/s.
- 8.1.3 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.

9 SUMMARY

- 9.1.1 This site-specific flood risk assessment is based on Flood Maps, the Local Authority's Strategic Flood Risk Assessment and Public Sewer Records.
- 9.1.2 The site is currently a previous garage site and commercial site with hardstanding impermeable areas and gravel surfacing.
- 9.1.3 The development lies within Flood Zone 1. The existing run-off from the site is collected by a gully and pipe drainage system and discharged un-controlled to the boundary watercourse.
- 9.1.4 Post-development surface water run-off will be managed through sustainable drainage measures, with the installation of porous surfacing, 2 no. storage ponds and a controlled outfall meaning overland flows can be attenuated on site and released to the watercourse at a rate with a significant betterment, without causing surface water flooding on site.
- 9.1.5 The wastewater from the proposed development will discharge to the public foul sewer via a proposed pumping station. A S106 application will be required in order to establish connection, and the existing foul water drainage on site should also be investigated for existing connections.
- 9.1.6 The completion of the development will not increase flood risk on or off the site.
- 9.1.7 Information has been provided to state why this development passes the Sequential Test.
- 9.1.8 In conclusion, this development is suitable with regards to flood risk and surface water drainage.

DRAWINGS



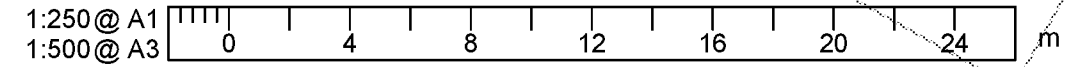
-EXISTING SITE KEY-

- Site Boundary (6604m² - 0.66 Ha.)
- Existing Spot Level
- Existing Contour (Primary)
- Existing Contour (Secondary)
- Existing Slope
- Overland Flow Arrow
- Ultimate Low Point

Contours are only as accurate as the initial land survey information.
Contours are approximate only and spot levels may vary slightly on site.

-CATCHMENT KEY-

- Existing Drainage System Catchment
TOTAL = 1838m²
- Existing Overland Runoff (Impermeable)
TOTAL = 644m²
- Existing Overland Runoff (Porous)
TOTAL = 2176m²

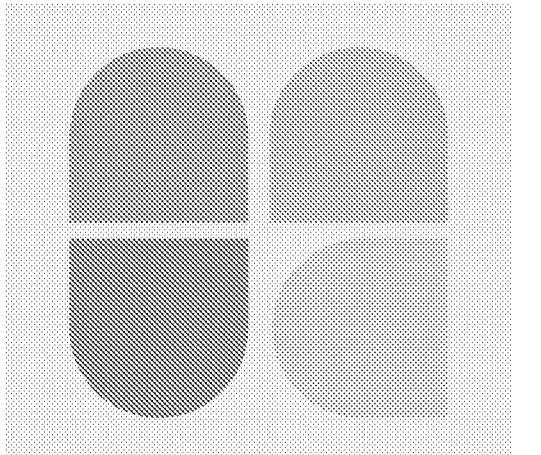


NOTES

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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.

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A	Revised Issue with Catchment	18/05/2021
A	Original Issue	14/05/2021
Rev.	Amendments	Date



BRIGHT PLAN CIVILS
Transport Planning and Infrastructure Design Consultants
2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF
Tel: 01243 030418
www.bpcivils.co.uk enquiries@bpcivils.co.uk

Drawing Status **PLANNING**

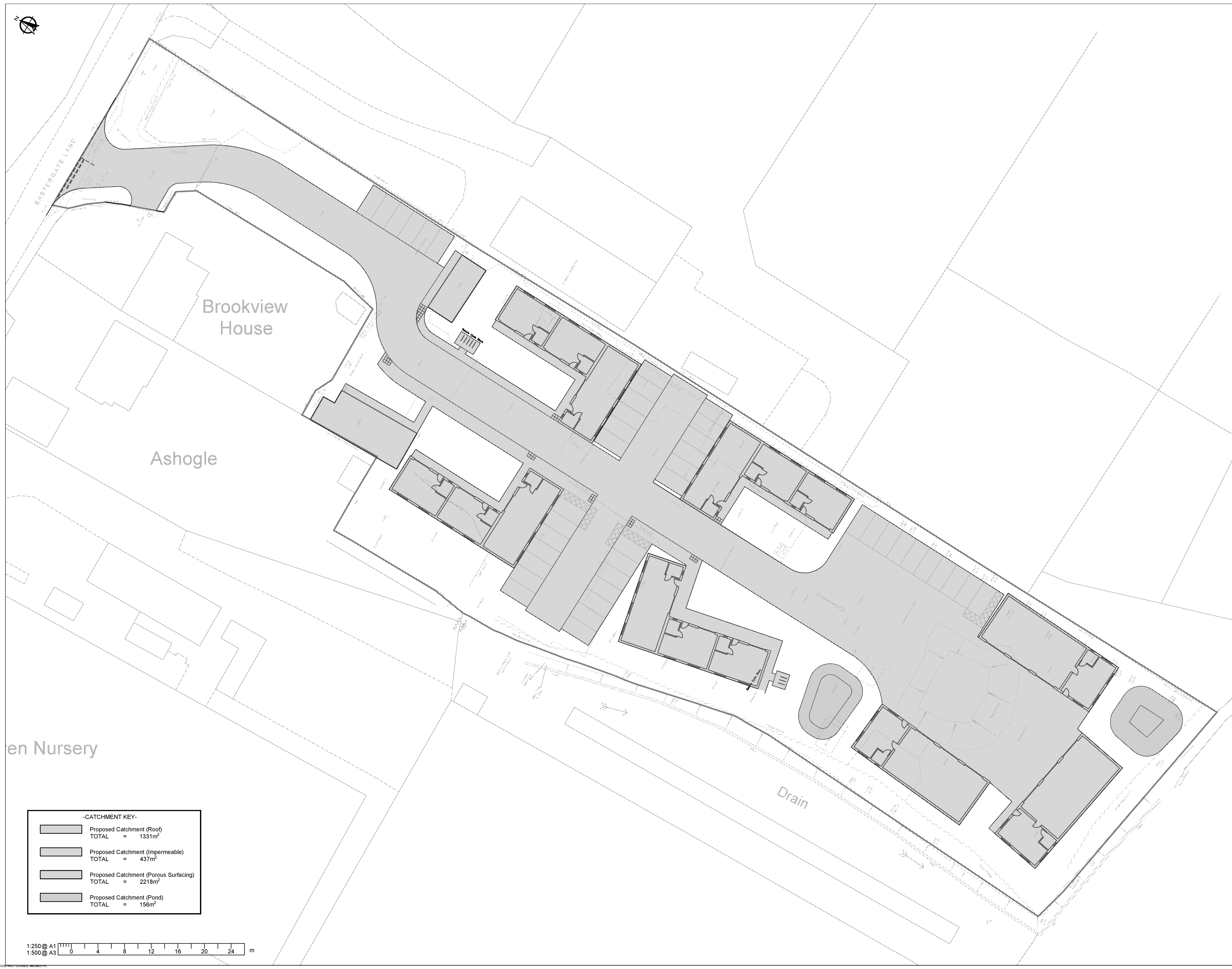
Client **Philip Sowden**

Project **Land at Brookview Nursery
Eastergate Lane, Walberton BN18 0BA**

Drawing Title **Existing Levels, Drainage
& Overland Runoff**

Scale	Date	Drawn By	Checked By
1:250	18/05/21	DJL	MJA

Drawing No.	Rev.
D1963-PL100	A



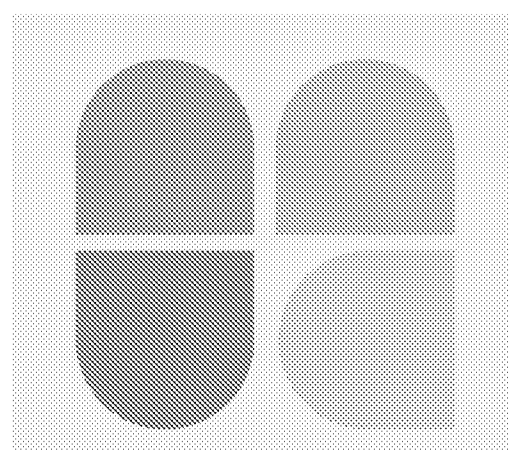
NOTES

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.
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-	Original Issue	07/06/2021
Rev.	Amendments	Date



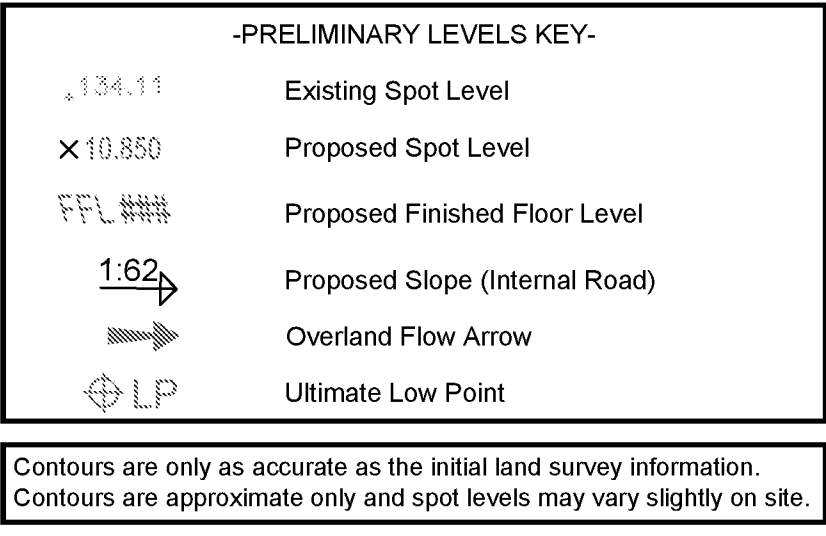
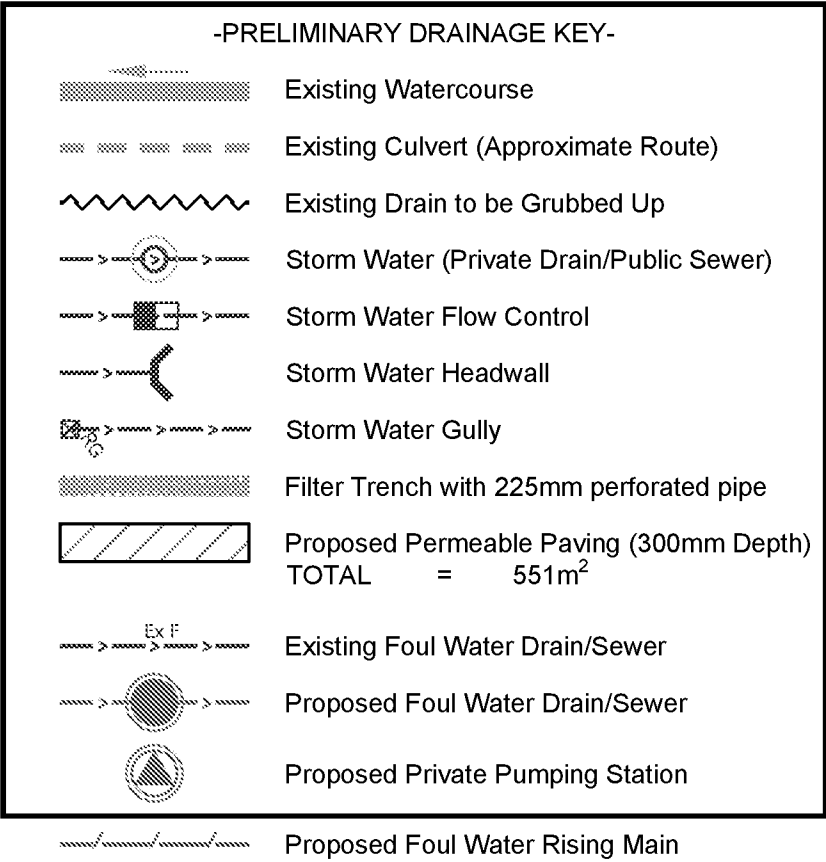
BRIGHT PLAN CIVILS
Transport Planning and Infrastructure Design Consultants
2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF
Tel: 01243 210418
www.bpcivils.co.uk enquiries@bpcivils.co.uk

Drawing Status	PLANNING		
Client	Philip Sowden		
Project	Land at Brookview Nursery Eastergate Lane, Walberton BN18 0BA		
Drawing Title	Impermeable Areas & Catchment Appraisal		
Scale	Date	Drawn By	Checked By
1:250	07/06/21	DJL	MJA
Drawing No.	D1963-PL200		Rev.
		-	



- SURFACE WATER STRATEGY-**
- Surface water disposal should be managed in view of the SuDS hierarchy;
 1. Infiltration
 2. Watercourse
 3. Public Surface Water Sewer(s)
 - Initial investigation demonstrates that the site is underlain by Clay. It is presumed that infiltration would therefore not be viable, subject to infiltration testing and groundwater monitoring prior to detailed design in the next winter months.
 - The existing site discharges to the watercourse via an uncontrolled connection, with existing peak annual hardstanding runoff estimated at 34.5/s.
 - In view of the above, it is proposed that a connection to the Ordinary Watercourse is utilised. Attenuation will be provided by site in the form of permeable surfacing and open storage ponds.
 - Flow control devices will be required in order to restrict flows to the Ordinary Watercourse, at a rate of 7.0/s, providing a betterment compared with the existing site.
 - Hydraulic calculations adhere to the following criteria, providing storage capacity without flooding for;
 - a 1-in-30 year storm event, with sufficient freeboard
 - a 1-in-100 year storm event, with an allowance of 40% for climate change.

- FOUL WATER STRATEGY-**
- Foul water disposal should adhere to the following hierarchy;
 1. Public Sewer
 2. Private Treatment Plant
 3. Septic Tank and Drainage Field
 4. Cesspool
 - It is proposed that, post-development, foul flows generated by the site will outfall to the public foul water sewer north of the site, to a new online manhole.
 - A S106 application will be required, and approval will need to be obtained from Southern Water.
 - An internal pumped connection will be required to connect to the public foul sewer.
 - Post-development foul flows have been determined to be in the region of 0.45/s (based on Water UK Design & Construction Guidance, 4000/day) for 9 No. units.



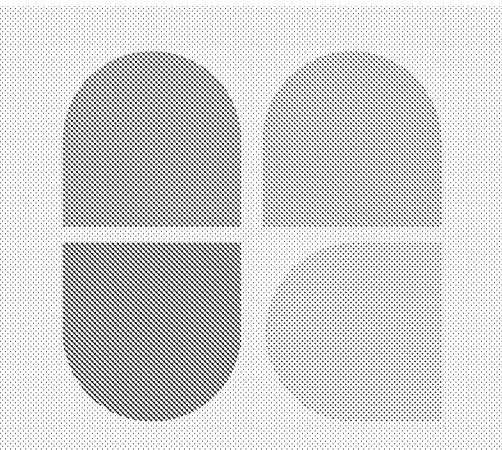
NOTES

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Original Issue	07/06/2021
Rev.	Amendments



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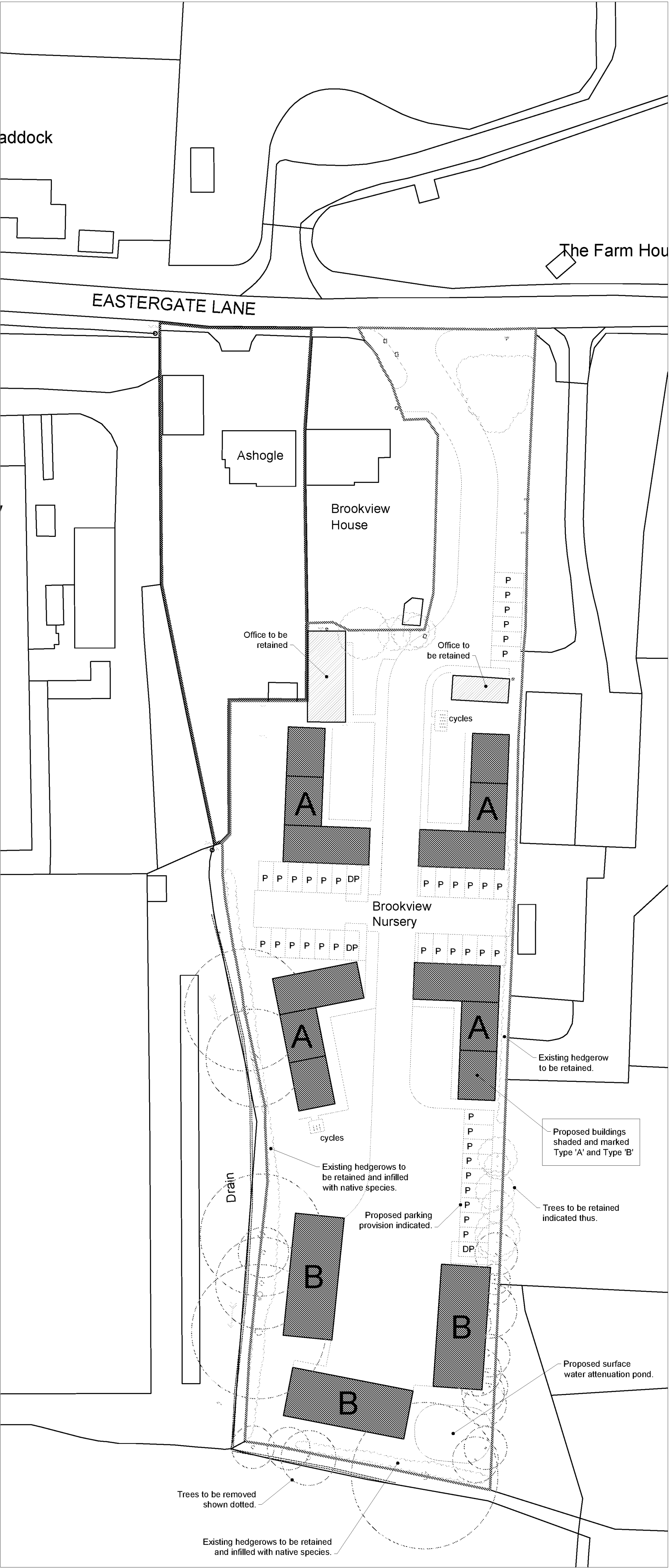
Drawing Status	PLANNING
Client	Philip Sowden
Project	Land at Brookview Nursery Eastergate Lane, Walberton BN18 0BA
Drawing Title	Preliminary Levels & Drainage Design
Scale	1:250
Date	07/06/21
Drawn By	DJL
Checked By	MJA
Drawing No.	D1963-PL300
Rev.	-

APPENDICIES

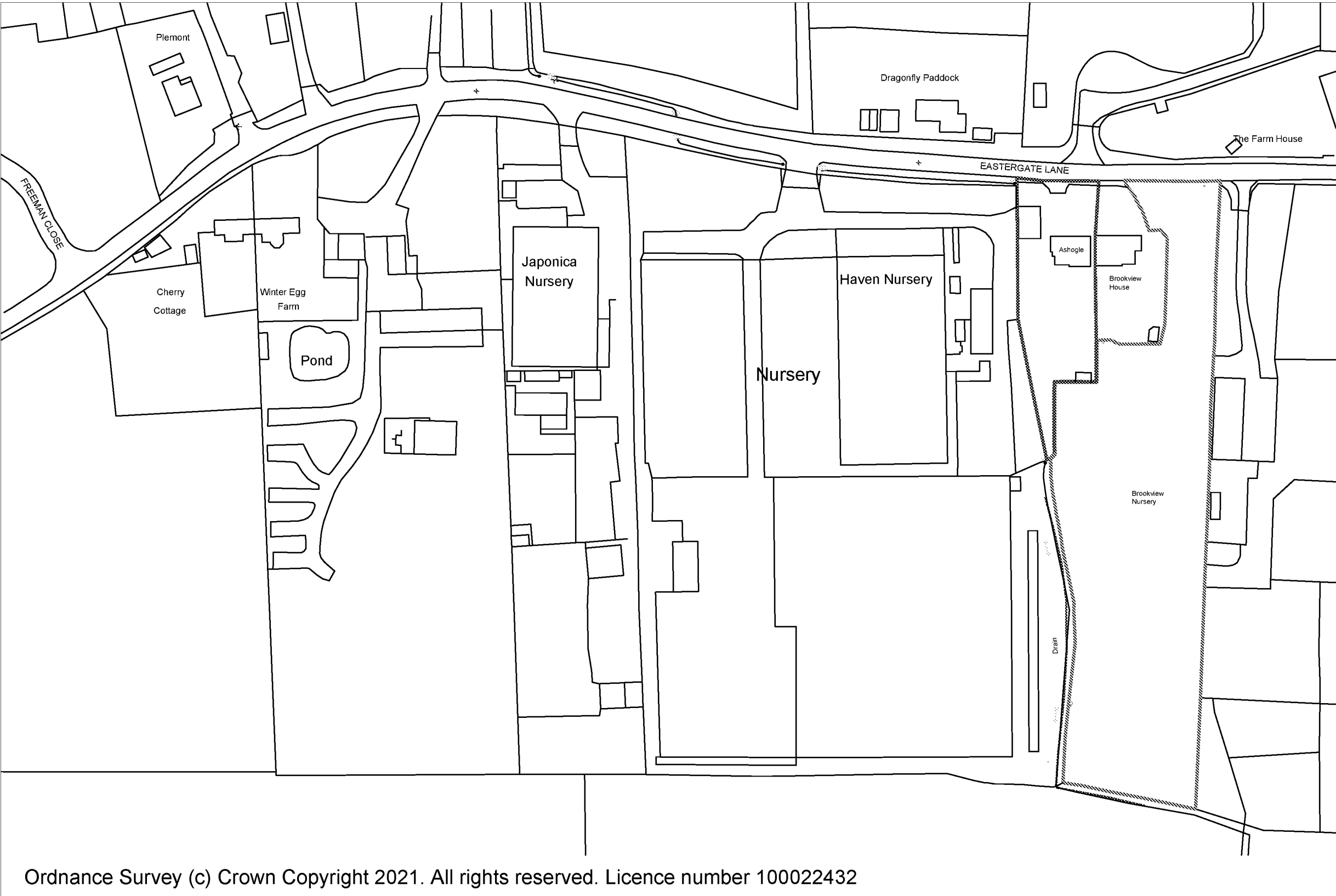
Appendix A Preliminary Site Layout



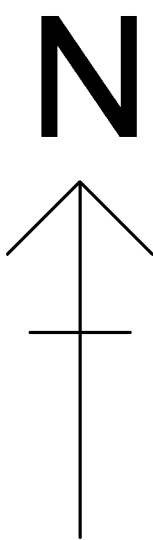
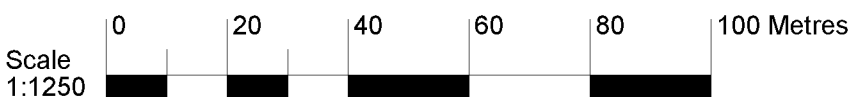
Existing Block Plan
Scale 1:500



Proposed Block Plan
Scale 1:500



Location Plan
Scale 1:1250



D	Unit plans removed, 'existing' and 'proposed' block plans & location plan added.	27.05.21
C	Arrangement revised, detail added.	26.05.21
B	Arrangement revised, parking added.	21.01.21
A	Unit B added.	20.01.21
Rev.	Description:	Date:



Horizon Design Limited
15 Uplands Avenue
Worthing BN13 3AA
01903 205868

info@horizon-design.co.uk www.horizon-design.co.uk

Client:
Mr & Mrs Sowden

Project:
**New Commercial Units:
Brookview Nursery
Eastergate Lane
Walberton
West Sussex, BN18 0BA**

Drawing title:
**Existing & Proposed Block Plans,
Location Plan**

Scale:
1:500 / 1:1250 @ A1

Date:
14.01.21

Drawn:
KWF

Drawing number:
3058-01

Revision:
D

Appendix B Topographical Survey



Grid

N

W

E

S

LEGEND

BANKING

Top

Bottom

BUSHES & HEDGES

MT / 3T / 0.2 / 6

MT / 3T / 0.2 / 6

TREES

Single

Cluster

GATES

Single

Cluster

WALL

WALLS shown to scale

0.2m

BUILDING

OPEN SIDED BUILDING

GLASS ROOFED

CONTOURS

20.00

ABBREVIATIONS (WHERE APPLICABLE)

ARCH HEAD HEIGHT

AHH

ARCH HEAD LEVEL

AHL

ARCH SPRINGER HEIGHT

ASH

ARCH SPRINGER LEVEL

ASL

AIR VALVE

AV

BED LEVEL

BL

BELISHA BEACON

BB

BOLLARD

B

BRITISH TELECOM BOX

BTB

BRITISH TELECOM MANHOLE

BTMH

BRICKWORK

BRWK

BUS STOP

BS

CABLE TV

CATV

COVER LEVEL

CL

CABLE MARKER

CM

COLUMN

Col

CONCRETE POST

CP

EAVES LEVEL

EAV

ELECTRICAL COVER

ELEC

ELECTRICITY CONTROL BOX

ECB

ELECTRICITY POLE

EP

EARTH ROD

ER

FLOWER BED

FB

FINISHED FLOOR LEVEL

FFL

FIRE HYDRANT

FH

FLOOR LEVEL

FL

FLAG STAFF

FS

GAS PIPE

GP

GAS VALVE

GV

GULLY

G

GATE STOP

GS

INSPECTION COVER

IC

INVERT LEVEL

IL

LAMP POST

LP

MARKER

MONITORING WELL

NOTICE BOARD

NAME PLATE

OVERHEAD WIRES

RODGING EYE

RETAINING WALL

RAIN WATER PIPE

SLUICE VALVE

STOP COCK

SOFFIT LEVEL

STRUCTURAL SLAB LEVEL

TREE STUMP

SOIL AND VENT PIPE

THRESHOLD LEVEL

TELEGRAPH POLE

TELEPHONE CALL BOX

TOP OF KERB

TURNSTILE

TRAFFIC LIGHT

TOP OF WALL

UNABLE TO LIFT

UNABLE TO SURVEY

VENT PIPE

WATER METER

WATER LEVEL

WASH OUT

WASTE PIPE

WATER TANK

WATER VALVE

MKR

MM

NB

CHW

PM

RID

RL

RS

RE

RTW

RWP

SV

SC

SOF

SSL

ST

SUP

THL

TP

TCB

TK

TS

TL

TW

UTL

UTS

VP

VM

WL

VO

WP

WT

WV

FENCES

BARBED WIRE FENCE

BWF

CORRUGATED IRON FENCE

CIF

CLOSE BOARD FENCE

CBF

CHAIN LINK FENCE

CLF

CHESTNUT PALING FENCE

CPF

FENCE POST

FPO

INTERWOVEN FENCE

IWF

IRON RAILING FENCE

IRF

LARCH LAP FENCE

METAL RAILING FENCE

POST AND CHAIN FENCE

PICKET FENCE

POST AND RAIL FENCE

RPO

STEEL PALISADE SECURITY FENCE

STEEL PALISADE SECURITY FENCE

TUBULAR STEEL RAIL FENCE

LLF

MRP

PCF

P/F

PRF

PWF

SPSF

TSRF

REV.	NOTES	DWN	DATE
A	---	---	---

QMS

ISO 9001

REGISTERED

QMS

ISO 14001

REGISTERED

A MEMBER OF

THE SURVEY

ASSOCIATION

Notes:
Grid and levels relate to OS GPS Active Network.
Sheet is North orientated.

Maltby Surveys Ltd

2 QUEENS ROAD

HAYWARDS HEATH

WEST SUSSEX

RH18 1EB

Tel: 01444 416246

Fax: 01444 417697

E-Mail: mls@maltbysurveys.com

WebSite: http://www.maltbysurveys.com

SURVEYED	LCD	CLIENT
DRAWN	LCD	Philip Sowden
CHECKED	AKM	SCALE
		1/500 (A1 Sheet)

Brookview Nursery, Walberton, BN18 0BA

TOPOGRAPHICAL SURVEY		
Job No	Rev	Drawing Number
21/114		21/114/100-Overview
Date :	April 2021	

Appendix C Geotechnical Information

N. 14452

RECORD OF WELL

At Stoneyfields NurseryTown or Village EasteigateCounty SurrexSix-inch County Sheet Surrex 62 NE/W

Six-inch National Grid sheet and reference

For P. H. Twenty Eqs.

State whether owner, tenant, builder, contractor, consultant, etc.:

Address (if different from above)

Level of ground surface above sea level (O.D.) ft (..... m)

If well top is not at ground level, state how far above* ft (..... m)
below:

SHAFT ft (..... m); diameter ft (..... m);

HEADINGS (please attach details—dimensions and directions)

BORE 250 ft (76.20 m); diameter: at top 6 in (152.4 mm); at
bottom 6 in (152.4 mm)

Full details of permanent lining tubes (position, length, diameter, plain, slotted, etc.)

(150mm) 6" NB Steel lining tube to 221' (67.36 m)
6" open hole from 221' (67.36 m) to 250' (76.20 m) B.S.L.Water struck at depths of 181' ft (55.16 m) below well topRest level of water 36' 1" ft (11 m) above* well top. Suction at ft (..... m)
belowYield on hours* test pumping at 2460 galls (..... m³) per hour with
days*depression to 129.7' ft (39.48 m) below well top. Recovery to rest level in mins*
hoursCapacity of pump g.p.h. (..... m³/h)

Date of measurements

DESCRIPTION OF PERMANENT PUMPING EQUIPMENT:

Make and/or type Motive power

Capacity galls (..... m³) per hour. Suction at ft (..... m)below well top. Amount pumped galls (..... m³) per day. Estimatedconsumption galls (..... m³) per weekWell made by Duke and Ockenden Date of sinking June / Sept 1977

ADDITIONAL NOTES ANALYSIS (please attach copy if available)

EXACT SITE
OF WELL.

*DELETE

NECESSARY

TEST
CONDITIONSNORMAL
CONDITIONSLOG OF
STRATA
OVERLEAFINSTITUTE OF GEOLOGICAL SCIENCES,
WATER DEPARTMENT,
SOUTH KENSINGTON,
LONDON, S.W.7.

Date 11.11.77
 Observation well
 Recorder
 E.R. log
 Site marked on Inst. Grid Sheet
 1" map
 6" map
 (use symbol)
 Copy to
 Date

(For Institute use only)
GEOLOGICAL
CLASSIFICATION

SU 90 NE/32
NATURE OF STRATA

511/445

THICKNESS

DATE

If measurements start below
ground surface, state how far.

Feet Inches Metres Feet Inches

Top Soil	Top soil/brown clay/gravel/flints	2	9	0.83	2	9	0.83	
Head Valley Gravel	Gravel and clay (compacted)	2	9	0.83	5	6	1.67	
	Compacted chalky gravel	13	6	4.11	19	-	5.79	5.8
London Clay	Brown Sandy clay	2	-	0.60	21	-	6.40	6.4
	Stiff Grey clay	65	-	19.81	86	-	26.21	26.4
	Mottled clay	8	-	2.43	94	-	28.65	
Hertfordshire blays	Red/Brown clay	30	-	9.14	124	-	37.79	
Woodwicks Reading Beds	Grey clay	5	-	1.52	129	-	39.31	
	Brown clay	9	-	2.74	138	-	42.06	
	Grey clay	9	-	2.74	147	-	44.80	
	Red/Brown clay	6	-	1.82	153	-	46.63	30
	Grey clay	10	-	3.04	163	-	49.68	
	Mottled clay	14	-	4.26	177	-	53.95	
	Grey clay	7	6	2.28	184	6	56.23	
1. Breccaceous (Chalk), U. CK	Chalk and flints	65	6	19.96	250	-	76.20	20

Res.

8.3.78

Date

Bank

British Geological Survey

British Geological Survey

British Geological Survey

DRG. No. 12647. H.

Section of Borehole for P.H. FUENTY Esq. Stonefields Nursery
Eastergate

JOB. No. CW 2397

DUKE & OCKENDEN LTD.
LITTLEHAMPTON SUSSEX

MAP REFERENCE SU. 989 654

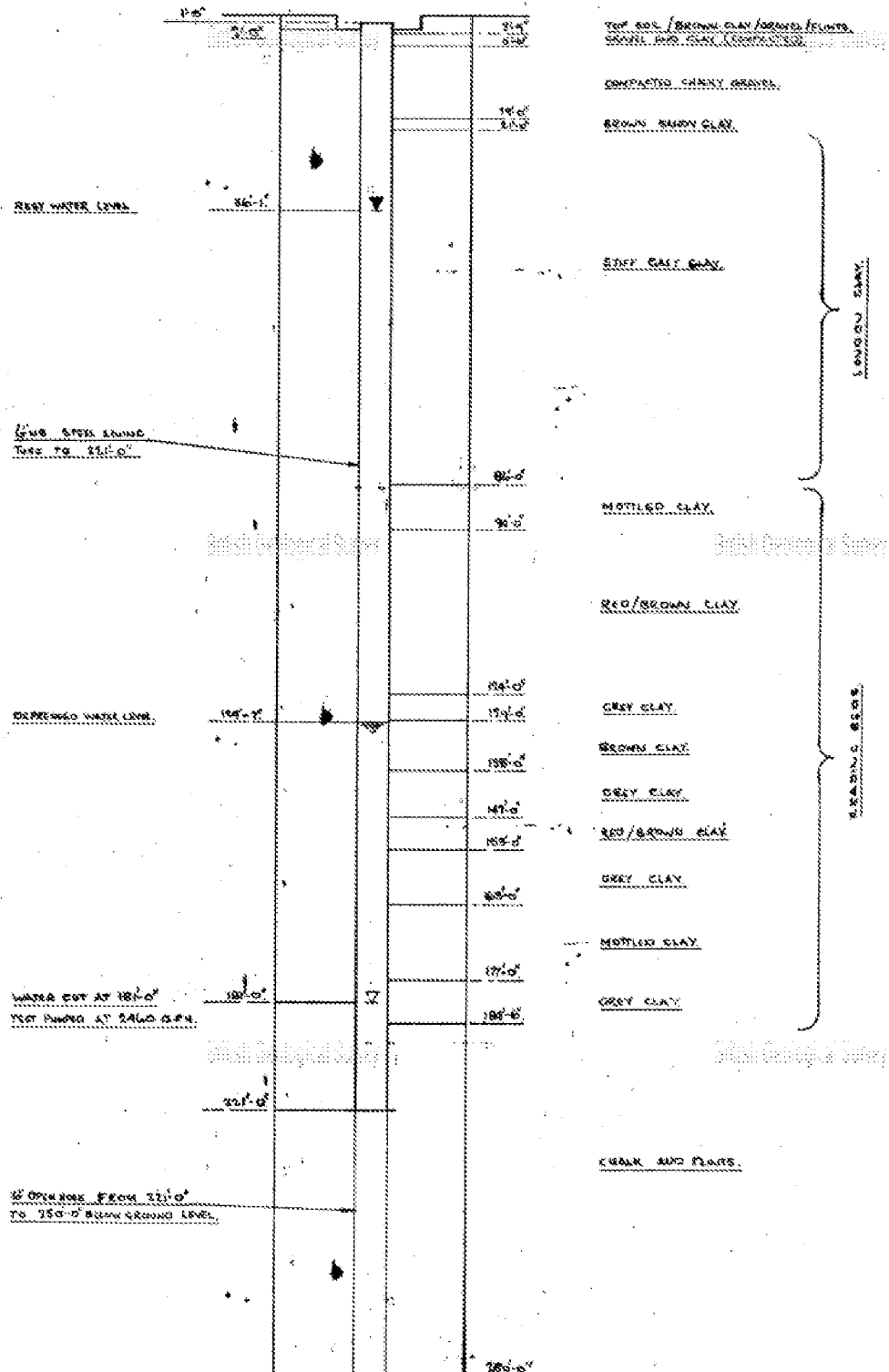
317/445

317/445

N. 14452

DATE COMMENCED 17-6-77.
DATE COMPLETED 18-9-77.

Survey No. 10/W.



BOREHOLE DRILLED BY F. BISHOPWAY

Appendix D Lead Planning Authority and Lead Local Flood Authority Consultation

WT C_{EL} $\uparrow$ $\downarrow$ $\uparrow$ $\downarrow$

T: 01903 737819
E: paul.cann@arun.gov.uk



Arun District Council, Civic Centre, Maltravers Rd, Littlehampton, West Sussex, BN17 5LF
www.arun.gov.uk



{T I^ozha U^dp_rka^oza^ozha}

$\alpha \in \mathbb{R}^n$ and $\beta \in \mathbb{R}^n$ are the parameters of the model. The model is trained by minimizing the loss function $\mathcal{L}(\alpha, \beta)$ over the training data. The loss function is defined as the sum of the squared residuals, i.e., $\mathcal{L}(\alpha, \beta) = \sum_{i=1}^n (y_i - \hat{y}_i)^2$, where y_i is the observed value and $\hat{y}_i$ is the predicted value. The model is trained using the gradient descent method. The parameters are updated iteratively until the loss function converges to a minimum value.

YT ↑    

$\circ$ T QIT iXtixlPHE CUBXXO QALUTT IIt It CTB OQCLLET JJJLT E=IXJDF LIXT JHT CTB ZIX% GT ELPTY% EXDX%
iXIXOT Q ZODPLE=I% JHT DNX ILCXI=XSDJL Lix IX OQLLET DDAAGGTT%Zσ

C/XXO à IXF↑

- [illegible]

[illegible]
$$\underline{DIXT} \rightleftharpoons \underline{LIT}$$

2 t % lT dIXE I OT pIe IXE= eIXE Z lT pBXOUE QUGU OUPd lT l-OPVbOE BXO % T p-BXO T qn
lT E=lPpE % lT doIXVfEX I lOXE lOXE lT r% jo pXr r jo l-OPV lT

[illegible]

2 t % l T d i x e I G e p a r t l i t u e = d o n x d o s t i t o z l i t d i x i j t z o d o m x q u d y t u d o e = i x d a j i t x u l i t
i x i G o t I c h i t d i x o j z d a r t l i t u e % x u t t t i f f s t o z

[illegible]

IX. $\Rightarrow$ C

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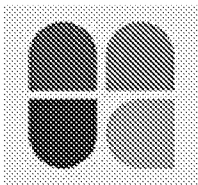
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WT CELLO

Mark Akmenka
Managing Director



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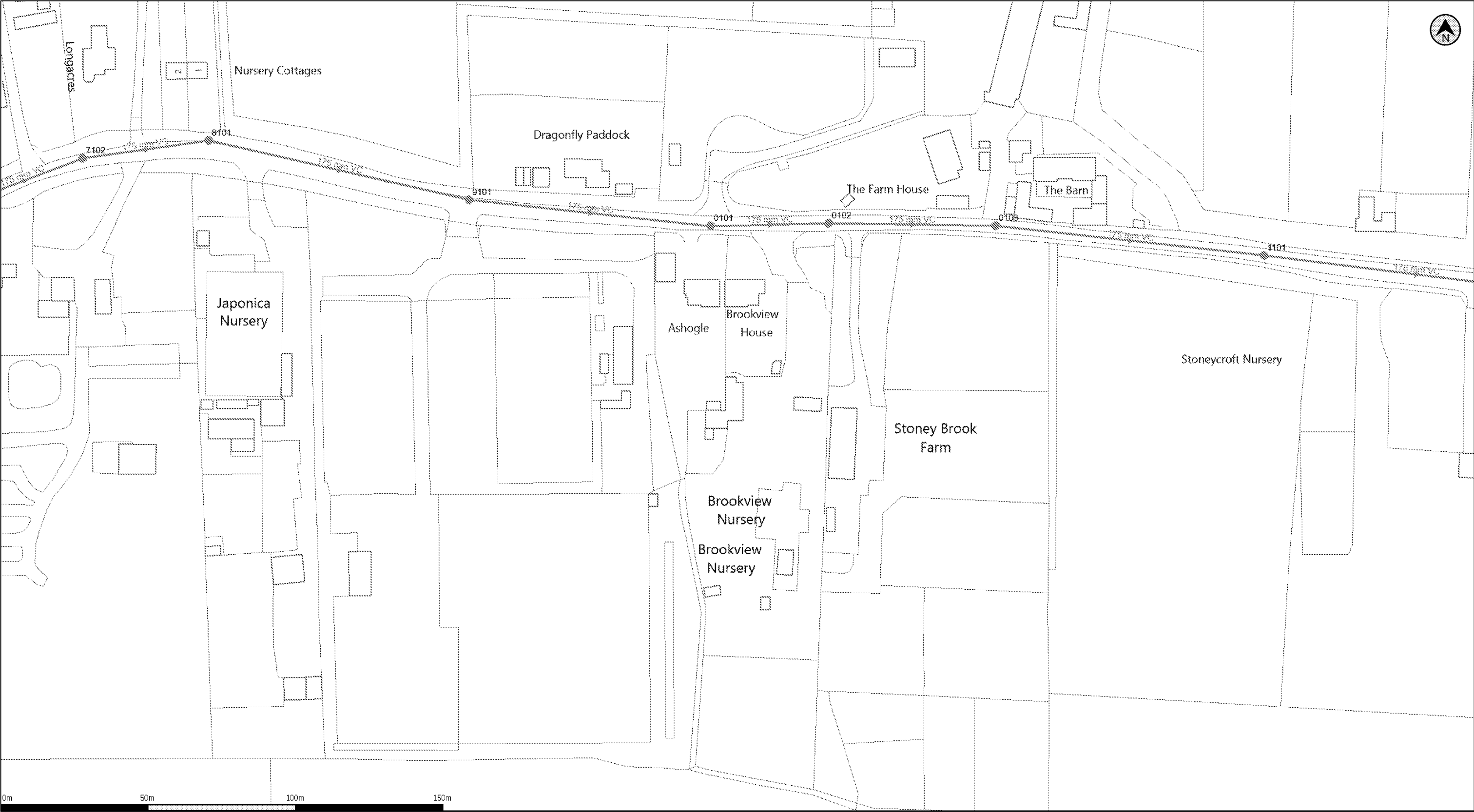
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Appendix E Public Sewer Records



(c) Crown copyright and database rights 2021 Ordnance Survey 100031673 Date: 13/05/21 Scale: 1:1250 Map Centre: 496009,106070 Data updated: 19/04/21 Our Ref: 557336 - 1 Wastewater Plan A3

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2021 Ordnance Survey 100031673. This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

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

searches@bpcivils.co.uk
D1963



Appendix F Environment Agency Product 4 Response

Our reference: SSD213968

SENT BY EMAIL ONLY

11 May 2021

Dear Dan,

Thank you for your request of 17 March to use Environment Agency Product 4 data, for the site at Brookview Nursery, Eastergate Lane, BN18 0BA

Response to your request

The Environment Agency's records indicate that the above site is located in Flood Zone 1 (land assessed as having less than 0.1% (1 in 1,000) chance of flooding in any given year from **rivers or the sea**). Therefore, the likelihood of flooding from rivers and sea in this area is estimated as 'very low'.

Proximity to Flood Zones 2 or 3

The above site is approximately 270 metres away from Flood Zone 3. We are therefore unable to provide data from our detailed fluvial or tidal models which is relevant to your site.

More information on Flood Zones can be found on the GOV.UK website:

<http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/flood-zone-and-flood-risk-tables/table-1-flood-zones/>

Surface water flooding

Our mapping indicates that this site is at risk of surface water flooding.

For information on flooding from all other sources, such as surface water, please contact the Lead Local Flood Authority, which in this case is West Sussex County Council. A link to their information available online is shown below:

<https://www.westsussex.gov.uk/fire-emergencies-and-crime/dealing-with-extreme-weather/dealing-with-flooding/flood-risk-management/local-flood-risk-management-strategy/>

Please note that the above is a link to an external website which the Environment Agency does not control or maintain. Therefore, the link may not be the most up-to-date at the date of this letter. If the link does not work, and you are unable to find the information about surface water flooding on the relevant website, please contact the authority named above directly.



Where you can find further information

- Detailed long-term flood information and maps can be found on the GOV.UK website:
<https://flood-warning-information.service.gov.uk/long-term-flood-risk/>
- Flood maps for planning can be found on the GOV.UK website:
<https://flood-map-for-planning.service.gov.uk/>
- Please be aware that in February 2016 the Environment Agency updated its guidance on climate change allowances. The standard allowance of adding 20% to peak flows – as per previous guidance in the National Planning Policy Framework, may not be applicable for the purposes of informing development proposals. It is possible that our current modelling has under estimated flood risk when taking climate change into consideration. This does not however have an effect on Flood Zones 2 or 3. For further information please visit:
<https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>
- Further details about the Environment Agency information supplied can be found on the GOV.UK website:
<https://www.gov.uk/browse/environment-countryside/flooding-extreme-weather>
- If you have requested this information to help inform a development proposal, then you should note the information on GOV.UK on the use of Environment Agency information for Flood Risk Assessments:
<https://www.gov.uk/planning-applications-assessing-flood-risk>
<https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion>

If you have any queries or would like to discuss the content of this letter further please call us on 03708 506 506, or reply to the email sent to you with this letter attached.

Please get in touch if you have any further queries or contact us within two (2) months if you would like us to review the information we have sent.

For information on what you can expect from us and our full service commitment to you, please click on this link:

<https://www.gov.uk/government/publications/environment-agency-customer-service-commitment-2/environment-agency-customer-service-commitment>

Yours sincerely,

Nick Allen

Customers and Engagement Officer

Environment Agency | Romsey District Office, Canal Walk, Romsey, SO51 7LP

Appendix G 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)	0.500
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

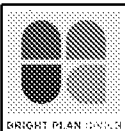
Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
14	0.012	5.00	11.900	1200	0.650
13			11.850	1200	0.650
12			11.700	1200	0.650
11	0.013	5.00	11.500	1200	0.650
10	0.036	5.00	11.450	1200	0.794
9	0.036	5.00	11.150	1200	0.725
8			11.100	1200	0.725
7			11.100	1200	0.742
6		5.00	11.000	1200	1.000
5			11.000	1200	1.014
4			11.000	1200	1.027
3		5.00	11.000	1200	0.650
2			11.000	1200	0.670
1			11.000	1200	0.690
15			11.100	1200	1.095
16	0.048	5.00	11.300	1200	1.025
17	0.126	5.00	11.300	1200	0.943
18	0.127	5.00	11.500	1200	0.800

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)
4.001	2.131	105.0	150	11.000	10.330	0.520	11.000	10.310	0.540
4.000	2.089	105.0	150	11.000	10.350	0.500	11.000	10.330	0.520
3.001	2.271	175.0	225	11.000	9.986	0.789	11.000	9.973	0.802
3.000	2.435	175.0	225	11.000	10.000	0.775	11.000	9.986	0.789
1.006	3.855	296.6	225	11.100	10.375	0.500	11.100	10.362	0.513
1.005	12.919	258.4	225	11.150	10.425	0.500	11.100	10.375	0.500
1.004	47.221	204.4	225	11.450	10.656	0.569	11.150	10.425	0.500

Link	US Node	DS Node
4.001	2	1
4.000	3	2
3.001	5	4
3.000	6	5
1.006	8	7
1.005	9	8
1.004	10	9



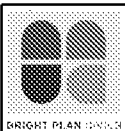
Pipeline Schedule

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)
1.003	21.004	176.5	150	11.500	10.850	0.500	11.450	10.731	0.569
1.002	15.968	79.8	150	11.700	11.050	0.500	11.500	10.850	0.500
1.001	23.747	158.3	150	11.850	11.200	0.500	11.700	11.050	0.500
1.000	8.613	172.3	150	11.900	11.250	0.500	11.850	11.200	0.500
2.002	7.654	61.2	225	11.300	10.275	0.800	11.100	10.150	0.725
2.001	10.271	125.3	225	11.300	10.357	0.718	11.300	10.275	0.800
2.000	102.573	299.0	225	11.500	10.700	0.575	11.300	10.357	0.718

Link	US Node	DS Node
1.003	11	10
1.002	12	11
1.001	13	12
1.000	14	13
2.002	16	15
2.001	17	16
2.000	18	17

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
14	11.900	0.650	1200				
					0 1.000	11.250	150
13	11.850	0.650	1200				
					1 1.001	11.200	150
12	11.700	0.650	1200				
					0 1.002	11.050	150
11	11.500	0.650	1200				
					1 1.003	10.850	150
10	11.450	0.794	1200				
					0 1.004	10.656	225
9	11.150	0.725	1200				
					1 1.005	10.425	225
8	11.100	0.725	1200				
					0 1.006	10.375	225

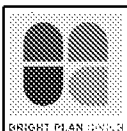


Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
7	11.100	0.742	1200		1 1.006	10.362	225
6	11.000	1.000	1200		0 3.000	10.000	225
5	11.000	1.014	1200		1 3.000	9.986	225
4	11.000	1.027	1200		0 3.001	9.986	225
3	11.000	0.650	1200		1 3.001	9.973	225
2	11.000	0.670	1200		0 4.000	10.350	150
1	11.000	0.690	1200		1 4.000	10.330	150
15	11.100	1.095	1200		0 4.001	10.310	150
16	11.300	1.025	1200		1 2.002	10.150	225
17	11.300	0.943	1200		0 2.001	10.275	225
18	11.500	0.800	1200		1 2.000	10.357	225

Node 2 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	10.330	Product Number	CTL-SHE-0072-2000-0670-2000
Design Depth (m)	0.670	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200



Node 5 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	9.986	Product Number	CTL-SHE-0105-5000-1010-5000
Design Depth (m)	1.010	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.0	Min Node Diameter (mm)	1200

Node 18 Online Orifice Control

Flap Valve	x	Invert Level (m)	10.700	Discharge Coefficient	0.600
Replaces Downstream Link	x	Diameter (m)	0.040		

Node 17 Online Orifice Control

Flap Valve	x	Invert Level (m)	10.357	Discharge Coefficient	0.600
Replaces Downstream Link	x	Diameter (m)	0.060		

Node 6 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	5.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	10.000	Main Channel Slope (1:X)	1000.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.025

Inlets

15

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	11.0	0.0	1.000	79.0	0.0

Node 3 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	8.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	10.350	Main Channel Slope (1:X)	1000.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.025

Inlets

7

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	25.0	0.0	0.650	75.0	0.0

Node 18 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	11.100	Slope (1:X)	290.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.300
Safety Factor	2.0	Width (m)	13.750	Inf Depth (m)	
Porosity	0.32	Length (m)	80.000		

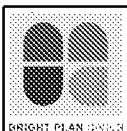
Node 17 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	10.900	Slope (1:X)	290.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	232	Depth (m)	0.300
Safety Factor	2.0	Width (m)	13.750	Inf Depth (m)	
Porosity	0.32	Length (m)	80.000		



Rainfall

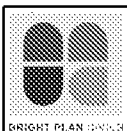
Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	109.521	30.991	30 year 360 minute summer	31.221	8.034
1 year 30 minute summer	71.439	20.215	30 year 480 minute summer	24.324	6.428
1 year 60 minute summer	48.435	12.800	30 year 600 minute summer	19.756	5.404
1 year 120 minute summer	30.053	7.942	30 year 720 minute summer	17.490	4.687
1 year 180 minute summer	23.233	5.979	30 year 960 minute summer	14.215	3.743
1 year 240 minute summer	18.475	4.882	30 year 1440 minute summer	10.161	2.723
1 year 360 minute summer	14.169	3.646	100 year +40% CC 15 minute summer	488.233	138.153
1 year 480 minute summer	11.185	2.956	100 year +40% CC 30 minute summer	320.551	90.705
1 year 600 minute summer	9.182	2.511	100 year +40% CC 60 minute summer	214.603	56.713
1 year 720 minute summer	8.203	2.199	100 year +40% CC 120 minute summer	129.587	34.246
1 year 960 minute summer	6.768	1.782	100 year +40% CC 180 minute summer	97.729	25.149
1 year 1440 minute summer	4.949	1.326	100 year +40% CC 240 minute summer	75.977	20.078
30 year 15 minute summer	268.706	76.035	100 year +40% CC 360 minute summer	56.677	14.585
30 year 30 minute summer	174.929	49.499	100 year +40% CC 480 minute summer	43.979	11.622
30 year 60 minute summer	116.589	30.811	100 year +40% CC 600 minute summer	35.604	9.738
30 year 120 minute summer	70.438	18.615	100 year +40% CC 720 minute summer	31.433	8.424
30 year 180 minute summer	53.298	13.715	100 year +40% CC 960 minute summer	25.432	6.697
30 year 240 minute summer	41.604	10.995	100 year +40% CC 1440 minute summer	18.055	4.839



Results for 1 year Critical Storm Duration. Lowest mass balance: 99.04%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	14	10	11.286	0.036	1.6	0.0534	0.0000	OK
15 minute summer	13	11	11.235	0.035	1.6	0.0395	0.0000	OK
15 minute summer	12	12	11.078	0.028	1.6	0.0317	0.0000	OK
15 minute summer	11	12	10.900	0.050	3.2	0.0760	0.0000	OK
15 minute summer	10	11	10.724	0.068	7.6	0.1392	0.0000	OK
15 minute summer	9	11	10.524	0.099	12.0	0.2109	0.0000	OK
60 minute summer	8	45	10.499	0.124	8.4	0.1398	0.0000	OK
60 minute summer	7	45	10.498	0.140	8.2	0.1589	0.0000	OK
120 minute summer	6	100	10.254	0.254	6.1	0.2868	0.0000	SURCHARGED
120 minute summer	5	100	10.253	0.267	4.9	0.3020	0.0000	SURCHARGED
120 minute summer	4	100	10.026	0.053	4.9	0.0000	0.0000	OK
60 minute summer	3	45	10.498	0.148	5.1	0.1679	0.0000	OK
60 minute summer	2	45	10.498	0.168	2.0	0.1899	0.0000	SURCHARGED
60 minute summer	1	45	10.344	0.034	1.9	0.0000	0.0000	OK
120 minute summer	15	100	10.254	0.249	7.5	0.2812	0.0000	OK
15 minute summer	16	11	10.339	0.064	10.1	0.1314	0.0000	OK
60 minute summer	17	41	10.883	0.526	13.4	2.0001	0.0000	SURCHARGED
60 minute summer	18	47	11.189	0.489	11.5	7.1107	0.0000	SURCHARGED

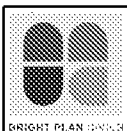
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	14	1.000	13	1.6	0.502	0.116	0.0269	
15 minute summer	13	1.001	12	1.6	0.584	0.111	0.0637	
15 minute summer	12	1.002	11	1.5	0.420	0.076	0.0586	
15 minute summer	11	1.003	10	3.0	0.609	0.229	0.1052	
15 minute summer	10	1.004	9	7.4	0.548	0.204	0.6384	
15 minute summer	9	1.005	8	11.5	0.672	0.358	0.2221	
60 minute summer	8	1.006	7	8.2	0.634	0.273	0.0916	
60 minute summer	7	Flow through pond	3	5.1	0.041	0.002	4.4248	
120 minute summer	6	3.000	5	4.9	0.316	0.125	0.0968	
120 minute summer	5	3.001	4	4.9	0.633	0.125	0.0176	35.8
60 minute summer	3	4.000	2	2.0	0.385	0.118	0.0368	
60 minute summer	2	4.001	1	1.9	0.606	0.112	0.0068	9.3
120 minute summer	15	Flow through pond	6	6.1	0.038	0.001	4.9210	
15 minute summer	16	2.002	15	10.0	1.153	0.151	0.0667	
60 minute summer	17	2.001	16	5.2	0.811	0.111	0.0767	
60 minute summer	18	2.000	17	-5.8	-0.186	-0.196	3.8182	



Results for 30 year Critical Storm Duration. Lowest mass balance: 99.04%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	14	10	11.308	0.058	3.9	0.0867	0.0000	OK
15 minute summer	13	11	11.256	0.056	3.9	0.0630	0.0000	OK
15 minute summer	12	11	11.095	0.045	3.9	0.0505	0.0000	OK
15 minute summer	11	11	10.936	0.086	7.9	0.1312	0.0000	OK
15 minute summer	10	11	10.770	0.114	19.1	0.2332	0.0000	OK
120 minute summer	9	96	10.701	0.276	13.6	0.5856	0.0000	SURCHARGED
120 minute summer	8	96	10.700	0.325	11.9	0.3680	0.0000	SURCHARGED
120 minute summer	7	96	10.700	0.342	11.4	0.3871	0.0000	OK
240 minute summer	6	240	10.536	0.536	7.4	0.6058	0.0000	SURCHARGED
240 minute summer	5	240	10.535	0.549	5.1	0.6209	0.0000	SURCHARGED
60 minute summer	4	37	10.027	0.054	5.0	0.0000	0.0000	OK
120 minute summer	3	96	10.700	0.350	6.8	0.3962	0.0000	FLOOD RISK
120 minute summer	2	96	10.700	0.370	2.2	0.4182	0.0000	SURCHARGED
15 minute summer	1	44	10.344	0.034	2.0	0.0000	0.0000	OK
240 minute summer	15	240	10.536	0.531	9.8	0.6001	0.0000	OK
240 minute summer	16	240	10.537	0.262	9.8	0.5411	0.0000	SURCHARGED
60 minute summer	17	48	11.034	0.677	32.3	14.0449	0.0000	FLOOD RISK
120 minute summer	18	116	11.283	0.583	17.8	23.8236	0.0000	FLOOD RISK

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	14	1.000	13	3.9	0.635	0.287	0.0524	
15 minute summer	13	1.001	12	3.9	0.753	0.275	0.1227	
15 minute summer	12	1.002	11	3.8	0.524	0.193	0.1180	
15 minute summer	11	1.003	10	7.8	0.775	0.586	0.2114	
15 minute summer	10	1.004	9	19.0	0.672	0.524	1.3183	
120 minute summer	9	1.005	8	11.9	0.478	0.370	0.5138	
120 minute summer	8	1.006	7	11.4	0.423	0.380	0.1533	
120 minute summer	7	Flow through pond	3	6.8	0.045	0.003	13.2800	
240 minute summer	6	3.000	5	5.1	0.251	0.131	0.0968	
240 minute summer	5	3.001	4	5.0	0.637	0.128	0.0179	99.1
120 minute summer	3	4.000	2	2.2	0.421	0.129	0.0368	
120 minute summer	2	4.001	1	2.0	0.611	0.115	0.0070	27.2
240 minute summer	15	Flow through pond	6	7.4	0.034	0.001	15.5386	
240 minute summer	16	2.002	15	9.8	1.043	0.147	0.3044	
60 minute summer	17	2.001	16	6.0	0.681	0.130	0.2961	
120 minute summer	18	2.000	17	3.8	0.162	0.128	4.0794	



Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.04%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	14	10	11.333	0.083	7.2	0.1245	0.0000	OK
15 minute summer	13	11	11.278	0.078	7.1	0.0880	0.0000	OK
15 minute summer	12	12	11.133	0.083	7.0	0.0937	0.0000	OK
15 minute summer	11	12	11.115	0.265	14.4	0.4061	0.0000	SURCHARGED
15 minute summer	10	12	11.011	0.355	34.7	0.7230	0.0000	SURCHARGED
120 minute summer	9	120	10.972	0.547	22.6	1.1620	0.0000	FLOOD RISK
120 minute summer	8	122	10.972	0.597	21.4	0.6751	0.0000	FLOOD RISK
120 minute summer	7	122	10.972	0.614	21.0	0.6943	0.0000	OK
360 minute summer	6	360	10.789	0.789	7.8	0.8924	0.0000	FLOOD RISK
360 minute summer	5	360	10.789	0.803	5.1	0.9077	0.0000	FLOOD RISK
15 minute summer	4	196	10.027	0.054	5.0	0.0000	0.0000	OK
120 minute summer	3	122	10.972	0.622	11.6	0.7033	0.0000	FLOOD RISK
120 minute summer	2	122	10.971	0.641	2.3	0.7253	0.0000	FLOOD RISK
360 minute summer	1	560	10.344	0.034	2.0	0.0000	0.0000	OK
360 minute summer	15	360	10.789	0.784	10.6	0.8868	0.0000	OK
360 minute summer	16	360	10.790	0.515	11.3	1.0651	0.0000	SURCHARGED
120 minute summer	17	112	11.135	0.778	34.0	38.0518	0.0000	FLOOD RISK
180 minute summer	18	180	11.382	0.682	24.1	53.4955	0.0000	FLOOD RISK

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	14	1.000	13	7.1	0.738	0.526	0.0827	
15 minute summer	13	1.001	12	7.0	0.880	0.500	0.2174	
15 minute summer	12	1.002	11	7.4	0.565	0.372	0.2202	
15 minute summer	11	1.003	10	13.3	0.827	0.996	0.3698	
15 minute summer	10	1.004	9	29.1	0.735	0.803	1.8780	
120 minute summer	9	1.005	8	21.4	0.538	0.665	0.5138	
120 minute summer	8	1.006	7	21.0	0.528	0.701	0.1533	
120 minute summer	7	Flow through pond	3	11.6	0.049	0.005	30.1609	
360 minute summer	6	3.000	5	5.1	0.135	0.131	0.0968	
360 minute summer	5	3.001	4	5.0	0.637	0.128	0.0178	143.1
120 minute summer	3	4.000	2	2.3	0.477	0.135	0.0368	
120 minute summer	2	4.001	1	2.0	0.611	0.115	0.0070	37.2
360 minute summer	15	Flow through pond	6	7.8	0.017	0.001	29.6822	
360 minute summer	16	2.002	15	10.6	0.991	0.160	0.3044	
120 minute summer	17	2.001	16	5.9	0.696	0.128	0.4085	
180 minute summer	18	2.000	17	2.2	0.136	0.074	4.0794	