LAND AT THE INGLENOOK, PAGHAM ROAD, BOGNOR REGIS PO21 3QB

RESIDENTIAL DEVELOPMENT

Flood Risk Assessment

Prepared on Behalf of

ADM Architects

ADMA/18/D1456

04 May 2018

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1 INTRODUCTION

1.1 Background

1.1.1 RGP Design Ltd (RGP) is instructed by ADM Architects to prepare a Site-Specific Flood Risk Assessment (FRA) to support a planning application for a residential development in relation to Land at The Inglenook, Pagham Road, Bognor Regis PO21 3QB.

1.1.2 This FRA has been undertaken in accordance with Planning Practice Guidance: Flood Risk and Costal Change (FRCC) and National Planning Policy Framework Section 10.

1.1.3 The proposed development will involve the construction of 9 new residential units at the above location, as shown on the architect's site layout 1594-05, included within **Appendix A**.

1.1.4 In preparing this report, RGP has made reference to the following documents and 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
- Southern Water and Local Authority Drainage Records
- British Geological Survey & Records

1.1.5 This FRA 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 totals 0.48Ha in size and is located to the rear of The Inglenook Hotel and Restaurant to the west of Pagham Road, Bognor Regis.

1.2.2 The site is located approximately 5.68km west of the centre of Bognor Regis and is in a sub-urban/semi-rural residential area.

1.2.3 The land which will accommodate the proposed development is currently an undeveloped greenfield.

1.2.4 There is an existing watercourse (unnamed) located approximately 45m south of the site which is understood to be flowing in a westerly direction, as confirmed by Arun District Council records.

1.2.5 The topographical survey confirms that the rear of the site whereby the development is proposed largely falls from east to west, with levels ranging from 6.13m AOD to 5.29m AOD. The areas of the site which are already developed appear to fall from west to east however, towards Pagham Road. Levels are demonstrated as ranging from 6.13m AOD to 5.58m AOD.

1.2.6 The existing impermeable area of the site totals 328m^2 (0.03Ha).

1.3 Ground Conditions

1.3.1 An intrusive geotechnical has not yet been conducted in relation to the site, meaning it has not been possible to confirm precise underlying soil conditions to assist with the design of sustainable drainage systems

1.3.2 Reference has been made to the British Geological Survey (BGS) website to gain an understanding of the expected soil conditions at the site.

1.3.3 Bedrock geology is recorded by the BGS as being 'London Clay Formation – Clay, Silt and Sand' from the Ypresian Age.

1.3.4 Superficial deposits are recorded as 'Alluvial Fan Deposits – Gravel, Sand, Silt and Clay' from the Quaternary Period.

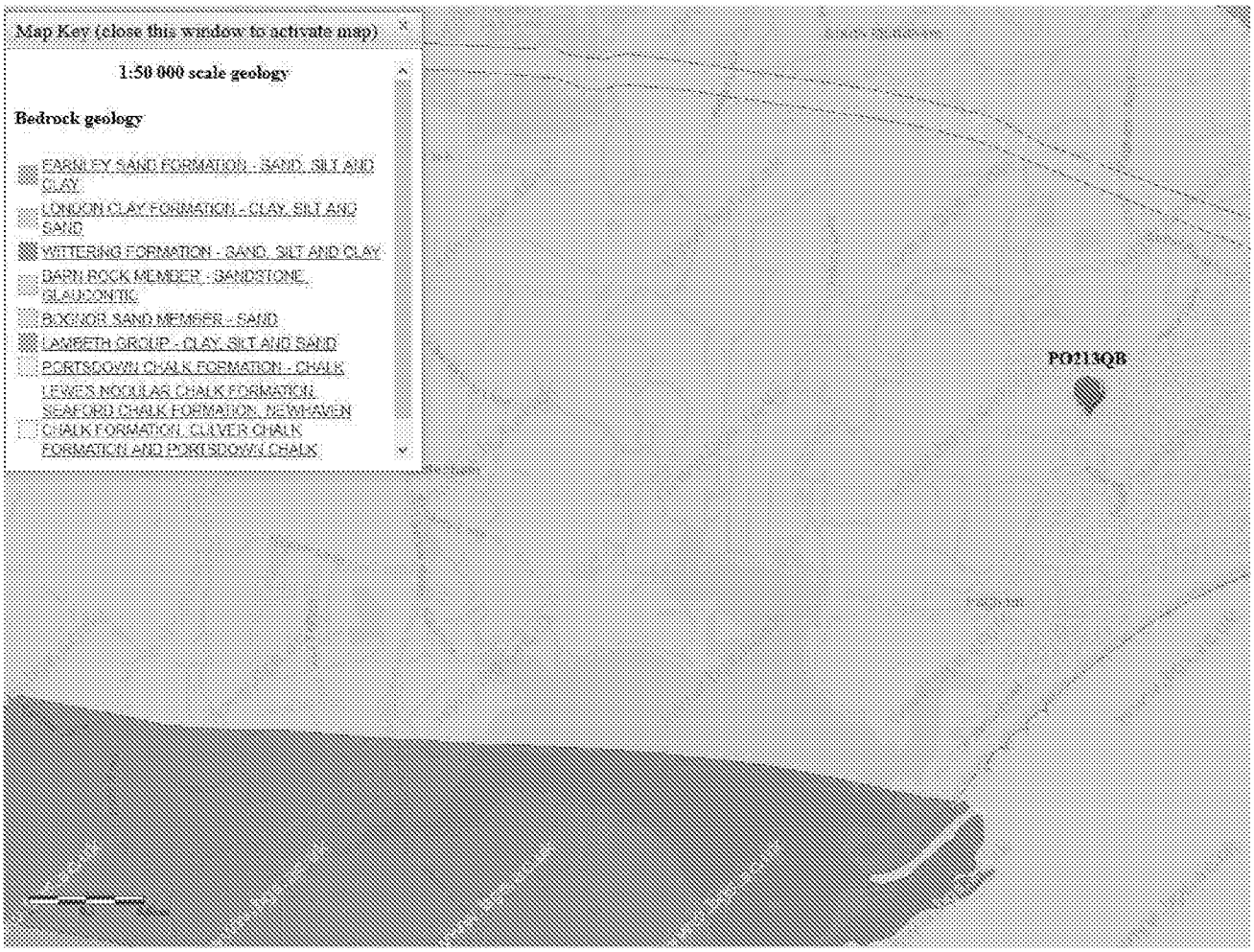

Figure 1. Bedrock geology is confirmed as 'Weald Clay Formation – Mudstone' by the BGS website – this is consistent with the results of the site specific geotechnical investigation conducted by Geo-Environmental

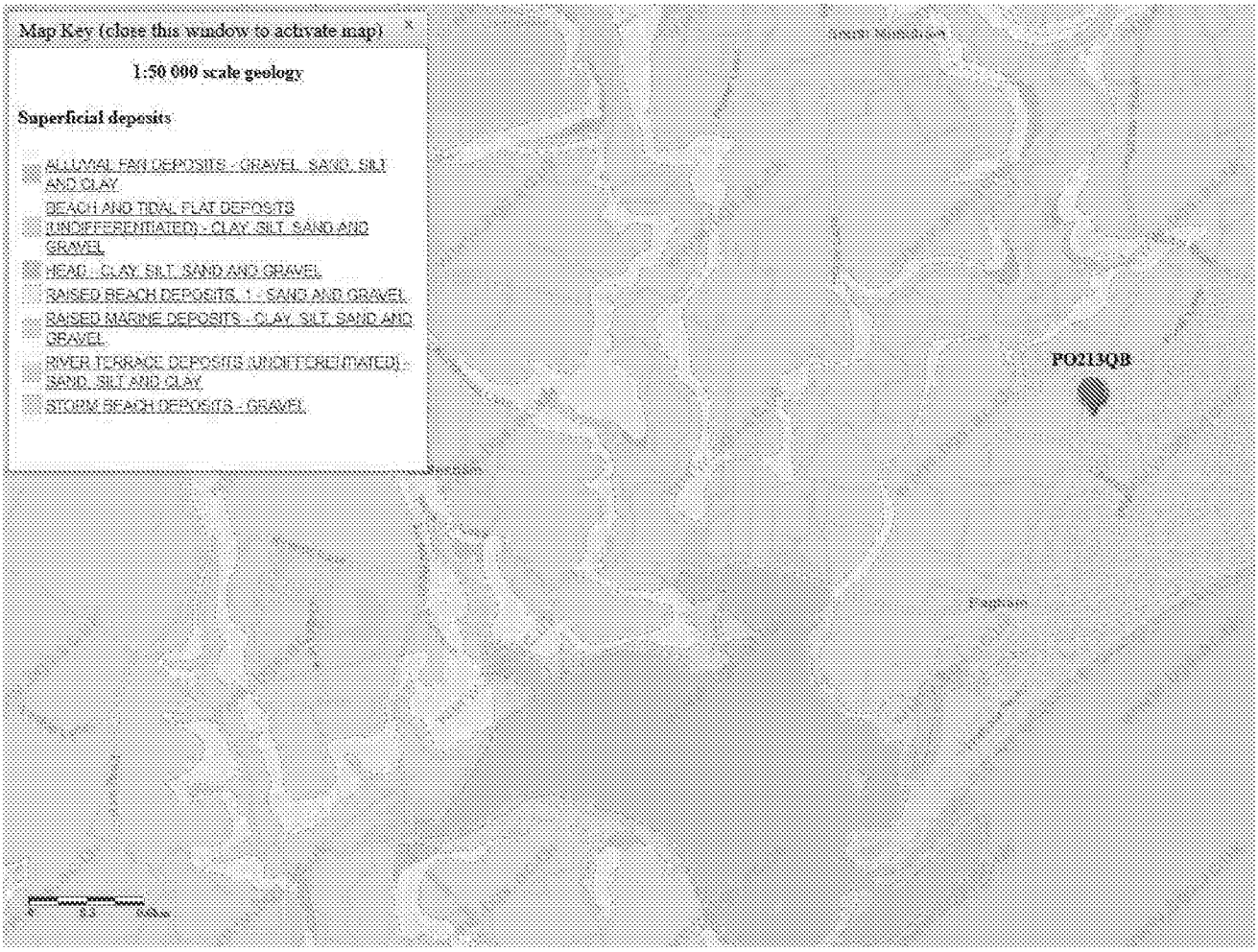

Figure 2. As confirmed in 1.3.4, Superficial deposits are stated by the BGS as Alluvial Fan Deposits – Gravel, Sand, Silt and Clay' from the Quaternary Period

1.3.5 Historic borehole records held and maintained by the BGS have been reviewed – of which there are two within approximately 2km of the site.

1.3.6 The first of the two historic boreholes reviewed (SZ89NE4) is located approximately 1.2km north of the site at The Village Hall (formerly Sefter School) on Pagham Road, at the junction with Sefter Road. This borehole has a recorded depth of 142.34m deep.

1.3.7 The conditions experienced were consistent with those expected in relation to the wider mapping provided by BGS with varying clays experienced – ranging from hard, blue and brownish clay to mottled red and brown clay. Chalk and flints were experienced at depths of 57m bgl to the end of the borehole.

1.3.8 The second of the two historic boreholes reviewed (SZ99NW13) is located within Barrack Lane, approximately 1.5km east of the site, and has a recorded depth of 121.92m.

1.3.9 The conditions and underlying geology of this borehole was experienced as largely very similar to borehole SZ89NE4. Blue clay assigned as London Clay was experienced to depths of 33.52m bgl, after which mottled clay and sand was experienced to depths of 64m bgl. Chalk and flint was encountered at depths of up to 121.92m at which point the borehole ended.

1.3.10 Whilst the BGS records reviewed offer an indication as to the conditions which could be expected whereby the site is concerned, a site-specific geotechnical investigation should be undertaken in order to confirm precise geological conditions and geotechnical properties to assist in the design of sustainable drainage systems in view of the proposed development.

1.3.11 Copies of the BGS records reviewed can be found within **Appendix C** of this report.

Figure 3. The locations of the two BGS boreholes as referred to in 1.3.2-1.3.10

1.4 Groundwater

1.4.1 As stated in '**1.3 Ground Conditions**' a site-specifc geotechnical investigation has not been undertaken, therefore it has not been possible to confirm whether groundwater is present underlying the site, and if so, at what depth(s).

1.4.2 Of the two BGS historic borehole records reviewed, SZ89NE4 to the north of the site specifically states that groundwater was not encountered during excavation. The records for borehole SZ99NW13 makes not reference to groundwater, however.

1.4.3 Information obtained from WSCC confirms that groundwater levels are shown to be between 0.025m and 0.5m bgl, based on current JBA groundwater mapping.

1.4.4 Environment Agency Groundwater Mapping indicates that the site is not located within, or nearby any Groundwater Source Protection Zones.

1.4.5 The same mapping tool indicates that the site falls within a 'Medium-Low' Groundwater Vulnerability Zones.

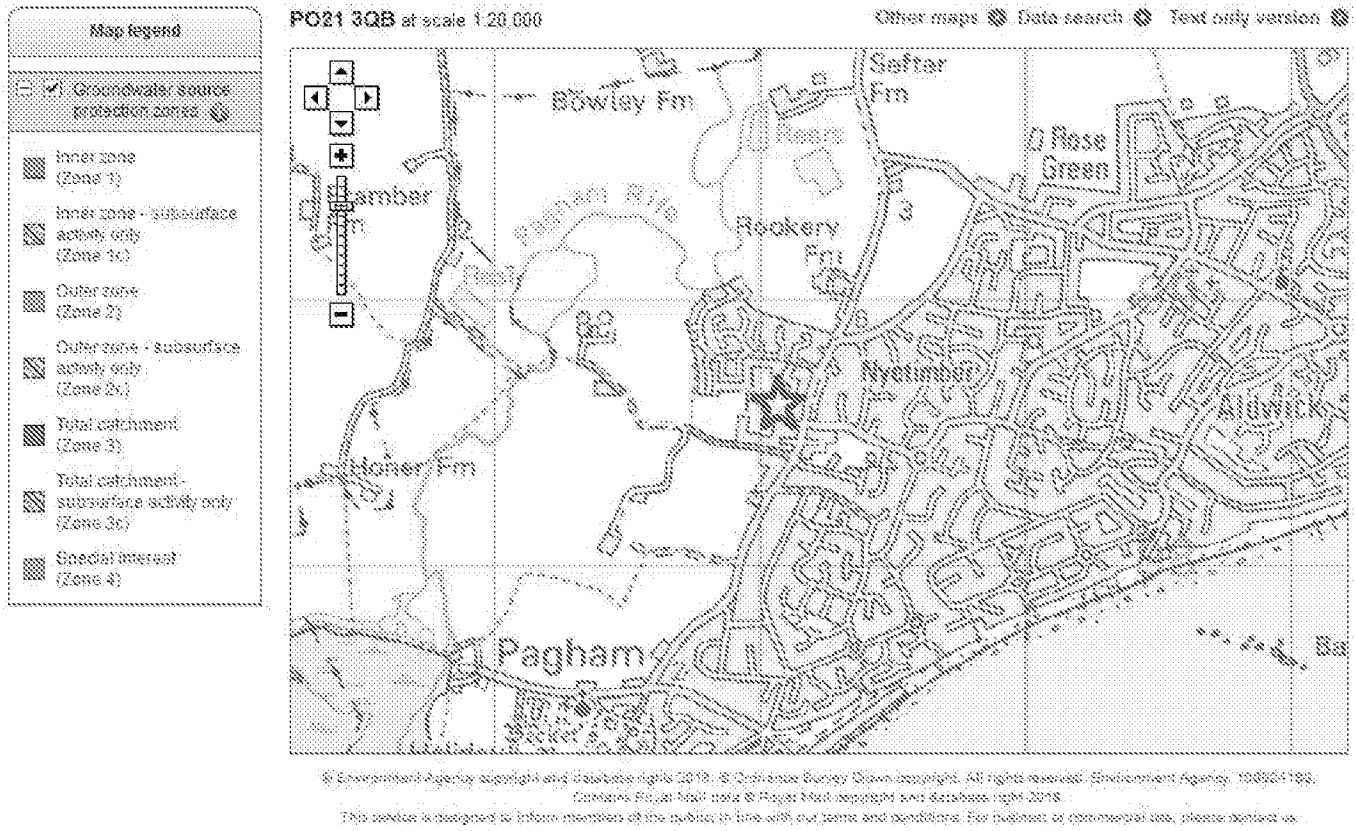

Figure 4. Environment Agency Groundwater Mapping indicates that the site does not fall within any Groundwater Source Protection Zones

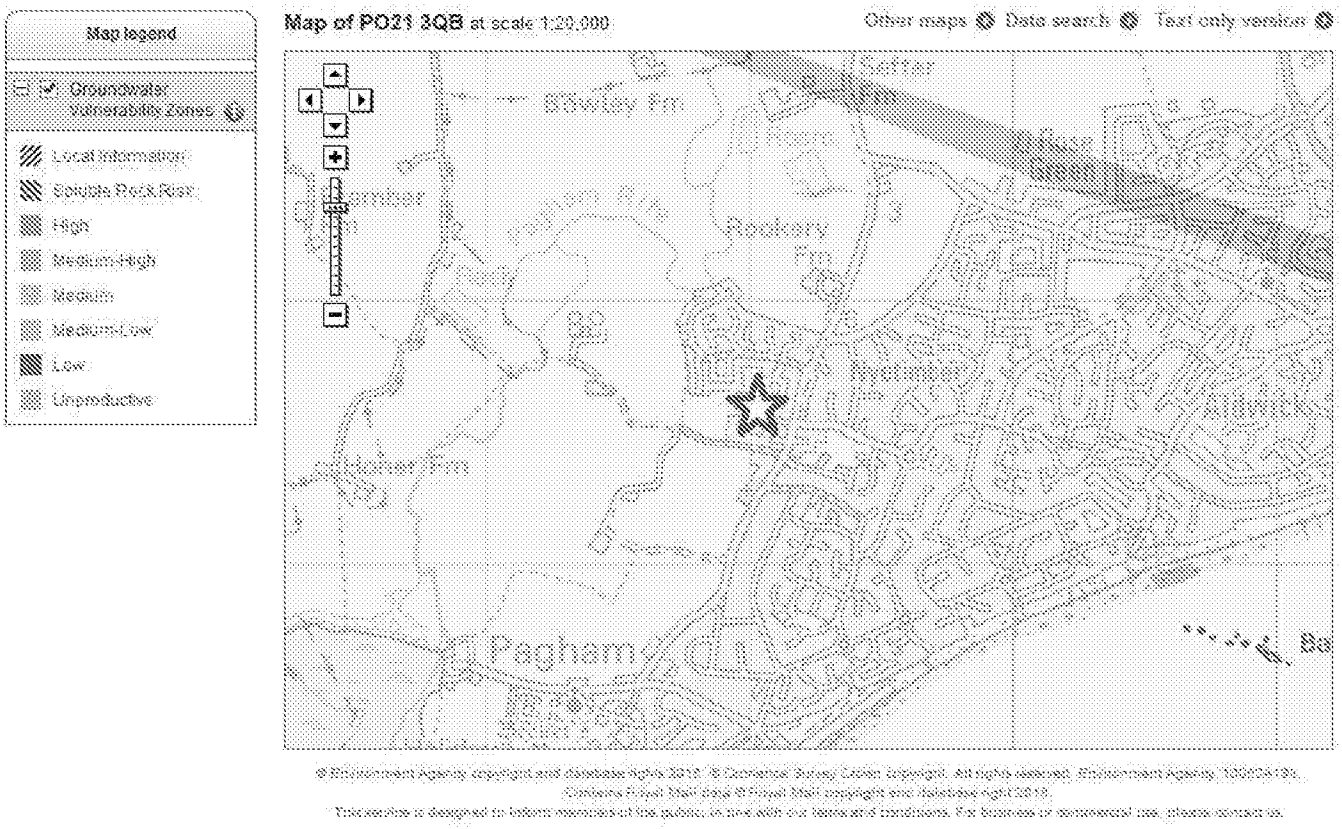

Figure 5. Environment Agency Groundwater Mapping demonstrates that the site falls within a Medium-Low Groundwater Vulnerability Zone

1.5 Existing Drainage

1.5.1 The site falls within the administrative areas of both Arun District Council and West Sussex County Council - both of whom 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 have also been consulted, and public sewer records have been obtained, as contained within this report in **Appendix B**.

1.5.3 Surface Water:

- The Southern Water public sewer records **(Appendix B)** demonstrate that there is an existing public sewer water sewer located in Pagham Road to the east of the site. This is recorded as ranging from 150mm in diameter to 300mm in diameter. The sewer records state that this sewer flows in a northerly direction. The depth of this sewer is approximately 1.23m deep.

- As stated in 1.2.4, there is an existing watercourse located approximately 45m south of the southern boundary of the site. WSCC has advised that they believe that there is no positive outfall to this watercourse, and it acts solely as a storage ditch. As the watercourse falls beyond the site boundary, it is likely that the developer may not have control of this watercourse and therefore the right to discharge to it.

- A recent development immediately abutting the southern boundary of the site (PL/125/14/PL) which saw the construction of 40 No. of residential units implemented a surface water drainage strategy which utilises 3 No. of outfalls to this watercourse, which will have an impact upon the available capacity.

- Owing to the expected underlying soil conditions, it is unlikely that there will be any significant volume of surface water being managed through infiltration methods and techniques.

- Greenfield runoff rate (Qbar) has been calculated to be 1.7l/s (Q1 = 1.4l/s, Q30 = 3.8l/s and Q100 = 5.3l/s).

- The percentage Greenfield run-off has been determined to be 36.43%, whilst the Greenfield run-off volume is calculated to be 110.214m^3 (Based on FEH, SPR of 37.00% and 1-in-100 year, 360-minute event).

1.5.4 Foul Water:

- The Southern Water public sewer records **(Appendix B)** show that there are two public foul water sewers located in Pagham Road, to the east of the site.

- The first of the two public foul water sewers is shown as running in a southerly direction down Pagham Road and measures 150mm in diameter. This sewer has a recorded depth of 1.54m.

- The second of the two public foul water sewers is shown as running in a northerly direction and measures 150mm in diameter. This sewer has a recorded depth of 0.82m.

- It is understood that The Inglenook Hotel and Restaurant utilises existing connections to the public foul water sewers stated above.

1.5.5 Highway Drainage:

- Pagham Road is served by existing positive highway drainage infrastructure, with road gullies located along both the eastern and western channels of the public highway, as shown in **Appendix D**. It is understood that these outfall to the existing public surface water sewer located in Pagham Road.

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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 on-line Flood Maps for Planning (rivers and sea) show that the site is located fully within Flood Zone 1, as demonstrated below.

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)

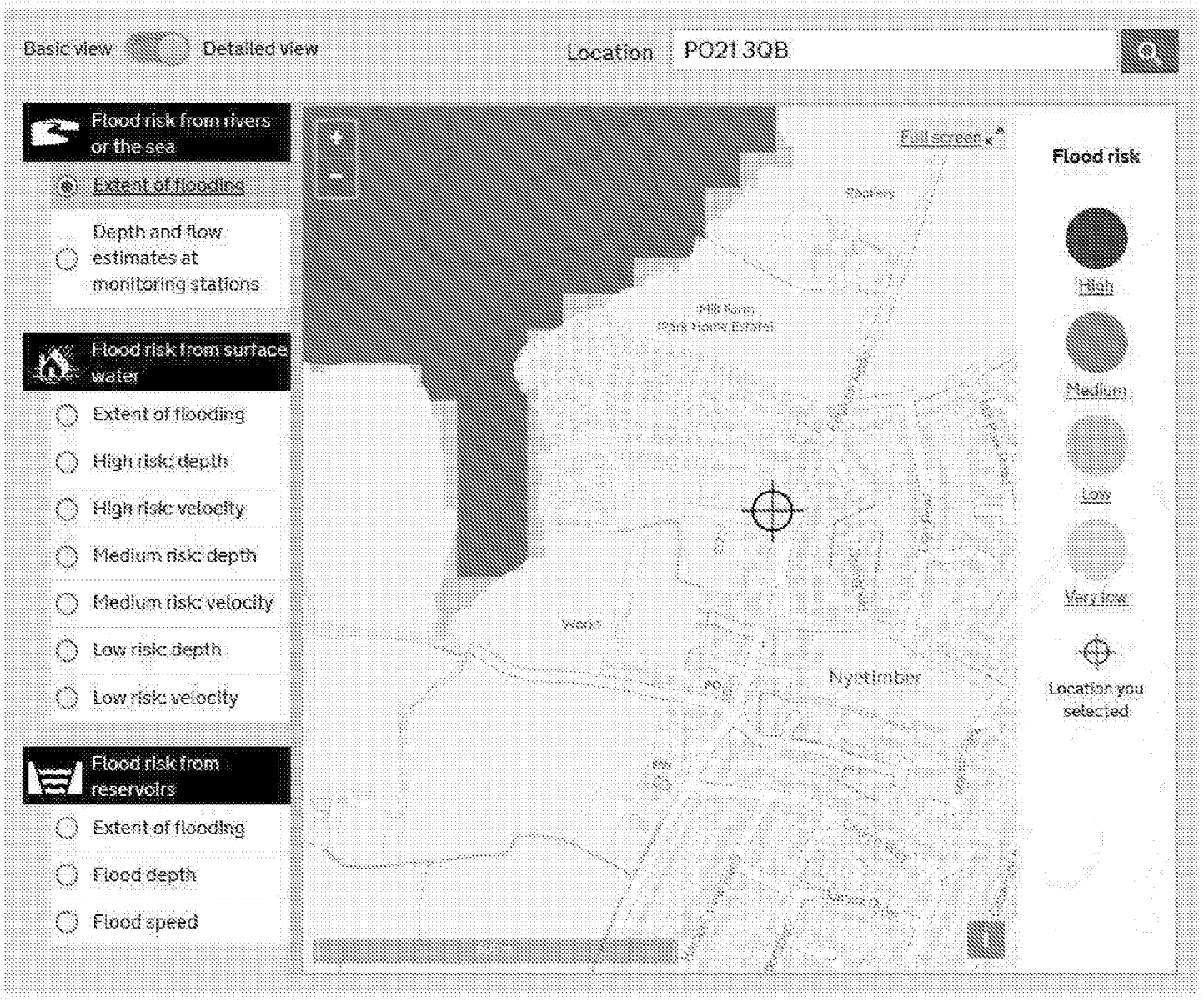

Figure 6. Long Term Flood Map demonstrating flood risk from river and/or the sea (Gov.uk)

2.2.2 The Long-Term Flood Risk Map for Surface Water show that the risk of surface water flooding to the site is 'Very Low'. An area to the south-east corner of the site whereby the proposed access road is to be located is shown to be at 'Low' risk of surface water flooding from surface water.

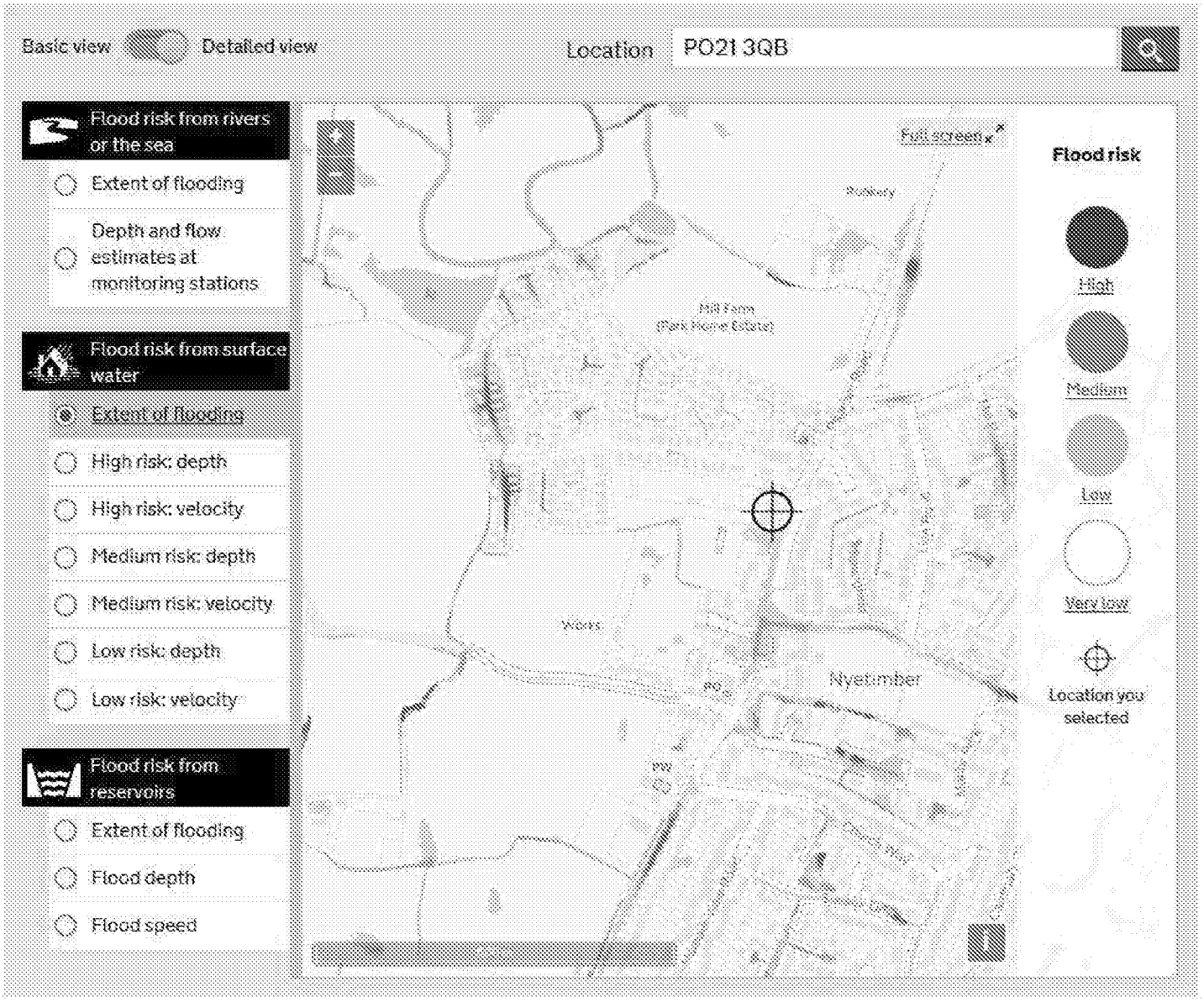

Figure 7. Long Term Flood Map demonstrating flood risk from surface water (Gov.uk)

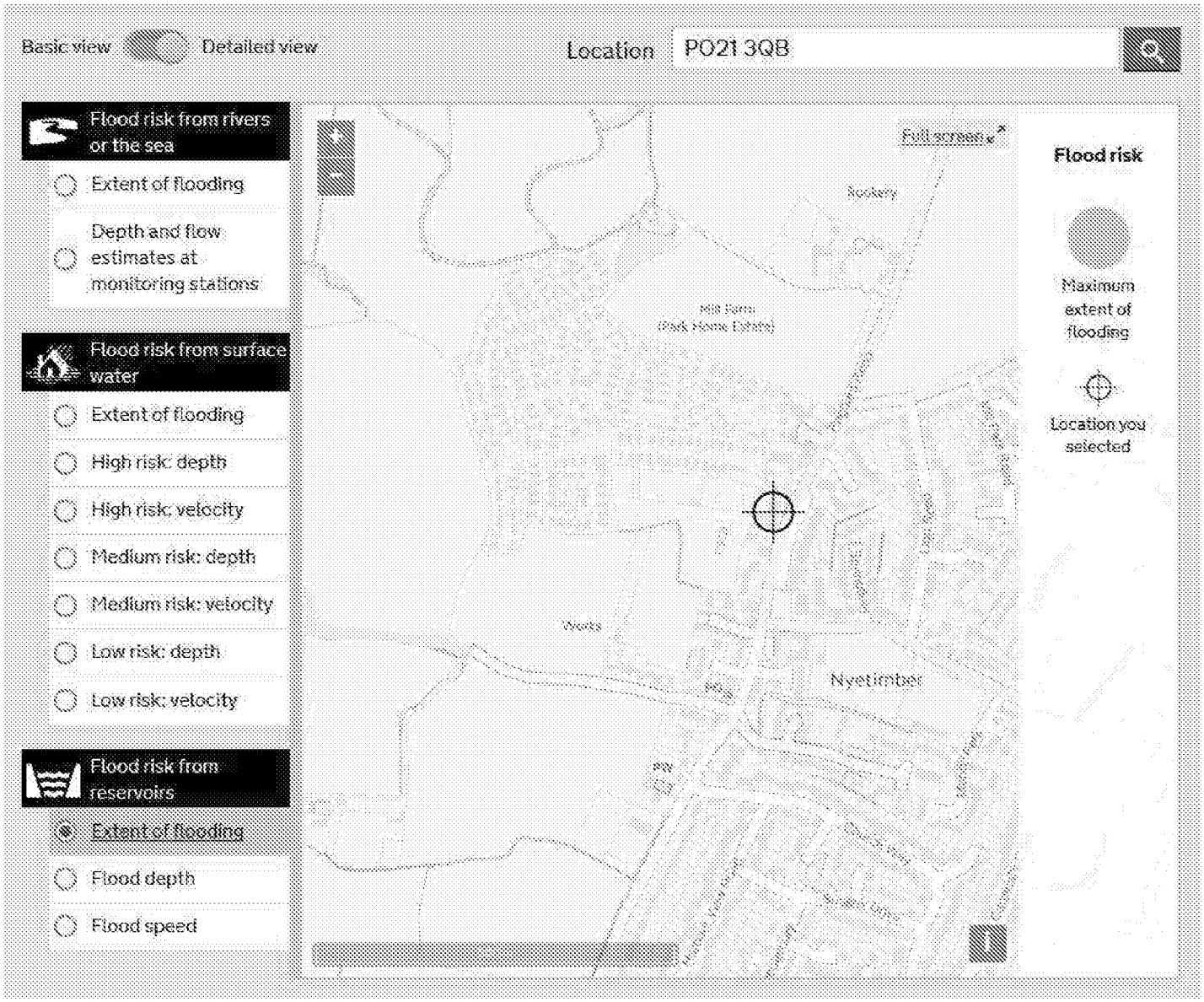

Figure 8. Long Term Flood Map demonstrating flood risk from reservoirs (Gov.uk)

2.3 Strategic Flood Risk Assessment

2.3.1 The site falls within the administrative boundaries of West Sussex County Council (WSCC) and Arun District Council (ADC).

2.3.2 WSCC has published a Strategic Flood Risk Assessment, dated January 2010. In addition to this, WSCC has also published a Local Flood Risk Management Strategy (May 2014). Flood mapping and information obtained therein is consistent with other flood maps reviewed and detailed within this report, although the site itself is not specifically referenced.

2.3.3 Arun District Council has published its own Strategic Flood Risk Assessment, dated August 2016.

2.3.4 As with WSCC's SFRA and Local Flood Risk Management Strategy, the ADC SFRA does not specifically reference the site, although Pagham as a wider parish is discussed in terms of flood risk and management. Information and mapping contained within this document is consistent with other mapping and information reviewed as part of this FRA.

2.4 Historic Flooding

2.4.1 The relevant Local Authorities as well as The Environment Agency have all confirmed that they are not aware of any instances of historic flooding within the confines of the site.

2.4.2 WSCC has stated that, although they are not aware of any instances of historic flooding affecting the site, this is not to say that flooding has been occurred, just that it has not been reported to them as LLFA. This is also the case for possible flooding within close proximity of the site, including within the public highway.

2.4.3 WSCC has advised that they are not aware of any future drainage improvements proposed within the area.

2.4.4 Further to 2.4.3, WSCC has also confirmed that they are not aware of any current or future flooding alleviation and defences in the area.

2.5 Summary of Flood Risk

2.5.1 The potential sources of flooding are:

Source of Flooding	Level of Risk
Rivers and Watercourses	**Very Low** The risk of flooding from rivers and watercourses is stated as being 'Very Low'. The western boundary of the proposed development site is located within approximately 225m of land which is stated as being at 'High' risk of flooding from rivers and/or the sea, and approximately 200m from land which is demonstrated as being at 'Low' risk.
The Sea	**Very Low** The site is located approximately 1.18km inland, whilst ADC's SFRA confirms that the stance where possible coastal flooding is concerned is to 'hold the line'. Flood defence maps contained with ADC's SFRA also serve to demonstrate that the site can be deemed as being as 'Very Low' risk of flooding from the sea.

Surface Water	**Very Low - Low** The Long-Term Flood Map for Surface Water (Figure 7) demonstrates that the site it largely regarded as being at 'Very Low' risk of surface water flooding. The site frontage to the south-east corner of the site where the proposed site access road is to be located is demonstrated as being at slightly higher risk of surface water flooding, although this risk is categorised as being 'Low'.
Groundwater	**Medium** WSCC has advised that JBA Groundwater Mapping indicates that groundwater levels are shown to be between 0.025m and 0.5m below ground level, although a site-specific geotechnical investigation has not been undertaken to confirm this.
Sewers (*)	**Very Low** No reference to historic flooding from sewers has been discovered, therefore the risk of flooding from this source is deemed to be 'Very Low'.
Artificial Sources	**None**

3 PROPOSED DEVELOPMENT

3.1 Description of Development

3.1.1 The proposed development will involve the construction of 9 No. dwellings as demonstrated within **Appendix A**. The proposed development will also incorporate an access road into the development, footpaths, private and shared parking areas along with areas of additional soft and hard landscaping.

3.1.2 The type of development falls within the 'More Vulnerable' classification (Flood Risk and Costal Change Table 2) and is compatible with Flood Zones 1 and 2 (Flood Risk and Costal 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 †	✗	✓	✓	✓
Flood Zone 3b*	Exceptions Test Required *	✗	✗	✗	✓*
✓ = Development is appropriate ✗ = Development should not be permitted					

3.1.3 The development proposes to utilise land which is currently undeveloped to the rear of The Inglenook Hotel and Restaurant. The proposed development involves the creation of new impermeable areas and therefore has the potential to increase the rate or volume of run-off generated by the site.

3.1.4 The post-development impermeable area has been determined to be in the region of 2,870m^2 (0.29Ha).

3.1.5 The increase in impermeable areas will result in an increase in surface water run-off, which will be mitigated through the use of 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.

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

3.1.7 The proposed site layout is shown on drawing 1594-05 **(Appendix A)** prepared by ADM Architects.

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.
Basins and Ponds - Constructed Wetlands - Balancing Ponds - Detention Basins - Retention Ponds	 Yes Yes Yes Yes	No current constraints exist limiting the use of such measures, although anticipated 'land take' should be considered
Filter strips and swales	Yes	There are no current constraints which would limit the use of such techniques, although potential 'land take' should be considered.
Infiltration Devices - Soakaways - Infiltration trenches and basins	No	Although a site specific geotechnical investigation has not been undertaken to confirm precise infiltration rates and underlying geological conditions, it is believed that the soils will not be conducive of allowing infiltration methods and techniques to be implemented. This should be confirmed following on-site investigation however.

Permeable surfaces and filter drains - Gravelled areas - Solid paving blocks Porous paviors	 Yes Yes Yes	Whilst such measures could be implemented, owing to the anticipated low rates of infiltration offered by the site, it is unlikely that sufficient levels of infiltration will be achieved in order to benefit the site from a drainage perspective.
Tanked systems Oversized pipes Cellular tanks	 Yes Yes	No initial constraints.

4.1.2 As has already been confirmed, a site-specific geotechnical investigation has not yet been undertaken at the site. In view of this, it has not been possible to ascertain precise infiltration rates in relation to the underlying soils.

4.1.3 The existing watercourse to the south of the site is outside the bounds of the development site, and also the developer's control, meaning rights to discharge to this would need to be agreed with the Riparian owner. In addition to this, the development immediately abutting the southern boundary has recently established 3 No. outfalls to this watercourse – which has been confirmed as having no outfall and instead solely offers storage.

4.1.4 Further to 4.1.2 and 4.1.3, it is proposed to connect the development to the existing public surface water sewer located in Pagham Road, to the east of the site.

4.1.5 Surface water run-off generated by the development will be attenuated within the confines of the site within the tanked permeable paving, before being released to the public surface water sewer at a controlled rate of 2.5l/s.

4.1.6 It is proposed that permeable paving totalling 807.867m^2 would provide a level of attenuated storage to the volume of 363.54m^3.

4.1.7 FFLs are to be set above the existing ground level to allow a gravity-based connection, as well as to mitigate the risk of groundwater flooding.

4.1.8 A second strategy (SK301) has been prepared which demonstrates that a pumped solution can also be implemented should a gravity-based solution be deemed unsuitable in the event that FFLs are restricted by the Local Planning Authority (LPA). The pumped solution will require FFLs to be set 300mm above the existing ground profile.

4.1.9 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 the run-off from the private drives and shared parking areas receives a level of treatment that meets the requirement of the SuDS Manual due to naturally occurring microbes digesting Hydrocarbons entering the system and the filtration effects of the aggregates and geotextiles.

4.2.2 Impermeable hard stand areas will be drained by trapped road gullies and/or channel with a sump providing a basic level of treatment by collecting silts and oil pollutants. Catchpits will also be provided to collect silts and oil pollutants.

4.2.3 The CIRIA SuDS Manual C753 outlines three categories of pollution hazard identification for the various types of land use as follows:

- Total Suspended Solids (TSS).
- Metals (M).
- Hydrocarbons (H).

4.2.4 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.

- For other impermeable surfaces - low/TSS-0.5/M-0.4/H-0.4.

4.2.5 In accordance with C753 table 26.3 to establish whether a proposed surface water management technique can provide sufficient treatment for runoff, the values are compared. If the treatment score for each pollutant category is higher than the pollution score, then the chosen technique is sufficient. If a single technique is not judged to provide enough treatment, then other techniques can be added to the system.

4.2.6 The treatment afforded by the proposed outline surface water management strategy has been assessed based on the following components:

- Permeable pavement – TSS-0.7/M-0.6/H-0.7

4.2.7 In conclusion, the above SuDS methods and techniques can be considered to provide sufficient treatment.

4.3 Foul Water Drainage

4.3.1 It is proposed to connect the development to the existing Southern Water 150mm dia. public foul water sewer located in Pagham Road, to the east of the site via a gravity-based connection, as shown on drawing SK300. Confirmation of levels will be required, as well as the ability for the existing foul sewers to cope with the increased capacity.

4.3.2 A second strategy (SK301) has been prepared which demonstrates that a pumped solution can also be implemented should a gravity-based solution be deemed unsuitable in the event that FFLs are restricted by the Local Planning Authority (LPA). The pumped solution will require FFLs to be set 300mm above the existing ground profile.

4.3.3 Based on the residual design guidance provided in Sewers for Adoption, the proposed foul flow will be 0.42l/s (based on 4,000 l/day Sewers for Adoption 7th Edition), subject to confirmation from Southern Water that sufficient capacity is available within the existing sewer network.

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 April 2016, 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 The proposed development involves the creation of additional impermeable areas; therefore, rainfall increases need to be incorporated into the existing surface water drainage regime.

5 RESIDUAL RISK AND MITIGATION

5.1 Residual Risk

5.1.1 A residual risk has been identified in relation to the possible presence of high levels of groundwater. This has been confirmed as a potential risk by WSCC.

5.2 Mitigation

5.2.1 In view of the residual risks identified in Section 5.1, mitigation has been considered and implemented in view of the site arrangement and proposed drainage strategies for the site where both surface water and foul water are concerned.

5.2.2 Firstly, all structures have been located in the areas of the site where the risks of flooding from all sources are at their lowest.

5.2.3 Finished floor levels have been raised and set at a level to reduce the risk of possible groundwater flooding, whilst the drainage strategies for the site have been designed to accommodate for 1-in-100-year storm events, with consideration given to Climate Change up to 40%.

6 SEQUENTIAL AND EXCEPTION TESTS

6.1 Sequential Test

6.1.1 The site is in Flood Zone 1 and is at the lowest risk of flooding. In view of this, the application of the sequential test is not required.

6.1.2 Although as established in 6.1.1 that the sequential test is not required – as the site falls fully within Flood Zone 1, the site arrangement has been set out sequentially in order to minimise the risk of potential flooding from the sources detailed within **Section 2.5 - Summary of Flood Risk**.

6.2 Exception Test

6.2.1 Table 3 within Paragraph 067 of Flood Risk and Costal Change confirms that developments classified as "More Vulnerable" are suitable for Flood Zones 1 & 2. The proposed development is in Flood Zone 1 and therefore an exception test is not required.

7 FLOOD RISK MANAGEMENT

7.1 Safe Access and Egress

7.1.1 The proposed development falls entirely within Flood Zone 1 and is expected to remain in that zone throughout its design life.

7.1.2 The site is confirmed as being at 'Very Low' risk of surface water flooding, as suggested by the Long-Term Surface Water Flood Risk Map. The risk of flooding from surface water to the south-east corner of the site frontage (within the public highway) is demonstrated as being at a higher susceptibility of potential surface water flooding – categorised as 'Low', which is unlikely to have an impact upon access and egress.

7.1.3 All other potential sources of flooding have been confirmed as being either 'Very Low' or 'Low', therefore the risk of access and egress being affected by flooding is low.

7.2 Flood Warning

7.2.1 The site is at low risk of flooding therefore there is no requirement for a Flood Plan or warning system to be implemented.

7.3 Maintenance

7.3.1 Maintenance plays an important part in the long-term performance of a surface water drainage system and will be required to ensure that it remains fully operational.

7.3.2 Whilst the drainage system has been designed to operate with as little maintenance as possible, there are key operations that must regularly be undertaken to ensure that it remains in optimal condition, most of which are general housekeeping tasks that should be undertaken for any drainage system, but with additional attention to the catchpits upstream of the flow control devices and the permeable paving. These operations are summarised below together with recommended frequencies:

- Periodic desilting of catchpits, gully sumps and channel drains. These should be emptied at least as follows (but with an annual inspection and additional cleansing if required): On completion of drainage works, Year 1, Year 3, then every 5 years. The desilting of these items are required to ensure the Hydrobrake flow control device operates as per the design and does not become blocked.

- Periodic jetting or rodding of pipework as required to clear blockages.

- Gratings on any gullies and channel drains to be kept clear of debris.

- Any manufacturer specific requirements for maintenance (i.e. for the Hydrobrake) should be added to the periodic maintenance.

Permeable Paving / Diffuser Units

- 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 as the system is tanked.

- As part of the permeable paving system, diffuser units are used to discharge surface water run-off from roof areas into the subbase, 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 subbase base of the permeable paved areas.

- The areas of permeable paving will require additional maintenance measures to ensure they operate as designed. Failure to carry out this maintenance could increase the risk of flooding. The additional measures are as follow:

- 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.

Hydrobrake (Flow Control Chamber)

- A 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.

- 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.

- The Hydrobrake flow control chambers 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.

Remedial/Repair Actions

- Significant storm events may cause significant damage to SuDS. As such it may be necessary to inspect and carry out essential recovery works to return the feature to full working order.

- Resetting of uneven blocks by lifting block area, removing bedding material and relaying to match original design.

Accidental Spillages

- It is not envisaged that any materials are to be stored onsite once the development is completed, which could cause major spills and potential pollution issues within the drainage system. If this situation alters in the future a specialist will be required to be contacted to confirm if any upgrades to the existing system are required.

- Minor spillages of fuels and oils from motor vehicles will be dealt with by the permeable paving and deep trapped gullies, by biodegrading / collecting the hydrocarbons respectively.

Future Alterations to the Development

- 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 permeable paving level with the permeable system reinstalled above.

7.3.3 It is recommended that a simple maintenance strategy is prepared by monitoring the proposed drainage system over a specific duration to establish the rate at which silt builds up, which can then inform a programme of regular works.

8 OFFSITE IMPACTS

8.1.1 The proposed development will not have an impact on flooding issues off-site.

8.1.2 Surface water run-off will be managed within the confines of the site utilising sustainable methods and techniques, whilst flows being discharged to the public surface water sewer upon leaving the site will be done so at a controlled rate of 2.5l/s to reduce the impacts offsite.

8.1.3 Post development foul water flows have been assessed and are likely to amount to 0.42l/s. Southern Water are to confirm whether sufficient capacity is available in order to support the development in view of the proposed connection and strategy as confirmed in **4.3 – Foul Water Drainage.**

8.1.4 The effects of climate change should be 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 totals 0.48Ha in size and is located to the rear of The Inglenook Hotel and Restaurant to the west of Pagham Road, Bognor Regis, and is approximately 5.68km west of the centre of Bognor Regis in a sub-urban/semi-rural residential area.

9.1.3 The development lies within Flood Zone 1 and it is expected to remain unchanged for the duration of the development's life expectancy.

9.1.4 Post-development, the site will have an impermeable area in the region of 0.29Ha – increasing from 0.03Ha in its current use – an increase of 0.26Ha.

9.1.5 The existing run-off from the site is believed to follow existing overland flow routes and discharge to the ground via infiltration - although this is understood to be at a negligible.

9.1.6 Post-development surface water run-off will be managed through sustainable means; tanked permeable paving with a controlled discharge to the public surface water sewer of 2.5l/s.

9.1.7 The wastewater from the proposed development will outfall to the existing 150mm dia. public foul water sewer flowing in a southerly direction, located in Pagham Road to the east of the site, subject to confirmation of available capacity.

9.1.8 A secondary drainage strategy (SK301) has been prepared which demonstrates that pumped solutions for both foul and surface water can also be implemented should the gravity-based solutions be deemed unsuitable in the event that FFLs are restricted by the Local Planning Authority (LPA). The pumped solutions will require FFLs to be set 300mm above the existing ground profile.

9.1.9 Following completion of the development the flood risk both on and off the site will remain unchanged.

9.1.10 The nature of the development does not permit the sequential test to be applied but this FRA shows that the elements of the Exception test can be passed.

9.1.11 In conclusion, from a flood risk point of view the proposed development is suitable.

DRAWINGS

ARUN DISTRICT COUNCIL P/58/19/PL

ARUN DISTRICT COUNCIL P/58/19/PL

NOTES

A3

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Rev.	Date	Amendments	Drawn
-	22/03/2018	Original Issue	SPB

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Client
ADM Architects

Project
Land at The Inglenook, Pagham, Bognor Regis PO21 3QB

Drawing Title
Site Location Plan

Scale	Drawn By	Checked By	Approved By
1:750	SPB	MJA	MJA

Date	Drawing No.	Rev.
March 2018	2018-D1456-SK100	-

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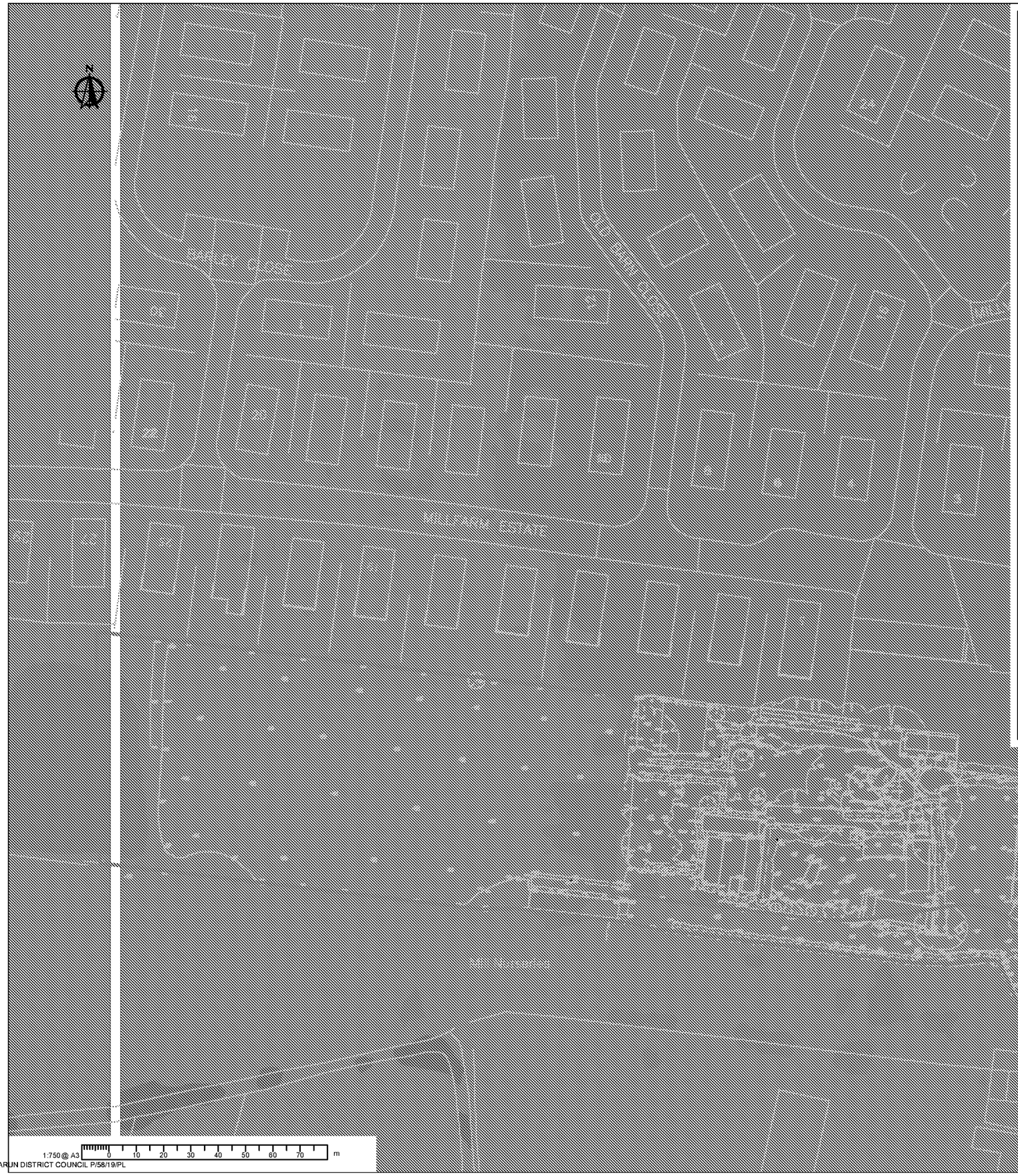
Drawing Title
LiDAR Contours

Scale	Drawn By	Checked By	Approved By
1:750	SPB	MJA	MJA

Date	Drawing No.	Rev.
March 2018	2018-D1456-SK101	-



SURFACE LEVEL DATA

NUMBER	MINIMUM LEVEL	MAXIMUM LEVEL	COLOUR
1	0.00	0.50	
2	0.50	1.00	
3	1.00	1.50	
4	1.50	2.00	
5	2.00	2.50	
6	2.50	3.00	
7	3.00	3.50	
8	3.50	4.00	
9	4.00	4.50	
10	4.50	5.00	
11	5.00	5.50	
12	5.50	6.00	
13	6.00	6.50	
14	6.50	7.00	
15	7.00	7.50	
16	7.50	8.00	
17	8.00	8.50	
18	8.50	9.00	
19	9.00	9.50	
20	9.50	10.00	
21	10.00	10.50	

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Land at The Inglenook,
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Drawing Title
LiDAR Banding

Scale	Drawn By	Checked By	Approved By
1:750	SPB	MJA	MJA

Date	Drawing No.	Rev.
March 2018	2018-D1456-SK102	-

-KEY-

Site Boundary (4,813m^2 - 0.48Ha)

Existing Impermeable Area (328m^2 - 0.03Ha)

Proposed Impermeable Area (2,870m^2 - 0.29Ha)

N

Mill Nurseries

PAGHAM ROAD

07 05 08 06 09 04 03 02 01

1:750 @ A3 0 10 20 30 40 50 60 70 m

ARUN DISTRICT COUNCIL P/58/19/PL

NOTES

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Client: ADM Architects

Project: Land at The Inglenook, Pagham, Bognor Regis PO21 3QB

Drawing Title: Impermeable Areas Comparison

Scale	Drawn By	Checked By	Approved By
1:750	SPB	MJA	MJA

Date	Drawing No.	Rev.
March 2018	2018-D1456-SK200	-

-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)

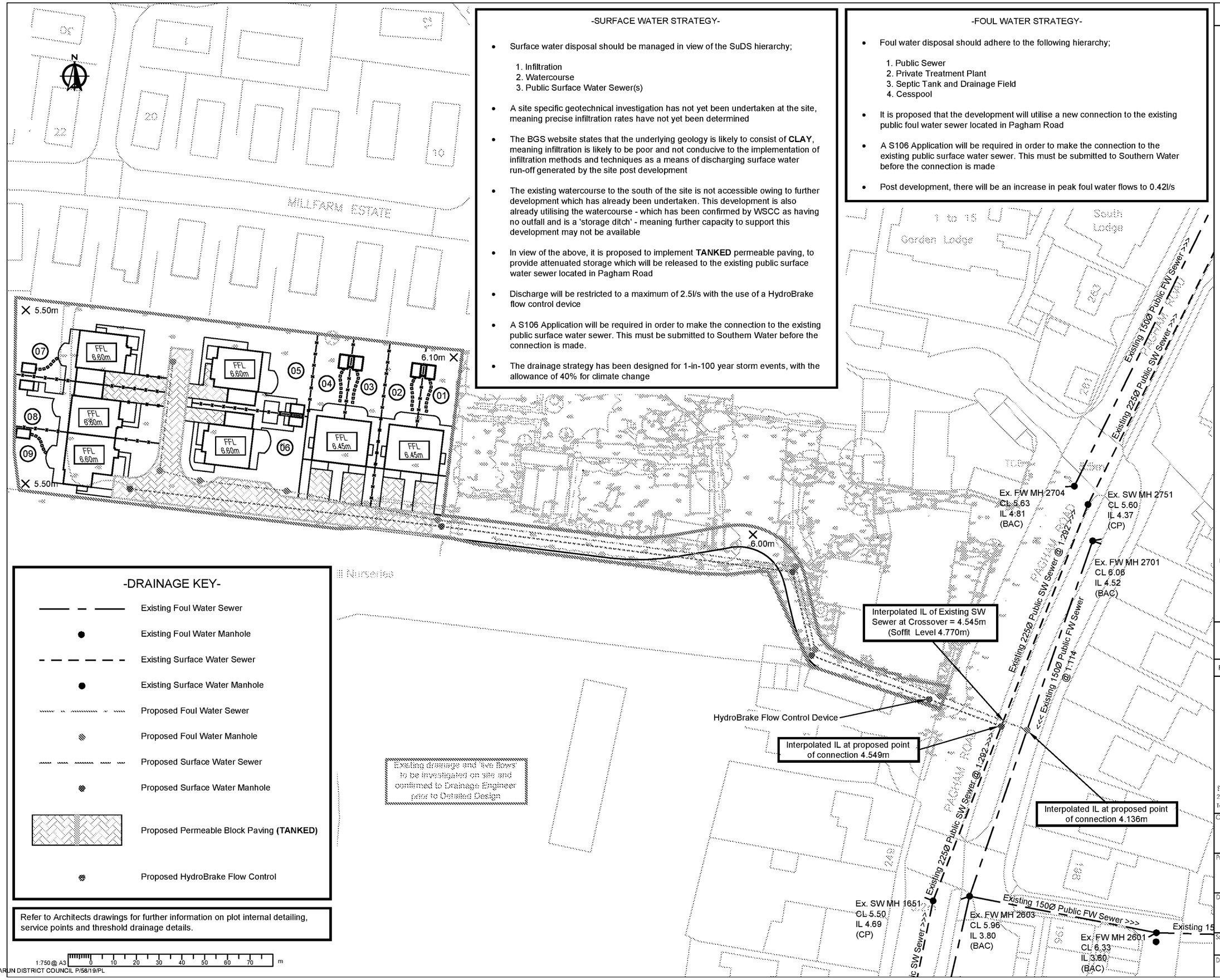
- A site specific geotechnical investigation has not yet been undertaken at the site, meaning precise infiltration rates have not yet been determined
- The BGS website states that the underlying geology is likely to consist of **CLAY**, meaning infiltration is likely to be poor and not conducive to the implementation of infiltration methods and techniques as a means of discharging surface water run-off generated by the site post development
- The existing watercourse to the south of the site is not accessible owing to further development which has already been undertaken. This development is also already utilising the watercourse - which has been confirmed by WSCC as having no outfall and is a 'storage ditch' - meaning further capacity to support this development may not be available
- In view of the above, it is proposed to implement **TANKED** permeable paving, to provide attenuated storage which will be released to the existing public surface water sewer located in Pagham Road
- Discharge will be restricted to a maximum of 2.5l/s with the use of a HydroBrake flow control device
- A S106 Application will be required in order to make the connection to the existing public surface water sewer. This must be submitted to Southern Water before the connection is made.
- The drainage strategy has been designed for 1-in-100 year storm events, with the 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 the development will utilise a new connection to the existing public foul water sewer located in Pagham Road
- A S106 Application will be required in order to make the connection to the existing public surface water sewer. This must be submitted to Southern Water before the connection is made
- Post development, there will be an increase in peak foul water flows to 0.42l/s



-DRAINAGE KEY-

- Existing Foul Water Sewer
- Existing Foul Water Manhole
- Existing Surface Water Sewer
- Existing Surface Water Manhole
- Proposed Foul Water Sewer
- Proposed Foul Water Manhole
- Proposed Surface Water Sewer
- Proposed Surface Water Manhole
- Proposed Permeable Block Paving **(TANKED)**
- Proposed HydroBrake Flow Control

Refer to Architects drawings for further information on plot internal detailing, service points and threshold drainage details.

1:750 @ A3 0 10 20 30 40 50 60 70 m

ARUN DISTRICT COUNCIL P/58/19/PL

NOTES

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Client: ADM Architects

Project: Land at The Inglenook, Pagham, Bognor Regis PO21 3QB

Drawing Title: Proposed Drainage Strategy

Scale	Drawn By	Checked By	Approved By
1:750	SPB	MJA	MJA

Date	Drawing No.	Rev.
March 2018	2018-D1456-SK300	-

-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)

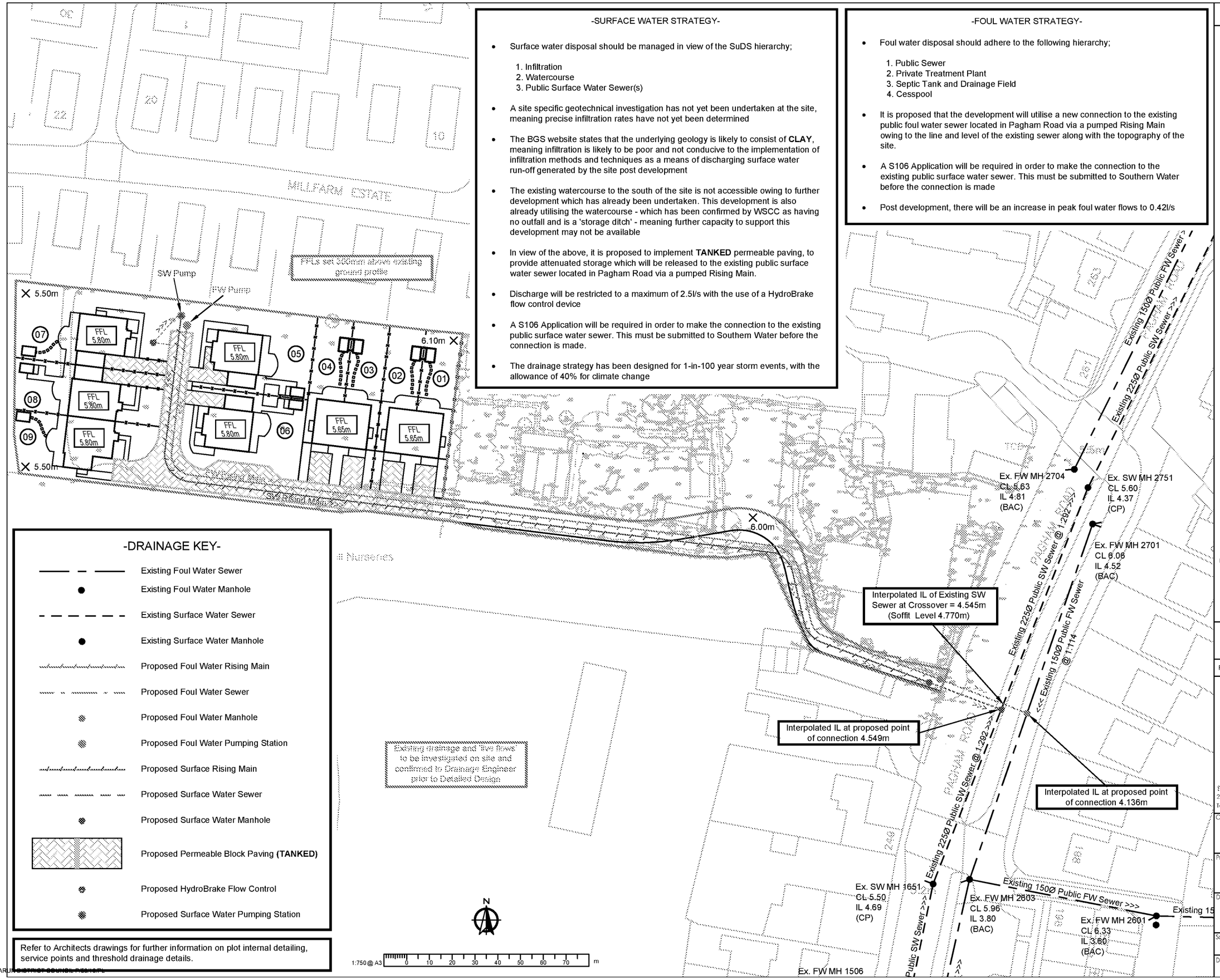
- A site specific geotechnical investigation has not yet been undertaken at the site, meaning precise infiltration rates have not yet been determined
- The BGS website states that the underlying geology is likely to consist of **CLAY**, meaning infiltration is likely to be poor and not conducive to the implementation of infiltration methods and techniques as a means of discharging surface water run-off generated by the site post development
- The existing watercourse to the south of the site is not accessible owing to further development which has already been undertaken. This development is also already utilising the watercourse - which has been confirmed by WSCC as having no outfall and is a 'storage ditch' - meaning further capacity to support this development may not be available
- In view of the above, it is proposed to implement **TANKED** permeable paving, to provide attenuated storage which will be released to the existing public surface water sewer located in Pagham Road via a pumped Rising Main.
- Discharge will be restricted to a maximum of 2.5l/s with the use of a HydroBrake flow control device
- A S106 Application will be required in order to make the connection to the existing public surface water sewer. This must be submitted to Southern Water before the connection is made.
- The drainage strategy has been designed for 1-in-100 year storm events, with the 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 the development will utilise a new connection to the existing public foul water sewer located in Pagham Road via a pumped Rising Main owing to the line and level of the existing sewer along with the topography of the site.
- A S106 Application will be required in order to make the connection to the existing public surface water sewer. This must be submitted to Southern Water before the connection is made
- Post development, there will be an increase in peak foul water flows to 0.42l/s



-DRAINAGE KEY-

- Existing Foul Water Sewer
- Existing Foul Water Manhole
- Existing Surface Water Sewer
- Existing Surface Water Manhole
- Proposed Foul Water Rising Main
- Proposed Foul Water Sewer
- Proposed Foul Water Manhole
- Proposed Foul Water Pumping Station
- Proposed Surface Rising Main
- Proposed Surface Water Sewer
- Proposed Surface Water Manhole
- Proposed Permeable Block Paving **(TANKED)**
- Proposed HydroBrake Flow Control
- Proposed Surface Water Pumping Station

Refer to Architects drawings for further information on plot internal detailing, service points and threshold drainage details.

1:750 @ A3 0 10 20 30 40 50 60 70 m

ARUN DISTRICT COUNCIL PLANNING

NOTES

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Client
ADM Architects

Project
Land at The Inglenook, Pagham, Bognor Regis PO21 3QB

Drawing Title
Proposed Drainage Strategy Option B

Scale	Drawn By	Checked By	Approved By
1:750	SPB	MJA	MJA

Date	Drawing No.	Rev.
May 2018	2018-D1456-SK301	-

APPENDICIES

ARUN DISTRICT COUNCIL P/58/19/PL

Appendix A Architects Layout GA

ARUN DISTRICT COUNCIL P/58/19/PL

Unit 1
Unit 2
Unit 3
Unit 4
Unit 5
Unit 6
Unit 7
Unit 8
Unit 9
POS = 0.0184Ha
RAISED TABLE TOP TURNING HEAD
4.2m WIDE PINCH POINT
parking court
TPO 28
ash
beech
beech
approximate bank position
approximate bank position
drainage pipe
wooden picket fence
post and rail fence (as seen)
private property
ridge 9.81 eaves 8.82
ridge 10.09 eaves 8.99
ridge 10.02 eaves 9.10
roof 9.58
gfw c7.61 h8.63
gfw c7.51 h8.62
gfw h8.69
ridge 10.16 eaves 9.05
ridge 10.16 eaves 9.06
gfw h8.79
ridge 10.14 eaves 9.04
ridge 10.16 eaves 9.05
gfw c7.51 h8.48
ridge 10.14 eaves 9.01
gfw h8.59
ridge 10.34 eaves 9.20
gfw c7.67 h8.65
ridge 10.31 eaves 9.24
gfw c7.68 h8.66
ridge 10.17 eaves 9.35
gfw c7.81 h8.77
brick building ridge level 11.33 eaves level 9.36
98750N 98750N
98700N 98700N
ST118
ST119
ST120
ST121
ST122
ST123
ST124
ST125
ST126
DL
E
F
DLE
C
vp
bcp
plane
fir
fruit
ash
beech
ORIGINAL SIZE OF THIS DRAWING IS A1

NOTES: 1. DO NOT SCALE FROM THIS DRAWING (EXCEPT FOR PLANNING APPLICATION PURPOSES). 2. ALL DIMENSIONS AND LEVELS TO BE CHECKED ON SITE BEFORE CARRYING OUT WORK. 3. ALL DISCREPANCIES TO BE REPORTED TO THE ARCHITECT BEFORE CARRYING OUT WORK. 4. READ WITH OTHER CONTRACT DOCUMENTS & IF IN DOUBT ASK.

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REV.	DATE	REVISIONS

E-mail michael@admarchitects.co.uk
web site www.admarchitects.co.uk

PROJECT: Inglenook			CLIENT: Inglenook		
DRAWING TITLE: Site Plan - Topological Survey			COMPUTER FILE NAME: DWG.DWG		
			ORIGINAL SIZE OF THIS DRAWING IS A1		
			DRAWING NUMBER		
DRAWN	CHECKED	DATE	SCALE – AS SCALE RODS	PROJECT NUMBER	ACTUAL DRAWING NUMBER	REVISION
DCH	MB	Nov '17	1:200	1594	05	-

TRINITY, STRETTINGTON, CHICHESTER, WEST SUSSEX, PO18 0LA, UNITED KINGDOM. TEL. 01243 771166

ARCHITECTS DESIGN & MANAGEMENT

ARUN DISTRICT

Appendix B Public Sewer Maps

ARUN DISTRICT COUNCIL P/58/19/PL

SEWER RECORDS PAGE 1 OF 2

98859

98570

488875

489346

O.S. REF. SZ8998NW	Drawn by: kumaria	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 determnined on site. WARNING: BAC pipes are constructed of Bonded Asbestos Cement WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement
	Scale: 1:1250	
Title: 283549_Land at The Inglenook,	Date: 05/03/2018	Based upon Ordnance Survey Digital Data with the permission of the controller of H.M.S.O. Crown Copyright Reserved Licence No. WU 298530.

N

Southern Water

ARUN DISTRICT COUNCIL P/58/19/PL

SEWER RECORDS PAGE 2 OF 2

Node	Cover	Invert	Size	Material	Shape	Node	Cover	Invert	Size	Material	Shape	Node	Cover	Invert	Size	Material	Shape	Node	Cover	Invert	Size	Material	Shape
1504X			UNK	VC	CIRC																		
1505X			UNK	VC	CIRC																		
1552X	5.39	4.61	150	CP	CIRC																		
1651X	5.5	4.69	225	CP	CIRC																		
2501X	6.17	3.33	150	BAC	CIRC																		
2601X	6.33	3.6	150	BAC	CIRC																		
2602X	6.31	3.47	150	BAC	CIRC																		
2603X	5.96	3.8	150	BAC	CIRC																		
2701X	6.06	4.52	150	BAC	CIRC																		
2702X	6.23	4.99	150	VC	CIRC																		
2703X	5.84	4.42	150	BAC	CIRC																		
2704X	5.63	4.81	150	BAC	CIRC																		
2751X	5.6	4.37	225	CP	CIRC																		
2752X	5.86	4.44	300	CP	CIRC																		
2753X	6.19	5.31	150	CP	CIRC																		
2801X	6.1	4.19	150	BAC	CIRC																		
3504X	6.28	4.57	150	VC	CIRC																		
3701X	6.59	5.5	150	VC	CIRC																		
3751X	6.54	4.96	150	CP	CIRC																		
3851X	6.17	4.15	450	CP	CIRC																		

LINE STYLES / COLOURS

Brown	Foul
	Foul Syphon Sewer
	Foul Vacuum Main
	Foul Rising Main
Red	Combined
	Combined Syphon Sewer
	Combined Rising Main
	Lateral Drain
Orange	Building Over Agreement Area
Dark Blue	Treated Effluent
Purple	Sludge
	Sewer Catchment
	Section 104 Area
Light Blue	Surface Water
	Surface Water Rising Main
Yellow	Private
Green	Access Shaft
	Decommissioned

MATERIALS

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

LEGEND - SEWERS

- Manhole (SW)
- Manhole (F&C)
- Lamp hole (SW)
- Lamp hole (F&C)
- Pumping Station (SW)
- Pumping Station (F&C)
- Side entry manhole (SW)
- Side entry Manhole (F&C)
- Blind shaft (SW)
- Blind shaft (F&C)
- Ejector station (SW)
- Ejector station (F&C)
- Watertight door (SW)
- Watertight door (F&C)
- Flushing ch. Mn-e (SW)
- Flushing ch. Mn-e (F&C)
- Flushing ch. No-e (SW)
- Flushing ch. No-e (F&C)
- Demarcation Chamber
- Washout (SW)
- Washout (F&C)
- Rodding Eye (SW)
- Rodding Eye (F&C)
- Gauging point (SW)
- Gauging point (F&C)
- Intercept chamber (SW)
- Intercept chamber (F&C)
- Storm Tank (SW)
- Storm Tank (F&C)
- Vortex chamber (SW)
- Vortex chamber (F&C)
- Label ellipse
- Dummy/S24 manhole
- Outfall
- Penstock chamber
- Damboards
- Storm Overflow
- Backdrop manhole
- Other (s)
- Other
- Change in sewer (s)
- Change in sewer
- Raflux valve
- Flap valve
- Cascade
- Anode
- Valve
- Closed Valve
- Air Valve
- Hatch box (SW)
- Hatch box (F&C)
- Direction arrow
- Emptying valve
- Catchpit
- Soakaway
- Inlet
- Balancing Pond
- Wastewater treatment works
- Marine treatment works
- Outfall headworks
- Vent
- Vent column
- Tidal storage tank
- Blank end
- Head of Public Sewer
- Micro Pumping Station

SHAPES (S)

A	Arched	R	Rectangular
B	Barrel	S	Square
C	Circular	T	Trapezoidal
E	Egg	U	U Shape
H	Horseshoe	X	Other

NODE REFERENCING SYSTEM

- 1st digit: hundred metre easting identifier
- 2nd digit: hundred metre northing identifier
- sewer type identifier
- 3rd digit: 0-4 = Foul/Combined; 5-9 = Surface Water
- 4th digit: next sequential node

Drawn by:	kumaria
Title:	283549_Land at The Inglenook,
Date:	05/03/2018

Southern Water

Appendix C BGS Historic Borehole Records

ARUN DISTRICT COUNCIL P/58/19/PL

SZ 89 NE 4

338/19

19

PAGHAM.

SZ 8947 9962

TQ NE

Light Railway

Iron implements by Lake published, not found at mill
J.S.A.S. p. 72.

338/19. Pagham. Salty school. See W.S. Sx.A. p.72. We should be glad of any details, & deepening of shaft.

- No water, hole abandoned.

		Thickness (Feet)	Depth
Light Clay	Sandy gravel	5	5
	Gravel	10	15
	Hard blue clay, some white sandy	6	21
	Clay and stone mixed	5	32
	Clay mixed	14	46
	Blue clay and shells	11	57
	Gravel and blue clay	11	68
	Blue clay, not sandy	23	91
	Blue clay, some sandy	9	100
Under	Blue clay, not hard but sandy		
Clay 678	Hard rock & clay gravel	9	109
	Blue and brown clay	34	143
	Blue and brown clay,		
Light	very sandy	13	156
	Blue and brown clay,		
	still very sandy	11	167
	Black sandy clay	5	172
	Brown sandy clay	3	175 10
	Mottled red and brown clay		
	and sand	7	182 5½
Reading Beds 678	Grey clay	7	189
	Reddish clay	3	192
	Mottled clays	87	279
Upper Chalk	Chalk and flints (no water)	188	467

Well at 6" Farm [illegible] O.D. 10. Well at new Victory Inn, Bognor Rd. 30 ft.

Information from Mr. Goldsmith, Chemist, Bognor, May 1921. Other wells in Sussex Iron

ARUN DISTRICT COUNCIL P/58/19/PL

SZ89/2

338/19

PAGHAM.

TQ 89 NE

Duffer School

Bore records communicated by Mr. A. Mitchell, who sunk the well

W.S.Sx. I, p. 72.

338/19. Pagham, Duffer School. 89e N.E. No.1. p.72. We should be glad of any details, ? deepening of shaft.

From Publication 1891/2

- No western hole abandoned.

		Inches (Ft)	Depth
Drift 18ft.	Rainy gravel	5	5
	Shingle	10	15
	Hard blue clay and flint stones	6	21
	Light and Sharp sand	5	32
	Light sand	4	36
	Blue clay and shells	11	57
	Quicksand and blue clay	11	68
	Blue clay and sandy	23	91
	Blue clay, more sandy	9	100
London Clay 91ft.	Blue clay, with flints and fragments of clay mixed	9	109
	Blue and brownish clay	32	141
	Blue and brownish clay, more sandy	13	154
	Blue and brownish clay, still more sandy	11	165
	Black sandy clay	6	172
	Brown sandy clay	3	175
	Mottled red and brown clay	7	182
Bottom of Well 207ft.	Red clay	7	189
	Grey clay	3	192
	Mottled clays	87	279
Upper Chalk	Chalk with flints (as usual)	188	467

ARUN DISTRICT COUNCIL

332/19 The Village Hall, Pagham (formerly Sefton School). (Filled in)

R.S.Sx. 1, p. 72. Surface +18. Shaft. Ch +18). Bores fired. Yield small.
Combe, June 1890.

5289/2

Drift	Loamy gravel	8	8
18	Shrave	10	18
	Hard blue clay, more or less sandy	6	24
	Buff and brown sand ...	8	32
	Buff sand	14	46
	Blue clay and shells ...	11	57
	Brownish and blue clay ...	11	68
	Blue clay, not sandy ...	33	91
SC	Blue clay, more sandy ...	9	100
107	Blue clay, with portion and fragments of large oyster	9	109
	Blue and brownish clay ...	34	143
	Blue and brownish clay, more sandy	12	155
	Blue and brownish clay, still more sandy	11	167
	Black sandy loam ...	5	172
	Brown sandy loam ...	3	175
	Mottled red and brown clay and sand	7	182
RB	Grey loam	7	189
104	Blackish loam ...	3	192
	Shrafted clays ...	87	279
103	Chalk and flints (no water)	108	487
102			

SZ 99 NW 1/73

[redacted]

392

Pagham—Map N.S.C. xxx.

365. Halewick, a spring S.S.E. of village. 15ins. 8ft. above O.D. 50 ft. Map 24 N.W.

		Diameter	Depth
		Ft.	Ft.
Gravelly Clay	Blue clay	3	3
Sandstone	Quicksand	10	13
Rock ...	Rock	8	21
Upper Chalk	Chalk and flints	30	51

N.L.S. 35/5, shows. Lined with 44 in. tubbs to 13ft. 8 in., with 30 in. tubbs to 20ft. 9 in., with 24 in. tubbs to 30ft. 6 in., and with 24 in. perforated tubbs to 50ft. 6 in. Information from Messrs. Dobbs and Grimshaw, Ltd.

O.S. 6" 1913

392/1 All dimensions & depths are quoted from water level and not from ground level. Water level 32 ft 9 ins

Published in
'Wells & Springs
of Sussex'
Page 164
also W.S.Sx. II. p. 197

DATA Item

ARUN DISTRICT COUNCIL P/58/19/PL

S2991

Pagham—Map. S.S.G. 332.

345. Church Farm, a mile E.N.E. of village. 150ft. Ht above O.D. 50ft. Map 94 NW. 17 · 1 ·

					Thickness	Depth
					ft.	ft.
London Clay	Blue clay	...	...	...	95	95
Bracklesham	Mottled clay	...	...	...	135	230
Beds	Coated	...	...	...	98	328
	Upper Chalk	Chalk and flints	...	...	6	334
					200	600

S.S.W. 302 ft. down. Lined with 18 in. to 9 ft. 6 in. 300 ft., with 16 in. tubes to 308 ft., with 14 in. tubes to 340 ft., and with 12 in. perforated tubes to 600 ft. down. Information from Messrs. Cotton and Colcombe, Ltd.

Coal ground Water (well at 58 ord.) Known - encountered 6" Brown F.S.M. 63 ft Blue Clay Mottled Sand 194 ft.

334/8 old Longpond Cottages new pound house well not known and unable to trace in the ground at present Visited 22.10.57 DLH

Published in
'Wells & Springs
of Sussex'
Page 164
Also W.S Ex. II. p 197

DATA Bank

ARUN DISTRICT COUNCIL P/58/19/PL

SZ9053 9824 S299/1

332/8 Formerly Goastguard Station, Aldwick, Bognor Regis. (1 filled in)

O.S.No. XII. N. SW. Surface +15. Casing tubes: 180 x 4ft to From surface, X 2 to to 308 down; + 2ft to to 388 down; X 1ft to to 458 down (perforated). Dk +192. R.W.L. +14. Bonds, 1909.

LC	...	...	...	550	110
BB	...	...	...	900	310
LCS	...	...	...	990	400

Kimmeridge Blue clay		110	110
Purbeck	Mottled clay	94	204
Beds	Sand	6	210
Upper chalk - Chalk & flints		190	400

ARUN DISTRICT COUNCIL P/58/19/PL

Appendix D Arun District Council/West Sussex County Council Correspondence

ARUN DISTRICT COUNCIL P/58/19/PL

From: Paul Cann [mailto:Paul.Cann@arun.gov.uk]
Sent: 02 March 2018 11:35
To: Stuart Burnett <s.burnett@rgpdesign.co.uk>; Kevin Macknay <kevin.macknay@westsussex.gov.uk>
Subject: RE: D1456 Land at The Inglenook, Pagham, Bognor Regis PO21 3QB

Hi Stuart

I have enclosed our land drainage records fyi. It doesn't tell you a lot, but it is worth looking at the recent development drainage proposals immediately south of your site, whereby they needed a discharge to a watercourse in order to achieve a satisfactory design. I am sure they did an FRA too.

I also enclose our standard surface water drainage supplementary guidance notes.

The most recent SFRA (2016) is on our website.

Not aware of any planning drainage improvements in the area/or studies.

I am sure Kevin will add other comments/details.

Regards

Paul Cann
Senior Engineer (Drainage & Coastal)

Paul Cann | Senior Engineer (Drainage & Coastal), Engineering Services, Arun District Council | Location: First Floor, Arun Civic Centre, Maltravers Road, Littlehampton, BN17 5LF
Internal: 37819 | External: +44 (0) 1903 737819 | Fax: +44 (0) 1903 716019 | E-mail: Paul.Cann@arun.gov.uk
Arun is Working in Partnership with Chichester District Council
Visit Arun's web site at http://www.arun.gov.uk/ and www.chichester.gov.uk
Save the environment - think before you print.

From: Stuart Burne[redacted]
Sent: 01 March 20[redacted]
To: Paul Cann; Kev[redacted]
Subject: D1456 Land at The Inglenook, Pagham, Bognor Regis PO21 3QB

Afternoon Paul/Kevin,

Hope you're both well. We have been instructed to prepare a FRA and drainage strategy for the above site (location plan attached) and I would be grateful if you could provide any information you have which may assist. I have included our checklist of the usual items, below;

Flood Zones

- Please confirm the Flood Zones for this area.
- Please confirm surface water, reservoir flooding, sewer flooding. Please provide plans and depth data from your GIS UFMSW for 30yr, 100yr & 1000yr as applicable (OS Datum).
- Please confirm mapping and records for any surface water assets owned or maintained.
- Please confirm if there are any future drainage improvements proposed for this area.
- Please confirm details of existing or planned flood alleviation and defences in this area.
- Please confirm if you are aware of any historic flooding within the confines of the site.
- Please confirm if you are aware of any historic flooding in close vicinity and/or on the public highway.

Groundwater

- Please confirm details of any groundwater flooding issues in the area, including flood levels, flood extents and any available anecdotal information.

Assets

- Please confirm mapping and records for any surface water assets owned or maintained.
- Please confirm if there are any historic culverted watercourses within or in close vicinity to the site. Please provide map records where available.
- Please can you provide any map records denoting the highway drainage network. Is this a piped system or soakaways?

Policy/Future

- Please confirm the most recent Strategic Flood Risk Assessment (SFRA).
- Please confirm if there are any future drainage improvements proposed for this area.
- Please confirm if any drainage studies and/or SWMP have/are being assess for this area.

Thanks in advance for your help with this.

Kind regards

Stuart Burnett
Civil Engineering Technician
[redacted]

Arun District Council Maps

Mapping produced by Arun District Council

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Production Date: 02 March 2018

www.arun.gov.uk

[redacted]

Further to your recent enquiry. Please see below for replies to your questions:

Flood Zones

- Please confirm the Flood Zones for this area.
  The area of interest would appear to be outside of any EA flood zones, but you would need to check with the EA.

- Please confirm surface water, reservoir flooding, sewer flooding. Please provide plans and depth data from your GIS UFMSW for 30yr, 100yr & 1000yr as applicable (OS Datum).
  The area of interest is currently outside of any mapped surface water flood risk.

- Please confirm mapping and records for any surface water assets owned or maintained.
  See attached plan showing existing WSCC highway gullies in the area. Unfortunately, we do not have records that show our below ground network for this area.

- Please confirm if there are any future drainage improvements proposed for this area.
  We are not aware of any future drainage improvements proposed for this area.

- Please confirm details of existing or planned flood alleviation and defences in this area.
  We are not aware of any current or future flood alleviation and defences in this area.

- Please confirm if you are aware of any historic flooding within the confines of the site.
  We are not aware of any historic flooding within the confines of the site. That's not to say that flooding has never occurred, just that it has not been recorded to us as LLFA.

- Please confirm if you are aware of any historic flooding in close vicinity and/or on the public highway.
  We are not aware of any historic flooding in close vicinity and/or on the public highway. That's not to say that flooding has never occurred, just that it has not been recorded to us as LLFA.

Groundwater

- Please confirm details of any groundwater flooding issues in the area, including flood levels, flood extents and any available anecdotal information.
  Groundwater levels are shown to be between 0.025m and 0.5m below ground, based on current JBA groundwater mapping.

Assets

- Please confirm mapping and records for any surface water assets owned or maintained.
  As above.

- Please confirm if there are any historic culverted watercourses within or in close vicinity to the site. Please provide map records where available.
  See attached plan. This historic OS mapping shows that the site may once have been crossed by an open ditch which drained into a pond adjacent to the site.

- Please can you provide any map records denoting the highway drainage network. Is this a piped system or soakaways?
  As above.

Policy/Future

- Please confirm the most recent Strategic Flood Risk Assessment (SFRA).
  WSCC SFRA – June 2010

- Please confirm if there are any future drainage improvements proposed for this area.
  We are not aware of any future drainage improvements proposed for this area.

- Please confirm if any drainage studies and/or SWMP have/are being assess for this area.
  None current or planned.

Regards,

Kevin

[redacted]

Report a problem with a road or pavement or raise a highways related enquiry

Follow us at @WSHighways

From: Stuart Burnett [mailto:s.burnett@rgpdesign.co.uk]
Sent: 01 March 2018 16:43
To: Paul Cann; Kevin Macknay
Subject: D1456 Land at The Inglenook, Pagham, Bognor Regis PO21 3QB

Afternoon Paul/Kevin,

Hope you're both well. We have been instructed to prepare a FRA and drainage strategy for the above site (location plan attached) and I would be grateful if you could provide any information you have which may assist. I have included our checklist of the usual items, below;

Flood Zones

- Please confirm the Flood Zones for this area.
- Please confirm surface water, reservoir flooding, sewer flooding. Please provide plans and depth data from your GIS UFMSW for 30yr, 100yr & 1000yr as applicable (OS Datum).
- Please confirm mapping and records for any surface water assets owned or maintained.
- Please confirm if there are any future drainage improvements proposed for this area.
- Please confirm details of existing or planned flood alleviation and defences in this area.
- Please confirm if you are aware of any historic flooding within the confines of the site.
- Please confirm if you are aware of any historic flooding in close vicinity and/or on the public highway.

Groundwater

- Please confirm details of any groundwater flooding issues in the area, including flood levels, flood extents and any available anecdotal information.

Assets

- Please confirm mapping and records for any surface water assets owned or maintained.
- Please confirm if there are any historic culverted watercourses within or in close vicinity to the site. Please provide map records where available.
- Please can you provide any map records denoting the highway drainage network. Is this a piped system or soakaways?

Policy/Future

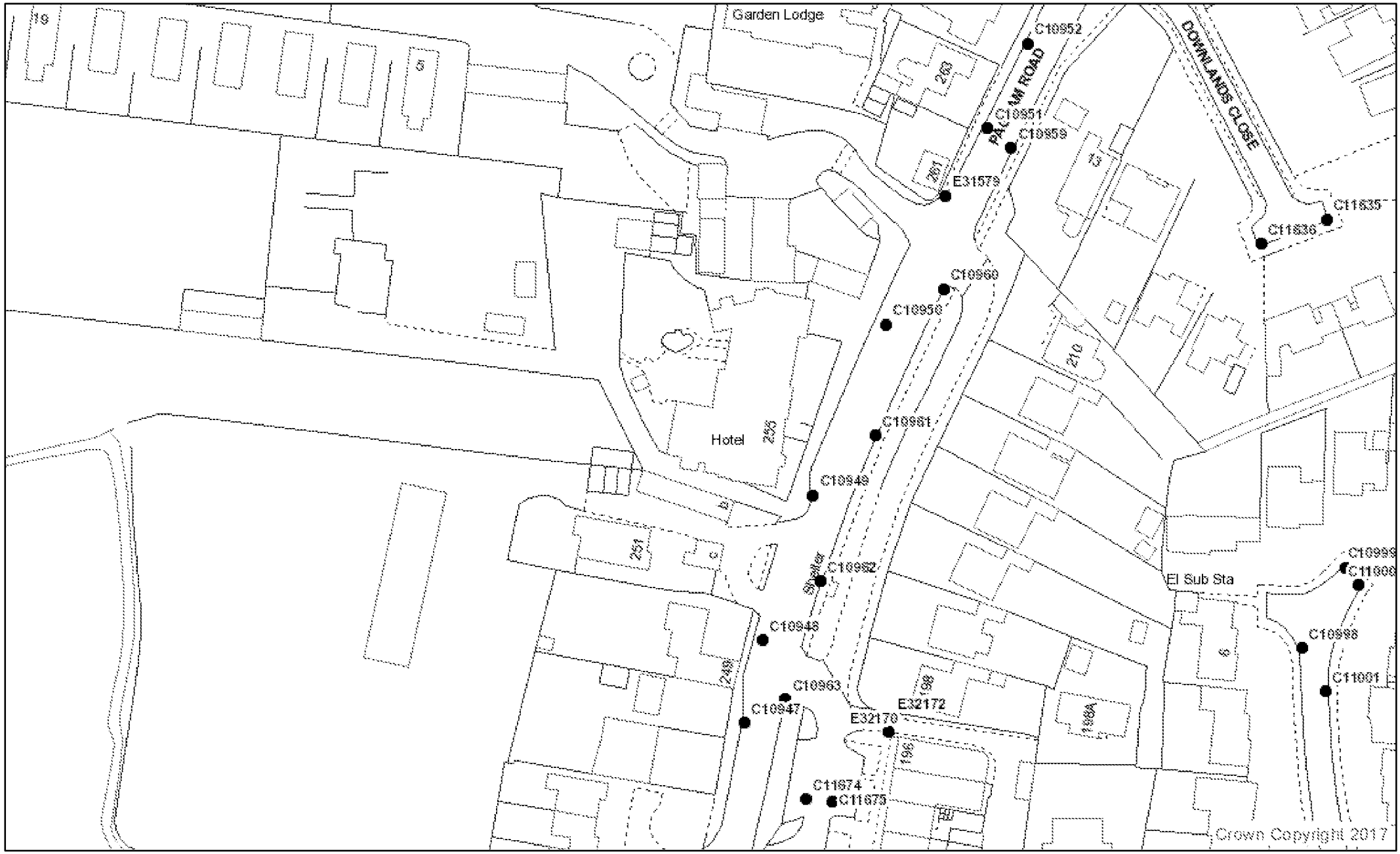
- Please confirm the most recent Strategic Flood Risk Assessment (SFRA).
- Please confirm if there are any future drainage improvements proposed for this area.
- Please confirm if any drainage studies and/or SWMP have/are being assess for this area.

Thanks in advance for your help with this.

Kind regards

Stuart Burnett
Civil Engineering Technician
[redacted]

Pagham Road, Pagham



Date: March 2018
Author: K Macknay
Scale 1:1,024

Map Notes:

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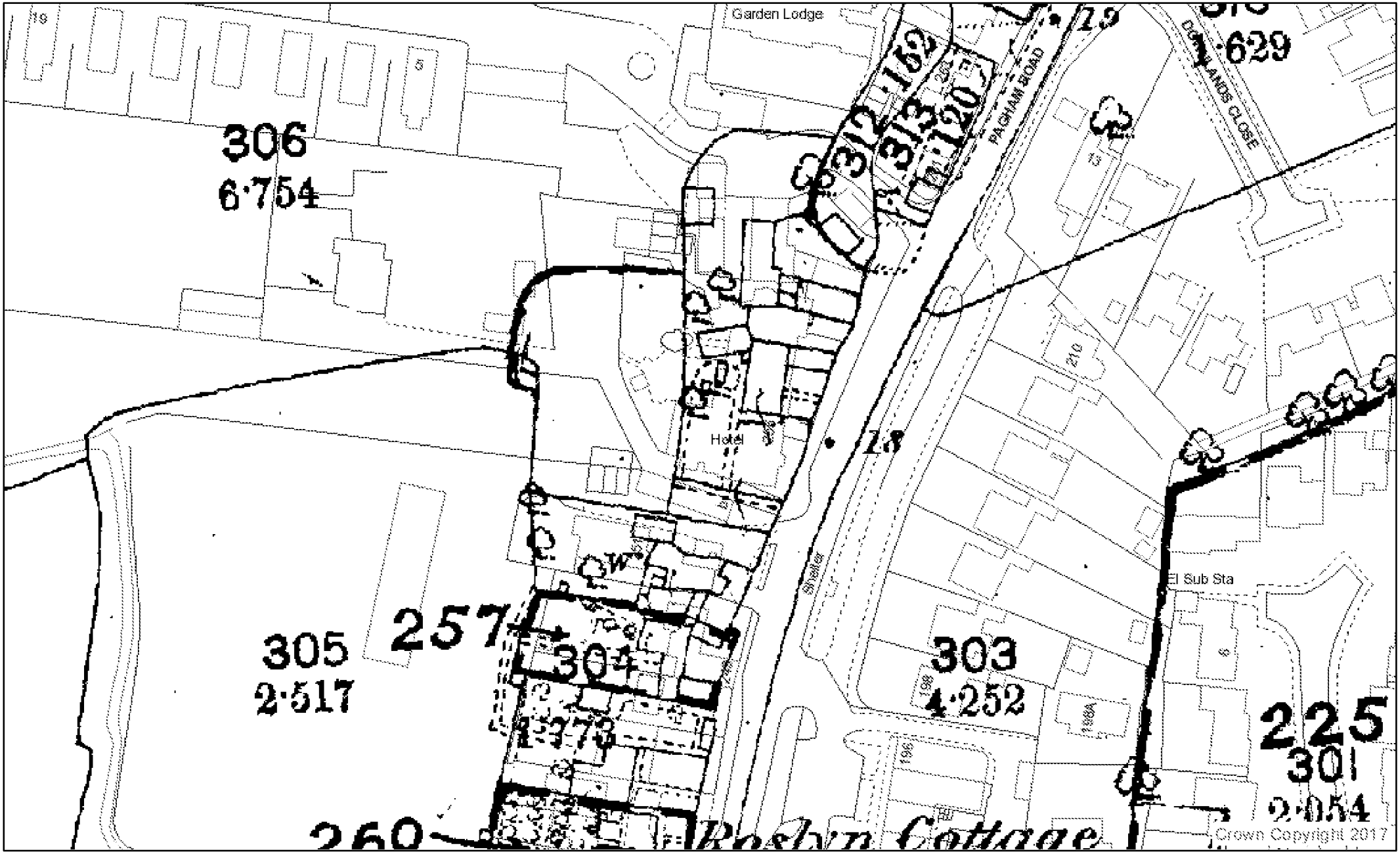
100023447 (2017)

ARUN DISTRICT COUNCIL PD/10/PL

Pagham Road, Pagham. Historic OS Mapping 1863



Date: March 2018
Author: K Macknay
Scale 1:1,024
Map Notes:

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ARUN DISTRICT COUNCIL LICENCE No. 100018926

Appendix E Microdrainage/Run-off Calculations

ARUN DISTRICT COUNCIL P/58/19/PL

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	0.480	Urban	0.000
SAAR (mm)	712	Region Number	Region 7

Results l/s

QBAR Rural	1.7
QBAR Urban	1.7
Q100 years	5.3
Q1 year	1.4
Q30 years	3.8
Q100 years	5.3

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Greenfield Runoff Volume

FSR Data

Return Period (years)	100
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	19.000
Ratio R	0.350
Areal Reduction Factor	1.00
Area (ha)	0.480
SAAR (mm)	712
CWI	106.548
Urban	0.000
SPR	37.000

Results

Percentage Runoff (%)	36.43
Greenfield Runoff Volume (m^3)	110.214

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RGP Design Limited		Page 1
Metro House Northgate Chichester PO19 1BE		
Date 23/03/2018 10:54 File D1456 CALCS WIP.MDX	Designed by m.akmenkalns Checked by	
XP Solutions	Network 2017.1.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.500
Maximum Rainfall (mm/hr)	0	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.350
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	1.000	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.055	4-8	0.195	8-12	0.040

Total Area Contributing (ha) = 0.290

Total Pipe Volume (m^3) = 13.941

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	68.894	0.230	299.5	0.210	5.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	77.761	0.280	277.7	0.020	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	18.854	0.070	269.3	0.020	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	27.488	0.095	289.3	0.020	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	16.937	0.060	282.3	0.020	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	0.00	6.27	5.219	0.210	0.0	0.0	0.0	0.90	63.8	0.0
1.001	0.00	7.65	4.347	0.230	0.0	0.0	0.0	0.94	66.3	0.0
1.002	0.00	7.98	4.567	0.250	0.0	0.0	0.0	0.95	67.4	0.0
1.003	0.00	8.48	4.497	0.270	0.0	0.0	0.0	0.92	65.0	0.0
1.004	0.00	8.96	4.402	0.290	0.0	0.0	0.0	0.59	10.5	0.0

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	6.000	0.781	Open Manhole	480	1.000	5.219	300				
2	6.000	1.153	Open Manhole	480	1.001	4.847	300	1.000	4.989	300	142
3	6.000	1.433	Open Manhole	480	1.002	4.567	300	1.001	4.567	300	
4	6.000	1.503	Open Manhole	480	1.003	4.497	300	1.002	4.497	300	
5	6.000	1.598	Open Manhole	480	1.004	4.402	150	1.003	4.402	300	
	5.650	1.308	Open Manhole	0		OUTFALL		1.004	4.342	150	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	300	1	6.000	5.219	0.481	Open Manhole	480
1.001	o	300	2	6.000	4.847	0.853	Open Manhole	480
1.002	o	300	3	6.000	4.567	1.133	Open Manhole	480
1.003	o	300	4	6.000	4.497	1.203	Open Manhole	480
1.004	o	150	5	6.000	4.402	1.448	Open Manhole	480

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	68.894	299.5	2	6.000	4.989	0.711	Open Manhole	480
1.001	77.761	277.7	3	6.000	4.567	1.133	Open Manhole	480
1.002	18.854	269.3	4	6.000	4.497	1.203	Open Manhole	480
1.003	27.488	289.3	5	6.000	4.402	1.298	Open Manhole	480
1.004	16.937	282.3		5.650	4.342	1.158	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.004		5.650	4.342	4.549	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	1.000	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	1.000
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	15
Ratio R	0.350		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 5, DS/PN: 1.004, Volume (m³): 2.2

Unit Reference	MD-SHE-0067-2500-1600-2500
Design Head (m)	1.600
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	67
Invert Level (m)	4.402
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	2.5
Flush-Flo™	0.297	2.0
Kick-Flo®	0.601	1.6
Mean Flow over Head Range	-	1.9

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.6	1.200	2.2	3.000	3.3	7.000	5.0
0.200	1.9	1.400	2.3	3.500	3.6	7.500	5.1
0.300	2.0	1.600	2.5	4.000	3.8	8.000	5.3
0.400	1.9	1.800	2.6	4.500	4.0	8.500	5.4
0.500	1.8	2.000	2.8	5.000	4.2	9.000	5.6
0.600	1.6	2.200	2.9	5.500	4.4	9.500	5.7
0.800	1.8	2.400	3.0	6.000	4.6		
1.000	2.0	2.600	3.1	6.500	4.8		

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Storage Structures for Storm

Porous Car Park Manhole: 1, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	80.8
Max Percolation (l/s)	224.4	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.219	Membrane Depth (mm)	0

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	1	0.141	4.870	189.314	194.326
1.001	2	0.209	5.497	0.000	5.705
1.002	3	0.259	1.333	0.000	1.592
1.003	4	0.272	1.943	0.000	2.215
1.004	5	0.289	0.299	0.000	0.588
Total		1.170	13.941	189.314	204.426

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