LAND NORTH WEST OF GORING STATION

PROPOSED RESIDENTIAL DEVELOPMENT

Flood Risk Assessment and Drainage Strategy

Prepared on Behalf of

Persimmon Homes

D1586/FRA/1.3

July 2020

RGP Design Limited – Transport Planning and Infrastructure Design Consultants www.rgpdesign.co.uk
Unit 2, West Barn, Norton Lane, Chichester, West Sussex, PO20 3AF T: 01243 210418

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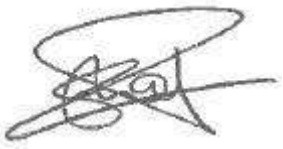
Author: **SPB**  **Date:** **30/07/2020**

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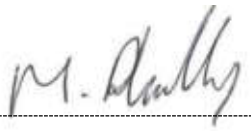
Approved by: **MJA**  **Date:** **30/07/2020**

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1.0	16/10/2019	Draft	SPB
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1.3	30/07/2020	FINAL	SPB

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1 INTRODUCTION

1.1 Background

1.1.1 RGP Design Ltd is instructed by Persimmon Homes to prepare a site-specific flood risk assessment (FRA) and supporting high-level drainage strategy to accompany the planning application for the proposed development at 'Land North West of Goring Station'.

1.1.2 The planning application will be an outline application, with all matters of detail reserved for determination at the Reserved Matters stage.

1.1.3 The proposals consist of a 'mixed use development comprising up to 475 dwellings along with associated access, internal roads and footpaths, car parking, public open space, landscaping, local centre (uses including A1, A2, A3, A4, A5, D1, D2, as proposed to be amended to use classes E, F and Sui Generis) with associated car parking, car parking for the adjacent railway station, undergrounding of overhead HV cables and other supporting infrastructure and utilities.'

1.1.4 The indicative masterplan, prepared by Thrive Architects, is included within **Appendix A** of this report.

1.1.5 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.

1.1.6 In preparing this report, RGP Design Ltd has referred to the following documents and information:

- Environment Agency (EA) Flood Maps for Planning
- Long Term Flood Risk Information; Flood Risk Maps
- Local Authority Strategic Flood Risk Assessments (SFRA)
- Southern Water and Local Authority Drainage Records
- British Geological Survey & Records

1.1.7 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.

1.1.8 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 19.96Ha in size and is located on the western side of Goring Street, opposite Goring by Sea railway station. The site is abutted by A259 (Littlehampton Road) to the north of the site, with an existing railway located adjacent to the southern boundary of the site.

1.2.2 The site is located in a built-up, residential area and is currently an undeveloped, greenfield location with no existing areas of impermeable surfacing.

1.2.3 A site-specific topographical survey has been undertaken by Sunshine Survey Ltd, dated April 2019. The survey demonstrates levels broadly ranging from 8.50m AOD to 5.00m AOD, with the land shown to be generally falling from the southern boundary, northwards toward Ferring Rife. The low point of the site is located to the north-west of the site, with the high point being located to the south-east of the site.

1.2.4 Ferring Rife (Main River) is shown to pass through the bounds of the site, flowing in an east-to-west direction.

1.3 Ground Conditions

1.3.1 A site-specific intrusive geotechnical investigation has been undertaken at the site by Soils Limited (Report Ref; 14131/GIR), dated January 2015. The investigation extended to include ground investigation confirming underlying geological conditions and composition, infiltration testing and groundwater monitoring.

1.3.2 22 No. trial pits were excavated across the site in order to provide 'adequate cover', and a fair indication as to the underlying geology and ground conditions.

1.3.3 TP1-8, TP10-15 and TP17-20 were all excavated to depths ranging from 1.00m to 3.00m.

1.3.4 The ground conditions encountered within the trial pits, as confirmed within Soils Limited's report (Table 2.2), are summarised, below;

Ground Conditions					
Strata	**Age**	**Depth Encountered (m bgl)**		**Typical Thickness**	**Typical Description**
		Top	**Bottom**		
Made Ground	Recent	Ground Level	0.40	0.40	Soft dark grey brown sandy CLAY with rootlets, rare brick fragments and occasional fine, sub-angular gravel.
Topsoil	Recent	Ground Level	0.30 – 0.40	0.40	Soft dark to light, brown, sandy CLAY with rootlets and occasional fine, angular to sub-angular gravel.
Alluvium	Recent	Not encountered during the investigation			
River Terrace Deposits	Quaternary	0.30 – 0.40	1.90 - >4.00*	>2.60*	Dark to light orange brown, clayey fine to medium SAND with rare rootlets and rare fine sub-angular to sub-rounded gravel. Or firm, dark to light, orangish brown sandy CLAY with

					occasional fine, sub-angular gravel.
White Chalk Subgroup	Cretaceous	1.90 – 3.50	>5.00*	Not Proven*	Pale off-white structureless CHALK. Recovered as comminuted matrix of sand sized intact chalk with occasional fine to coarse, sub-angular to angular gravel sized intact chalk and flint fragments.

*The base of the strata was not encountered in any of the sampler boreholes

1.3.5 Soils described as 'Made Ground' were encountered in one of the twenty-two trial pits, to a depth of up to 0.40m bgl (WS10).

1.3.6 Soils described as 'Topsoil' were encountered in twenty-one of the twenty-two trial pits, from depths of 0.30m to 0.40m bgl.

1.3.7 'River Terrace Deposits' were encountered within all trial pits, at depths ranging from 1.90m to 4.00m bgl.

1.3.8 Soils described as the 'White Chalk Subgroup' were encountered within eight of the twenty-two trial pits directly below the River Terrace Deposits and were identified to the full depth of the investigation (5.00m bgl).

1.3.9 Soakage testing was undertaken within trial pits TP3, TP4, TP7 and TP14, in accordance with BRE Digest 365.

1.3.10 A summary of the infiltration test results can be found within the table, below;

Summary of Infiltration Test Results				
Trial Pit	**Test Depth (m bgl)**	**Stratum**	**Indicative Infiltration Rate (m/sec)**	**Notes**
TP3	2.74	River Terrace Deposits – sandy CLAY	8.9×10^{-6}	Extrapolated 240 – 310 minutes
TP4	2.74	White Chalk Subgroup	N/A	Negligible infiltration after 180 minutes
TP7	2.97	White Chalk Subgroup	N/A	Negligible infiltration after 240 minutes, partial collapse after 90 minutes
TP14	2.98	River Terrace Deposits – sandy CLAY	N/A	Insufficient infiltration after 240 minutes

1.3.11 The Soils Limited report states that 'The results from the Infiltration Testing suggest that the majority of the site will exhibit low infiltration characteristics and alternative means of surface water disposal will be required'.

1.3.12 Following discussions with Worthing Borough Council's (WBC) Drainage Officer, shallow infiltration testing will be required to ascertain whether ground conditions at shallow depths will permit the use of infiltration methods and techniques – such as permeable paving. This will be required to support either a Full or Reserved Matters application.

1.3.13 Extracts from the Soils Limited report, including trial pit logs and information relating to the groundwater monitoring and infiltration testing undertaken, can be found within **Appendix I**.

1.3.14 Further to Soils Limited's intrusive on-site investigation, reference has also been made to the British Geological Survey (BGS) website to verify the findings of the Soils Limited report.

1.3.15 Bedrock geology is recorded by the BGS as being variable across the site, as confirmed by **Figure 1**. The central and south-eastern areas of the site are shown to consist of 'Lewes Nodular Chalk Formation', with the north-eastern corner of the site stated as consisting of 'Seaford Chalk Formation'. The areas to the west of the site are indicated as being 'Tarrant Chalk Member'.

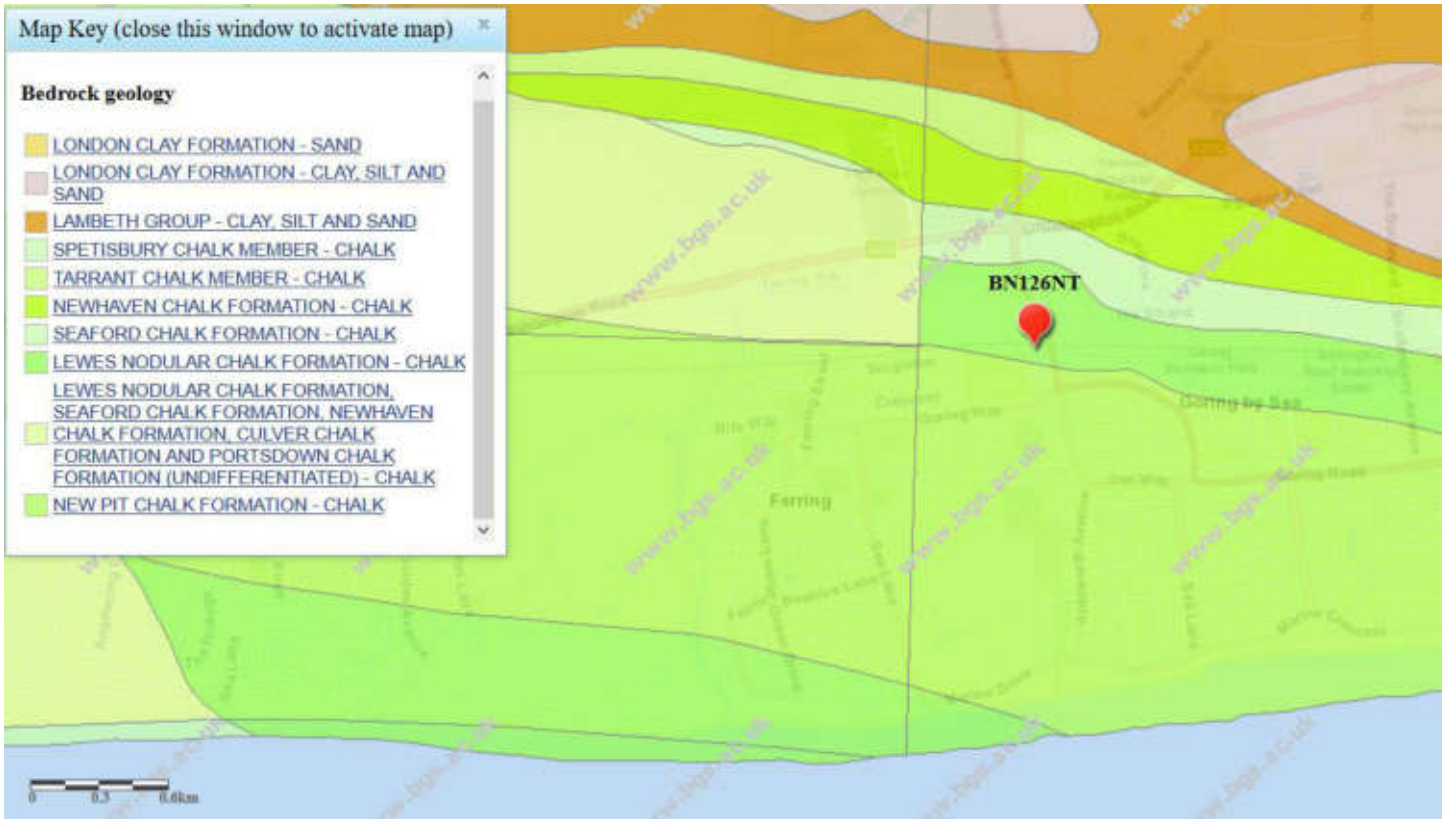


Figure 1. BGS Bedrock Geology Map

1.3.16 Superficial deposits are recorded as being variable; for the most part 'River Terrace Deposits (Undifferentiated) – Sand, Silt and Clay' and/or 'Storm Beach Deposits' are confirmed as being present, although the areas adjacent to Ferring Rife crossing the site are shown to consist of 'Alluvium – Clay, Silt, Sand and Peat/Gravel'.

Figure 2. BGS Superficial Deposits Geology Map

1.3.17 The BGS website holds information relating to the locations of historic boreholes within the local area. Reference has been made to these logs to qualify the findings of the Soils Limited report. The locations of the boreholes closest to the site are shown in **Figure 3.**

1.3.18 The nearest borehole in relation to the site **(TQ10SW135)** is located approximately 60m east of the eastern boundary **(E: 510480, N: 103330)** and has a recorded depth of 5.00m.

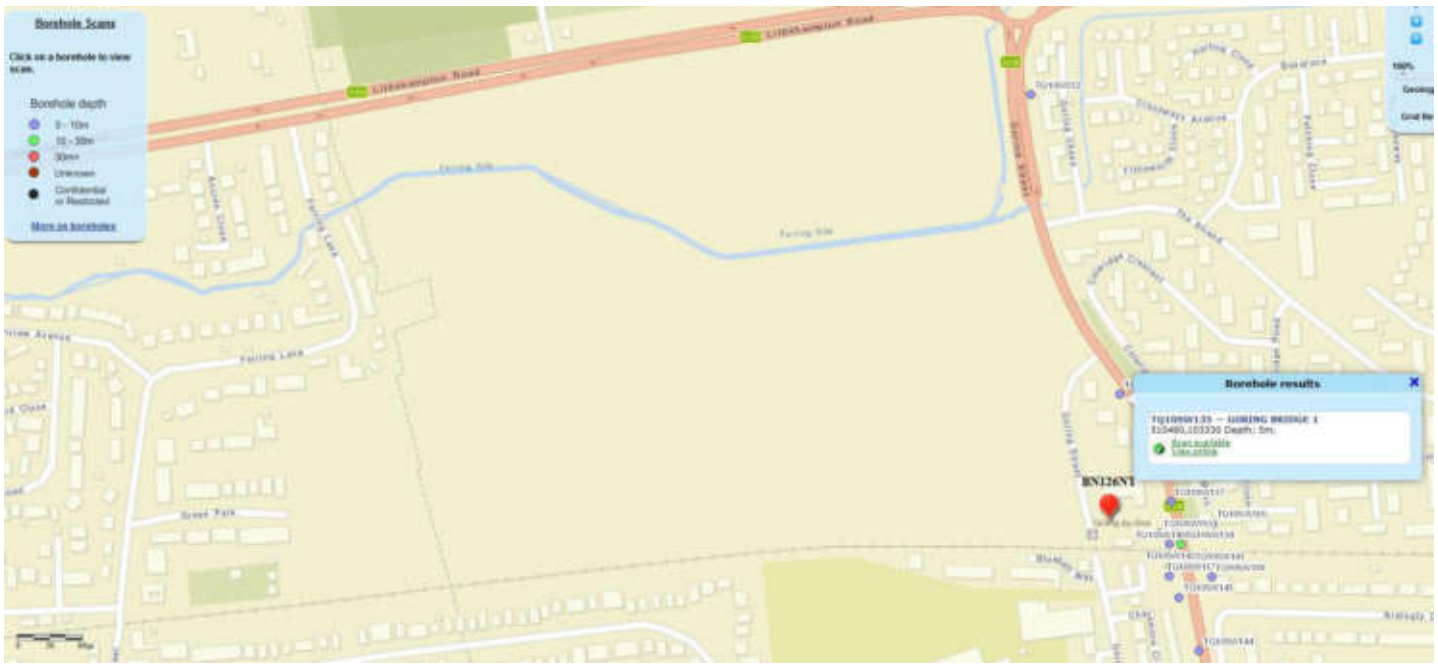


Figure 3. BGS Borehole Locations

1.3.19 The borehole log confirms that topsoil was encountered to depths of up to 200mm below ground level (bgl), after which 'Firm, Brown, Silty Clay' was recorded to depths up to 3.10m bgl. For the remainder of the borehole, 'Chalk – Grade II with Flints' was encountered.

1.3.20 In addition to the information and records available on the BGS website, an 'Infiltration SuDS GeoReport' has been obtained from the BGS in order to gain a further understanding as to the anticipated suitability of the subsurface for the inclusion of infiltration-based SuDS – this report was purchased by RGP Design Ltd prior to receipt of the site-specific Soils Limited geotechnical investigation report.

1.3.21 The Infiltration SuDS GeoReport provided by the BGS states that, in terms of the drainage potential at the site, there are 'Opportunities for bespoke infiltration SuDS', and that 'The subsurface is potential suitable although the design will be influenced by the ground conditions, as indicated below in **Figure 4**.

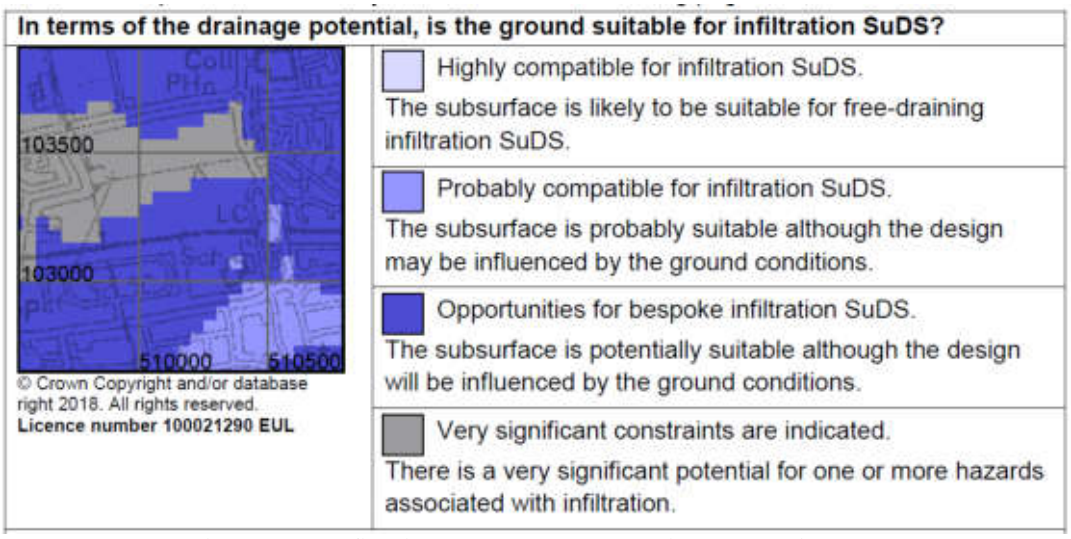


Figure 4. BGS Infiltration SuDS GeoReport – Drainage Potential Map

1.3.22 The Infiltration SuDS GeoReport states that the Superficial Deposits at the site are 'likely to permit moderate infiltration', as indicated below in **Figure 5**.

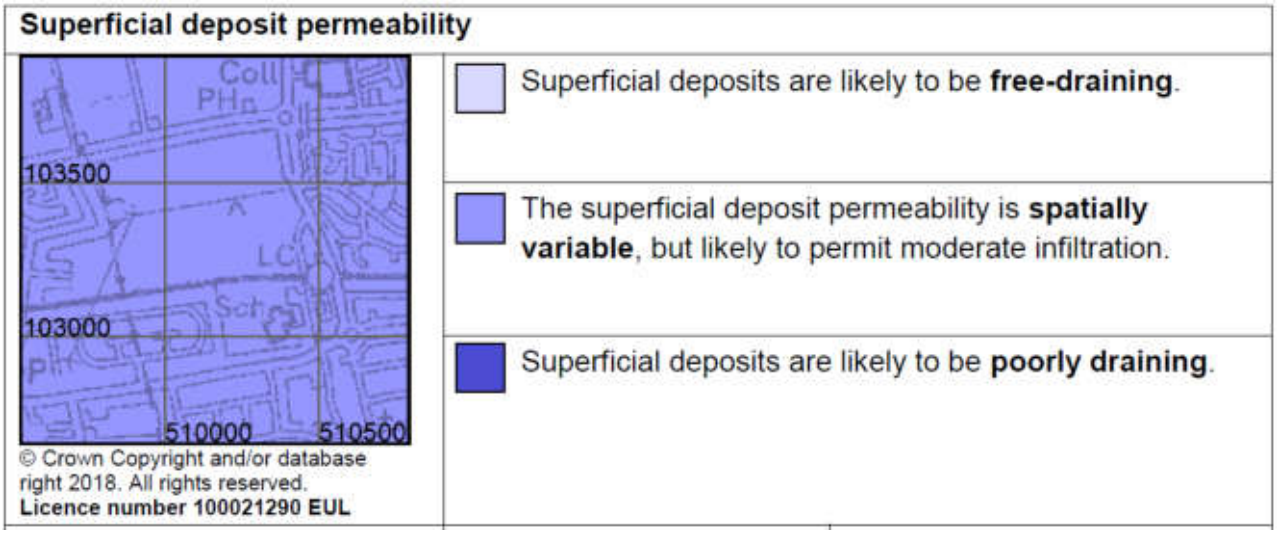


Figure 5. BGS Infiltration SuDS GeoReport – Superficial Deposits Permeability Map

1.3.23 The Infiltration SuDS GeoReport states that the Bedrock at the site is 'likely to be free-draining', as indicated below in **Figure 6**.

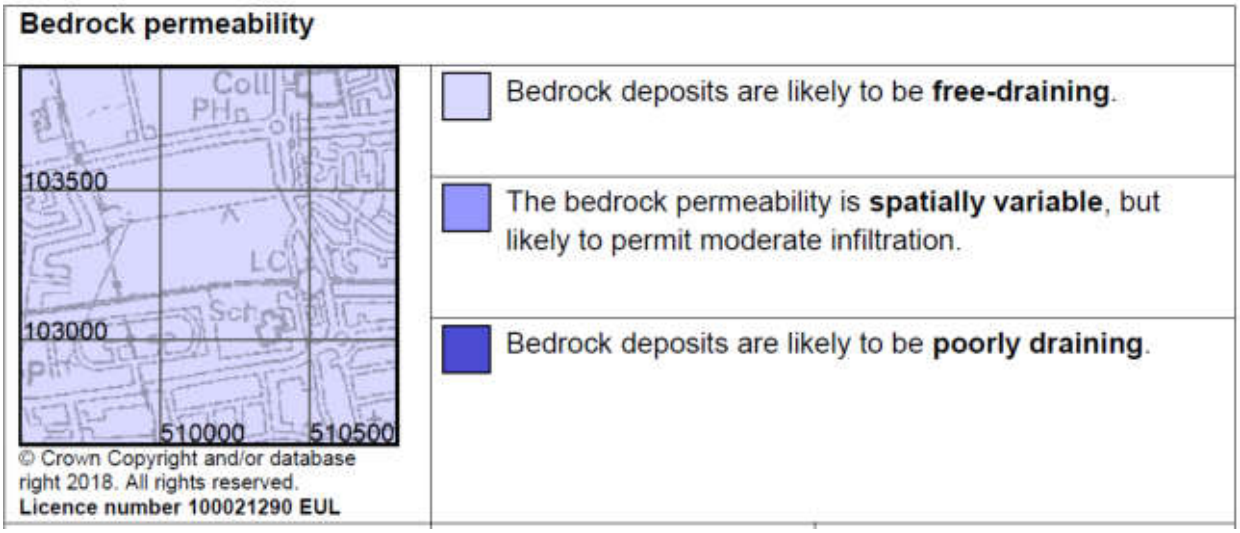


Figure 6. BGS Infiltration SuDS GeoReport – Bedrock Permeability Map

1.3.24 A copy of the BGS records reviewed can be found within **Appendix C** of this report, whilst the BGS Infiltration SuDS GeoReport referred to can be found within **Appendix D**.

1.4 Groundwater

1.4.1 As has already been confirmed, a site-specific intrusive geotechnical investigation has been undertaken at the site, by Soils Limited. Groundwater investigation and a period of monitoring was undertaken as part of the scope of works.

1.4.2 Groundwater was encountered within two out of the twenty-two trial pits – WS1 and WS6. It should be noted that the investigative works were undertaken in September 2014 – at a time when groundwater levels are likely to be at, or approaching, the lowest (minimum) level.

1.4.3 Groundwater monitoring was undertaken between 26th September and 31st October 2014, with the results summarised in the table, below;

Groundwater Monitoring Results			
Monitoring Date	**Trial Hole**	**Depth to water (m bgl)**	**Depth of hole (m bgl)**
26/09/2014	WS1	3.48	5.00
	WS6	2.54	3.98
	WS10	4.28	4.98
08/10/2014	WS1	3.14	5.03
	WS6	2.45	3.95
	WS10	4.28	5.06
15/10/2014	WS1	2.67	5.03
	WS6	2.15	3.86
	WS10	3.86	5.03
22/10/2014	WS1	2.97	5.04
	WS6	2.24	3.83
	WS10	4.02	5.01
31/10/2014	WS1	3.03	5.05
	WS6	2.36	3.80
	WS10	4.11	5.00

1.4.4 Soils Limited has stated within their report that 'True groundwater levels may be represented by the level of water within Ferring Rife' and that 'perched water may be present within the granular soils of the River Terrace Deposits'.

1.4.5 It should be noted that groundwater monitoring should usually be undertaken between October and March (inclusive) in order to establish winter groundwater levels – when groundwater is likely to be at its 'peak' (i.e. its highest level). This information should be utilised to then, in turn, inform the design of SuDS.

1.4.6 In view of the infiltration tests undertaken in September 2014 as part of Soil Limited's on-site, intrusive investigation, it has been confirmed that infiltration is not a viable means of managing run-off generated by development at the site. WBC's Drainage Officer has requested shallow infiltration testing to be undertaken to ascertain whether permeable paving may be utilised as part of a wider strategy. This will be required prior to a Full or Reserved Matters application being submitted.

1.4.7 WBC's Drainage Officer has advised winter groundwater monitoring (between October and March) will be required to accompany a Full or Reserved Matters application, at the location(s) of proposed SuDS features. Regardless of whether infiltration is viable or not, groundwater monitoring will be required to assist in the design of the lining of features such as ponds (impermeable membranes) as well as to assist in preparing flotation calculation, if necessary.

1.4.8 Extracts of Soils Limited's report relating to groundwater can be found within **Appendix I**.

1.4.9 Further to Soils Limited's geotechnical investigation and subsequent report, reference has again been made to the BGS website and the historic borehole referred to within **1.3 – Ground Conditions**.

1.4.10 The borehole log **(TQ10SW135)** confirms that the excavation remained dry during investigation and that groundwater was not encountered.

1.4.11 Further to consultation, West Sussex County Council (WSCC) has confirmed that nothing has been reported to the Lead Local Flood Authority (LLFA) regarding groundwater flooding at the site, although current JBA groundwater mapping suggests that the site is at 'High Risk' of groundwater flooding.

1.4.12 Further to 1.4.10, WBC has confirmed that they are not aware of any groundwater related issues having affected the site.

1.4.13 In addition to the responses received from WSCC and WBC, The EA has also confirmed that there are no know groundwater flooding issues in the area.

1.4.14 The BGS Infiltration SuDS GeoReport referred to earlier within this report indicates that there is likely to be 'persistent or seasonally shallow groundwater' prevalent at the site, especially to the northern extents of the site, within close proximity of Ferring Rife, as indicated below in **Figure 7**. This may relate to perched groundwater, as referred to and stated within Soils Limited's report (refer to 1.4.4).

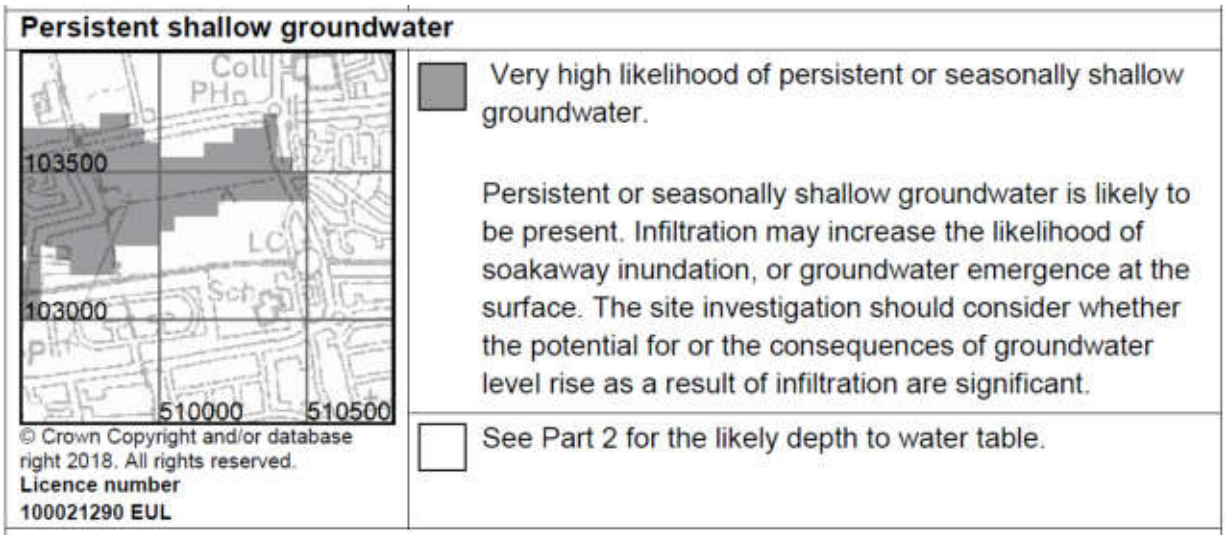


Figure 7. BGS Infiltration SuDS GeoReport – Persistent Shallow Groundwater Map

1.4.15 The 'Depth to Groundwater Table' mapping contained within the BGS Infiltration SuDS GeoReport indicates that 'Groundwater is likely to be less than 3m below the ground surface for at least part of the year' – information which is consistent with that obtained from WSCC, as referred to within **1.4.3**, as well as Soils Limited's groundwater monitoring results.

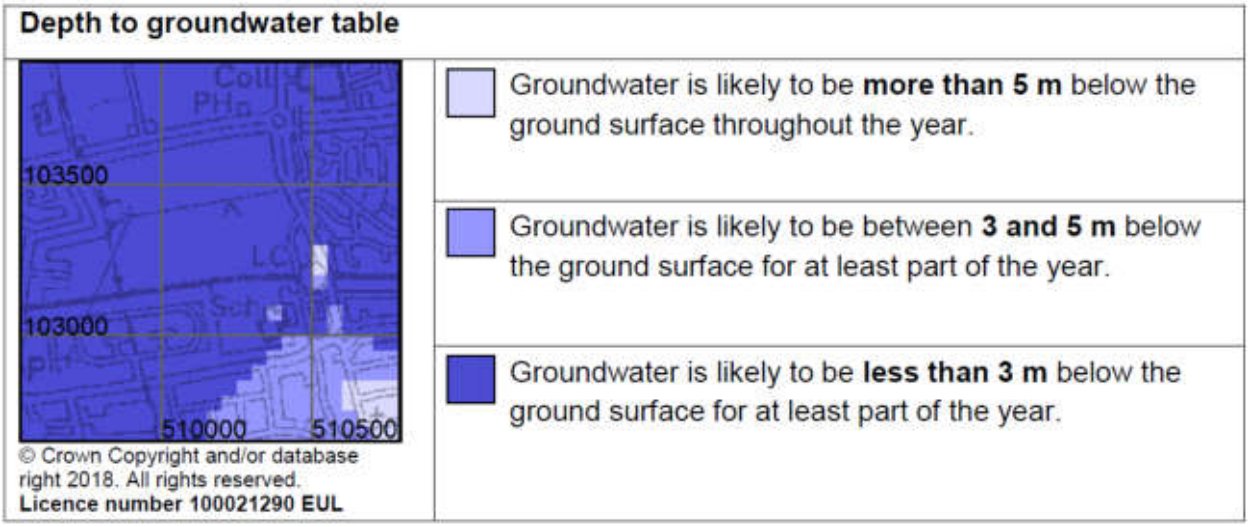


Figure 8. BGS Infiltration SuDS GeoReport – Depth to Groundwater Table Map

1.4.16 The 'Geological Indicators of Flooding' map contained within the BGS Infiltration SuDS GeoReport **(Figure 9)** indicates Ferring Rife is likely to impact upon groundwater levels at the site, which may in turn have adverse effects upon any potential infiltration SuDS methods and/or techniques implemented on site in order to support the proposed development. This statement is supported by Soils Limited and their report.

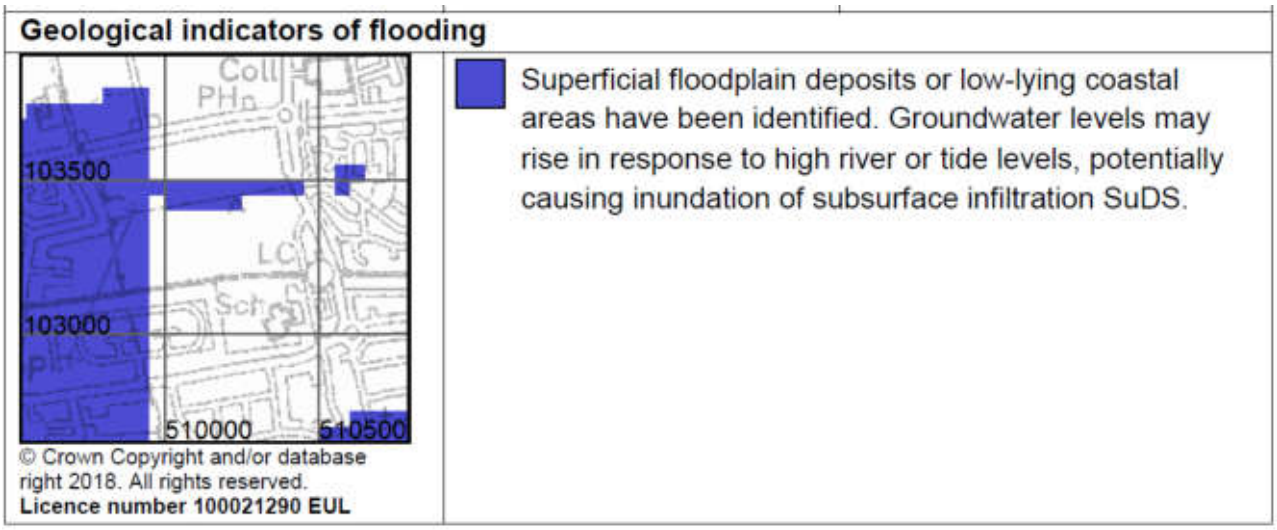


Figure 9. BGS Infiltration SuDS GeoReport – Geological Indicators of Flooding

1.4.17 Online mapping tools managed by MAGIC (magic.defra.gov.uk) provide authoritive 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.

1.4.18 The Aquifer Designation Map (Bedrock) confirms that the site is classified as falling within an area designated as being a 'Principle' aquifer. 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.

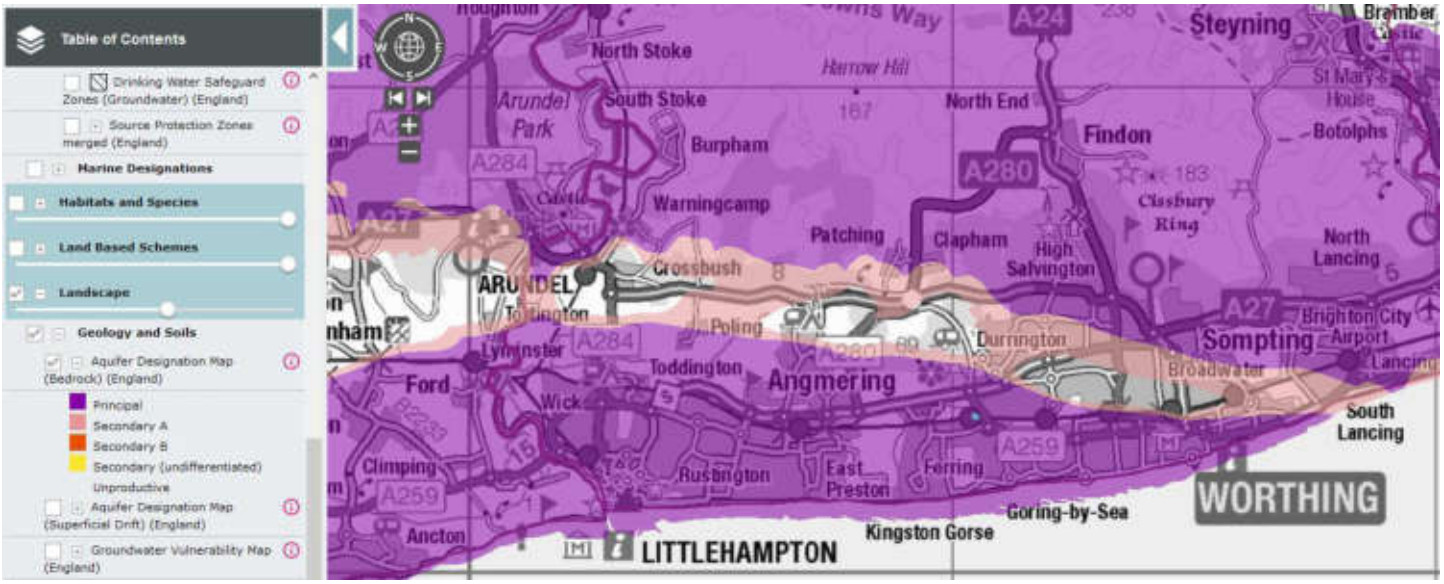
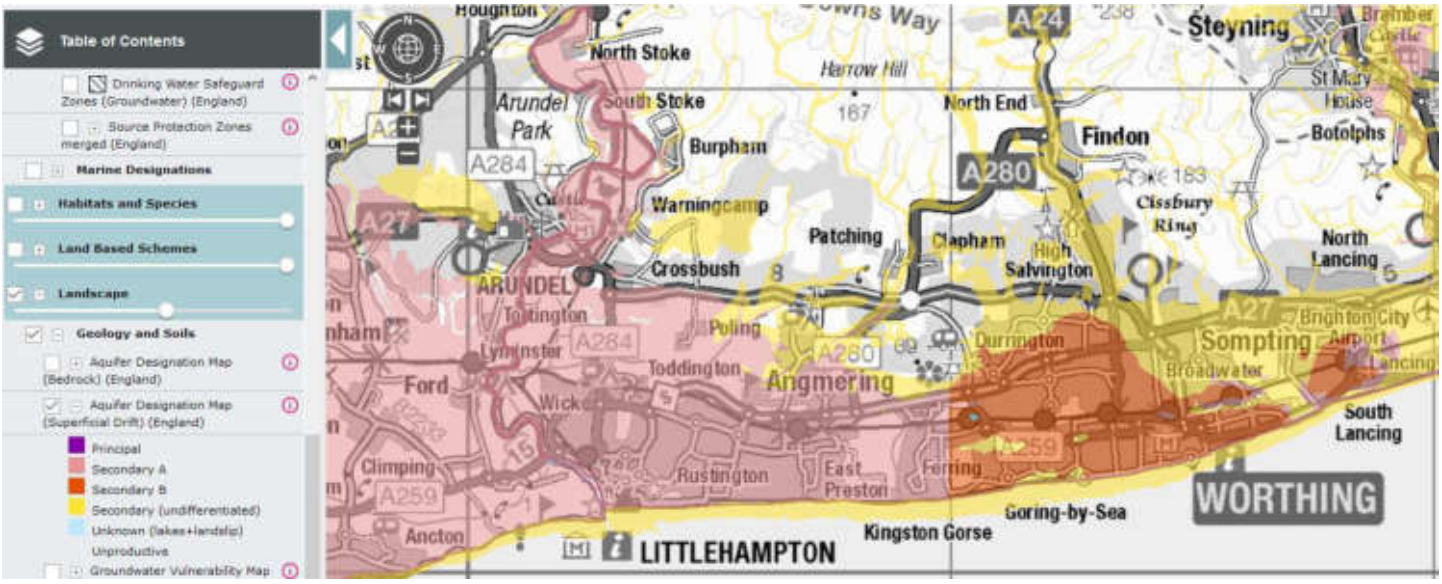


Figure 10, DEFRA Aquifer Designation Map (Bedrock)

1.4.19 The Aquifer Designation Map (Superficial Drift) confirms that the western half of the site is classified as falling within a 'Secondary A' aquifer, whilst the eastern half of the site is classified as 'Secondary B'.

Figure 11. DEFRA Aquifer Designation Map (Superficial Drift)



1.4.20 The Groundwater Vulnerability Map confirms that the site falls mostly within a 'Major Aquifer Intermediate' vulnerability zone, although the south-western corner appears to be classified as a 'Major Aquifer High' vulnerability zone.

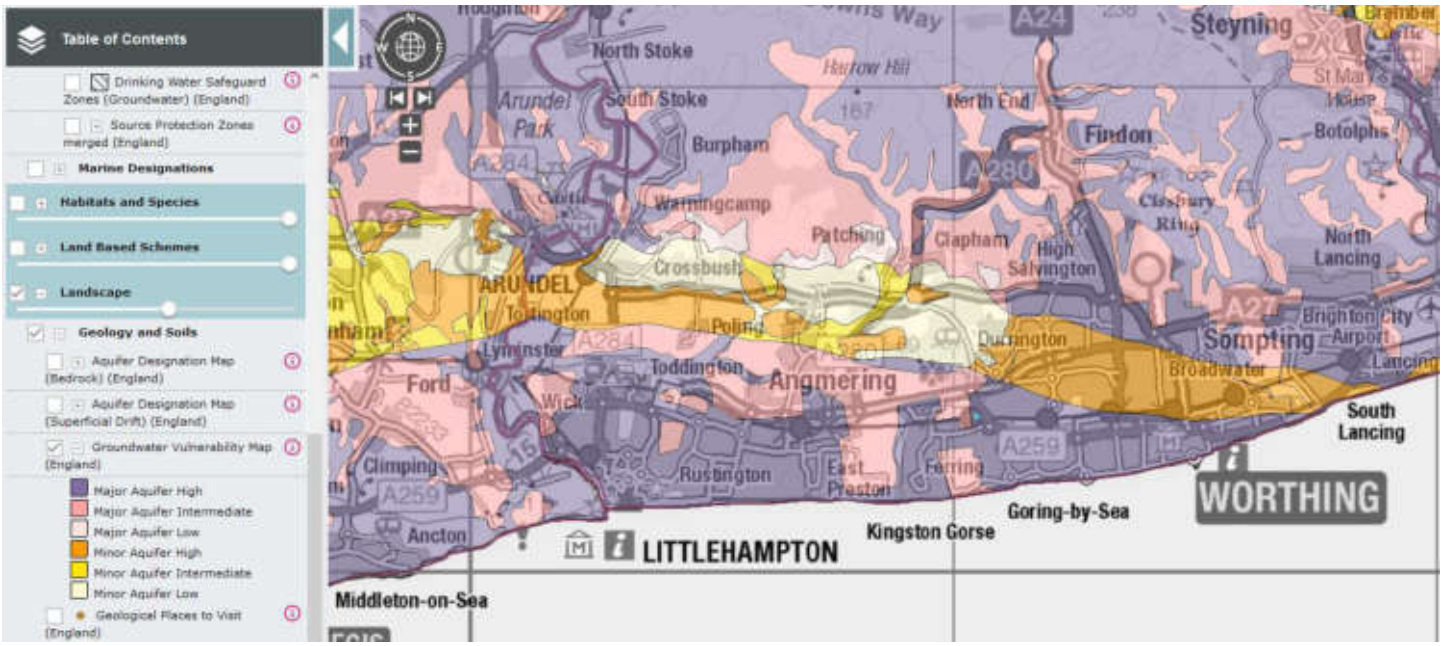


Figure 12. DEFRA Groundwater Vulnerability Map

1.4.21 The Groundwater Source Protection Zones map confirms that the site falls outside of any groundwater protection zones. This is also confirmed within the BGS Infiltration SuDS GeoReport.

Figure 13. DEFRA Groundwater Source Protection Zone Map

1.5 Existing Drainage

1.5.1 The site falls within the administrative area of WSCC and WBC, 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. 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 are public surface water sewers located immediately to the east of the site, in Goring Street which are shown to fall to the north, outfalling to Ferring Rife.

- The public sewer records suggest that there is fall of around 1.31m along the length of the sewer adjacent to the site. There are 7 No. existing manholes located within Goring Street to which a connection could be made if required. The diameter of most of this length of sewer is unconfirmed, although at manholes 4354 and 4455 the sewer is confirmed as measuring 900mm dia.

- There are further public surface water sewers located to the south of the site in Singleton Crescent, although establishing a connection to these sewers is unviable, owing to the presence of the existing railway line which abuts the southern boundary of the site and the need to cross third-party land.

- The site-specific topographical survey indicates falls towards Ferring Rife, with greenfield run-off understood to fall towards, and discharge to this Main River. It is also assumed that some greenfield run-off will infiltrate into the underlying soils, although limited, owing to the underlying geological conditions.

- Greenfield runoff rate (Qbar) has been calculated to be 69.60l/s (3.49l/s per hectare) (Q1 = 59.20/s – 2.97l/s per hectare, Q30 = 157.80l/s – 7.91l/s per hectare and Q100 = 222.10l/s – 11.13l/s per hectare).

1.5.4 Foul Water:

- The Southern Water public sewer records **(Appendix B)** demonstrate that there are also public foul water sewers located to the east of the site (in Goring Street) as well as to the west of the site (in Green Park and Ferring Lane) and also to the south of the site, beyond the existing railway line, in Singleton Crescent.

- The nearest and most viable points of connection have been determined to be at manhole 4303 in the shared footway/cycleway to the east of the site – which has a confirmed depth of 2.00m (150mm dia.), as well as to the west of the site at manhole 6202 located in Green Park, with an unconfirmed depth of 2.72m (150mm dia).

- Within manhole 4303, located within the shared footway/cycleway to the east of the site, an additional branch off of the main run was identified, which would indicate a possible upstream catchment crossing the site – this should be investigated in order to verify and establish any possible link(s).

1.5.5 Highway Drainage:

- WSCC has provided records confirming the locations of existing road gullies which serve the roads surrounding the site. Goring Street, to the east of the site is shown to be served by traditional road gullies. A27 (Littlehampton Road) to the north of the site is also shown to be served by traditional road gullies, as is Ferring Lane to the west of the site. It is understood most, if not all, outfall to Ferring Rife.

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:

- EA 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 (SFRA)
- Consultation with Local Authority/Lead Local Flood Authority/EA

2.2 Flood Maps and Modelling

2.2.1 Following a Product 4 request which was lodged with the EA, a Flood Map for Planning (Rivers and Sea) and modelled flood data (based upon JFlow modelling completed in 2009, comprising the 0.1% AEP event) has been provided.

2.2.2 The Product 4 data confirms that, as has already been established, areas of the site (within the vicinity and following the course of Ferring Rife) fall within Flood Zones 2 and 3. The areas of the site where development is proposed, however, fall within Flood Zone 1.

2.2.3 The modelled flood data provided – based on JFlow modelling undertaken in 2009, indicates a modelled flood level (0.1% Undefended Annual Exceedance Probability) of 6.29m AOD, with a Fluvial Undefended water depth of 0.53m.

			Modelled Flood Levels (m AOD)
			Undefended Annual Exceedance Probability
Node Reference	**Eastings**	**Northings**	**0.1%**
1	509871	103475	6.59

Figure 14. Environment Agency Product 4 – Water Levels Fluvial Undefended

			Modelled Flood Depths in Metres
			Undefended Annual Exceedance Probability
Node Reference	**Eastings**	**Northings**	**0.1%**
1	509871	103475	0.53

Figure 15. Environment Agency Product 4 – Water Depths Fluvial Undefended

2.2.4 The Product 4 data also confirms that there are no formal raised flood defences in the vicinity of the site, although following a site visit, it is evident that the banks of the river and the adjacent ground is considerably higher than the bed of the river – supported by the topographical survey which indicates that in places the adjacent land beyond the top of the banks is some 2.00m – 3.00m higher.

2.2.5 Full correspondence received from the EA can be found within **Appendix E** of this report.

2.2.6 Further to discussions with WSCC and WBC, it has been identified that the EA Product 4 information – specifically the modelled flood level data provided, cannot be relied upon to accurately determine true flood extents and levels in view of climate change. As such, independent flood modelling has been requested in order to better understand the 'true' extents of flooding, including levels, in view of a 1-in-100 year storm event, inclusive of an allowance where climate change is concerned of 40%, to establish a more accurate predicted flood outline.

2.2.7 Site-specific hydraulic flood modelling works have been completed by Ambiental Environmental Assessment (Report 5216_BP_Civils_Goring dated 24th April 2020). Reference should be made to this report, along with a letter addendum provided to WBC's Drainage Officer dated 17th June 2020 (5216-LTR-02).

2.2.8 Following Ambiental Environmental Assessment's modelling works, modelled flood levels have been provided for the site. These levels are summarised in the table, below;

Return Period	Flood Level (mAOD)	
	Node 1	Node 2
1-in-100-year	6.765	-
1-in-1000-year	6.859	5.464
1-in-100-year + 45% Climate Change	6.837	5.369
1-in-100-year + 105% Climate Change	6.895	5.641

2.2.9 The associated drawing produced depicting the locations of the two nodes referred to above, can be found within **Appendix K** of this report.

2.2.10 The modelling works undertaken are to be reviewed by the EA, in conjunction with all other relevant materials submitted as part of this planning application.

2.2.11 WBC's Drainage Officer has already been presented with Ambiental Environmental Assessment's modelling works for review.

2.2.12 WBC's Drainage Officer has provided mapping in relation to the site from the draft Level 2 SFRA. It was not known that revised strategic level modelling was being undertaken (by the EA) which may otherwise have been utilised, prior to instructing site-specific modelling works. Since its release (the updated EA modelling), WBC commissioned additional works to extend the updated model further north to better identify the risks associated with sites in the draft Local Plan, as well as to understand the risk associated with Somerset Lake (approximately 1.50km to the north-east of the site), as part of the update to the local SFRA.

2.2.13 The mapping as referred to above in 2.2.12 is contained within **Appendix L**.

2.2.14 The Indicative Masterplan prepared by Thrive Architects **(Appendix A)** avoids development in areas of the site identified by both models as being 'at risk' of flooding, although the extents associated with the site-specific modelling undertaken by Ambiental Environmental Assessment are reduced when compared with the extents indicated by the Level 2 SFRA mapping. In both instances, the extents of flooding are reduced when compared with the current Flood Maps for Planning and Long-Term Flood Risk Maps which are publicly available.

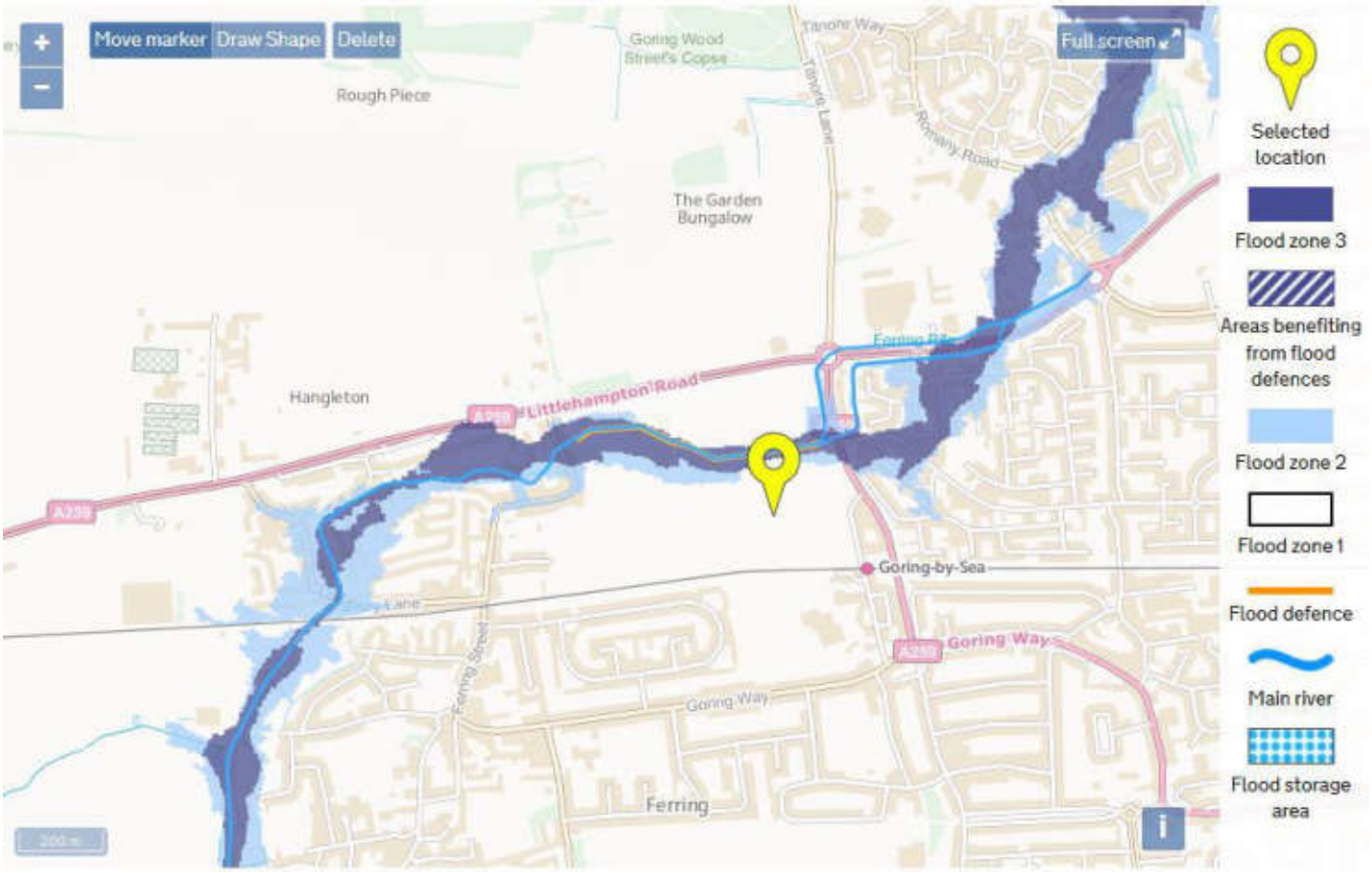


Figure 16. Flood Maps for Planning (.gov.uk)

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 EA. (Not separately distinguished from Zone 3a on the Flood Map)

2.2.15 The Long-Term Flood Risk Map for Rivers and/or the Sea confirms that the areas of the site earmarked for development are not at risk of flooding from this source. The land immediately to the north and south adjacent to Ferring Rife is stated to be at 'Medium' to 'High' risk of flooding from this source, however. Following consultation, the EA has confirmed that there are no formal raised flood defences in the vicinity of the site.

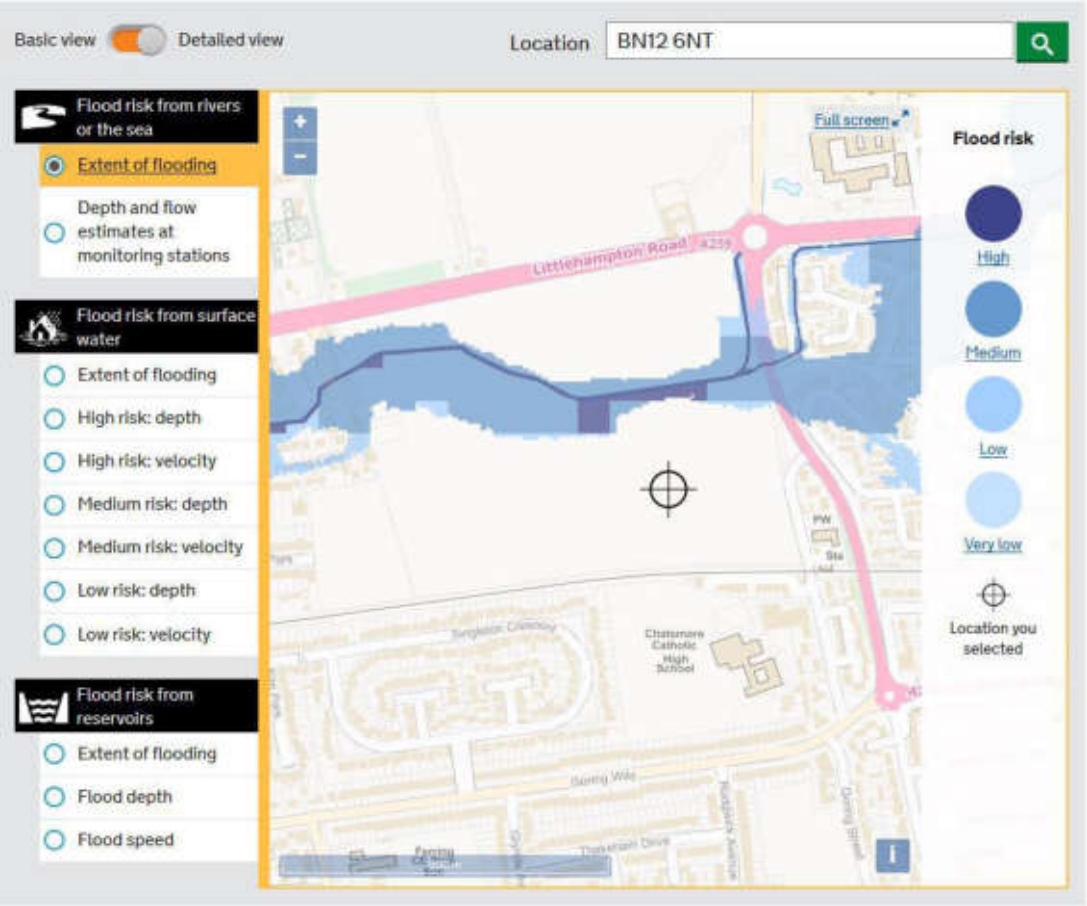


Figure 17. Long Term Flood Risk Map (Rivers or the Sea) (.gov.uk)

2.2.16 The Long-Term Flood Risk Map for surface water shows that the site is largely at 'Very Low' risk of flooding where surface water is concerned. There is a correlation between the extents of the site which are designated as Flood Zones 2 and 3 and an increased risk of surface water flooding – within the vicinity of Ferring Rife which passes through the site. Land to the south of Ferring Rife is shown to be at 'Low' risk of surface water flooding, whilst areas to the west of the site where Ferring Rife leaves the site is shown to be at an increased risk of surface water flooding ('Medium' risk). Beyond the northern extent of Ferring Rife, the north-west corner of the site is shown to be at 'Medium' risk of surface water flooding. Development is restricted to take place to the south of the site, where the risk of surface water flooding is shown to be 'Very Low,' apart from two areas – one adjacent to the southern boundary and the other to the south-east corner of the site – where the risk is stated to be 'Low'.

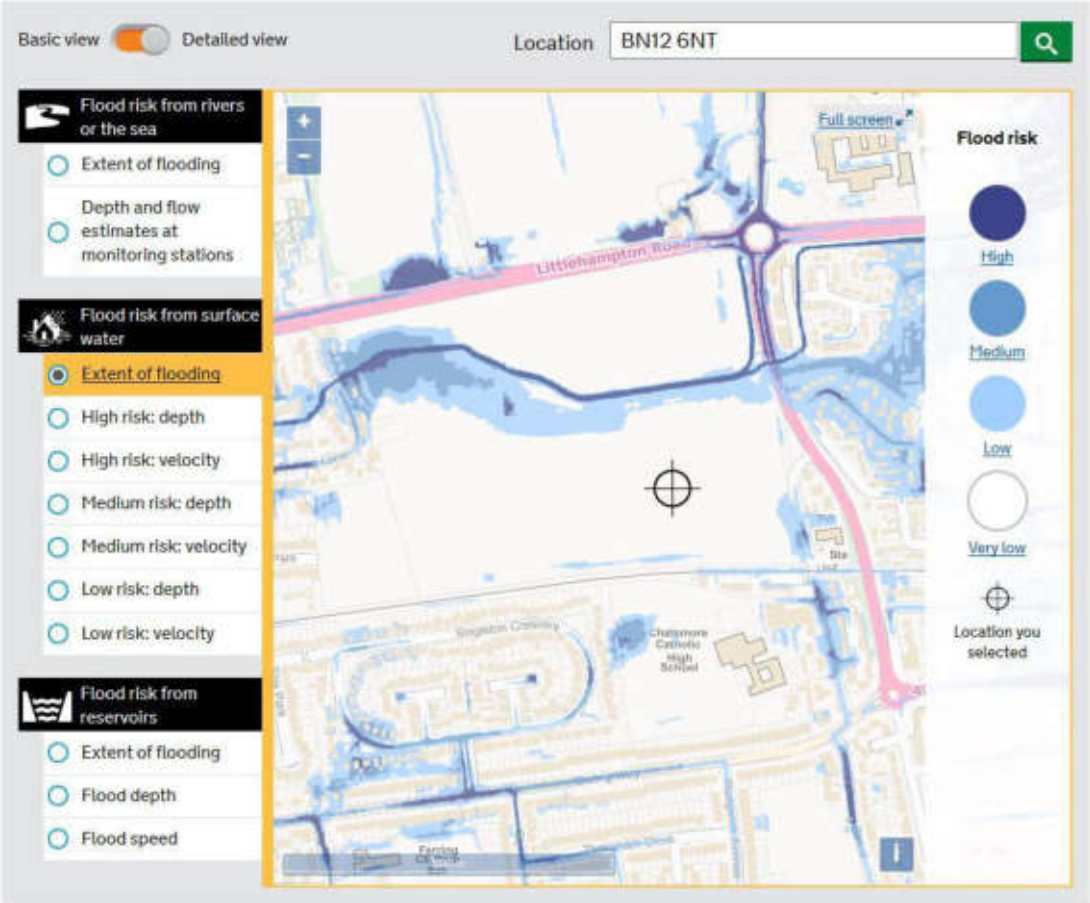


Figure 18. Long Term Flood Risk Map (Surface Water) (.gov.uk)

2.2.17 The Flood Maps for Reservoirs (gov.uk) show that the site is not at risk from this source.

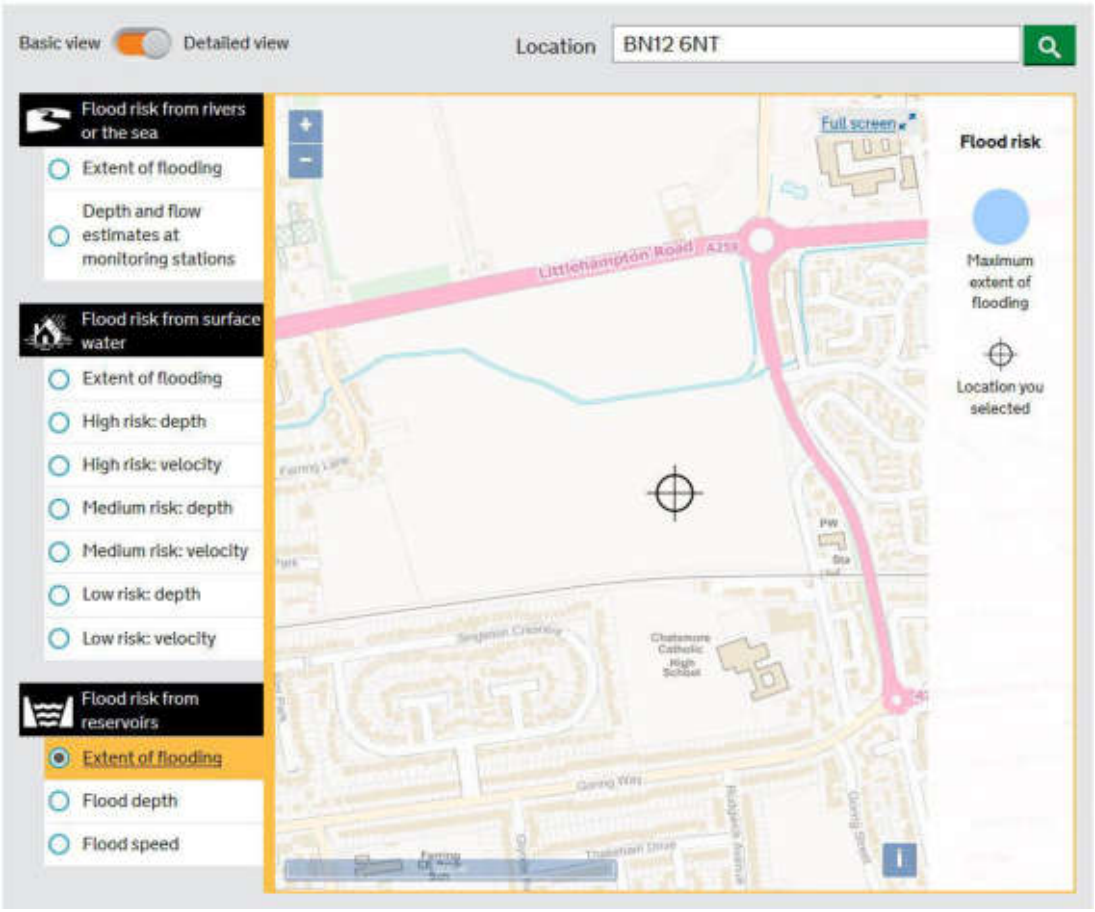


Figure 19. Long Term Flood Risk Map (Reservoirs) (.gov.uk)

2.3 Strategic Flood Risk Assessment

2.3.1 Adur District Council (ADC) and WBC have produced a combined Strategic Flood Risk Assessment (SFRA) update (January 2012).

2.3.2 Although the site is not specifically referred to within the SFRA, reference *is* made to Ferring Rife, which has been confirmed to pass through the site. Areas adjacent to Ferring Rife are detailed within the SFRA as being classified as Flood Zone 3b (functional floodplain).

2.3.3 Mapping and information contained within the SFRA is consistent with that provided by the LLFA, WSCC.

2.3.4 Extracts and mapping from the ADC and WBC SFRA can be found within **Appendix G**.

2.3.5 WBC has/is preparing a draft Level 2 SFRA, which has been confirmed identifies the site and makes specific reference to. Summary sheets from this have been provided by WBC.

2.3.6 Mapping from the draft Level 2 SFRA, as referred to above, can be found within **Appendix K.**

2.4 Historic Flooding

2.4.1 WSCC, WBC and the EA have all been consulted regarding historic flooding at the site. In all cases, no historic instances of flooding have been recorded, although it should be stated that this does not mean that flooding has not occurred, only that it may not have been reported and/or recorded. Given that the site is currently in agricultural use, it may be that any flooding that has occurred, simply has not been reported, and therefore has not been recorded.

2.5 Summary of Flood Risk

2.5.1 The potential sources of flooding are:

Source of Flooding	Level of Risk
Rivers and Coastal	Medium to High The Long-Term Flood Risk Map for Rivers and the Sea indicates that there is a 'Medium' to 'High' risk of flooding, specifically within the immediate vicinity of Ferring Rife. Site-specific modelling works undertaken by Ambiental Environmental Assessment identifies significantly reduced extents as to the areas of the site which are at risk of flooding from Ferring Rife. The draft Level 2 SFRA summary sheets for the site, provided by WBC's Drainage Officer draws similar comparisons to the Ambiental modelling, whereby reduced extents identifying flood risk are confirmed when compared with the existing Long-Term Flood Risk Maps. The modelling works undertaken by Ambiental Environmental Assessment confirms 'peak' modelled flood levels of 6.895mAOD (Node 1) and 5.641mAOD (Node 2) in relation to the site – these levels relating to a 1-in-100-year return period and a climate change allowance of 105%. The levels for the same return period with a 45% climate change allowance are 6.837mAOD (Node 1) and 5.369mAOD (Node 2). Further to review of the site-specific topographical survey, it is evident that existing site levels within the vicinity of the two nodes provided by Ambiental Environmental Assessment are 6.80mAOD (Node 1) and 5.10mAOD (Node 2). Given the existing topography of the site – which falls towards Ferring Rife, levels are increasingly elevated moving further away from Ferring Rife. The initial masterplan for the site avoids, in all instances where the mapping and modelling reviewed is concerned, the areas of the site which are indicated as being at risk of flooding. All development will be located in land currently designated as Flood Zone 1.

Surface Water	Very Low to High The site is indicated as being largely at 'Very Low' risk of surface water flooding, although areas within the immediate vicinity of Ferring Rife are indicated as being at elevated risk – for the most part at 'Low' to 'Medium' risk. There is an isolated low point which is indicated as being at 'High' risk of surface water flooding, however development is not proposed within those areas confirmed as being at increased risk of surface water flooding. As confirmed above in relation to Rivers and Coastal sources of flooding, the initial masterplan has been developed to ensure development avoids the extents identified as being at risk of flooding from this source (surface water).
Groundwater	Medium Groundwater monitoring undertaken on-site between 26th September and 21st October 2014 confirmed a lowest recorded depth to groundwater of 4.28m bgl (September 2014). During monitoring, groundwater levels peaked at 2.15m bgl (WS6 - October 2014). Information available from other sources (e.g. BGS GeoSuDS Report, referred to earlier in this report) suggest that there may be a 'High' risk of groundwater flooding, influenced and linked to 'high water level' events associated with Ferring Rife. Winter groundwater monitoring has not been undertaken in order to establish 'peak groundwater' levels, however. Therefore, at present the risk of groundwater flooding is viewed to be 'Medium'. Winter groundwater monitoring must be undertaken (between October and March) in order to identify 'peak' groundwater levels, to accompany a Full or Reserved Matters planning application.

Sewers	TBC A feasibility study has been submitted to Southern Water to ascertain whether capacity is currently available to support the development, as well as to establish whether there are currently any known issues affecting the area, and/or historic occurrences of sewer flooding. Southern Water are, however, responsible for ensuring that capacity exists within their network to support development and where this does not currently exist, to provide it, through the S106 process and associated charges.
Artificial Sources	Low WBC's Drainage Officer has confirmed that, as part of the exercise of preparing the draft Level 2 SFRA, it has been identified that the site is at risk of flooding in the event of a 'breach' to Somerset Lake which is located approximately 1.50km to the north-east of the site, as confirmed by the draft mapping from the Level 2 SFRA (Appendix L). WBC's Drainage Officer has provided a report, prepared by JBA Consulting for reference (2019s0745). JBA Consulting's report confirms that Somerset Lake is not a 'larger raised reservoir' under the Reservoirs Act 1975 and is believed to have a capacity of approximately 16,000m^3. The extents of the site indicated as being at risk of flooding in the event of a breach at Somerset Lake are primarily limited to the north-western corner of the site, within the vicinity of Ferring Rife. As confirmed earlier in this section, such areas of the site are not earmarked for development, with proposed dwellings to be located outside of these extents.

3 PROPOSED DEVELOPMENT

3.1 Description of Development

3.1.1 As stated in 1.1.3, the proposals consist of a 'mixed use development comprising up to 475 dwellings along with associated access, internal roads and footpaths, car parking, public open space, landscaping, local centre (uses including A1, A2, A3, A4, A5, D1, D2, as proposed to be amended to use classes E, F and Sui Generis) with associated car parking, car parking for the adjacent railway station, undergrounding of overhead HV cables and other supporting infrastructure and utilities.' The initial masterplan prepared by Thrive Architects is contained within **Appendix A**.

3.1.2 The proposed development at the site, as detailed in 3.1.1, is categorised as 'More Vulnerable' (Flood Risk and Coastal Change Table 2). Given that the proposed development will fall within areas of the site which are classified as Flood Zone 1, Flood Risk and Coastal Change Table 3 (below) indicates that the development is compatible.

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

3.1.3 The proposed development will result in the introduction of impermeable areas of hardstanding surface finishes, which will result in an increased rate of run-off generated by the site. As present, the site is a 'greenfield' location with no areas of hardstanding.

3.1.4 An assessment has been made in order to establish the potential impermeable area which will result from development of the site, to the level established in 3.1.1. Drawing **D1586-PL500** has been prepared to demonstrate the approximate extent of the site which is to be developed, and where areas of hardstanding will be introduced. A preliminary assessment has been made that, in the event that those areas highlighted provide an impermeable area of 60% of the total areas shown, the impermeable area of the site will total **73,462m² (7.35Ha, or 8.081Ha inclusive of 10% Urban Creep allowance)**. This is considered at present to be a fair assessment given the large areas of soft landscaping and permeable surfaces which are to be retained on site following development, as well as in view of the overall density of the proposed development.

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.

3.1.7 A high-level drainage opportunities plan is included within this report, as shown on drawing **D1586-PL600.**

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 - Constructed Wetlands - Balancing Ponds - Detention Basins - Retention Ponds	 Yes Yes Yes Yes	No constraints associated with such features and given the density of the proposed development and the vast amounts of available open space, such measures should be strongly considered, and implemented where possible. Basins and ponds should be located outside of the extents of the site identified as being at risk of flooding.
Filter strips and swales	Yes	Potential shallow groundwater during winter months and the risk of emergence limits the use of infiltration techniques; however, such features should still be considered, with shallow infiltration testing and winter groundwater monitoring undertaken to accompany a Full or Reserved Matters application.

Infiltration Devices - Soakaways - Infiltration trenches and basins	No	Infiltration testing undertaken at the site has confirmed negligible to poor infiltration potential of the underlying soils. Peak winter groundwater levels have also not been established and may also impact upon such measures. Shallow infiltration testing must be undertaken to establish whether such is a viable means to support a wider drainage strategy, along with winter groundwater monitoring. This will be required to support either a Full or Reserved Matters planning application.
Permeable surfaces and filter drains - Gravelled areas - Solid paving blocks - Porous pavers	 Yes Yes Yes	Infiltration potential has been determined to be poor further to current testing undertaken on site, and surface water flooding may limit the viability of tanked permeable paving, however this could be considered in areas at lower risk of surface water or fluvial flooding to capture and attenuate flows. Peak winter groundwater levels have not yet been established, however initial testing may indicate the potential for features at shallow depths to be implemented. Winter groundwater monitoring will be required in addition to further infiltration testing, to be undertaken at shallow depths.
Tanked systems - Oversized pipes - Cellular tanks	 Yes Yes	SuDS systems would be depth limited due to the presence of shallow groundwater and flood risk in some areas of the site, however this should be confirmed following on-site investigation.

4.1.2 It is proposed that permeable paving will be introduced across the site for private driveways and shared parking areas, whilst consideration should also be given to the inclusion of such for sections of the main estate roads, where possible. Winter groundwater monitoring has not yet been undertaken, however, if this (groundwater) is established to be present at shallow depths, the permeable paving can be tanked to provide attenuated storage which would be unaffected by possible shallow groundwater present at the site.

4.1.3 Infiltration methods and techniques should be prioritised and implemented where possible, however, in view of the infiltration test results provided by Soils Limited, such methods and techniques are not viable owing to poorly draining soils – Soils Limited explicitly state alternative methods should be implemented. WBC has requested infiltration testing at shallow depths, however, this has not yet been undertaken. It may be possible to utilise infiltration at shallow depths to support a broader drainage strategy.

4.1.4 Additional attenutated storage will be provided with a pond feature or features across the site, which would utilise a positive outfall to Ferring Rife where flows could then discharge to. In order for flows to discharge to Ferring Rife, approval would be required from the EA, in the form of a Flood Defence Consent, as this (Ferring Rife) is confirmed as being a 'Main River'.

4.1.5 It is proposed that attenutated storage would reduce the rate of run-off compared with existing greenfield rates, as so to provide betterment to the existing situation and use of the site. Existing Greenfield run-off rates have been determined to be 69.60l/s (3.49l/s per hectare).

4.1.6 Preliminary storage calculations suggest that storage to the volume of **5,200m³ – 7,363m³** will be required to support the development, based on the current assessment in terms of the proposed impermeable area **(8.081Ha - inclusive of 10% Urban Creep allowance)** and a controlled outflow of **49.90l/s (2.5l/s per hectare)** to provide betterment.

4.1.7 The proposed strategy will ensure that there is no increase in the rate of run-off leaving the site – there will infact be a reduction and therefore betterment, meaning there will be no increase in the risk of flooding.

4.1.8 As referred to earlier in this report **(Section 2.2 Flood Maps and Modelling)** reference has been made to Flood Maps for Planning, Long-Term Flood Risk Maps, Product 4 data issued by the EA as well as updated modelling contained within the draft Level 2 SFRA provided by WBC and also site-specific modelling undertaken by Ambiental Environmental Assessment. The initial masterplan has been developed to avoid the indicated extents of flooding and flood risk in relation to all mapping and modelling.

4.1.9 The draft Level 2 SFRA and site-specific modelling undertaken by Ambiental Environmental Assessment draw similar comparisons, in the fact that both demonstrate reductions in the areas presented as 'at risk' of flooding when compared with current publicly available EA mapping and modelling. As mentioned above, the initial masterplan has been developed in order to avoid the extents identified by all mapping and modelling.

4.1.10 Ambiental Environmental Assessment's modelling has confirmed modelled flood levels of 6.837mAOD (1-in-100-year return period, 45% climate change) for Node 1 (east of the site) and 5.369mAOD for Node 2, to the west of the site (for the same return period). It is proposed that finished floor levels should be set at least 300mm above these modelled flood levels to provide mitigation in view of the modelled risk(s) of flooding. The existing ground levels within the vicinity of the two nodes are 6.80mAOD (Node 1) and 5.10mAOD (Node 2). It is therefore evident that levels will need to be engineered (raised) to achieve these levels in order to provide freeboard in relation to the modelled flood levels. Further south, moving towards the southern boundary of the site, existing levels are already elevated above the modelled flood levels, and even above the levels inclusive of the 300mm freeboard proposed.

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 run-off 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. This 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
- Individual property driveways and low traffic roads – Low/TSS=0.5/ M=0.4/H=0.4
- All roads except low traffic roads and trunk roads/motorways - Medium/TSS=0.7/ M=0.6/H=0.7

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
- Swale – TSS=0.5/M=0.6/H=0.6
- Pond – TSS=0.7/M=0.7/H=0.5
- Wetland – TSS=0.8/M=0.8/H=0.8

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 The topography of the site, as well as the location and depth of the existing foul sewers located within Green Park and within the footway/cycleway beyond the eastern boundary of the site, means that gravity-based connection(s) to the public foul sewer network are likely to be viable (subject to confirmation of a detailed site arrangement). It is unlikely that all areas of the site will be able to drain by gravity to a single outfall location, owing to the distances across the full extents of the site, and constraints relating to the depths of the existing public foul water sewers.

4.3.2 Subject to S106 approval from Southern Water, it is proposed that connections to the public foul water sewer network will be implemented in order to support the development. Two connections are proposed in order to ensure that gravity-based connections can be achieved, avoiding the necessity to provide a pumped solution, which has increased maintenance and cost implications.

4.3.3 It is proposed that the western extent of the development will drain to the existing public foul water sewer located in Green Park, whilst the eastern extent of the development will drain to the public foul water sewer located within the shared footway/cycleway adjacent to Goring Street.

4.3.4 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.

4.3.5 Based on the design guidance provided in Sewers for Adoption, the proposed foul flow to the public foul sewer will be 21.99l/s (based upon Sewers for Adoption).

4.4 Climate Change

4.4.1 In February 2016 the EA published the climate change allowances (available online at https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances), which has been most recently updated as of 22nd July 2020. These allowances support the NPPF in making an allowance for climate change within flood risk assessment. The allowances provide predictions of anticipated change for peak river flow by river basin district and peak rainfall intensity.

4.4.2 The table below shows the anticipated changes in extreme rainfall intensity for small and urban catchments. For flood risk assessments, both the central and upper end allowances should be assessed to understand the range of impact.

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

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

4.4.4 The modelling works undertaken by Ambiental Environmental Assessment has been conducted to establish a 'true' flood extent in view of the requirements detailed by WBC. The modelling has considered a 1-in-100-year storm event, inclusive of climate changes allowances of 45% as well as 105%. The independent, site-specific modelling was requested owing to the 'coarse nature' of JFlow modelling provided by the EA as part of their Product 4 data response.

4.4.5 Modelled flood levels, as ascertained by Ambiental Environmental Assessment, have been confirmed as follows;

Return Period	Flood Level (mAOD)	
	Node 1	Node 2
1-in-100-year	6.765	-
1-in-1000-year	6.859	5.464
1-in-100-year + 45% Climate Change	6.837	5.369
1-in-100-year + 105% Climate Change	6.895	5.641

4.5 Urban Creep

4.5.1 Based upon the assumption that there will be an urban creep on new developments through their lifetime, an allowance for potential urban creep should be considered.

4.5.2 WSCC's 'Policy for the Management of Surface Water', dated 27th November 2018 confirms the allowances which should be made for potential urban creep across the lifetime of the development (as per Table 5.2).

4.5.3 In view of the initial masterplan, it is evident that residential development density will be less than 25 units per hectare, meaning an allowance of 10% should be made in view of the overall proposed impermeable area.

4.6 Residual Risk

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

i. Increased flow through Ferring Rife as a result of climate change, causing flooding to the site

ii. Blockage of Ferring Rife as a result of debris or otherwise, causing flooding to the site

iii. Breach of upstream sources of flood risk (i.e. Somerset Lake)

iv. Extreme rainfall events that exceed the design criteria used for the drainage system causing surface water flooding

v. Blockage/failure of the proposed drainage system causing flooding to the site

vi. Groundwater flooding to the site caused by groundwater levels exceeding the ground surface level

vii. Surface water flooding of proposed buildings

4.7 Mitigation

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

i. As has already been established in this report, site-specific modelling works have been undertaken by Ambiental Environmental Assessment, where modelled flood levels have been determined. This has confirmed modelled flood levels as follows;

Return Period	Flood Level (mAOD)	
	Node 1	Node 2
1-in-100-year	6.765	-
1-in-1000-year	6.859	5.464
1-in-100-year + 45% Climate Change	6.837	5.369
1-in-100-year + 105% Climate Change	6.895	5.641

Existing ground levels within the vicinity of the Ambiental Environmental Assessment nodes are 6.80mAOD (Node 1) and 5.10mAOD (Node 2). Finished floor levels should be set at least 300mm above the 1-in-100-year + 45% climate change levels in order to provide mitigation, with freeboard. The initial masterplan has been developed to avoid not just the extents of flood risk identified by Ambiental Environment Assessment further to their modelling works, but also in view of the extents identified as per the data provided by WBC forming part of the draft Level 2 SFRA as well as current publicly available mapping (i.e. Flood Maps for Planning and Long-Term Flood Risk Maps).

ii. In view of the fact that Ferring Rife is designated as a Main River, the EA is responsible for ensuring that it is maintained. Responsible riparian ownership should also be encouraged, with any issues identified being raised with the EA as soon as possible. Mapping provided by WBC as part of the draft Level 2 SFRA identifies the extents of flood risk associated where potential blockage is concerned. Again, such extents are avoided where proposed development is concerned. Ambiental Environmental Assessment have also provided allowance for blockage(s) within their modelling therefore the risk of such has been mitigated through avoiding developing those areas of the site indicated as being 'at risk'.

iii. Works associated with WBC's draft Level 2 SFRA has identified that the site is at risk of flooding in the event of a breach relating to Somerset Lake, located approximately 1.50km north-east of the site. As with the other sources of potential flooding identified and assessed, the associated extents have been avoided where the initial masterplan and proposed development is concerned. Blockage and breach scenarios and associated extents of potential flooding could be argued to be likened to the extents of Flood Zone 2, crudely whereby development can be implemented in such areas, albeit with sufficient mitigation being afforded to offer protection. Given the extents deemed to be 'at risk' are to be avoided, and also given that levels on site are to be raised, it is evident that sufficient mitigation is afforded in this instance.

iv. 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 follow the existing topography – falling to the north towards Ferring Rife. The proposed drainage strategy will see flows discharging to Ferring Rife, therefore in both sets of circumstances – as designed as well as in exceedance events, run-off with fall and discharge to Ferring Rife. Existing and proposed drainage infrastructure should also be considered which can intercept run-off in an exceedance event, including gullies and channel drains.

v. The proposed drainage system will attenuate and store run-off 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 existing drainage system and watercourse, however maintenance measures proposed in Chapter 8 will mitigate the risk of the system becoming blocked.

vi. Due to the underlying ground conditions of the site and the anticipated presence of groundwater (during winter months), 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 was to occur, it would flow away from the proposed dwellings, falling towards Ferring Rife, as existing – following the existing topography of the site. Groundwater monitoring will be required during winter months prior to a Full or Reserved Matters application in order to fully co-ordinate proposals.

vii. 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.

5 SEQUENTIAL AND EXCEPTION TESTS

5.1 Sequential Test

5.1.1 The site is proposed to be set out sequentially to ensure that all of the proposed properties are located within Flood Zone 1, which presents the lowest risk of flooding. The initial masterplan is indicative of this arrangement.

5.1.2 In view of the above, application of the sequential test is not required.

5.2 Exception Test

5.2.1 Table 3 within Paragraph 067 of Flood Risk and Coastal Change confirms that developments classified as 'More Vulnerable' are suitable for Zones 1 and 2. If all dwellings are constructed in Flood Zone 1, as proposed, application of exception test is not required.

5.3 Safe Access and Egress

5.3.1 The site is to be set out sequentially with all habitable dwellings located within Flood Zone 1 meaning that access/egress routes are deemed to be dry and not offering any possible risk.

5.4 Flood Warning

5.4.1 Although the proposed development will fall fully within Flood Zone 1, as areas of the site are demonstrated to fall within Flood Zones 2 and 3 and are indicated to be at risk of fluvial and surface water flooding, there is a need for a Flood Evacuation Plan (FEP). This should consider the provision of a Flood Warning System.

6 MAINTENANCE

6.1 Proposed Maintenance Regime

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

6.1.2 The drainage system has been designed to minimise maintenance requirements, however a number of key tasks will need to be undertaken so that the system remains in optimal condition. These operations are summarised in the table below, along with the required frequency of works.

Drainage System feature	Proposed maintenance / remedial works	Required frequency of works
Permeable Paving	Surface sweeping to reduce silt and debris accumulation.	Every 8 to 12 weeks
	Removal / management of weed growth	At least once a year
	Silt removal from permeable surfaces, possibly involving raking out of joints, redressing, removal and remedial works.	As required / to be specified by manufacturer
Pond	Inspection, vegetation clearance and additional clearing/cleansing of potential surface blockages	At least once a year
	Inspection and clearance of blockages	After major storm events
Swales	Inspection and clearance	Annual, and after every storm event
	Desilting	Year 1, Year 3, then every 5 years
Diffuser units & catch pits, gully sumps and drains	Inspection and additional cleansing as required.	Annual
	Desilting	Year 1, Year 3, then every 5 years
Inlets & Outfalls	Clearance of safety grilles and pipework	After every storm event/ regularly / to be specified by manufacturer
Pipework	Jetting to clear blockages	As required
HydroBrake	As specified by manufacturer	As specified by manufacturer

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

6.1.4 A detailed maintenance document shall be established prior to appointment in order to detail the roles and responsibilities where maintenance is concerned.

HydroBrake (Flow Control Chamber)

6.1.5 It is proposed that a HydroBrake (or similar) flow control unit will be introduced on site in order to restrict flows outfalling from the drainage system to Ferring Rife. 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.

6.1.6 The flow control device has two measures in case 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 within the flow control manhole. Both measures allow the system to drain down freely, until the blockage can be cleared.

6.1.7 The HydroBrake flow control chamber will require additional maintenance measures to ensure it operates as designed. The additional measures are as follows:

- 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

6.1.8 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.

Accidental Spillages

6.1.9 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.

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

Future Alterations to the Development

6.1.11 Any future alterations to the proposed drainage system should be confirmed by a specialist, prior to any change being implemented.

7 OFFSITE IMPACTS

7.1.1 The proposed development will have a positive impact on flooding issues off-site by reducing run-off rates to the Ferring Rife, offering an improvement when compared with existing greenfield run-off rates. This will be provided through attenuation within the bounds of the site, with sustainable drainage methods and techniques introduced.

7.1.2 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 21.99l/s.

7.1.3 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.

8 SUMMARY

8.1.1 This site-specific flood risk assessment is based on EA Flood Maps for Planning; Long Term Flood Maps; WSCC, WBC and EA records and information; WSCC and ADC/WBC Strategic Flood Risk Assessments; BGS Geology mapping, records and information and Southern Water public sewer records.

8.1.2 The site is currently an undevelopment greenfield site, measuring 19.96Ha.

8.1.3 The site is located in Flood Zone 1 to 3, although development will be restricted to falling fully within Flood Zone 1.

8.1.4 Surface water will be dealt with via sustainable means – with attenutated storage being provided through permeable paving and above ground features including pond(s) and wetland(s). Flows will discharge to Ferring Rife as infiltration has been found to be unviable following on-site investigation and testing – shallow infiltration testing is to be undertaken to verify whether infiltration is viable at shallow depths.

8.1.5 Betterment will be provided in terms of run-off rates; which will be less than existing 'pre-development' greenfield run-off rates.

8.1.6 The on-site drainage proposals will accommodate a 1-in-100-year storm event, inclusive of an allowance (40%) for climate change as well as urban creep (10%).

8.1.7 Additional, independent flood modelling has been undertaken to fully establish and consider the predicted flood extents and levels in view of a 1-in-100-year storm event, inclusive of climate change allowances.

8.1.8 The initial masterplan avoids the areas of the site indicated as being 'at risk' of flooding in view of all mapping and modelling assessed.

8.1.9 It is proposed that foul water will outfall to the Southern Water public sewer network, via gravity connections to the public sewers located in Green Park (west) as well as in Goring Street (east).

8.1.10 The proposed development will fall fully within Flood Zone 1, therefore the application of the Sequential and Exception Tests are not required.

8.1.11 In conclusion, this development is suitable with regards to flood risk and surface water drainage.

DRAWINGS

NOTES

A3

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

N

PLANNING

Rev.	Date	Amendments
A	23/07/2020	Revised site boundary
-	16/10/2019	Original issue

rgp Design

Transport Planning and Infrastructure Design Consultants
2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF
Tel: 01243 210418 Fax: 01483 861682 www.rgp.co.uk

Client: Persimmon Homes

Project: Land at Chatsmore Farm, Goring

Drawing Title: Site Location Plan

Scale	Drawn By	Checked By	Approved By
1:2500	SPB	MJA	MJA

Date	Drawing No.	Rev.
October 2019	D1586-PL100	A

-CONTOURS KEY-

Primary Contour

Secondary Contour

A259

Ferring Lane

Goring Street

Railway

Singleton Crescent

1:2500 @ A3

0 20 40 60 80 100 m

NOTES

A3

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N

PLANNING

Rev.	Date	Amendments
A	23/07/2020	Revised site boundary
-	16/10/2019	Original issue

rgp Design

Transport Planning and Infrastructure Design Consultants
2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF
Tel: 01243 210418 Fax: 01483 861682 www.rgp.co.uk

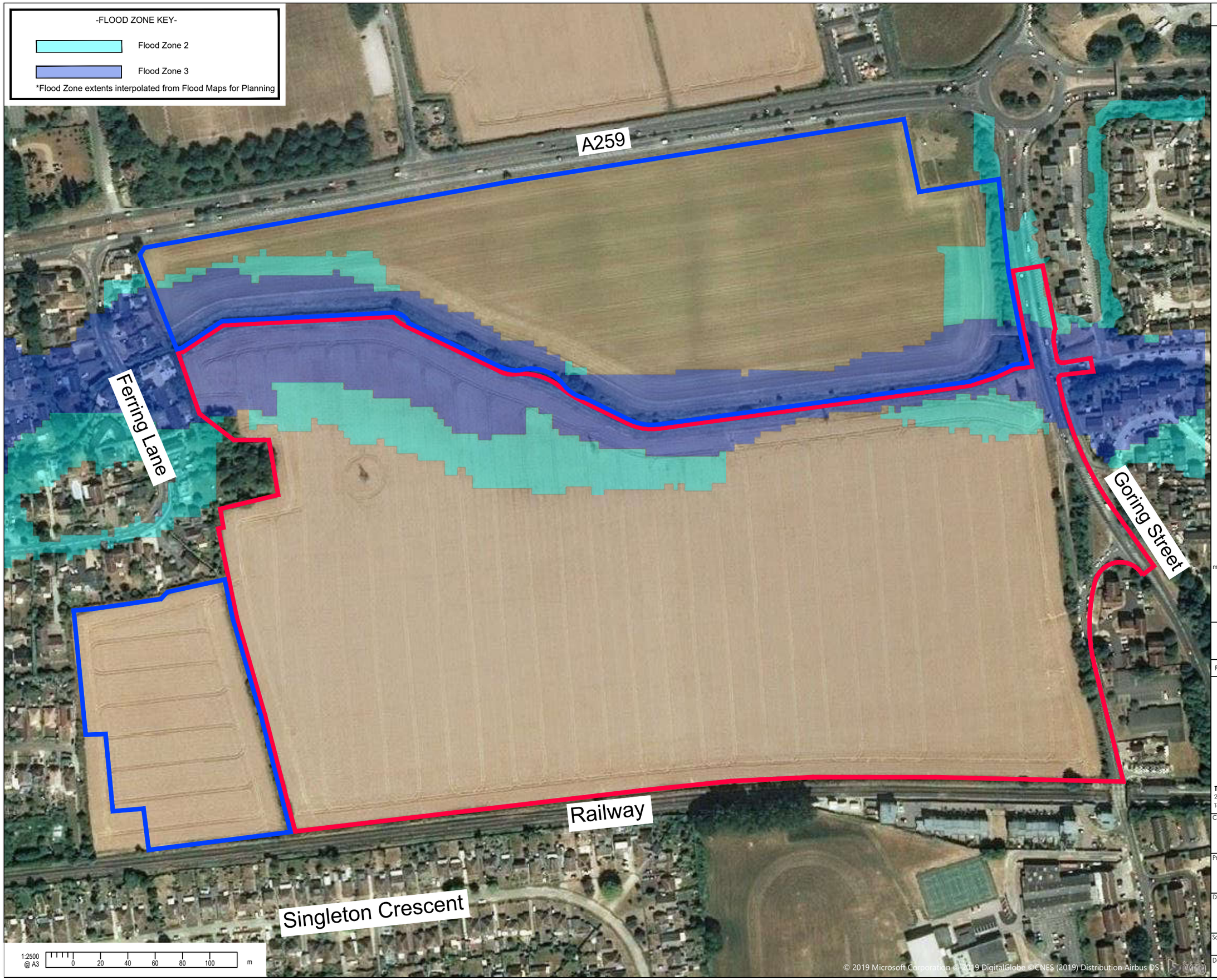
Client: Persimmon Homes

Project: Land at Chatsmore Farm, Goring

Drawing Title: Existing Site Topography

Scale	Drawn By	Checked By	Approved By
1:2500	SPB	MJA	MJA

Date	Drawing No.	Rev.
October 2019	D1586-PL200	A



NOTES

A3

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

N

PLANNING

Rev.	Date	Amendments
A	23/07/2020	Revised site boundary
-	16/10/2019	Original issue

rgp Design
Transport Planning and Infrastructure Design Consultants
2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF
Tel: 01243 210418 Fax: 01483 861682 www.rgp.co.uk

Client: Persimmon Homes

Project: Land at Chatsmore Farm, Goring

Drawing Title: Existing Flood Zone Overlay

Scale	Drawn By	Checked By	Approved By
1:2500	SPB	MJA	MJA

Date	Drawing No.	Rev.
October 2019	D1586-PL300	A

NOTES

A3

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

N

PLANNING

Rev.	Date	Amendments
A	23/07/2020	Revised site boundary
-	16/10/2019	Original issue

rgp Design
Transport Planning and Infrastructure Design Consultants
2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF
Tel: 01243 210418 Fax: 01483 861682 www.rgp.co.uk

Client: Persimmon Homes

Project: Land at Chatsmore Farm, Goring

Drawing Title: Surface Water Flood Risk Extents

Scale	Drawn By	Checked By	Approved By
1:2500	SPB	MJA	MJA

Date	Drawing No.	Rev.
October 2019	D1586-PL400	A

-IMPERMEABLE AREA KEY-

Indicative Extent of Proposed Development

-IMPERMEABLE AREA ASSESSMENT-

In The absence of a detailed site arrangement, an assessment has been made to ascertain the possible extent of impermeable surfacing post-development.

The areas of the site which have been identified to be development have been defined indicatively, as depicted on this drawing.

An assumed impermeable area in relation to both of the extents identified has then been determined. In this instance, it has been assumed - for preliminary calculation purposed - that the extent of impermeable area in relation to the extents shown would be in the region of 60%.

In view of the above, a 60% impermeable area for the extents defined has been assumed for initial calculations and estimate, which will be refined upon confirmation of a detailed site arrangement.

A259

Ferring Lane

Goring Street

Railway

Singleton Crescent

Indicative Area of Proposed Development

Plan Area = 51,974.873m^2 **(5.20Ha)**

Assumed 60% Impermeable Area = 31,184.92m^2 **(3.12Ha)**

Indicative Area of Proposed Development

Plan Area = 70,461.289m^2 **(7.05Ha)**

Assumed 60% Impermeable Area = 42,276.77m^2 **(4.23Ha)**

1:2500 @ A3

0 20 40 60 80 100 m

NOTES

A3

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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.

N

PLANNING

Rev.	Date	Amendments
A	23/07/2020	Site boundary updated, areas adjusted
-	16/10/2019	Original issue

rgp Design

Transport Planning and Infrastructure Design Consultants
2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF
Tel: 01243 210418 Fax: 01483 861682 www.rgp.co.uk

Client: Persimmon Homes

Project: Land at Chatsmore Farm, Goring

Drawing Title: High Level Impermeable Area Assessment

Scale	Drawn By	Checked By	Approved By
1:2500	SPB	MJA	MJA

Date	Drawing No.	Rev.
October 2019	D1586-PL500	A

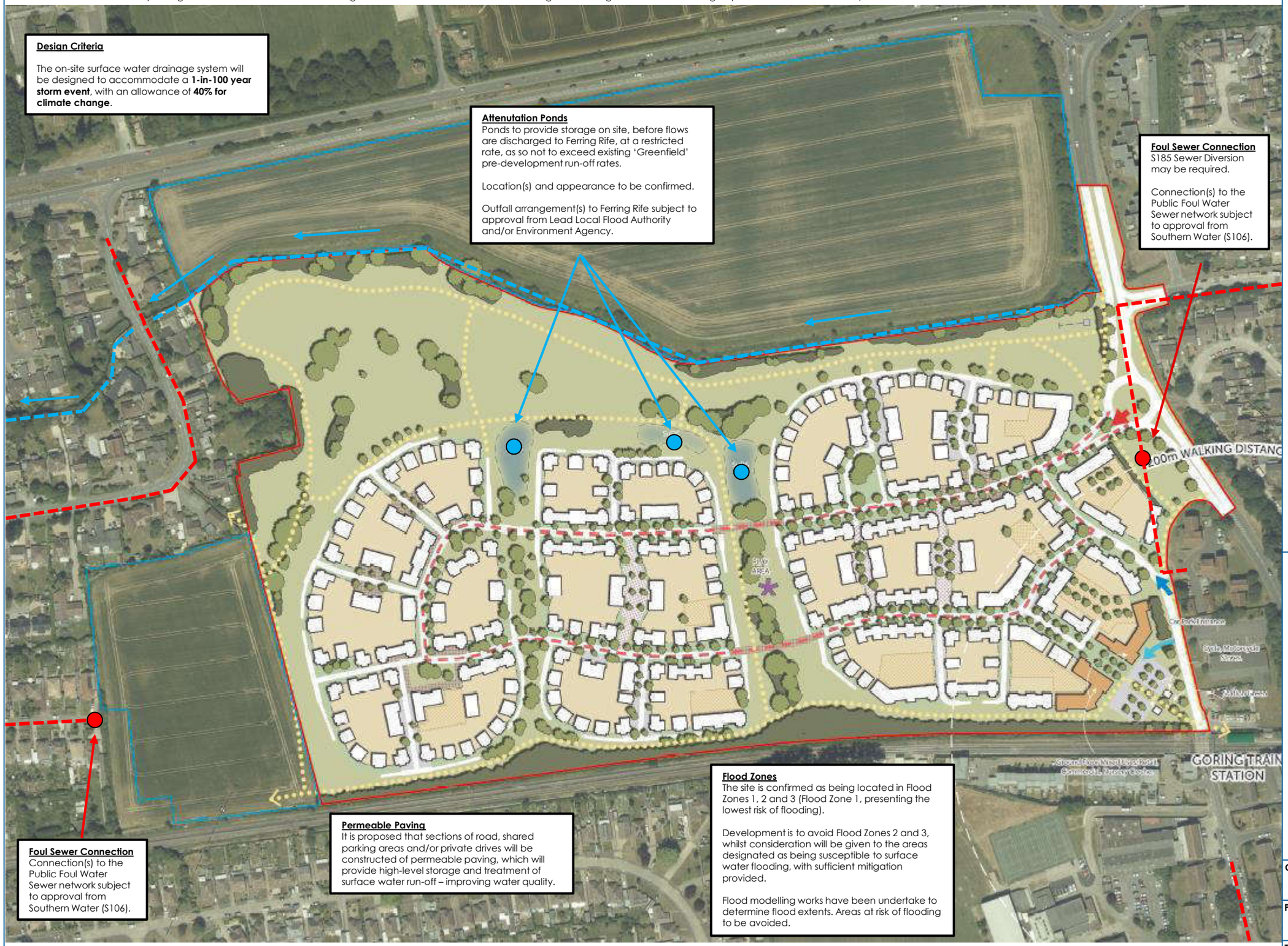
Surface Water Drainage

Surface Water Drainage is to be dealt within in view of the hierarchy as confirmed within The SuDS Manual and Building Regulations, Part H;

1. Utilise infiltration techniques
2. Attenuate rainwater in ponds or open water features for gradual release
3. Attenuate rainwater by storing in tanks or sealed water features for gradual release
4. Discharge rainwater direct to a watercourse
5. Discharge rainwater to a surface water sewer/drain
6. Discharge rainwater to a combined sewer

Groundwater
Owing to anticipated shallow Groundwater, it is unlikely that infiltration methods and techniques will be viable, also given the anticipated underlying geological conditions. Shallow infiltration testing and winter groundwater monitoring required.

Attenuation
It is proposed that surface water run-off will be attenuated on site through sustainable means – with permeable paving providing both treatment (to improve the quality of run-off) as well as high-level storage, along with the introduction of ponds/open water features. It is proposed that such features will then outfall to Ferring Rife (Main River) which crosses the site. Run-off will be restricted to mimic existing greenfield run-off rates, as so not to increase the risk of flooding on, or off site. Betterment in comparison to existing rates to be provided.



Foul Water Drainage

Foul water disposal should adhere to the following hierarchy;

1. Discharge to a Public Sewer
2. Private Treatment Plant
3. Septic Tank and Drainage Field Arrangement
4. Cesspool

It is proposed that the development will utilise connections to Southern Water's public sewer network, with x2 No. points of connection identified; one to the east of the site, which will support development to the eastern extents of the site, with the second to the west of the site, to support the western areas of the development. Diversionary works may be required.

Southern Water Consultation
Southern Water has been consulted in view of the development proposals and are currently undertaking a Feasibility Study to ascertain the impact this will have on their network, as well as identifying any required infrastructure upgrades which may be necessary.

It is anticipated that peak foul flows generated by the development will be in the region of 24.21l/s, based on Sewers for Adoption 7th Edition (based on 4,000l/day)

Connectivity
Connection(s) to Southern Water's Public Sewer Network subject to S106 approval.

LEGEND

- EXISTING PUBLIC FOUL SEWER
- FERRING RIFE (MAIN RIVER)
- SUGGESTED PUBLIC FOUL SEWER CONNECTION POINTS
- INDICATIVE POND LOCATION(S)

BRIGHT PLAN
Transport Planning and Civil Engineering Consultants
Unit 2, West Barn, Norton Lane, Chichester,
West Sussex, PO20 3AF
Tel: 01243 210418 Fax: 01483 861682
www.bpcivils.co.uk

Client:	Persimmon Homes
Project:	Land adjacent to Goring Station
Title:	High Level Drainage Opportunities

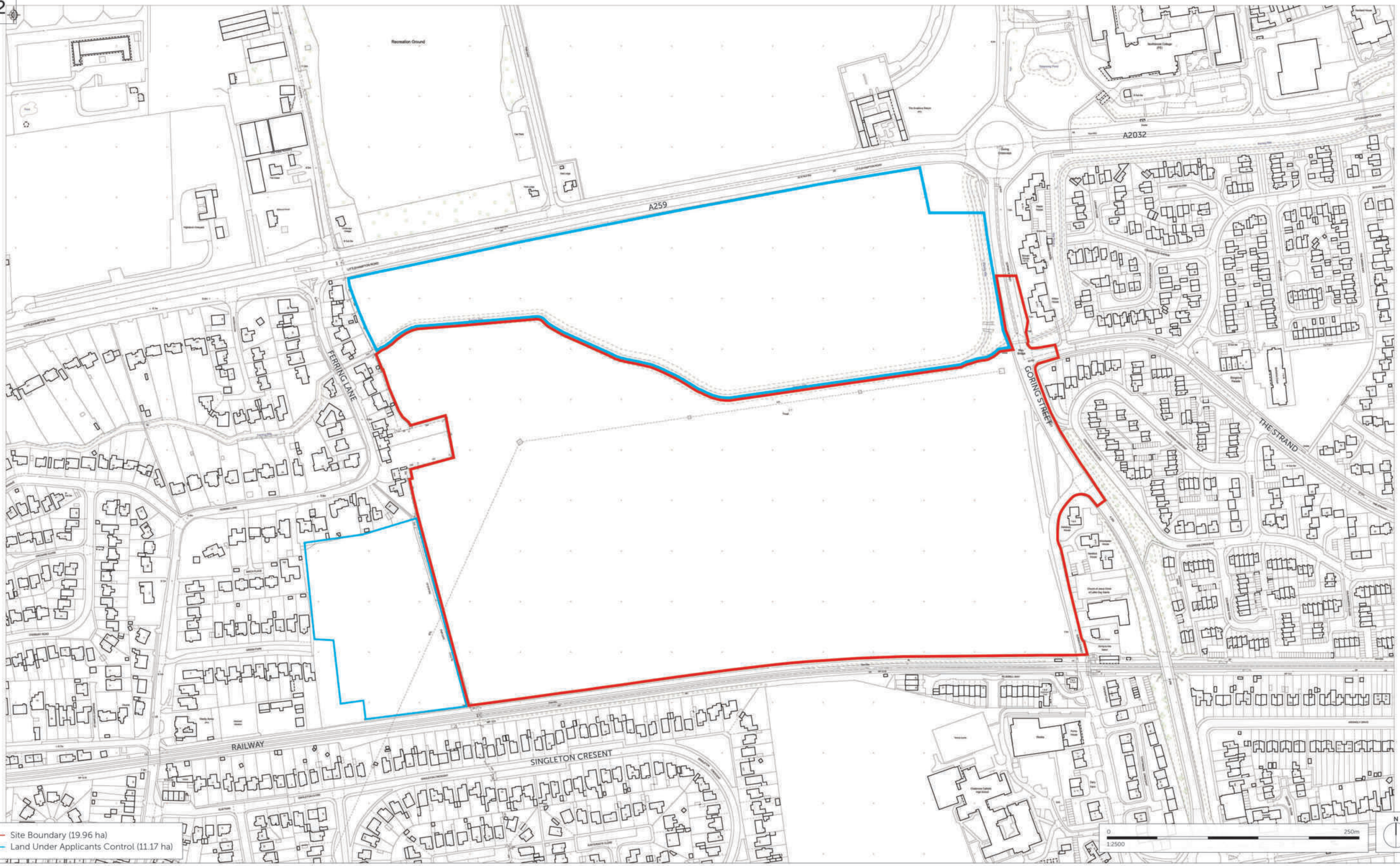
Scale:	Date:	Drawn By:	Checked By:
NTS	October 2019	SPB	MJA

Plan No:	Job No:	Rev:
SK001	D1586	A

APPENDICIES

Appendix A Architect's Conceptual General Arrangement

A2



Romsey Office
Building 300, The Grange,
Romsey Road,
Michelmersh, Romsey,
Hampshire, SO51 0AE.
T:01794 367703 F:01794 367276

Portishead Office
Unit 5, Middle Bridge Business Park,
Bristol Road,
Portishead,
Bristol, BS20 6PN.
T:01275 407000 F:01794 367276

www.thrivearchitects.co.uk

Rev	Description	Date	Au	Ch
P1	Preliminary Issue	03.02.20	PM/dr	--/--
P2	Revised Redline	12.02.20	PM/dr	--/--
P3	Revised Redline	29.06.20	MB/aa	MB/--
P4	Revised Redline	14.07.20	MB/aa	MB/--
P5	Adjustment to Area Totals	15.07.20	MB/aa	MB/--

Project	**Goring Station**				
Drawing	**Site Location Plan - 02**				
Client	**PERSIMMON (THAMES VALLEY)**				
Job no.	**PERS190227PJ**			Date	**03.02.20**
Dwg no.	**SLP-02**			Rev.	**P5**
Author	**PM/dr**	Checked	**-/-**	Scale	**1:2500@A2**
Status	**PRELIMINARY**			Office	**Romsey**
Client ref.	**-**				

thrive. architects

A1

SuDS
SuDS
SuDS
PLAY AREA
200m WALKING DISTANCE
Car Park Entrance
Cycle, Motorcycle Stores.
Station Green
Ground Floor Mixed Uses/Retail, Commercial, Nursery Creche.
GORING TRAIN STATION
N
0 (1:1250) 50m 100m

NOTES

Contractors, Sub-contractors and suppliers are to check all relevant dimensions and levels of the site and building before commencing any shop drawings or building work. Any discrepancies should be recorded to the Architect.
Where applicable this drawing is to be read in conjunction with the Consultants' drawings.

REV	DESCRIPTION	DATE	AUTHOR	CHK'D
P1	Preliminary Issue	12/06/19	PM/SWD	MB
P2	Amendments to Layout	19/06/20	MB/aa	MB
P3	Amendments to Layout	26/06/20	MB/aa	MB
P4	Amendments to Layout	29/06/20	MB/aa	MB
P5	Amendments to Layout and Redline Boundary	10/07/20	MB/aa	MB
P6	Amendments Boundaries	15/07/20	MB/aa	MB

KEY

- Site Boundary (19.96 Ha)
- Land in Applicant's Control (11.17 Ha)
- Proposed Development Parcels
- Indicative Development Units
- Mixed Use Development Blocks
- Key Space
- Shared Surface
- Courtyard
- Mews Lane
- Parkland
- Open Space
- Sustainable Drainage Strategy (SuDS)
- Existing Vegetation
- Proposed Vegetation
- Proposed Planting to Northern Boundary
- Potential New Pedestrian Route
- Principal Vehicular Access Point
- Principal Vehicular Route
- Potential Location of Play Area
- 200m Walking Distance from Goring Station
- Existing High Voltage Cable
- Pylon Grounded
- Potential Secondary Access
- Proposed Car Park Entrance

thrive. architects
Romsey Office
Building 300, The Grange, Romsey Road, Michelmersh, SO51 0AE
t: 01794 367703 f: 01794 367276 www.thrivearchitects.co.uk

PROJECT
Goring Station
Goring-on-Sea
For: Persimmon Thames Valley

DRAWING
Concept Masterplan - 02

SCALE	DATE	AUTHOR	CHK'D
1:1250 @ A1	12/06/19	PM/SWD	PM

JOB NO.	DRAWING NO.	REV
PERS190227	CMP-02	P6

Appendix B Southern Water Public Sewer Records

Appendix C British Geological Survey Records

TQ 10 SE [illegible] / 186

SITE	[illegible] Bridge	LOCATION	[illegible]	BOREHOLE [illegible]
CLIENT	West Sussex County Council	GROUND LEVEL	[illegible] A.O.D.	SHEET 1 OF 1

DAILY PROGRESS (CASING)	DEPTH TO WATER	S.P.T. RESULT	SAMPLES AND TESTS DEPTH FROM	DEPTH TO	TYPE	DEPTH (THICKNESS)	LEGEND	REDUCED LEVEL	DESCRIPTION
	m		m	m		m		m	GROUND LEVEL
11.1.86						0.2		[illegible]	TOPSOIL
			0.5		D				
		4,7	1.2	1.65	U[illegible]				Firm brown silty CLAY
						(2.1)			
		11	1.7		D				
		8	2.4	2.85	SPT				
						2.3		[illegible]	
			3.0		D				
			3.[illegible]	3.7[illegible]	[illegible]				CHALK - GRADE II with FLINTS
			3.7		D	(2.7)			
			4.1		D				
			4.75	5.05	[illegible]				
5.0m	Dry		5.05		D	5.0		[illegible]	
									End of borehole

REMARKS: [illegible] [illegible] 1750
Chalk classified on the basis of S.P.T. results according to Wakeling (1965)

TYPE OF BORING	Light cable tool percussion
DIAMETER	150mm
START 11.1.86	FINISH 11.1.86
LOGGED BY	[illegible]
REPORT No.	[illegible]

GROUND EXPLORATIONS LIMITED

Appendix D British Geological Survey Infiltration SuDS GeoReport

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

GeoReports

Stuart Burnett
RGP Design Ltd
2 West Barn
Norton Land
Chichester
West Sussex
PO20 3AF

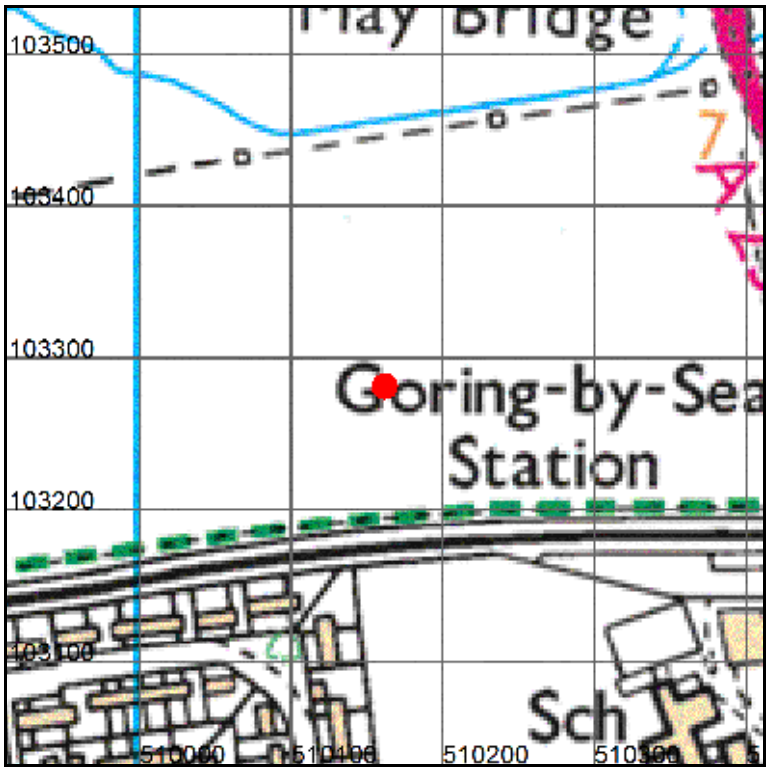
Infiltration SuDS GeoReport:

This report provides information on the suitability of the subsurface for the installation of infiltration sustainable drainage systems (SuDS). It provides information on the properties of the subsurface with respect to significant constraints, drainage, ground stability and groundwater quality protection.

Report Id: ***GR_219590/1***

Client reference: D1586 Land Adjacent to Goring Station

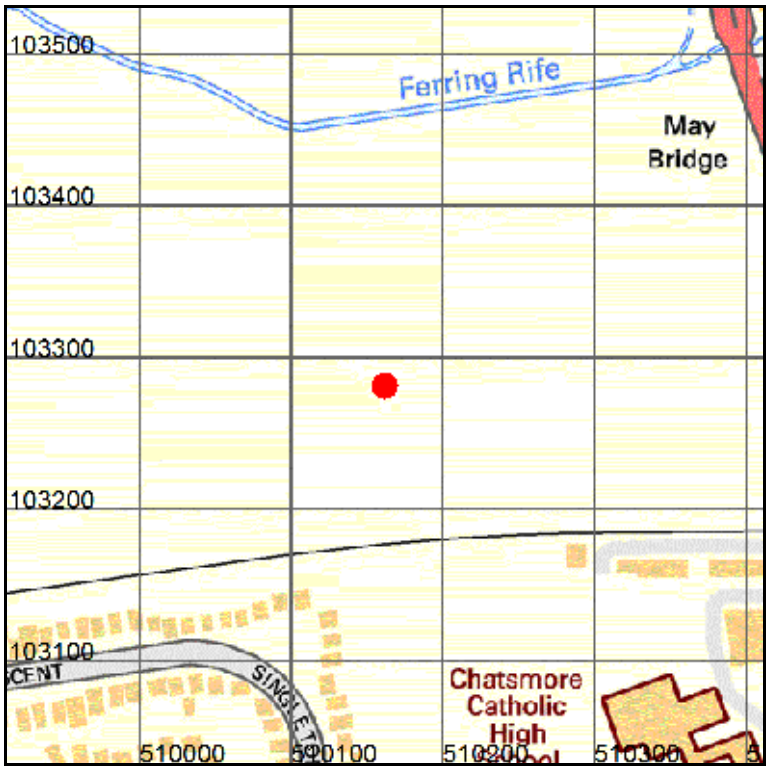
Search location



Point centred at:
510162,103281

Search location indicated in red

Scale: 1:5 000 (1cm = 50 m)



OS Street View: Scale: 1:5 000 (1cm = 50 m)

Assessment for an infiltration sustainable drainage system

Introduction

Sustainable drainage systems (SuDS) are drainage solutions that manage the volume and quality of surface water close to where it falls as rain. They aim to reduce flow rates to rivers, increase local water storage capacity and reduce the transport of pollutants to the water environment. There are four main types of SuDS, which are often designed to be used in sequence. They comprise:

- **source control:** systems that control the rate of runoff
- **pre-treatment:** systems that remove sediments and pollutants
- **retention:** systems that delay the discharge of water by providing surface storage
- **infiltration:** systems that mimic natural recharge to the ground.

This report focuses on infiltration SuDS. It provides subsurface information on the properties of the ground with respect to drainage, ground stability and groundwater quality protection. It is intended principally for those involved in the preliminary assessment of the suitability of the ground for infiltration SuDS, and those involved in assessing proposals from others for sustainable drainage, but it may also be useful to help house-holders judge whether or not further professional advice should be sought. If in doubt, users should consult a suitably-qualified professional about the results in this report before making any decisions based upon it.

This GeoReport is structured in two parts:

- **Part 1. Summary data**.

  Comprises three maps that summarise the data contained within Part 2.

- **Part 2. Detailed data**.

  Comprises a further 24 maps in four thematic sections:

  - **Very significant constraints.** Maps highlight areas where infiltration may result in adverse impacts due to factors including: ground instability (soluble rocks, non-coal shallow mining and landslide hazards); persistent shallow groundwater, or the presence of made ground, which may represent a ground stability or contamination hazard.
  - **Drainage potential**. Maps indicate the drainage potential of the ground, by considering subsurface permeability, depth to groundwater and the presence of floodplain deposits.
  - **Ground stability**. Maps indicate the presence of hazards that have the potential to cause ground instability resulting in damage to some buildings and structures, if water is infiltrated to the ground.
  - **Groundwater protection**. Maps provide key indicators to help determine whether the groundwater may be susceptible to deterioration in quality as a result of infiltration.

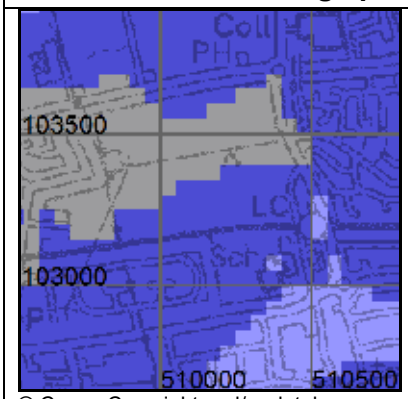
This report considers the suitability of the subsurface for the installation of infiltration SuDS, such as soakaways, infiltration basins or permeable pavements. It provides subsurface data to indicate whether, and which type of infiltration system may be appropriate. It does not state that infiltration SuDS are, or are not, appropriate as this is highly dependent on the design of the individual system. This report therefore describes the subsurface conditions at the site, allowing the reader to determine the suitability of the site for infiltration SuDS.

The map and text data in this report is similar to that provided in the '*Infiltration SuDS Map: Detailed'* national map product. For further information about the data, consult the '*User Guide for the Infiltration SuDS Map: Detailed'*, available from http://nora.nerc.ac.uk/16618/.

PART 1: SUMMARY DATA

This section provides a summary of the data on the following pages.

In terms of the drainage potential, is the ground suitable for infiltration SuDS?

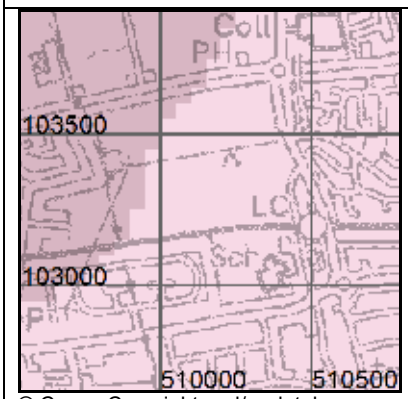


- Highly compatible for infiltration SuDS.
  The subsurface is likely to be suitable for free-draining infiltration SuDS.
- Probably compatible for infiltration SuDS.
  The subsurface is probably suitable although the design may be influenced by the ground conditions.
- Opportunities for bespoke infiltration SuDS.
  The subsurface is potentially suitable although the design will be influenced by the ground conditions.
- Very significant constraints are indicated.
  There is a very significant potential for one or more hazards associated with infiltration.

Is ground instability likely to be a problem?

- Increased infiltration is very unlikely to result in ground instability.
- Ground instability problems may be present or anticipated, but increased infiltration is unlikely to result in ground instability
- Ground instability problems are probably present. Increased infiltration may result in ground instability.
- There is a very significant potential for one or more geohazards associated with infiltration.

Is the groundwater susceptible to deterioration in quality?



- The groundwater is not expected to be especially vulnerable to contamination.
- The groundwater may be vulnerable to contamination.
- The groundwater is likely to be vulnerable to contaminants.
- Made ground is present at the surface. Infiltration may increase the possibility of remobilising pollutants.

PART 2: DETAILED DATA

This section provides further information about the properties of the ground and will help assess the suitability of the ground for infiltration SuDS.

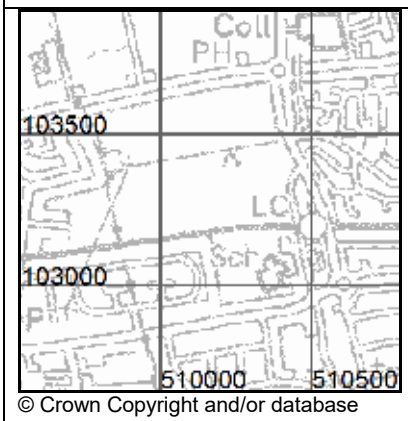
Section 1. Very significant constraints

Where maps are overlain by grey polygons, geological or hydrogeological hazards may exist that could be made worse by infiltration. The following hazards are considered:

- soluble rocks
- landslides
- shallow mining
- shallow groundwater
- made ground

For more information read 'Explanation of terms' at the end of this report.

Soluble rock hazard

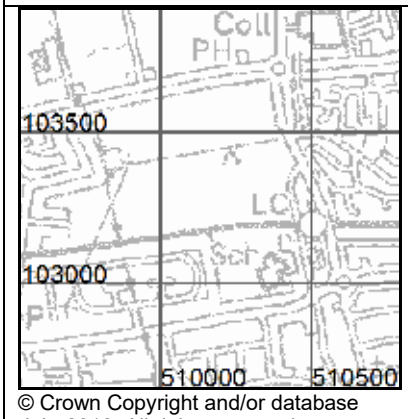


■ Very significant soluble rock hazard.

Soluble rocks are present with a very significant possibility of localised subsidence that could be initiated or made worse by infiltration. The site investigation should consider whether the potential for or the consequences of subsidence as a result of infiltration are significant.

☐ Very significant soluble rock hazards are not present; however this hazard may still need to be considered. See Part 3.

Landslide hazard

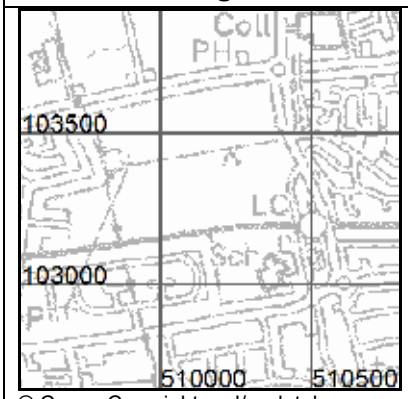


■ Very significant landslide hazard.

Slope instability problems are almost certainly present and may be active. An increase in moisture content as a result of infiltration may cause the slope to fail. The site investigation should consider whether the potential for or the consequences of landslide as a result of infiltration are significant.

☐ Very significant landslide hazards are not present; however this hazard may still need to be considered. See Part 3.

Shallow mining hazard

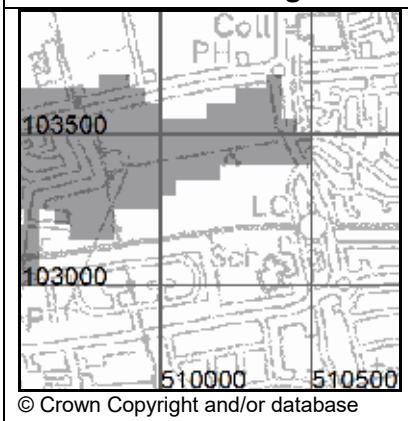


☒ Very significant mining hazard.

Shallow mining is likely to be present with a very significant possibility of localised subsidence that could be initiated or made worse by increased infiltration. Also, infiltration may increase the possibility of remobilising pollutants. The site investigation should consider whether the potential for or consequences of subsidence and/or remobilisation of pollutants as a result of infiltration are significant.

☐ Very significant mining hazards are not present; however this hazard may still need to be considered. See Part 3.

Persistent shallow groundwater

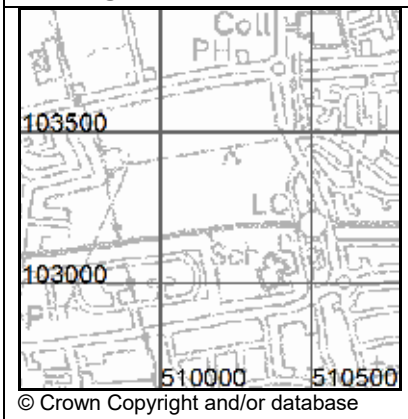


☒ Very high likelihood of persistent or seasonally shallow groundwater.

Persistent or seasonally shallow groundwater is likely to be present. Infiltration may increase the likelihood of soakaway inundation, or groundwater emergence at the surface. The site investigation should consider whether the potential for or the consequences of groundwater level rise as a result of infiltration are significant.

☐ See Part 2 for the likely depth to water table.

Made ground



☒ Made ground present.

Made ground is present at the surface. Infiltration may affect ground stability or increase the possibility of remobilising pollutants. The site investigation should consider whether the potential for or consequences of ground instability and/or pollutant leaching as a result of infiltration are significant.

☐ None recorded

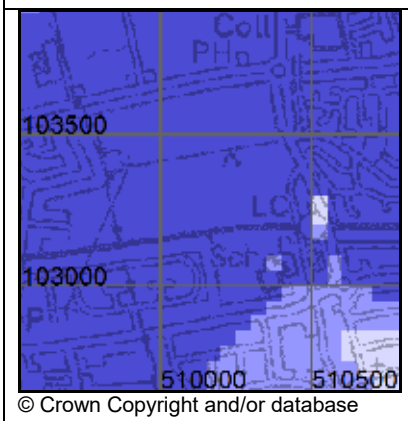
Section 2. Drainage potential

The following pages contain maps that will help you assess the drainage potential of the ground by considering the:

- depth to water table
- permeability of the superficial deposits
- thickness of the superficial deposits
- permeability of the bedrock
- presence of floodplains

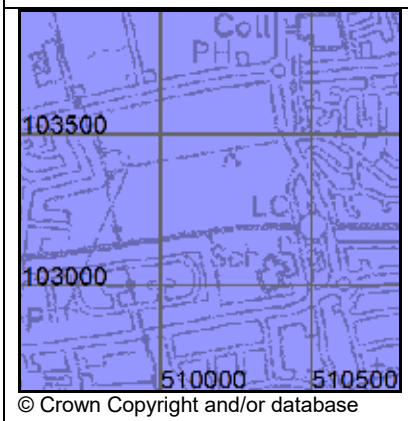
Superficial deposits are not present everywhere and therefore some areas of the *superficial deposit permeability* map may not be coloured. Where this is the case, the *bedrock permeability* map shows the likely permeability of the ground. Superficial deposits in some places are very thin and hence in these places you may wish to consider both the permeability of the superficial deposits and the permeability of the bedrock. The *superficial thickness* map will tell you whether the superficial deposits are thin (< 3 m thick) or thick (>3 m). Where they are over 3 m thick, the permeability of the bedrock may not be relevant.
For more information read 'Explanation of terms' at the end of this report.

Depth to groundwater table



	Groundwater is likely to be **more than 5 m** below the ground surface throughout the year.
	Groundwater is likely to be between **3 and 5 m** below the ground surface for at least part of the year.
	Groundwater is likely to be **less than 3 m** below the ground surface for at least part of the year.

Superficial deposit permeability



Superficial deposits are likely to be **free-draining**.

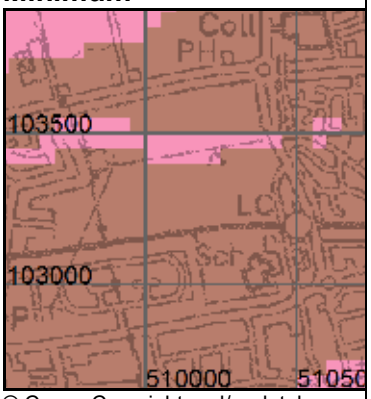
The superficial deposit permeability is **spatially variable**, but likely to permit moderate infiltration.

Superficial deposits are likely to be **poorly draining**.

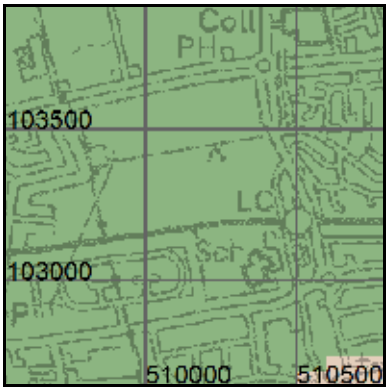
These maps show the permeability range that is summarised above.

- Very Low
- Low
- Moderate
- High
- Very High

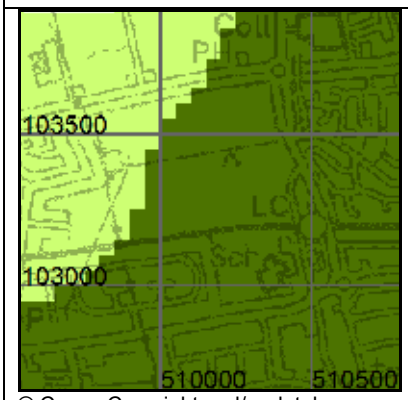
Minimum



Maximum



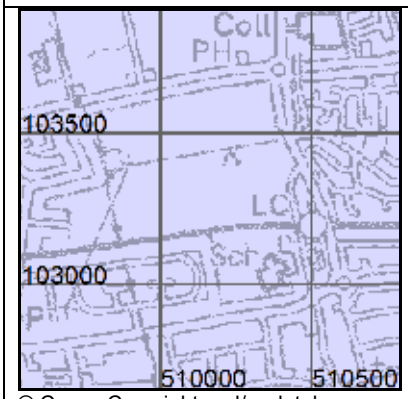
Superficial deposit thickness



The thickness of superficial deposits is **< 3 m** and hence the permeability of the ground may be dependent on both the superficial deposits (where present) and underlying bedrock (see below).

The thickness of superficial deposits is **> 3 m** and hence the permeability of the superficial deposits is likely to determine the permeability of the ground.

Bedrock permeability



Bedrock deposits are likely to be **free-draining**.

The bedrock permeability is **spatially variable**, but likely to permit moderate infiltration.

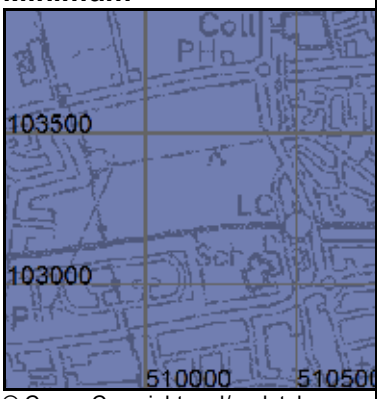
Bedrock deposits are likely to be **poorly draining**.

These maps show the permeability range that is summarised above.

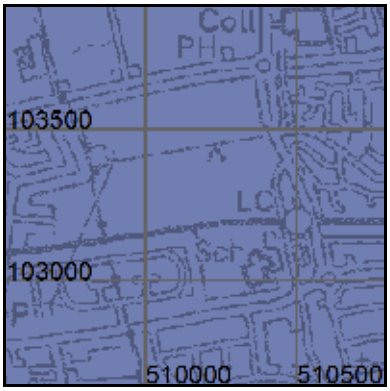
Key

- Very Low
- Low
- Moderate
- High
- Very High

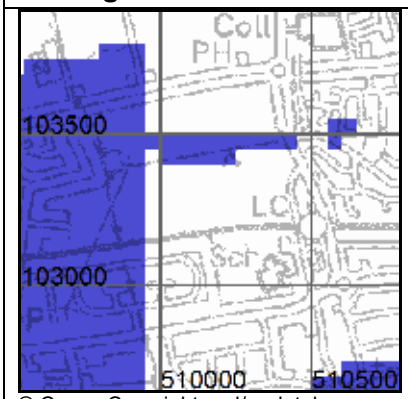
Minimum



Maximum



Geological indicators of flooding



Superficial floodplain deposits or low-lying coastal areas have been identified. Groundwater levels may rise in response to high river or tide levels, potentially causing inundation of subsurface infiltration SuDS.

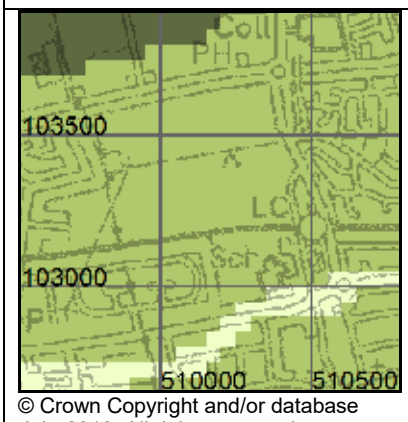
Section 3. Ground stability

The following pages contain maps that will help you assess whether infiltration may impact the stability of the ground. They consider hazards associated with:

- soluble rocks
- landslides
- shallow mining
- running sands
- swelling clays
- compressible ground, and
- collapsible ground

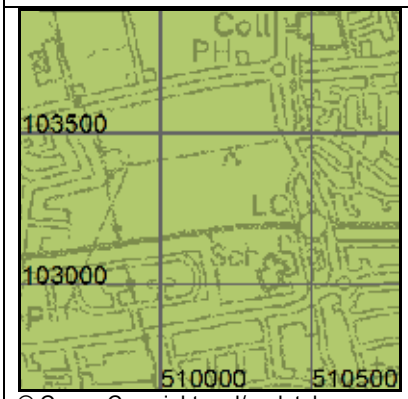
In the following maps, geohazards that are identified in green are unlikely to prevent infiltration SuDS from being installed, but they should be considered during design. For more information read 'Explanation of terms' at the end of this report.

Soluble rocks



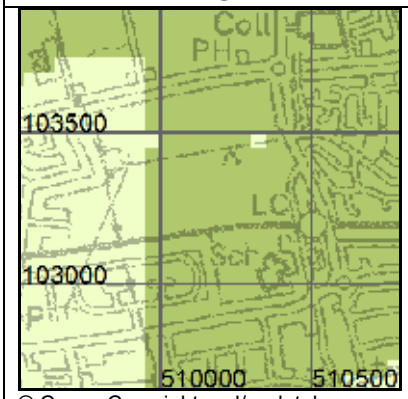
	Increased infiltration is unlikely to result in subsidence.
	Increased infiltration is unlikely to cause localised subsidence, but potential impacts should be considered.
	Increased infiltration may result in localised subsidence. The potential for or the consequences of subsidence associated with soluble rocks should be considered.
	Very significant possibility of localised subsidence that could be initiated or made worse by infiltration.

Landslides



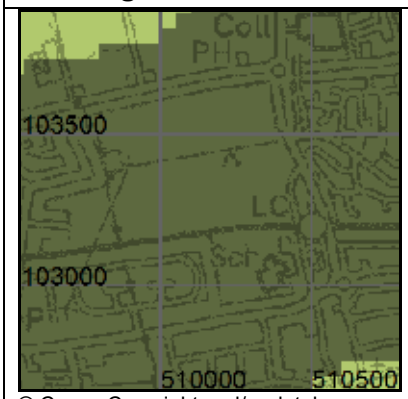
- Increased infiltration is unlikely to lead to slope instability.
- Slope instability problems may be present or anticipated, but increased infiltration is unlikely to cause instability
- Slope instability problems are probably present or have occurred in the past, and increased infiltration may result in slope instability.
- Slope instability problems are almost certainly present and may be active. An increase in moisture content as a result of infiltration may cause the slope to fail.

Shallow mining



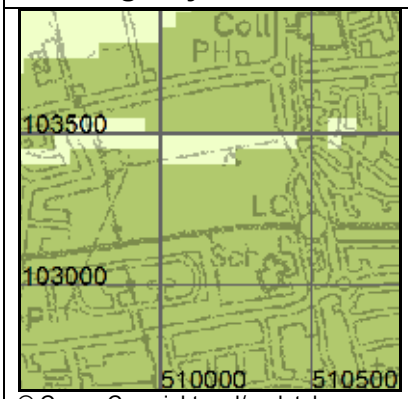
- Increased infiltration is unlikely to lead to subsidence.
- Shallow mining is possibly present. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Shallow mining could be present with a significant possibility that localised subsidence could be initiated or made worse by increased infiltration.
- Shallow mining is likely to be present, with a very significant possibility that localised subsidence may be initiated or made worse by increased infiltration.

Running sand



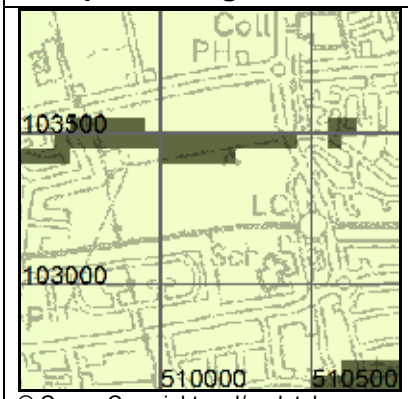
- Increased infiltration is unlikely to cause ground collapse associated with running sands.
- Running sand is possibly present. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Significant possibility for running sand problems. Increased infiltration may result in a geohazard.

Swelling clays



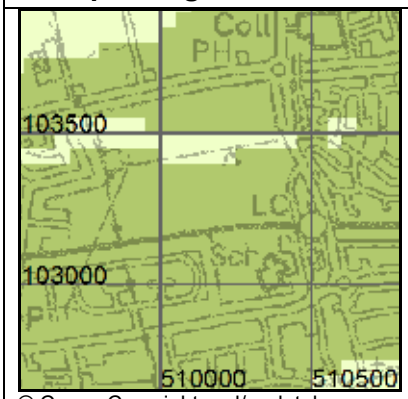
- Increased infiltration is unlikely to cause shrink-swell ground movement.
- Ground is susceptible to shrink-swell ground movement. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Ground is susceptible to shrink-swell ground movement. Increased infiltration may result in a geohazard.

Compressible ground



- Increased infiltration is unlikely to lead to ground compression.
- Compressibility and uneven settlement hazards are probably present. Increased infiltration may result in a geohazard.

Collapsible ground



- Increased infiltration is unlikely to result in subsidence.
- Deposits with potential to collapse when loaded and saturated are possibly present in places. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Deposits with potential to collapse when loaded and saturated are probably present in places. Increased infiltration may result in a geohazard.

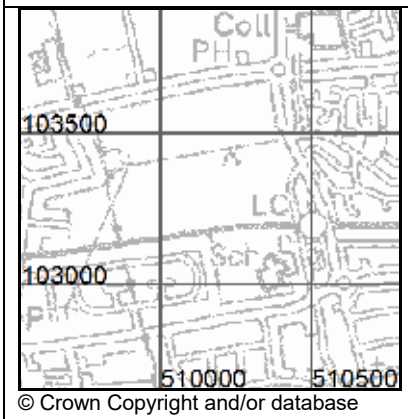
Section 4. Groundwater quality protection

The following pages contain maps showing some of the information required to ensure the protection of groundwater quality. Data presented includes:

- groundwater source protection zones (Environment Agency data)
- predominant flow mechanism
- made ground

For more information read 'Explanation of terms' at the end of this report.

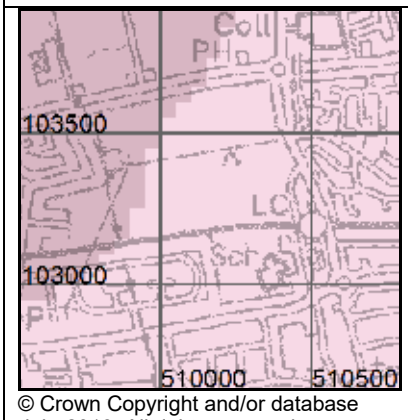
Groundwater source protection zones



Derived in part from Source Protection Zone data provided under licence from the Environment Agency © Environment Agency 2018.

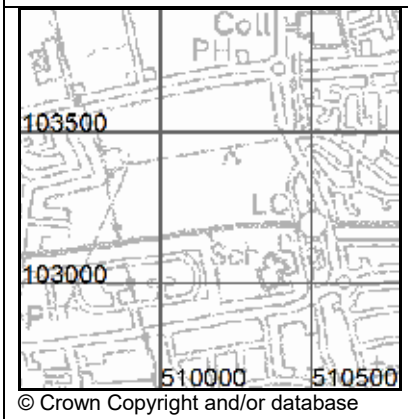
- Groundwater is not within a source protection zone.
- Source protection zone IV
- Source protection zone III
- Source protection zone II
- Source protection zone I.

Predominant flow mechanism



- Water is likely to percolate through the unsaturated zone to the groundwater through either the pore space in granular media or through porespace and fractures; these processes have some potential for contaminant removal and breakdown.
- Water is likely to percolate through the unsaturated zone to the groundwater through fractures, a process which has little potential for contaminant removal and breakdown.

Made ground

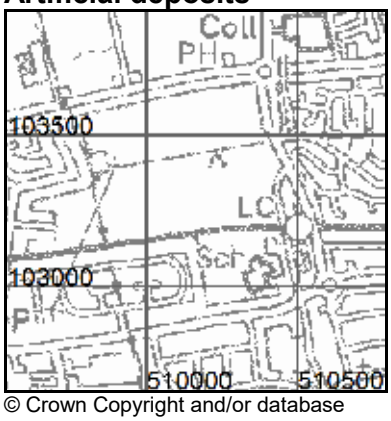


Made ground is present at the surface. Infiltration may increase the possibility of remobilising pollutants.

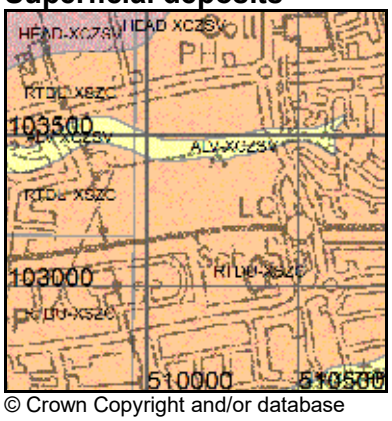
Section 5. Geological Maps

The following maps show the artificial, superficial and bedrock geology within the area of interest.

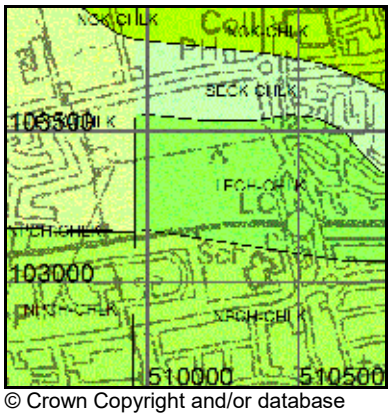
Artificial deposits



Superficial deposits



Bedrock



Fault

Coal, ironstone or mineral vein

Note: Faults and Coals, ironstone & mineral veins are shown for illustration and to aid interpretation of the map. Not all such features are shown and their absence on the map face does not necessarily mean that none are present

Key to Artificial deposits:
No deposits recorded by BGS in the search area

Key to Superficial deposits:

Map colour	Computer Code	Rock name	Rock type
	ALV-XCZSP	ALLUVIUM	CLAY, SILT, SAND AND PEAT
	ALV-XCZSV	ALLUVIUM	CLAY, SILT, SAND AND GRAVEL
	HEAD-XCZSV	HEAD	CLAY, SILT, SAND AND GRAVEL
	RTDU-XSZC	RIVER TERRACE DEPOSITS (UNDIFFERENTIATED)	SAND, SILT AND CLAY

Key to Bedrock geology:

Map colour	Computer Code	Rock name	Rock type
	TACH-CHLK	TARRANT CHALK MEMBER	CHALK
	NCK-CHLK	NEWHAVEN CHALK FORMATION	CHALK
	SECK-CHLK	SEAFORD CHALK FORMATION	CHALK
	LECH-CHLK	LEWES NODULAR CHALK FORMATION	CHALK
	LPCK-CHLK	LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMATION, NEWHAVEN CHALK FORMATION, CULVER CHALK FORMATION AND PORTSDOWN CHALK FORMATION (UNDIFFERENTIATED)	CHALK
	NPCH-CHLK	NEW PIT CHALK FORMATION	CHALK

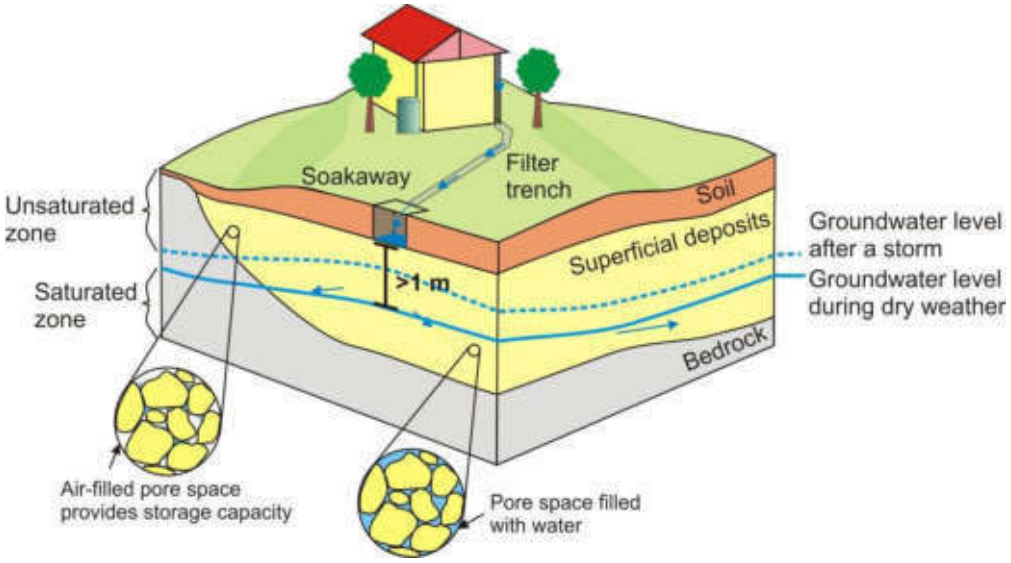
Limitations of this report:

- This report is concerned with the potential for infiltration-to-the-ground to be used as a SuDS technique at the site described. It only considers the subsurface beneath the search area and does NOT consider potential surface or subsurface impacts outside of that area.
- This report is NOT an alternative for an on-site investigation or soakaway test, which might reach a different conclusion.
- This report must NOT be used to justify disposal of foul waste or grey water.
- This report is based on and limited to an interpretation of the records held by the British Geological Survey (BGS) at the time the search is performed. The datasets used (with the exception of that showing depth to water table) are based on 1:50 000 digital geological maps and not site-specific data.
- Other more specific and detailed ground instability information for the site may be held by BGS, and an assessment of this could result in a modified assessment.
- To interpret the maps correctly, the report must be viewed and printed in colour.
- The search does NOT consider the suitability of sites with regard to:
    - previous land use,
    - potential for, or presence of contaminated land
    - presence of perched water tables
    - shallow mining hazards relating to coal mining. Searches of coal mining should be carried out via The Coal Authority Mine Reports Service: www.coalminingreports.co.uk.
    - made ground, where not recorded
    - proximity to landfill sites (searches for landfill sites or contaminated land should be carried out through consultation with local authorities/Environment Agency)
    - zones around private water supply boreholes that are susceptible to groundwater contamination.
- This report is supplied in accordance with the GeoReports Terms & Conditions available separately, and the copyright restrictions described at the end of this report

Explanation of terms

Depth to groundwater

In the shallow subsurface, the ground is commonly unsaturated with respect to water. Air fills the spaces within the soil and the underlying superficial deposits and bedrock. At some depth below the ground surface, there is a level below which these spaces are full of water. This level is known as the groundwater level, and the water below it is termed the groundwater. When water is infiltrated, the groundwater level may rise temporarily. To ensure that there is space in the unsaturated zone to accommodate this, there should be a minimum thickness of 1 m between the base of the infiltration system and the water table. An estimate of the *depth to groundwater* is therefore useful in determining whether the ground is suitable for infiltration.



Groundwater flooding

Groundwater flooding occurs when a rise in groundwater level results in very shallow groundwater or the emergence of groundwater at the surface. If infiltration systems are installed in areas that are susceptible to groundwater flooding, it is possible that the system could become inundated. The susceptibility map seeks to identify areas where the geological conditions and water tables indicate that groundwater level rise could occur under certain circumstances. A high susceptibility to groundwater flooding classification does not mean that groundwater flooding has ever occurred in the past, or will do so in the future as the susceptibility maps do not contain information on how often flooding may occur. The susceptibility maps are designed for planning; identifying areas where groundwater flooding might be an issue that needs to be taken into account.

Geological indicators of flooding
In floodplain deposits, groundwater level can be influenced by the water level in the adjacent river. Groundwater level may increase during periods of fluvial flood and therefore this should be taken into account when designing infiltration systems on such deposits. The *geological indicators of flooding* dataset shows where there is geological evidence (floodplain deposits) that flooding has occurred in the past.

For further information on flood-risk, the likely frequency of its recurrence in relation to any proposed development of the site, and the status of any flood prevention measures in place, you are advised to contact the local office of the Environment Agency (England and Wales) at www.environment-agency.gov.uk/ or the Scottish Environment Protection Agency (Scotland) at www.sepa.org.uk.

Artificial ground
Artificial ground comprises deposits and excavations that have been created or modified by human activity. It includes ground that is worked (quarries and road cuttings), infilled (back-filled quarries), landscaped (surface re-shaping), disturbed (near surface mineral workings) or classified as made ground (embankments and spoil heaps). The composition and properties of artificial ground are often unknown. In particular, the permeability and chemical composition of the artificial ground should be determined to ensure that the ground will drain and that any contaminants present will not be remobilised.

Superficial permeability
Superficial deposits are those geological deposits that were formed during the most recent period of geological time (as old as 2.6 million years before present). They generally comprise relatively thin deposits of gravel, sand, silt and clay and are present beneath the pedological soil in patches or larger spreads over much of Britain. The ease with which water can percolate through these deposits is controlled by their permeability and varies widely depending on their composition. Those deposits comprising clays and silts are less permeable and thus infiltration is likely to be slow, such that water may pool on the surface. In comparison, deposits comprising sands and gravels are more permeable allowing water to percolate freely.

Bedrock permeability
Bedrock forms the main mass of rock forming the Earth. It is present everywhere, commonly beneath superficial deposits. Where the superficial deposits are thin or absent, the ease with which water will percolate into the ground depends on the permeability of the bedrock.

Natural ground instability

Natural ground instability refers to the propensity for upward, lateral or downward movement of the ground that can be caused by a number of natural geological hazards (e.g. ground dissolution/compressible ground). Some movements associated with particular hazards may be gradual and of millimetre or centimetre scale, whilst others may be sudden and of metre or tens of metres scale. Significant natural ground instability has the potential to cause damage to buildings and structures, especially when the drainage characteristics of a site are altered. It should be noted, however, that many buildings, particularly more modern ones, are built to such a standard that they can remain unaffected in areas of significant ground movement.

Shrink-swell

A shrinking and swelling clay changes volume significantly according to how much water it contains. All clay deposits change volume as their water content varies, typically swelling in winter and shrinking in summer, but some do so to a greater extent than others. Contributory circumstances could include drought, leaking service pipes, tree roots drying-out the ground or changes to local drainage patterns, such as the creation of soakaways. Shrinkage may remove support from the foundations of buildings and structures, whereas clay expansion may lead to uplift (heave) or lateral stress on part or all of a structure; any such movements may cause cracking and distortion.

Landslides (slope stability)

A landslide is a relatively rapid outward and downward movement of a mass of ground on a slope, due to the force of gravity. A slope is under stress from gravity but will not move if its strength is greater than this stress. If the balance is altered so that the stress exceeds the strength, then movement will occur. The stability of a slope can be reduced by removing ground at the base of the slope, by placing material on the slope, especially at the top, or by increasing the water content of the materials forming the slope. Increase in subsurface water content beneath a soakaway could increase susceptibility to landslide hazards. The assessment of landslide hazard refers to the stability of the present land surface. It does not encompass a consideration of the stability of excavations.

Soluble rocks (dissolution)

Some rocks are soluble in water and can be progressively removed by the flow of water through the ground. This process tends to create cavities, potentially leading to the collapse of overlying materials and possibly subsidence at the surface. The release of water into the subsurface from infiltration systems may increase the dissolution of rock or destabilise material above or within a cavity. Dissolution cavities may create a pathway for rapid transport of contaminated water to an aquifer or water course.

Compressible ground
Many ground materials contain water-filled pores (the spaces between solid particles). Ground is compressible if a building (or other load) can cause the water in the pore space to be squeezed out, causing the ground to decrease in thickness. If ground is extremely compressible the building may sink. If the ground is not uniformly compressible, different parts of the building may sink by different amounts, possibly causing tilting, cracking or distortion. The compressibility of the ground may alter as a result of changes in subsurface water content caused by the release of water from soakaways.

Collapsible deposits
Collapsible ground comprises certain fine-grained materials with large pore spaces (the spaces between solid particles). It can collapse when it becomes saturated by water and/or a building (or other structure) places too great a load on it. If the material below a building collapses it may cause the building to sink. If the collapsible ground is variable in thickness or distribution, different parts of the building may sink by different amounts, possibly causing tilting, cracking or distortion. The subsurface underlying a soakaway will experience an increase in water content that may affect the stability of the ground. This hazard is most likely to be encountered only in parts of southern England.

Running sand
Running sand conditions occur when loosely-packed sand, saturated with water, flows into an excavation, borehole or other type of void. The pressure of the water filling the spaces between the sand grains reduces the contact between the grains and they are carried along by the flow. This can lead to subsidence of the surrounding ground. Running sand is potentially hazardous during the drainage system installation. During installation, excavation of the ground may create a space into which sand can flow, potentially causing subsidence of surrounding ground.

Shallow mining hazards (non coal)
Current or past underground mining for coal or for other commodities can give rise to cavities at shallow or intermediate depths, which may cause fracturing, general settlement, or the formation of crown-holes in the ground above. Spoil from mineral workings may also present a pollution hazard. The release of water into the subsurface from soakaways may destabilise material above or within a cavity. Cavities arising as a consequence of mining may also create a pathway for rapid transport of contaminated water to an aquifer or watercourse. The mining hazards map is derived from the geological map and considers the potential for subsidence associated with mining on the basis of geology type. Therefore if mining is known to occur within a certain rock, the map will highlight the potential for a hazard within the area covered by that geology.

For more information regarding underground and opencast **coal mining**, the location of mine entries (shafts and adits) and matters relating to subsidence or other ground movement induced by **coal mining** please contact the Coal Authority, Mining Reports, 200 Lichfield Lane, Mansfield, Nottinghamshire, NG18 4RG; telephone 0845 762 6848 or at www.coal.gov.uk**.** For more information regarding other types of mining (i.e. non-coal), please contact the British Geological Survey.

Groundwater source protection zones

In England and Wales, the Environment Agency has defined areas around wells, boreholes and springs that are used for the abstraction of public drinking water as source protection zones. In conjunction with Groundwater Protection Policy the zones are used to restrict activities that may impact groundwater quality, thereby preventing pollution of underlying aquifers, such that drinking water quality is upheld. The Environment Agency can provide advice on the location and implications of source protection zones in your area (www.environment-agency.gov.uk/)

Contact Details

Keyworth Office
British Geological Survey
Environmental Science Centre
Nicker Hill
Keyworth
Nottingham
NG12 5GG
Tel: 0115 9363143
Fax: 0115 9363276
Email: enquiries@bgs.ac.uk

Wallingford Office
British Geological Survey
Maclean Building
Wallingford
Oxford
OX10 8BB
Tel: 01491 838800
Fax: 01491 692345
Email: hydroenq@bgs.ac.uk

Edinburgh Office
British Geological Survey
Lyell Centre
Research Avenue South
Edinburgh
EH14 4AP
Tel: 0131 6671000
Email: enquiry@bgs.ac.uk

Terms and Conditions

General Terms & Conditions

This Report is supplied in accordance with the GeoReports Terms & Conditions available on the BGS website at https://shop.bgs.ac.uk/georeports and also available from the BGS Central Enquiries Desk at the above address.

Important notes about this Report

- The data, information and related records supplied in this Report by BGS can only be indicative and should not be taken as a substitute for specialist interpretations, professional advice and/or detailed site investigations. You must seek professional advice before making technical interpretations on the basis of the materials provided.
- Geological observations and interpretations are made according to the prevailing understanding of the subject at the time. The quality of such observations and interpretations may be affected by the availability of new data, by subsequent advances in knowledge, improved methods of interpretation, and better access to sampling locations.
- Raw data may have been transcribed from analogue to digital format, or may have been acquired by means of automated measuring techniques. Although such processes are subjected to quality control to ensure reliability where possible, some raw data may have been processed without human intervention and may in consequence contain undetected errors.
- Detail, which is clearly defined and accurately depicted on large-scale maps, may be lost when small-scale maps are derived from them.
- Although samples and records are maintained with all reasonable care, there may be some deterioration in the long term.
- The most appropriate techniques for copying original records are used, but there may be some loss of detail and dimensional distortion when such records are copied.
- Data may be compiled from the disparate sources of information at BGS's disposal, including material donated to BGS by third parties, and may not originally have been subject to any verification or other quality control process.
- Data, information and related records, which have been donated to BGS, have been produced for a specific purpose, and that may affect the type and completeness of the data recorded and any interpretation. The nature and purpose of data collection, and the age of the resultant material may render it unsuitable for certain applications/uses. You must verify the suitability of the material for your intended usage.
- If a report or other output is produced for you on the basis of data you have provided to BGS, or your own data input into a BGS system, please do not rely on it as a source of information about other areas or geological features, as the report may omit important details.
- The topography shown on any map extracts is based on the latest OS mapping and is not necessarily the same as that used in the original compilation of the BGS geological map, and to which the geological linework available at that time was fitted.
- Note that for some sites, the latest available records may be quite historical in nature, and while every effort is made to place the analysis in a modern geological context, it is possible in some cases that the detailed geology at a site may differ from that described.

Report issued by
BGS Enquiry Service

Appendix E Environment Agency Correspondence (inc. Product 4)

From: SSD Enquiries <SSDEnquiries@environment-agency.gov.uk>
Sent: 19 October 2018 13:18
Subject: 181019:SSD101228: Land adjacent to Goring Station ref D1586

From: SSD Enquiries
Sent: 19 October 2018 13:12
Subject: 181019:SSD101228: Land adjacent to Goring Station ref D1586

Dear Stuart,

Thank you for your Product 4 request for **Land Adjacent to Goring Station, Worthing**. Please find attached the flood risk data.

For FRA and pre-planning advice please see attached FRA Advisory Text and Planning Advice from the Environment Agency.

For information on flooding from other sources, such as surface water, groundwater and ordinary watercourses, please contact the Lead Local Flood Authority, West Sussex County Council.

Guidance on climate change allowances and how to use them in Flood Risk Assessments can be found here.

For future reference, detailed flood information and maps can be viewed using the Long Term Flood Risk Information service and Flood Map for Planning service. Flood and Coastal Risk Management asset information, and details of all planned maintenance activities can be viewed using the Asset Management Service.

If you have any further queries about this request, please do not hesitate to contact us at psowestsussex@environment-agency.gov.uk.

Kind regards,

Eleonora Pilla

FCRM Officer - PSO West Sussex

Does Your Proposal Have Environmental Issues or Opportunities? Speak To Us Early!

If you are planning a new project or development, we want to work with you to make the process as smooth as possible. Early engagement can improve subsequent planning applications to you and your clients' benefit and deliver environmental outcomes. For a cost recovery fee of £100 per hour plus VAT we will provide you with a project manager who will coordinate all meetings and reviews in order to give you detailed specialist advice with guaranteed delivery dates. More information can be found on our website here.

Sent: 25 September 2018 10:10
To: Enquiries, Unit <enquiries@environment-agency.gov.uk>
Subject: D1586 Land adjacent to Goring Station

Dear Sirs,

We are preparing a drainage strategy for the above site and would be grateful if you could provide us with any relevant information you have (via a 'Product 4' for EA only) as per our drainage checklist below:

Environment Agency

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).
  For information relating to surface water flooding please contact the local authority for additional information. Contact the water company for information relating to sewers.
- 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 any existing river and/or tidal levels, for the 100yr, 100yr with climate change, 200yr, 200yr with climate change, 1000yr, and 1000yr with climate change flood events.
- Please confirm any gauged flow records for river networks in close proximity to the site, with associated estimated return periods.
- 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.
- Please confirm details of aquifer designation, soil classification, and Source Protection Zones in this area. http://magic.defra.gov.uk/
- Please confirm details of any surface and groundwater discharges, abstractions including private licences and pollution incidents.
- Please confirm details of any recorded groundwater levels in the area, and groundwater vulnerability of the area.

Policy/Future

- Please confirm any Flood Modelling data undertaken within a 1 km radius of the site.
- Please confirm details of future defence upgrades and/or shoreline management plans/policies.

We look forward to hearing from you in due course.

Yours faithfully

Stuart Burnett
Engineer

T. 01243 210418

W. www.rgp.co.uk

Transport Planning and Infrastructure Design Consultants

From: SSD Enquiries <SSDEnquiries@environment-agency.gov.uk>
Sent: 19 October 2018 13:06
Subject: 181019:SSD101228: Land adjacent to Goring Station ref D1586:

Dear Stuart,

Thank you for your email of 25 September requesting information relating to the land adjacent to Goring Station.

River Flow

Please see the attached information from our technical teams regarding river flows. The nearest watercourse to this location is Ferring Rife though we do not monitor the flow here only the level. Please see attached stage data that we have for this site in 15 min values.

This information is supplied subject to the notice which can be viewed via the following link

http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/

Groundwater

There are no known groundwater flooding issues in this area. The nearest groundwater monitoring sites are Clapham Holt Farm 2.3km to the north, and Patching Pond 2.7km to the north west. Please NOTE the licence condition for this information.

This information is not available with the Open Government Licence but we may be able to license you under the Environment Agency Conditional licence as in the link below.

https://www.gov.uk/government/publications/environment-agency-conditional-licence/environment-agency-conditional-licence

Groundwater level measurements– AfA075 detailed information about this dataset including all the conditions applicable to this dataset, can be found on the Register Licence Abstract (you will need to download this spreadsheet to access the information about AfA 075). However, you must first check the supporting information and the below link to determine if the conditions on use are suitable for your purposes. If they are not, this information is not provided with a licence for use, and the data is provided for read right only.

https://data.gov.uk/dataset/f3684ee9-4c81-4ccd-a658-7f8d9dc70706/environment-agency-register-licence-abstracts

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

Due to the size of the attachments I will forward Product 4 information received from the Partnership team in a separate email.

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

Kind regards

Karen

Karen Allen
Customer Engagement | Environmental Planning and Engagement | Solent and South Downs Area |
Environment Agency | Guildbourne House, Chatsworth Road, Worthing, BN11 1LD

SSDEnquiries@environment-agency.gov.uk

National Contact Call Centre 03708 506506
External: 020 30257278

Stuart Burnett
Rgp Design
Suite 2
West Barn
Norton lane
Chichester
PO20 3AF

Our ref: SSD101228
Your ref: D1586
Date: 16/10/2018

Dear Stuart Burnett,

Enquiry Regarding Product 4 for Flood Risk Assessment for Land adjacent to Goring Station

Thank you for your enquiry which was received on 25 September 2018.

We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004. The information is attached.

The information on Flood Zones in the area relating to this address is as follows:

The site is in an area located within Flood Zone 3 as shown on our Flood Map for Planning (Rivers and Sea).

Note - This information relates to the area that the above named property is in and is not specific to the property itself as it is influenced by factors such as the height of door steps, air bricks or the height of surrounding walls. We do not have access to this information and is not currently used in our flood modelling.

Flood Zone definitions can be found at www.gov.uk/guidance/flood-risk-and-coastal-change#Table-1-Flood-Zones

Flood Defences
There are no formal raised flood defences in the vicinity of the site.

Model Information
The model used was the updated JFlow which was completed in 2009, and only comprises the 0.1% AEP event. Flood Zone 2 (1% AEP) is based on 2004 JFlow data which is not suitable to use in site specific Flood Risk Assessment. No climate change information are available for this area. The current climate change allowances should be checked at https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

Flood History
We hold no record of previous flooding events affecting this site.

Please note our records are not comprehensive and may not include all events. I recommend contacting the Lead Local Flood Authority, **West Sussex County**

Council or the Local Authority, **Worthing And Adur District Councils** for a more comprehensive flood history check.

FRA advisory text

Name	Product 4
Description	Detailed Flood Risk Assessment Map for **Land Adjacent To Goring Station, Worthing.**
Licence	Open Government Licence
Information Warnings	The current climate change allowances should be checked here: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.
Information Warning - OS background mapping	*The mapping of features provided as a background in this product is © Ordnance Survey. It is provided to give context to this product. The Open Government Licence does not apply to this background mapping. You are granted a non-exclusive, royalty free, revocable licence solely to view the Licensed Data for non-commercial purposes for the period during which the Environment Agency makes it available. You are not permitted to copy, sub-license, distribute, sell or otherwise make available the Licensed Data to third parties in any form. Third party rights to enforce the terms of this licence shall be reserved to OS.*
Attribution	Contains Environment Agency information © Environment Agency and/or database rights. Contains Ordnance Survey data © Crown copyright 2018 Ordnance Survey 100024198.

Data Available Online

Many of our flood datasets are available online:

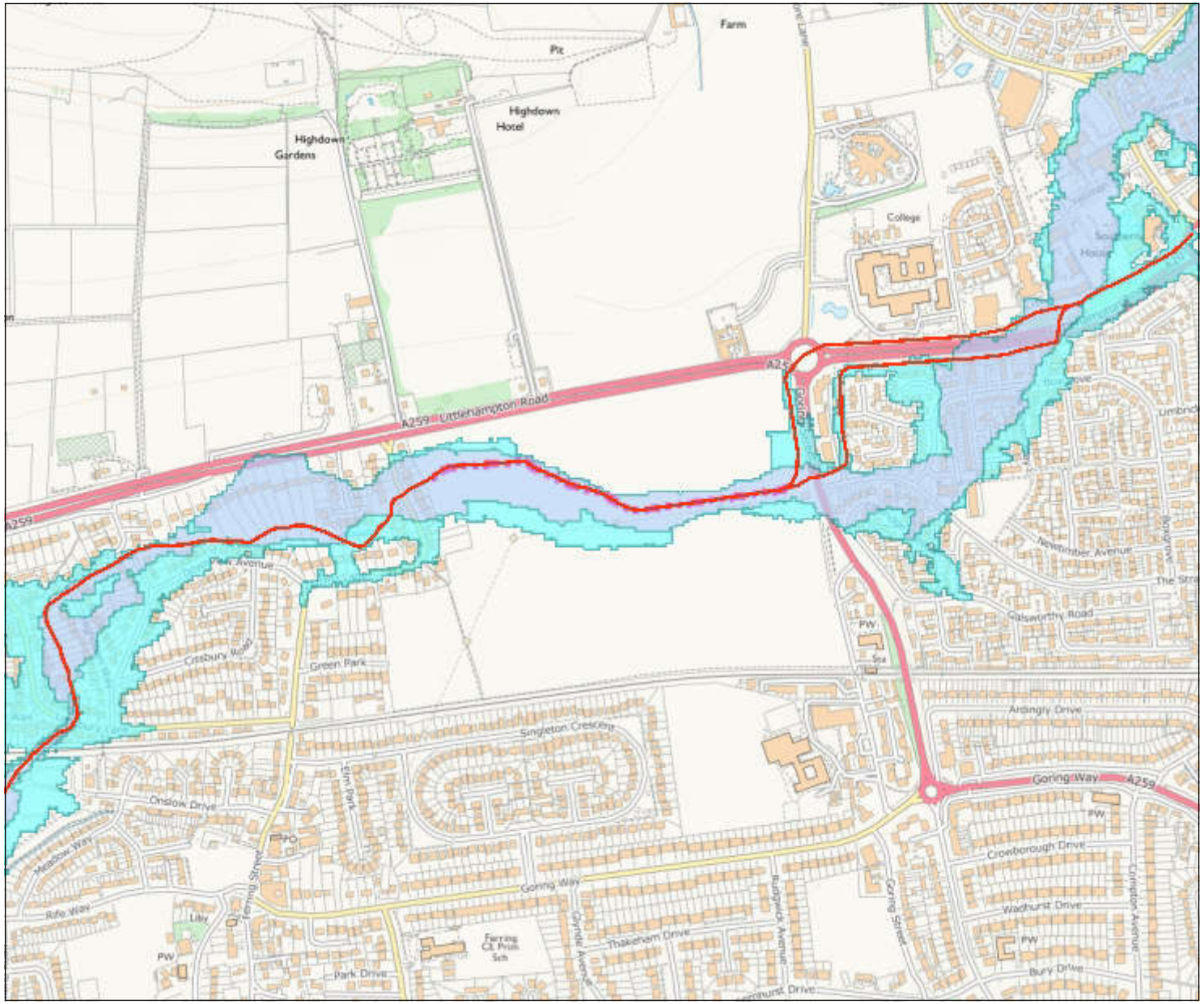
- Flood Map For Planning (Flood Zone 2, Flood Zone 3 ,Flood Storage Areas, Flood Defences, Areas Benefiting from Defences)
- Risk of Flooding from Rivers and Sea
- Historic Flood Map
- Current Flood Warnings

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

Yours sincerely,

Eleonora Pilla
FCRM Officer - PSO West Sussex

Flood Map for Planning (Rivers and Sea) created 16/10/2018



Environment Agency

Scale 1: 10,000

N W E S

Flood Map for Planning (Rivers & Sea)

- Sealed Main Rivers
- Defences
- Flood Storage Areas
- Areas benefiting from flood defences
- Flood Zone 3
- Flood Zone 2

Flood Map Areas (assuming no defences)

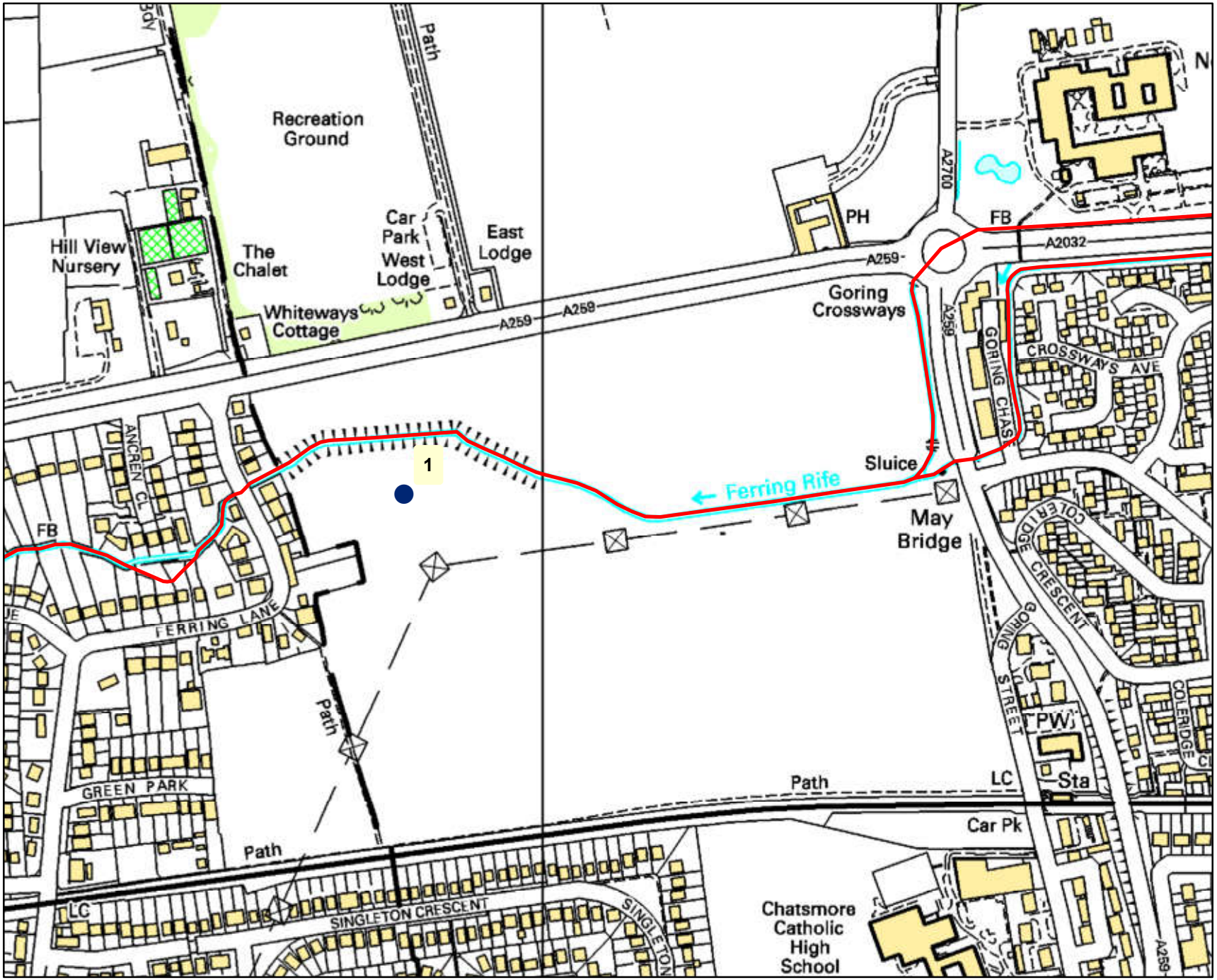
Flood Zone 3 shows the area that could be affected by flooding:

- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occuring each year.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Site Node Points. Centred Land adjacent to Goring Station. Created 16/10/2018 (Ref: SSD/101228)



Environment Agency

N

Legend

- Main River
- Node_Points

Scale: 1:5,000

0 0.1 0.2
Kilometers

Product 4 Flood Risk Data Requested by: Rgp Design

Site: Land Adjacent To Goring Station, Worthing

Table 1: Water Levels: Fluvial Undefended

	NGR		Modelled Flood Levels in Metres AOD Undefended Annual Exceedance Probability
Node Ref	Eastings	Northings	0.1%
1	509871	103475	6.29

Table 2: Water Depths: Fluvial Undefended

	NGR		Modelled Flood Depths in Metres Undefended Annual Exceedance Probability
Node Ref	Eastings	Northings	0.1%
1	509871	103475	0.53

All levels taken from: Updated JFlow 2009

Produced on: 16/10/2018

There is no additional information or health warnings for these levels/depths or the model from which they have been produced.

Office Address: Guildbourne House, Chatsworth Road, Worthing BN11 1LD.
Customer services line: 03708 506 506. Email: enquiries@environment-agency.gov.uk
www.gov.uk/government/organisations/environment-agency

Appendix F West Sussex County Council/Worthing Borough Council Correspondence

From: Kevin Macknay
Sent: 25 September 2018 11:46
To: Stuart Burnett
Subject: RE: D1586 Land adjacent to Goring Station

Stuart,

Please see my reply to your recent email below.

Regards,

Kevin

Kevin Macknay
Flood Risk Management – Team Leader
Economy, Infrastructure and Environment
Highways and Transport
West Sussex County Council

CALL IM EMAIL
Location: Western Area Office, Drayton Lane, Nr. Chichester, West Sussex. PO20 2AJ.

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

Follow us at @WSHighways

From: Stuart Burnett
Sent: 25 September 2018 10:17
To: Paul Cann; Kevin Macknay; Ken Argent
Subject: D1586 Land adjacent to Goring Station

Good morning all,

Hope you are all well. We have been approached by Persimmon Homes to prepare a combined FRA/Drainage Strategy in relation to the site adjacent to Goring Station. The proposals concern a development of up to 500 units. I have attached a plan to assist in locating the site which outlines high level proposals. Please could you provide any information you may have further to the standard checklist, below.

Flood Zones

- Please confirm the Flood Zones for this area.
  Areas of the site are within EA Flood Zones 2 and 3.
- 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).
  Areas of the site are at risk of surface water flooding. See attached plan.
- Please confirm mapping and records for any surface water assets owned or maintained.
  See attached plan showing existing road gullies in the adjacent roads. We do not have any details showing the WSCC below ground drainage assets for the area.
- Please confirm if there are any future drainage improvements proposed for this area.
  None that we are aware of.
- Please confirm details of existing or planned flood alleviation and defences in this area.
  None that we are aware of.
- Please confirm if you are aware of any historic flooding within the confines of the site.
  None that we are aware of.
- Please confirm if you are aware of any historic flooding in close vicinity and/or on the public highway.
  None that we are aware of.

Groundwater

- Please confirm details of any groundwater flooding issues in the area, including flood levels, flood extents and any available anecdotal information.
  Nothing has been reported to the LLFA regarding any groundwater flooding issues at this location. However, it should be noted that the current JBA ground water mapping shows the site to be at 'High Risk' of ground water flooding, with groundwater at or very near (within 0.025m) to the ground surface.

Assets

- Please confirm mapping and records for any surface water assets owned or maintained.
  See attached plan showing existing road gullies in the adjacent roads. We do not have any details showing the WSCC below ground drainage assets for the area.
- Please confirm if there are any historic culverted watercourses within or in close vicinity to the site. Please provide map records where available.
  We are not aware of any historic culverted watercourses within or in close vicinity to the site. However, reviewing the historic mapping it does appear that the site once had an historic ditch line run east to west across the site. See attached plan.
- Please can you provide any map records denoting the highway drainage network. Is this a piped system or soakaways?
  See attached plan showing existing road gullies in the adjacent roads. We do not have any details showing the WSCC below ground drainage assets for the area.

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.
  None that we are aware of.
- Please confirm if any drainage studies and/or SWMP have/are being assess for this area.
  None that we are aware of.

If you need any further information from us at this time, please let me know.

Thanks in advance for your input.

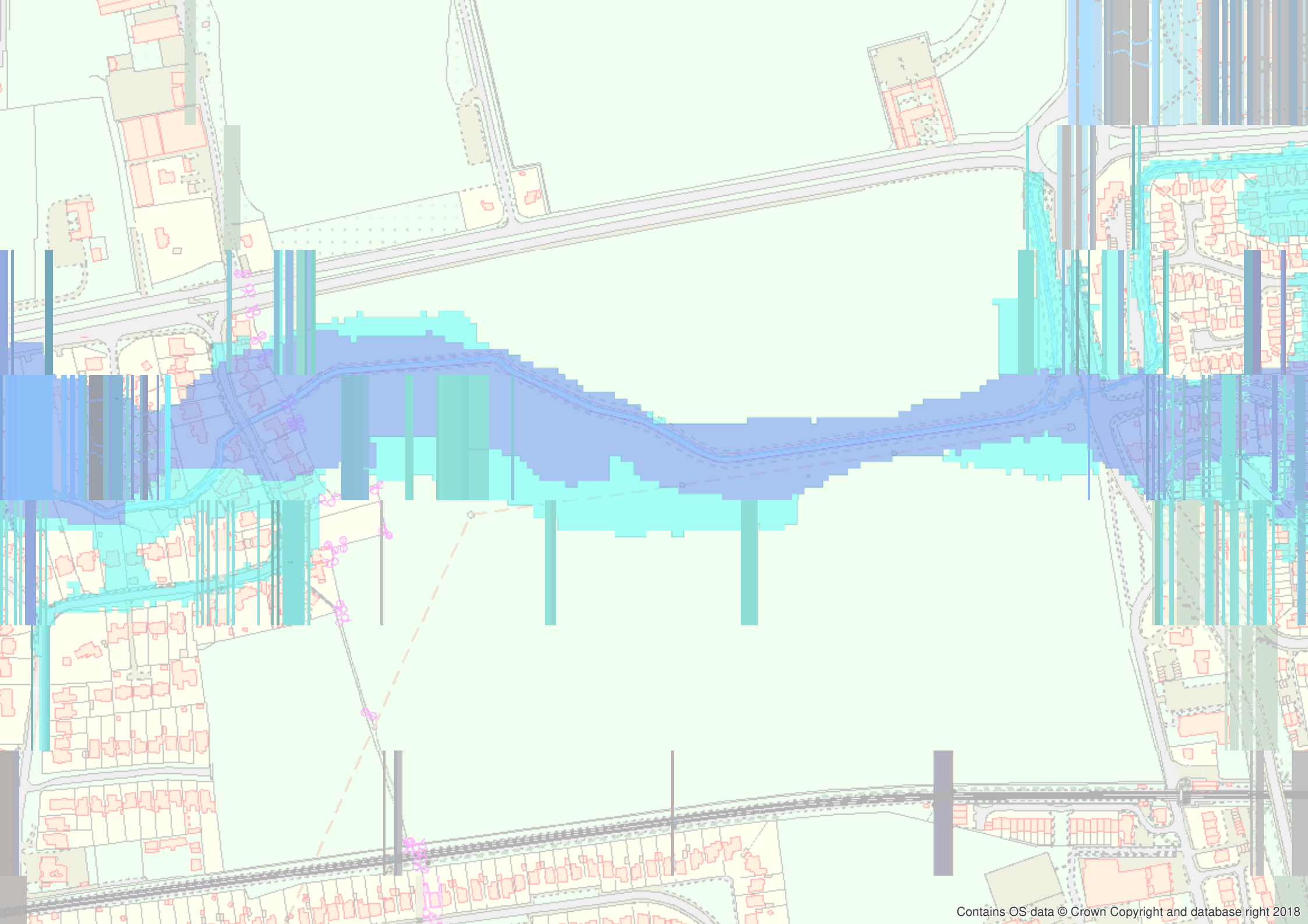
Kind regards

Stuart Burnett
Engineer

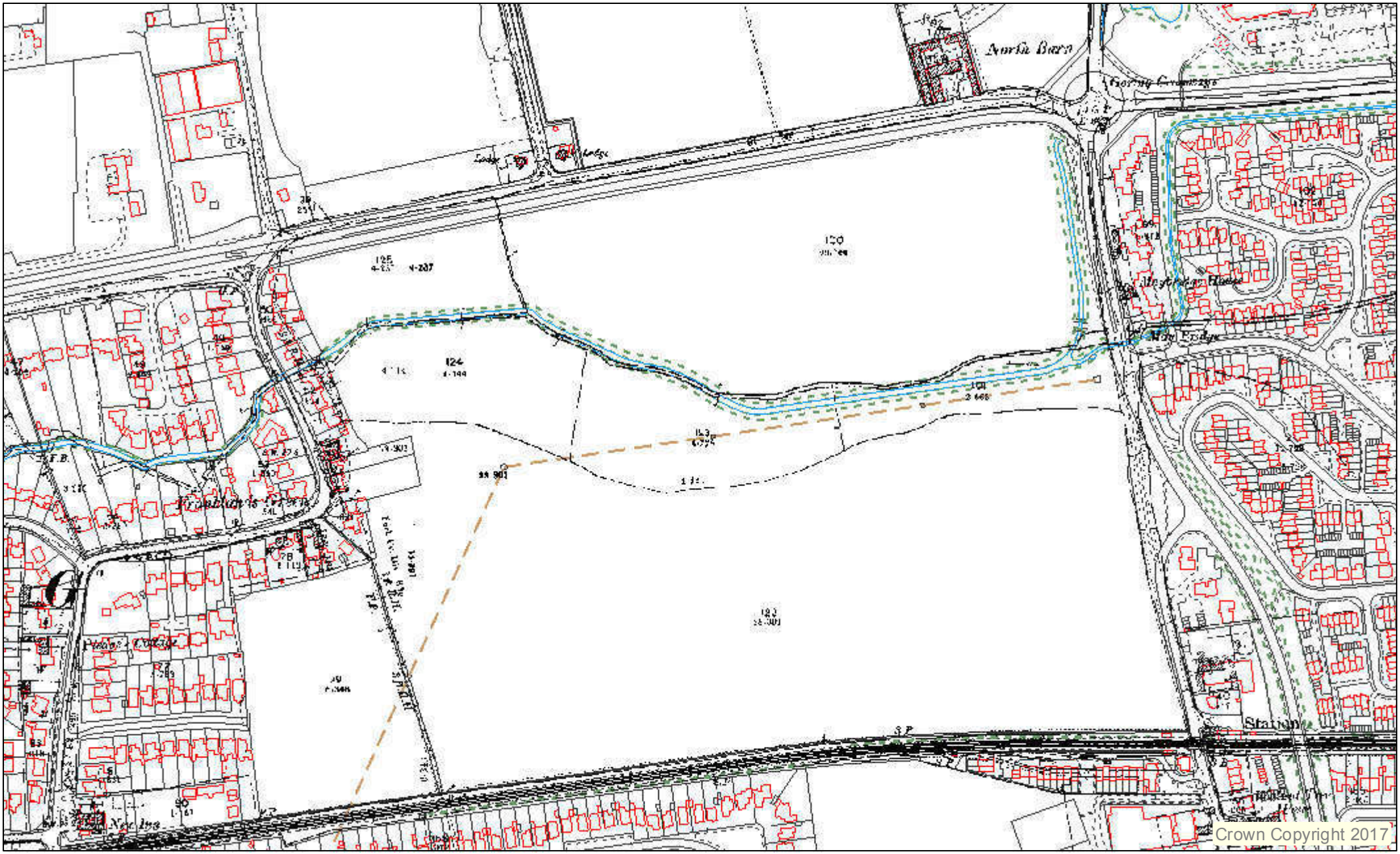
T. 01243 210418

W. www.rgp.co.uk

Transport Planning and Infrastructure Design Consultants

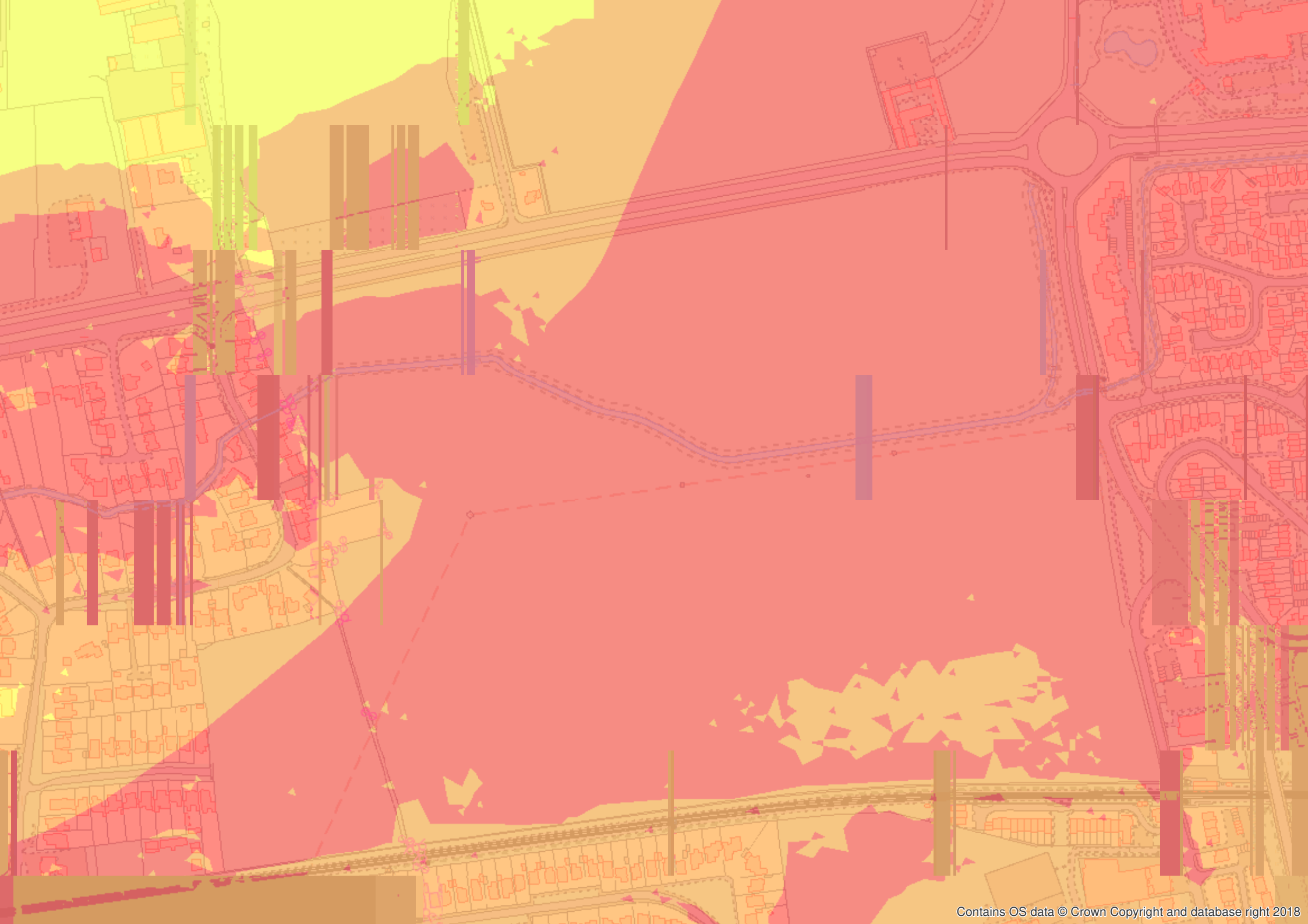


Land adjacent to Goring Station - Historic ditch lines

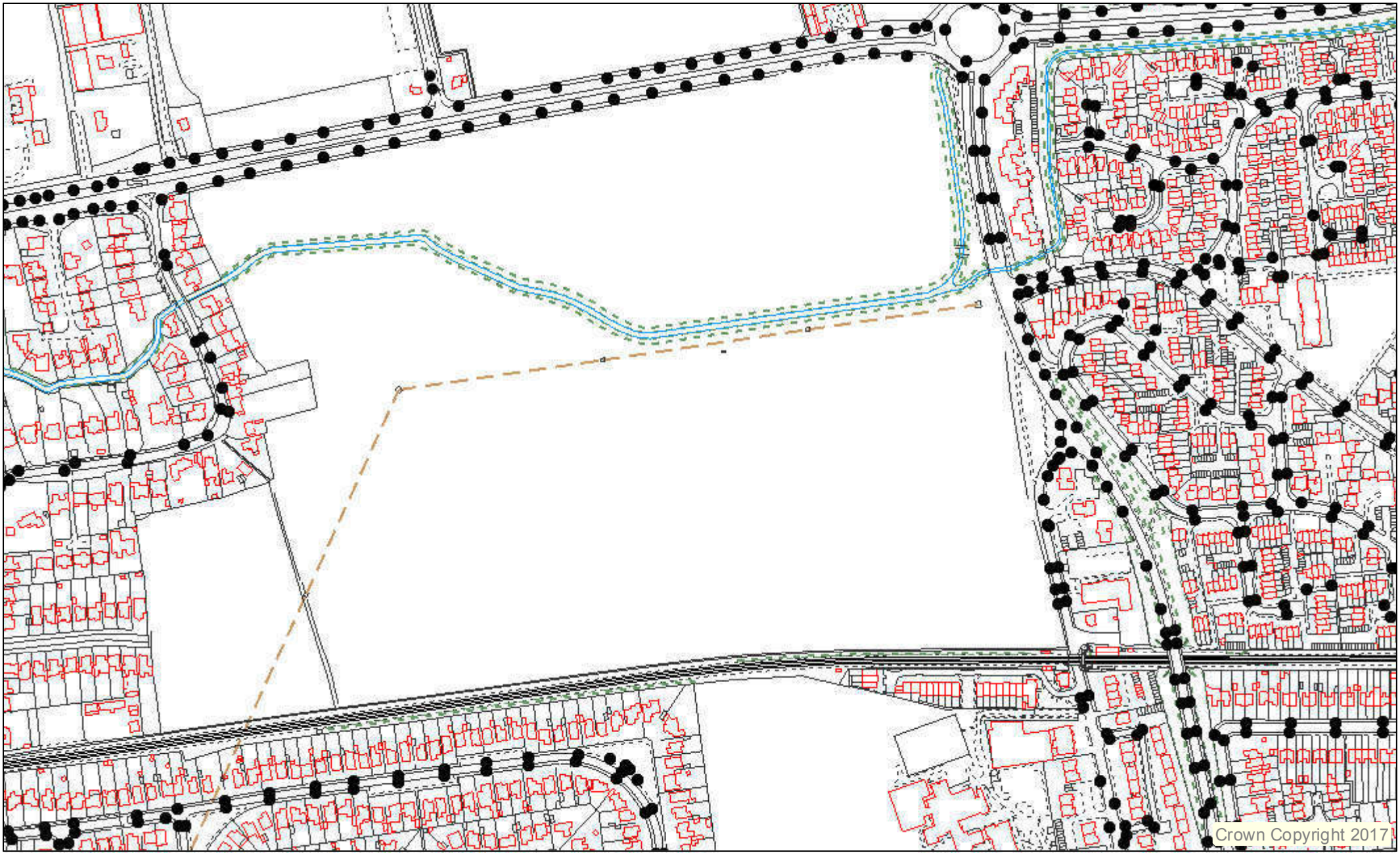


Date: September 2018
Author: K Macknay
Scale 1:4,000

Map Notes:

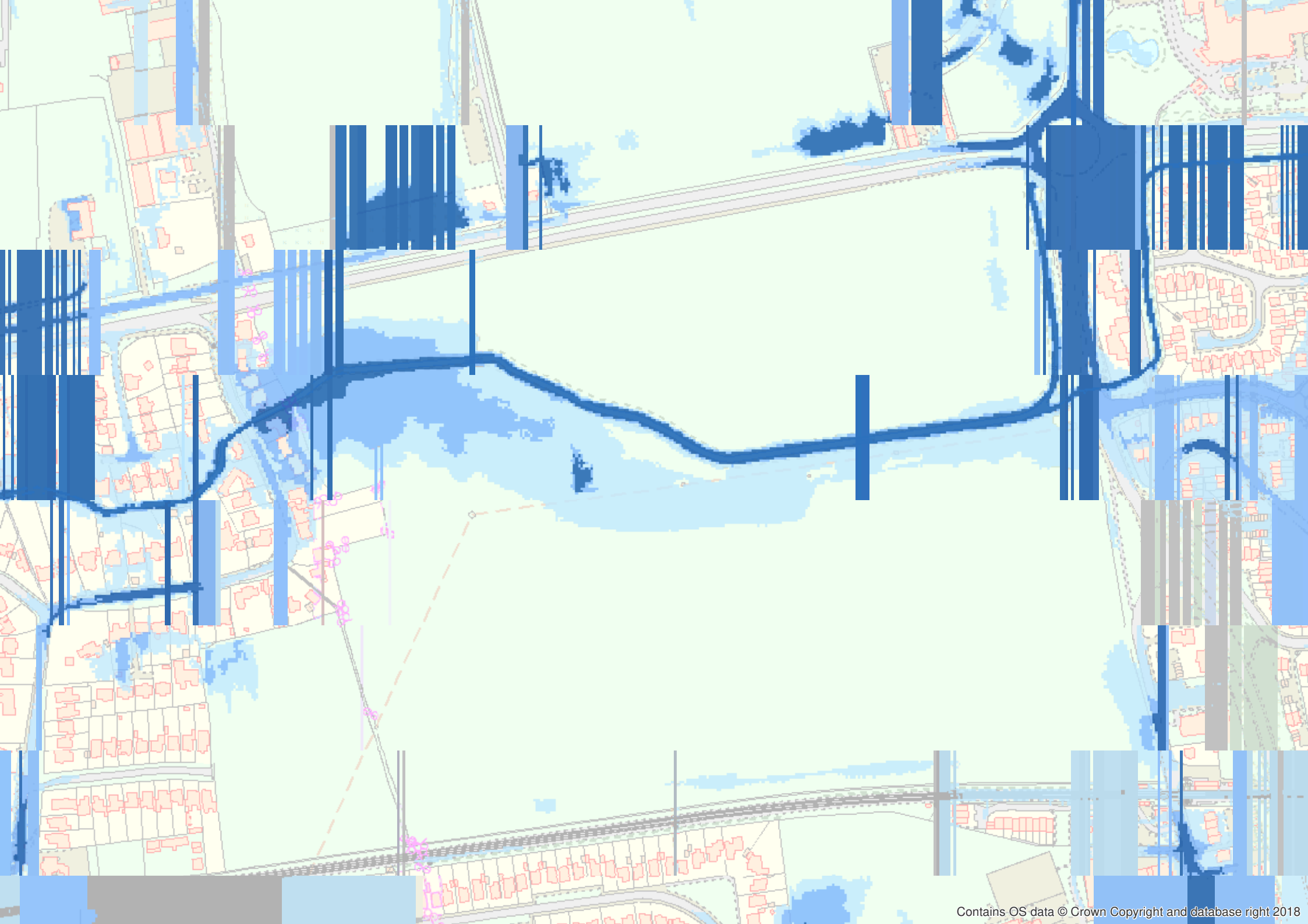


Land adjacent to Goring Station - Existing Road Gullies



Date: September 2018
Author: K Macknay
Scale 1:4,096

Map Notes:


Contains OS data © Crown Copyright and database right 2018

From: Ken Argent
Sent: 08 October 2018 10:41
To: Stuart Burnett
Subject: Re: D1586 Land adjacent to Goring Station

Stuart
Please see my responses below:
Flood Zones

- Please confirm the Flood Zones for this area. The majority of the site lies in flood zone 1 but flood zone 2/3 can be seen to extend either side of the Ferring Rife
- 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). Predicted surface water flooding is restricted to north east corner parallel to Goring Chase and along the railway line. Surface water flooding is also predicted to occur in the same vicinity as the flood zone 2/3. I have no records of sewer or reservoir flooding affecting this area.
- Please confirm mapping and records for any surface water assets owned or maintained. WBC have no assets in this area
- Please confirm if there are any future drainage improvements proposed for this area. Nothing planned that I am aware of
- Please confirm details of existing or planned flood alleviation and defences in this area. Nothing planned that I am aware of
- Please confirm if you are aware of any historic flooding within the confines of the site. None that I am aware of, but contact the EA as this is main river and their records may be different
- Please confirm if you are aware of any historic flooding in close vicinity and/or on the public highway. None that I am aware of,

Groundwater

- Please confirm details of any groundwater flooding issues in the area, including flood levels, flood extents and any available anecdotal information. None that I am aware of,

Assets

- Please confirm mapping and records for any surface water assets owned or maintained. . WBC have no assets in this area
- Please confirm if there are any historic culverted watercourses within or in close vicinity to the site. Please provide map records where available. . WBC have no assets in this area
- Please can you provide any map records denoting the highway drainage network. Is this a piped system or soakaways? N/A

Policy/Future

- Please confirm the most recent Strategic Flood Risk Assessment (SFRA). On the WBC ebsite
- Please confirm if there are any future drainage improvements proposed for this area. . None that I am aware of,
- Please confirm if any drainage studies and/or SWMP have/are being assess for this area. . None that I am aware of,

Ken Argent
Engineer, Adur & Worthing Councils
Phone: 01903221374
Website: www.adur-worthing.gov.uk
Address: Engineering Team, Worthing Town Hall, Chapel Road, Worthing, West Sussex, BN11 1HA

On Tue, 25 Sep 2018 at 10:16, Stuart Burnett <s.burnett@rgpdesign.co.uk> wrote:

Good morning all,

Hope you are all well. We have been approached by Persimmon Homes to prepare a combined FRA/Drainage Strategy in relation to the site adjacent to Goring Station. The proposals concern a development of up to 500 units. I have attached a plan to assist in locating the site which outlines high level proposals. Please could you provide any information you may have further to the standard checklist, 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.

If you need any further information from us at this time, please let me know.

Thanks in advance for your input.

Kind regards

Stuart Burnett
Engineer

T. 01243 210418

W. www.rgp.co.uk

Transport Planning and Infrastructure Design Consultants

Appendix G Adur District Council and Worthing Borough Council SFRA Extracts

1 Introduction

1.1 Background to the study

This version of the Adur District and Worthing Borough Councils SFRA replaces the previous document "Strategic Flood Risk Assessment of Worthing Borough Council and Adur District Council - Final - January 2008". The primary objective for updating the previous version of the SFRA was to prepare a document that was compliant with the latest guidance described in the Planning Policy Statement 25 (PPS25) Practice Guide[1].

The key issues being:

- the information on Sequential Testing was out of date;
- the flood modelling needed to be updated to reflect recent changes;
- the flood outlines needed to be updated to reflect the latest master planning proposals; and
- there was a need to clarify and provide a consistent approach to the designation of flood zone 3b (functional floodplain).

The report contains information on flood zones and an assessment of risks from all sources of flooding and contains more detailed information on the nature of flood hazards that exist in areas that do flood. In addition, the strategic responses that should be considered to address the effect of proposed development allocations are described to address conditions as they are now and as they will be in the future.

1.2 Study area

The study area comprises the whole of the district of Adur (43km^2) and the Borough of Worthing (34km^2), located on the south coast of England and is adjoined by the districts of Brighton and Hove, Horsham, and Arun. Around 50% of Adur and 25% of Worthing lies within the boundary of the South Downs National Park.

Adur District Council have highlighted ten potential development sites, the two largest of these are the brownfield sites 'Shoreham Harbour' and 'Shoreham Airport'. The remainder are greenfield sites, the two largest of these being 'New Monks Farm Extension' and 'Land North West of the Hasler Estate'. Worthing Borough Council highlighted 13 potential development sites. No specific site boundaries were available at the time of writing, but all the sites appear to be brownfield. The development sites and study area is outlined in Map1 (Appendix A).

Lying at the foot of the South Downs, the geology of the area is dominated by chalk, with a swath of clay, silt and sand, which stretches from West Durrington down to Lancing and then continues in a thin band along the coastline around Shoreham-by-Sea. The chalk layers of the South Downs are covered by generally shallow and well-drained topsoils, which allow rainfall to quickly seep into the chalk aquifers below. The underlying geology throughout Adur and Worthing is outlined in Map 2 (Appendix A).

There are three designated main rivers within the study area; these are shown on Map 2 (Appendix A):

- River Adur
- Teville Stream
- Ferring Rife

The section of the River Adur within the study area runs parallel to the A283 Steyning Road down to Shoreham where it flows through Shoreham Harbour to the sea. The river is tidally influenced throughout the study area, yet there is still a fluvial flood risk posed. There are defences along both banks of the River Adur through the study area. The defences on the River Adur upstream of Shoreham Harbour are predominantly earth embankments. According

[1] Planning Policy Statement 25: Development & Flood Risk Practice Guide (Communities and Local Government, March 2010)

to the Rivers Arun to Adur Flood and Erosion Management Strategy[2] "*the defences on the west bank are mostly maintained by the Environment Agency and provide a very low standard of protection with the possibility of regular overtopping and defence failure*". The defences of the River Adur through Shoreham Harbour include steel sheet piling, concrete walls, rock revetments and a shingle beach at Kingston Beach.

The Teville stream, designated as main river, begins south of Burry cottages and generally flows along the boundary between Adur and Worthing. At Deacon Way, east of Worthing, it enters a culvert then emerges at Willowbrook Road and runs parallel to the road until it reaches the railway. The Teville Stream then flows under the railway and continues south until it enters a culvert at the Industrial Estate, north of Dale Road. It emerges from the culvert in the north end of Valley Gardens at Brooklands Lake, before out falling to the sea. Brooklands Lake acts as a balancing pond and provides a storage area during tide-locking. Lengths of the Teville Stream are culverted, yet other than the balancing pond the Teville Stream is undefended.

The Ferring Rife, designated as main river, begins at Southern House south west of Longcroft Park. The Ferring Rife splits at Northbrook College with one branch entering a culvert and another flowing south under the A2032. It joins again at Amy bridge and from here it flows west across the Worthing-Arun border, and then south down to the sea at Ferring.

There has been a wide range of flooding events within Adur and Worthing in the past, from a range of sources including fluvial, sewer and surface water flooding. Map 3 (Appendix A) outlines known incidents of flooding in Adur and Worthing.

1.3 SFRA objectives

SFRAs should be a key part of the evidence base to help inform the allocation of development in a Local Plan area through the preparation of Local Development Documents (LDD). The primary objective of the SFRA is that it should form part of the evidence base of the Local Development Framework to inform Core Strategy allocations and ensure that they are in accordance with PPS25. In order to achieve this, the Practice Guide states that SFRAs need to provide sufficient detail on all types of flood risk to enable the Local Planning Authority (LPA) to:

- apply the Sequential and, where necessary, Exception Tests in determining land use allocations;
- fully understand flood risk from all sources within its area and also the risks to and from surrounding areas in the same catchment;
- inform the Sustainability Appraisal so that flood risk is fully taken account of when considering options and in the preparation of LPA land use policies.;
- prepare appropriate policies for the management of flood risk within LDDs;
- identify the level of detail required for site-specific flood risk assessments in particular locations;
- determine the acceptability of flood risk in relation to emergency planning capability;

To meet these objectives it will also be a requirement that those preparing information for assessment and testing of flood risk understand the assessment process and the specific characteristics of the flooding that affects the District/Borough. The SFRA should also:

- identify strategic measures required to address the effects of proposed development; and
- influence and provide evidence that assists when making decisions on windfall planning applications.

[2] Rivers Arun to Adur flood and erosion management strategy 2010 - 2020 (Environment Agency, April 2010)

1.4 Overarching legislation

1.4.1 Hierarchy

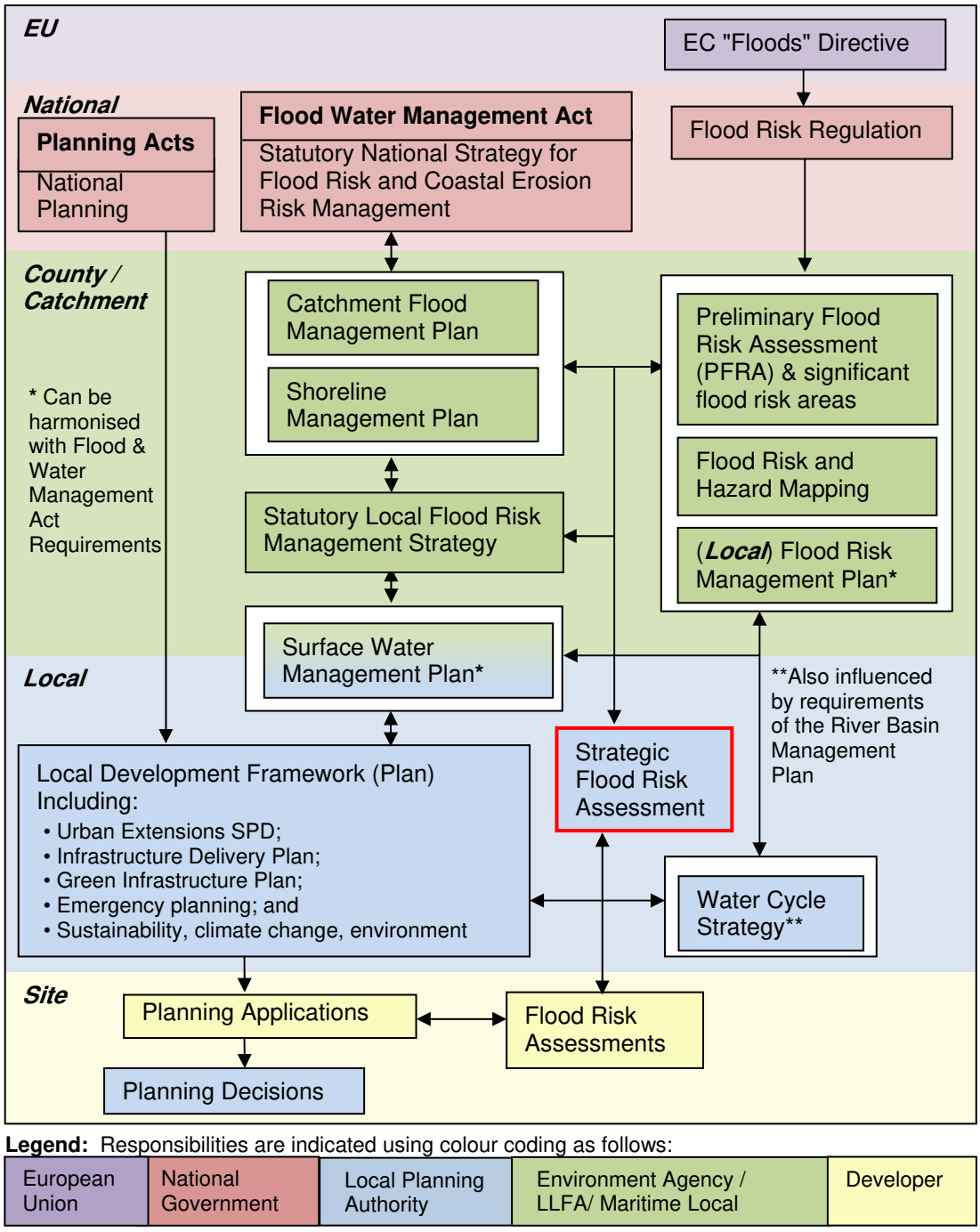
The over arching aim of planning policy on development and flood risk is to ensure that flood risk is taken into account at all stages of the planning process. Following announcements by Communities and Local Government (CLG) (on the 6th July 2010 the Secretary of State announced that all regional strategies were to be revoked)[3] Regional Spatial Strategies will no longer be attributed substantial weight in the local planning process. It can be concluded that the role of Regional Flood Risk Appraisals is also reduced, since the context for their preparation will be removed. The new landscape for the assessment of flood risk is now illustrated in Figure 1.1.

Figure 1.1 shows that the Flood Risk Regulations (2009) and the Flood and Water Management Act (2010) introduce a wider requirement for the exchange of information and the preparation of strategies and management plans than existed previously. SFRAs contain information that should be referred to in responding to the Flood Risk Regulations and the formulation of local flood risk management strategies and plans. As previously stated, SFRAs are also linked to the preparation of Catchment Flood Management Plans, Shoreline Management Plans and Surface Water Management Plans and Water Cycle Strategies.

It should be recognised that there is also a requirement for decisions to be based on sustainability appraisals and the information in the SFRA should be used to inform this process at the local level.

[3] This was challenged at Judicial review in November 2010 - but the outcome was not affected

Figure 1.1: Key documents and strategic planning links - Flood Risk - (©JBA)



1.4.2 Responsibilities

The new and emerging responsibilities under the Flood and Water Management Act and the Flood Risk Regulations are summarised in Table 1.1.

Table 1.1: Roles and responsibilities

Risk Management Authority (RMA)	Strategic Level	Operational Level
Environment Agency	National Statutory Strategy Reporting and general supervision	Main rivers Sea Reservoirs For these flood sources prepare and publish: PFRA; Significant Flood Risk Areas; Flood Risk and Hazard Maps; and Flood Risk Management Plan (or exercise "Exception")
Lead Local Flood Authority	Input to national strategy Formulate and implement local flood risk management strategy	Surface Water Groundwater, and Other sources of flooding For these flood sources prepare and publish: PFRA; Significant Flood Risk Areas; Flood Risk and Hazard Maps; and Flood Risk Management Plan (or exercise "Exception")
District Councils Internal Drainage Board	Input to National and Local Statutory Strategies	Ordinary watercourse and sea (with EA approval)

The River Adur Internal Drainage District's area extends from the Old Shoreham Tollbridge northwards up to a point several kilometres upstream from the tidal limits of the East and West Branch of the River Adur, extending outside of this study area. It includes the low lying areas of the river valley and the boundary roughly follows the predicted extreme flood outline. The Internal Drainage District has Byelaws to secure the effective working of the drainage system within the District, including Byelaw 33, which controls any works in, over, under or within 5 metres of any watercourse within the District. The Environment Agency acts as the Internal Drainage Board and undertakes its permissive powers to carry out maintenance works and enforces the Boards Byelaws.

Those making use of flood risk information described in the Adur and Worthing SFRA should also make reference to and be aware of the following:

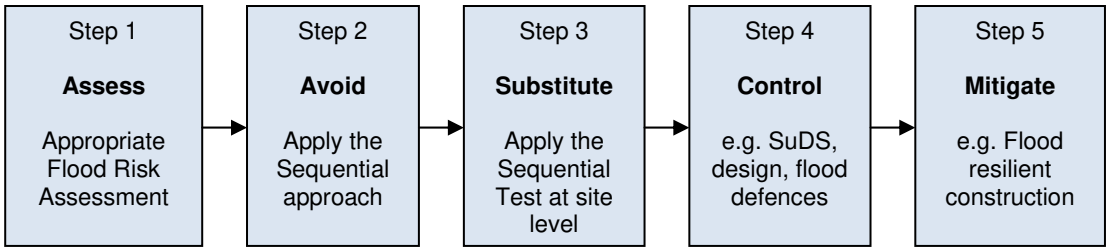
- River Adur Catchment Flood Management Plan (CFMP), published September 2009.
- Arun and Western Streams Catchment Flood Management Plan (CFMP) published December 2009.
- West Sussex Preliminary Flood Risk Assessment (PFRA), published May 2011.
- Worthing Surface Water Management Plan, 2011.

1.5 Approach

1.5.1 General assessment of flood risk

The SFRA adopts the flood risk management hierarchy advocated in the Practice Guide as summarised in Figure1.2.

Figure 1.2: Flood risk management hierarchy



This hierarchy underpins the risk based approach and must be the basis for making all decisions involving development and flood risk. When using the hierarchy account shall be taken of:

- The nature of the flood risk (the ***source*** of the flooding);
- the spatial distribution of the flood risk (the ***pathways*** & areas affected by flooding);
- climate change impacts; and
- the degree of vulnerability of different types of development (the ***receptors***).

Site allocations should reflect the application of the Sequential Test using the maps and guidance in this SFRA. The information in this SFRA should be used as evidence and where necessary reference should also be made to relevant evidence in the documents described in Section 1.4 of this chapter. The flood zone maps and flood risk information on other sources of flooding contained in this SFRA should be used to apply the Sequential Test.

Where other sustainability criteria outweigh flood risk issues, the decision making process should be transparent. Information from this SFRA should be used to justify decisions to allocate land in areas at high risk of flooding. To that end this report contains information on the level of flood hazard at the allocated sites proposed by Adur District and Worthing Borough Councils within their Local Plan and Core Strategy respectively.

The basis for all decision making in flood risk is to first understand the risk and then identify responses to that risk so that it is effectively managed. The SFRA provides detailed information that must be supplemented, where necessary, with more detailed information contained in the other relevant documents noted in this chapter.

1.5.2 Scope of assessment

This version of the SFRA contains flood risk information that satisfies the requirements of a Level 1 and Level 2 SFRA. The Practice Guide advises that:

"*A Level 1 SFRA should be sufficiently detailed to allow application of the Sequential Test (annex D table D.1 of PPS25) and to identify whether development can be allocated outside high and medium flood risk areas, based on all sources of flooding, not just river and coastal, or whether application of the Exception Test is necessary. The information may also be used to assess how any environmental objectives relating to flooding, as defined in the Sustainability Appraisal, may be affected by additional development. A Level 1 SFRA may principally be a desk-based study making use of existing information.*" and that

"*The Level 2 SFRA corresponds to the 'increased scope' SFRA referred to in paragraph E6 of PPS25. The principal purpose of a Level 2 SFRA is to facilitate application of the Sequential and Exception Tests. More detailed information is required where there is deemed to be development pressure in areas that are at medium or high flood risk and there are no other suitable alternative areas for development after applying the Sequential Test. This more detailed study should consider the detailed nature of the flood hazard, taking account of the presence of flood risk management measures such as flood defences. This will allow a sequential approach to site allocation to be adopted within a flood zone (paragraphs 17 and D4 of PPS25). It will also allow the policies and practices required to ensure that development in such areas satisfies the requirements of the Exception Test, to be identified for insertion into the LDD.*"

4 Flood risk in Adur and Worthing

4.1 Introduction

The Adur and Worthing SFRA update is undertaken for the entire area within the administrative boundaries. There are three designated main rivers, and a number of ordinary watercourses, within Adur and Worthing, and the area shares approximately 16km of its boundary with the sea. Underlying geology is dominated by chalk downland, the highly permeable nature of this bedrock contributes a risk of flooding through emergent groundwater.

Adur and Worthing are affected to varying degrees by all sources of flooding, including surface water, fluvial, tidal, sewer and groundwater. This section provides a summary of flood risk across Adur District and Worthing Borough.

4.1.1 How flood risk is assessed

A flood is now formally defined in the Flood and Water Management Act (2010).

A flood is defined by the act as "any case where land not normally covered by water becomes covered by water". The act also states that a flood, as defined above, can be caused by:

(a) heavy rainfall

(b) a river overflowing or its banks being breached

(c) a dam overflowing or being breached

(d) tidal waters

(e) groundwater

(e) anything else (including any combination of factors).

In the context of the FWMA (2010) a flood does not include:

(a) A flood from any part of a sewerage system, unless wholly or partly caused by an increase in the volume of rainwater (including snow and other precipitation) entering or otherwise affecting the system.

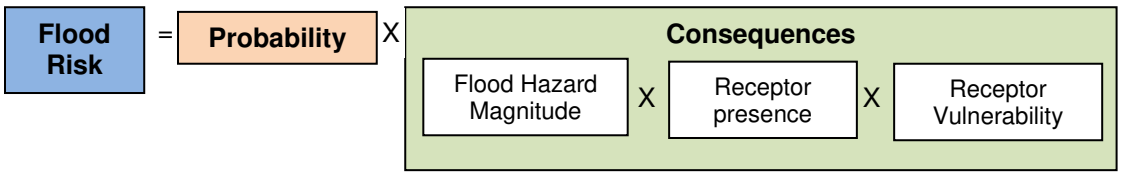
(b) A flood caused by a burst water main (within the meaning given by section 219 of the Water Industry Act 1991).

The FWMA (2010) states that flood risk *"means a risk in respect of flood", where risk is "assessed and expressed (as for insurance and scientific purposes) as a combination of the probability of the occurrence with its potential consequences".*

Thus it is possible to define flood risk as:

Flood Risk = (Probability of a flood) X (scale of the consequences)

On that basis it is useful to express the definition as follows:



4.2 Fluvial flood risk

4.2.1 Introduction

This section assesses risk in Adur and Worthing from fluvial flooding, now and in the future. It makes use of all the data and information described in Section 2. It defines the fluvial Flood Zones 1, 2, 3a and 3b, providing enough information for the Councils to perform the Sequential Test for these areas.

Flood Zones 1, 2 and 3 delineate areas at low risk, medium risk and high risk respectively from both tidal and fluvial flooding. Environment Agency Flood Maps, detailing Flood Zones 2

and 3, do not take into account the effects of flood defences, and as such provide a worst case assessment of flood risk. The delineation of flood zone 3b does take account of flood defences. The effects of fluvial defences in Adur and Worthing are described in Section 4.2.2.

4.2.2 Fluvial flood risk

Fluvial flooding is caused by high flows in rivers or streams exceeding the capacity of the river channel and spilling onto the floodplain, usually after a period of heavy rainfall.

The SFRA (2008) defined fluvial flood risk using the series of hydraulic models which were developed for the Environment Agency CFMP. These models were considered more detailed than the Environment Agency Flood Zones, therefore the results were used to delineate the Flood Zones. Flood Zone 3b was defined using the CFMP models, with defences for the 5% AEP flood event, where CFMP models were not available, Environment Agency Flood Zone 3a was used instead. The Fluvial Flood Zones for Adur and Worthing have been defined using the modelling undertaken for the SFRA (2008).

The only area that has been updated since the SFRA was completed is the Shoreham Harbour area south of the A27. As part of the Shoreham Harbour Study (2011) the fluvial Flood Zone 3b (1 in 20 year fluvial event accounting for the effect of existing defences) was remodelled. The delineation of the Flood Zones is shown on Map 4 (Appendix A), the map has been coloured to clearly show the where different data sets have been used to define the Flood Zone 3b.

The following sections briefly describe fluvial flood risk areas by watercourse.

River Adur

The fluvial flood risk from the River Adur was assessed using the SFRA (2008) data, except for the region south of the A27 where detailed modelling outputs from the Shoreham Harbour study has been used to update the Flood Zone 3b.

The largest areas of Flood Zones 2 and 3a are along the River Adur as the river is the largest in the study area and the land adjacent to the river channel is flat, allowing flood flows to spread out. The Flood Zone 3b is generally contained to the channel due to the presence of defences along the length of the River Adur.

Teville Stream

There was no new data available for Teville Stream at the time of writing. There is an ongoing Environment Agency Flood Mapping Study of the Teville Stream, but the outputs were not available in time for this SFRA update. Consequently, the fluvial flood risk was assessed using the SFRA (2008) data. The Teville Stream was modelled using the CFMP TUFLOW model updated as part of the SFRA (2008) with LIDAR data. The SFRA (2008) highlighted that there was low confidence in the results of this model. Consequently, any future development proposals near the Teville Stream should consult the most recent data (likely to be the new Environment Agency Flood Risk Mapping Study) when assessing flood risk.

The fluvial flood zones along the Teville Stream are clearly defined, and generally remain in bank for all return periods up to 1 in 1000 year (Flood Zone 2) along most of the channel. The only notable area of flooding occurs to the north of the Teville Stream, (within the Adur area) to the southwest of Sompting and the east of Decoy Farm. This appears to be due to flood flows being constrained by the railway embankment, which crosses the valley at this point.

Ferring Rife

There is no new data identified for Ferring Rife, therefore fluvial flood risk was assessed using the SFRA (2008) data. The Ferring Rife was modelled using the CFMP TUFLOW model updated as part of the SFRA (2008) with LIDAR data. The SFRA (2008) considered the model results of the Ferring Rife to be appropriate for use in this level of study.

The flood zones appear clearly defined with an extensive Flood Zone 3b. The flood zones show the area north of the A2032 at Yeoman Way and Southern House to be at risk of flooding, as well as part of the Northbrook College site. The residential area southwest of the A2032 towards May Bridge on the A259 is also shown to be at flood risk, including: Boxgrove, The Greenway, Patching Close, The Strand and Coleridge Close.

4.2.3 Fluvial functional floodplain

Flood Zone 3b indicates the 'functional floodplain', which is defined as an area of land where water has to flow or be stored in times of flood. This is usually taken to be the 1 in 20 year event taking into account the effects of defences and other flood risk management infrastructure. However, the practice guide also states *"developed areas are not generally part of the functional floodplain"*, yet:

"some developed areas may still provide an important flood storage and conveyance function, such as a car park that has been designed to flood periodically to preserve flood storage volumes at a riverside commercial development. Roads and other linear spaces can act as flow routes and the functionality of such areas should be considered when defining Flood Zones."

For the purposes of this SFRA the functional floodplain is defined as the defended 1 in 20 year flood extent. Amendments to the delineation of Flood Zone 3b in Adur and Worthing have been made to the River Adur south of the A27, following the Shoreham Harbour Study (2011). However, it should be noted that the differences between the SFRA (2008) fluvial Flood Zone 3b in this area and the new fluvial Flood Zone 3b are minimal.

Along the River Adur the modelling undertaken has shown, taking into account the effects of existing defences, the area south of the A27 does not convey or store flood flows from the perspective of fluvial flooding alone. The only area along the River Adur where storage or conveyance is operational in the 1 in 20 year defended case is the small low-lying area north of the A27 around Coombes Road. From an assessment of the OS mapping and the nature of land use in the area (a series of drainage networks and playing fields) it is apt that this area be defined as being 'functional'.

The Teville Stream flood zone mapping shows the area to the southwest of Sompting and the east of Decoy Farm designated as Flood Zone 3b. From an assessment of the OS mapping and the nature of land use in the area (a series of drainage networks and open land), it is apt that this area be defined as being 'functional'.

The Ferring Rife Flood Zone 3b extends from Yeoman Way and Southern House including part of the Northbrook College site across the A2032 and the residential area towards May Bridge on the A259 (covering Boxgrove, The Greenway, Patching Close, The Strand and Coleridge Close, and then west towards the border with Arun. The Yeoman Way - Southern House area and the residential area between the A2032 and May Bridge are well developed, as such in line with the comments made in the PPS25 practice guide (above) the actual 'functionality' of the area could be questioned. However, detailed hydraulic modelling would need to be undertaken to prove the area did not offer any storage or conveyance for floodwaters. The undeveloped open space along the remainder of the Ferring Rife Flood Zone 3b suggests these areas act 'functionally' in time of flood.

4.2.4 Fluvial defences

There are defences along both banks of the River Adur through the study area. The defences on the River Adur upstream of Shoreham Harbour are predominantly earth embankments. According to the Rivers Arun to Adur Flood and Erosion Management Strategy[9] "*the defences on the west bank are mostly maintained by the Environment Agency and provide a very low standard of protection with the possibility of regular overtopping and defence failure*". The defences of the River Adur through Shoreham Harbour include steel sheet piling, concrete walls, rock revetments and a shingle beach at Kingston Beach. The SFRA (2008) stated the SoP of these defences was 3.3 % upstream and 0.5% downstream of Shoreham Bridge. It is unclear as to whether the bridge referred to is the A27 or not although the statement appears to be consistent with what is shown in Map 5 (Appendix A).

There are no formal raised defences along the Teville Stream or Ferring Rife within the study area. However, Brooklands Lake is situated on the Teville Stream at its coastal outlet, and acts as a balancing pond and provides storage during tide-locking.

Map 5 and Map 16 (Appendix A) show the location of the defences through Adur and Worthing, and shows the actual flood risk from a 1 in 100 year fluvial event, accounting for the

[9] Rivers Arun to Adur flood and erosion management strategy 2010 - 2020 (Environment Agency, April 2010)

effect of defences. From viewing Map 5 it is clear the largest area which benefits from the fluvial defences is the Shoreham Airport - Lancing area on the west bank of the River Adur.

4.2.5 Fluvial residual risk

'Residual risk' is defined as the flood risk remaining with flood mitigation measures in place. The land behind the defences is only at risk of flooding through failure or overtopping of the defences.

Flood zones represent the undefended situation and can therefore be used to inform the scale of the residual risk from failure of a defence. Based on Flood Zone 3a, the Shoreham Airport - Lancing area on the west bank of the River Adur is shown to be at risk of a failure and overtopping of the defences.

In most instances in the study area, raised flood defences serve to protect land against both fluvial and tidal flooding. In these cases fluvial and tidal residual risk is often co-incident (Section 4.3.5). Development proposals in these areas would be required to consider further the extent and nature of residual risk and appropriately mitigate it.

4.2.6 Effects of climate change on fluvial flood risk

The effect of climate change on fluvial flood risk in Adur and Worthing has been assessed using the climate change results from the SFRA (2008).

The climate change modelling undertaken in the SFRA (2008) applied a 20% increase in flows for both epochs (2056 and 2106). The mean spring tide for the downstream boundary was varied accordingly for each epoch to represent the increases in sea level rise over time (367mm for 2056, and 1030mm for 2106). Consequently, only those areas that are tidally influenced vary between the two climate change epochs, as seen in Map 6 (appendix A). The main areas shown to be affected by fluvial flooding in the future are the tidally influenced areas around Shoreham-by-Sea and South Lancing.

Where there was no modelled climate change outline from the SFRA (2008), Flood Zone 2 should be used to represent future flood extent.

New climate change guidance

The new climate change advice note "Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities" was issued by the Environment Agency in September 2011[10]. The potential changes in river flows and sea level rise suggested correspond to the various emission scenarios stated in UKCP09. They range from the highest H++ emissions scenario to the low emission scenario. The medium emission scenario corresponds to the 'change factor', equivalent to the average predicted change. The guidance recommends that *"when considering climate change a full appreciation of emission scenario and climate uncertainty is taken into account. The upper and lower end estimates are designed to achieve this within flood and coastal erosion risk management applications."* It would be appropriate to consider the upper H++ scenario when reviewing some planning applications, for example critical infrastructure which could not readily be moved or protected in the event of climate change occurring at a rate beyond what is expected.

The existing estimates of the impact of climate change have used a 20% increase in river flows. This is within the bounds of the change factor up to the 2050s (Table 4.1) however in the future the change factor increases to 30%. The sea level rise calculated for 2056 in the SFRA (2008) is equivalent to the upper end estimate in Table 4.2; the level used for the 2106 scenario was less. For the purposes of this SFRA it was felt that the existing estimates were sufficient to provide an overview of the potential future risk across the area and to inform the Sequential Test of proposed sites. However, if more detailed modelling is undertaken in the future in support of a planning application it is recommended that regard is given to the latest climate change values available.

[10] Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities (Environment Agency, September 2011)

Table 4.1: Future changes in river flows for catchments in the South East of England[10]

	Total potential change anticipated for the 2020s	Total potential change anticipated for the 2050s	Total potential change anticipated for the 2080s
SE England			
Upper end estimate	30%	55%	100%
Change factor	10%	20%	30%
Lower end estimate	-15%	-5%	0%
H++	40%	70%	125%

Table 4.2: Future changes in sea level

	Sea level rise mm/yr up to 2025	Sea level rise mm/yr 2026 to 2050	Sea level rise mm/yr 2051 to 2080	Sea level rise mm/yr 2081 to 2115
H++ scenario	6	12.5	24	33
Upper end estimate	4	7	11	15
Change factor	Use UKCP09 relative sea level rise medium emission 95% projection for the project location available from the user interface.			
Lower end estimate	Use UKCP09 relative sea level rise low emission 50% projection for the project location available from the user interface.			

4.2.7 Flood warning system

The Environment Agency operates a flood warning service covering fluvial flooding for Adur and Worthing using its Flood Warnings Direct System. These areas are currently under revision by the Environment Agency to bring them up to date with guidance released in the last few years by making them more community orientated.

There is currently one flood warning area covering fluvial flood risk in the Adur and Worthing Study Area:

071FWF5301 - the Ferring Rife at North Ferring, including the Goring, A259 at Northbrook College, Ferring Lane, Highdown Way, Langbury Lane, and Downview Avenue. There are also four tidal flood warning areas, some of these cover the Teville Stream and the River Adur areas, see Section 4.3.8 for details.

4.3 Tidal flood risk

4.3.1 Introduction

This section assesses risk in Adur and Worthing from tidal flooding, now and in the future. It makes use of all the data and information described in Section 2. It defines the tidal Flood Zones 1, 2, 3a and 3b, providing enough information for the Councils to perform the Sequential Test for these areas.

Worthing's coastline extends from Ferring in the west to Lancing in the east, Adur's coastline then extends from Lancing to Shoreham Port in the east. Much of the area at risk from tidal flooding is protected by flood defences. However, there remains a residual risk that the defences could fail or be overtopped during a flood event.

4.3.2 Tidal flood risk

Tidal flood risk is assessed based on Extreme Still Water Sea-levels (ESWSL). An ESWSL is the level the sea is expected to reach during a storm event for a particular return period as a result of the combination of tides and surges. As these levels are based on 'still' water, the affect of short-term fluctuations in sea-level associated with wind and swell waves are not included.

In line with the approach agreed for the recent Arun to Adur Flood Risk Mapping Study, wave overtopping will be considered in this SFRA update within the assessment of actual risk or residual risk, not within the flood zone delineation. This approach balances the predominance of redevelopment and regeneration in the coastal frontage of the study area with the need to consider flood risk from all sources. Allowing for wave-overtopping increases the extent of flooding. In some instances, this can mean the defended 1 in 200 year outline with the effect of wave overtopping would be larger than the Flood Zone 3a tidal extent. Map 10 and 11 (Appendix A) demonstrate the effect of wave overtopping on the tidal flood extents at 0.5% AEP and 0.1% AEP respectively. The affect of wave overtopping is discussed further under Section 4.3.5. However, the nature of this flooding is very different from inundation arising from still water level flooding. Wave overtopping can lead to increases in volume of inundation, speed of inundation and overall hazard.

Tidal flooding is caused by extreme tide levels exceeding ground levels. Flood Zones 1, 2 and 3 delineate areas at low risk, medium risk and high risk respectively from both tidal and fluvial flooding. These flood zones do not take into account the effects of flood defences, and as such provide a worst-case assessment of flood risk. The delineation of the tidal flood zones and the areas of Adur and Worthing, which are within tidal flood zones are shown on Map 7 (Appendix A). The flood zone delineation north of the A27 is from SFRA (2008) modelling. Elsewhere the delineation uses the results from the recent Environment Agency studies: 'Arun to Adur Flood Modelling' (2011); and 'Shoreham Harbour Regeneration: Design and Flood Risk Study' (2011).

In Worthing the main areas to be shown at tidal flood risk by the flood zones is the Brooklands Pleasure Ground and the area from Alinora and Marine Crescent to the West Parade. Along the remainder of the coastal frontage, the flood zones are confined to the beach.

In Adur, the tidal flood zones are more extensive, covering parts of South Lancing, Shoreham by Sea, Shoreham Harbour and Shoreham Airport. The tidal flood zones continue north of the A27 along the River Adur.

4.3.3 Tidal functional floodplain

Flood zone 3b indicates the ‘functional floodplain’, which is defined as an area of land where water has to flow or be stored in times of flood. This is usually taken to be the 1 in 20 year event taking into account the effects of defences and other flood risk management infrastructure see Map 7 (appendix A). However, the practice guide also states *"developed areas are not generally part of the functional floodplain"*, yet:

"some developed areas may still provide an important flood storage and conveyance function, such as a car park that has been designed to flood periodically to preserve flood storage volumes at a riverside commercial development. Roads and other linear spaces can act as flow routes and the functionality of such areas should be considered when defining Flood Zones."

The question as to whether the area delineated as flood zone 3b, and therefore 'functional floodplain', actually acts functionally has arisen in the past. To argue that an area, regardless of size, is not ‘functional’ there is a need to demonstrate the area does not provide a *flood storage or conveyance function.*

The recent Shoreham Harbour Regeneration: Design and Flood Risk Study undertook an investigation around the Shoreham Harbour regeneration area (one of the Core Strategy sites) to determine whether those areas within the 1 in 20 year extent act functionally. An option, "River/Canal Flood Defence Option A", was modelled which looked at the impact of defending the Shoreham Harbour regeneration ‘Development Areas’. The scenario modelled flood walls in the Shoreham Harbour regeneration area with a crest level of a 0.5% AEP tidal event. When the results from this were compared to the defended 1 in 20 year event it showed that the "presence of the Development Areas and their defences, for the most part, do not increase flood levels by more than 0.01m". A small area on the south bank of the river adjacent to the development area was shown to experience a localised increase in the flood level of up to 0.05m. However, the study determined that "on the whole, the Development Areas do not provide significant storage or conveyance potential which materially impacts flood risk elsewhere". As a result, the area is no longer considered 'functional'.

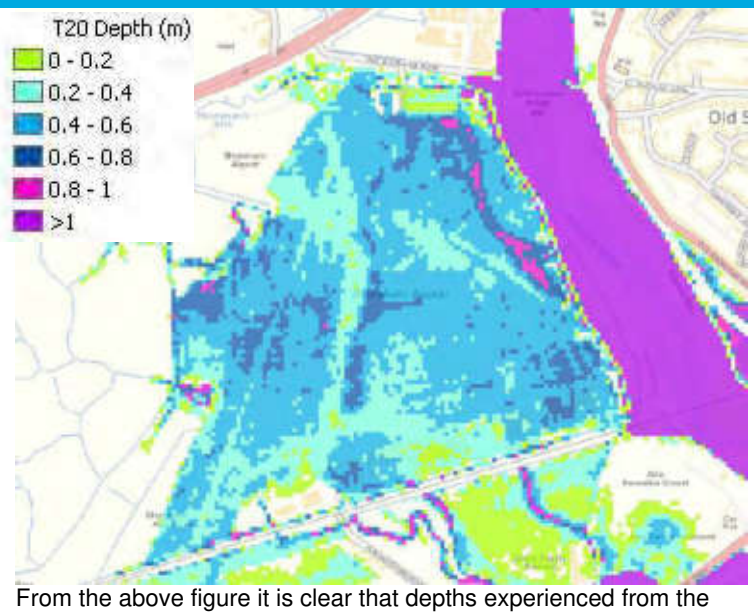
This area of non-functionality has been shown on Map 7 as a 'cross-hatched' polygon.

The functionality of the area shown to inundate during the 1 in 20 year event at Shoreham Airport, Old Shoreham and some of the land immediately north of the Hasler estate is also open to question.

In 2010 an investigation was undertaken which contested the designation of the Shoreham Airport site as 'functional floodplain' (detailed in chapter 2.2.4) which was based on probability of inundation alone.

Results from the most recent and detailed modelling of the area undertaken as part of the Shoreham Harbour Regeneration study are compared to the conclusions drawn from the 2010 investigation in Table 4.3.

Table 4.3 Comparison of studies covering Shoreham Airport

WSP Shoreham Airport 1 in 20 modelling Conclusions	Results from Shoreham Harbour Regeneration: Design and Flood Risk Study
The site only experienced short duration shallow flooding. The defence overtopping in the 1 in 20 year event occurred for a length of time of 0.5hours, with the peak level above the defence being 0.04m.	 From the above figure it is clear that depths experienced from the overtopping of defences are generally around half a metre deep and in places deeper. This contradicts the conclusion of the WSP study that suggests the area only experiences 'shallow' flooding.
A 20m grid resolution applied for the model means that a larger area (20mx20m) would be shown as wet even with a small volume of flood water.	A 10m x 10m grid resolution was used for the Shoreham Harbour Regeneration study modelling. Inundation depths are shown above.
A long drainage ditch appeared to be present immediately behind the flood defence, which was not reflected in the SFRA model. This drainage ditch could potentially collect and divert floodwater which spills over the defences	The recent TUFLOW model uses a more detailed grid resolution and up to date LIDAR data for the area, so would have better represented the floodplain drainage networks.

Additionally, recent modelling to test the effect of building the west bank Adur Tidal Walls showed that if the walls were built along the west bank the depth of flooding, and hence risk, increases on the east bank[6].

This information suggests that the west bank area of the Adur (including Shoreham Airport) provides a degree of storage at present and should, based on the evidence available, be considered functional.

However, the Adur Tidal Walls scheme will improve the defences along the west bank and the standard of protection afforded to the area. Following construction the area will no longer be inundated during the 1 in 20-year flood event, the extent of the area no longer inundated is shown in Map 17 (Appendix A). Consequently, in the future it will be appropriate for this area to be considered non-functional and will lead to the redefinition of Flood Zone 3b. It is understood that the impact of the scheme on flood risk on the east bank will be mitigated through local improvements to the east bank defences. *At the time of writing the scheme had yet to be ratified and the funding secured.*

The Old Shoreham area, along Freehold Street to The Meads, is also shown to flood with a probability of 1 in 20 years or greater. However this area will benefit from the east bank defence improvements.

It is noted that a small stretch of the east bank, downstream of Norfolk Bridge and immediately to the west of the Shoreham Harbour regeneration area, is shown to suffer inundation in the 1 in 20-year event. This area is similar to the regeneration area in that it is currently developed land and is adjacent to the High Street within Shoreham town centre. The practice guide advises that "developed areas are not generally part of the functional floodplain". Neighbouring land around Shoreham Harbour was shown to not act functionally in time of flood and it is feasible that this small stretch would also not act functionally. In light of the current land use and the fact that PPS25 allows flexibility to make allowance for local circumstances it is reasonable for this area not to be defined as flood zone 3b.

The other significant areas shown to be within flood zone 3b (the Coombes Road area north of the A27, and the Adur recreation ground / South Saxon north of the Brighton Road) are areas of low-lying open space, with some recreational use, therefore it is deemed apt that these areas be defined as functional floodplain.

It should also be noted that the coastal frontage in Worthing and from South Lancing to Portslade-by-Sea (Shoreham Harbour) in the Adur and Worthing plan areas suffers from wave overtopping. Wave overtopping is not considered in the delineation of the functional floodplain. It is important that wave overtopping is considered when making land use planning decisions (section 2.2.4). The effect of wave overtopping should therefore be investigated thoroughly in flood risk assessments accompanying development applications in these areas. The allocation of land uses within these areas should be made on a sequential risk basis and suitable mitigation measures incorporated to manage the affects of wave overtopping where this cannot be avoided. Wave overtopping should be managed effectively through the design of development.

4.3.4 Tidal defences

The Adur and Worthing seafront is protected from tidal flooding by formal defences. The beaches along the coastal frontage consist of managed shingle ridges controlled by groynes. The tidally dominated River Adur, including Shoreham Harbour, is lined with formal defences on both banks. The defences along the River Adur vary in type, condition and standard of protection. The defences along the River Adur include earth embankments, steel sheet piling, concrete walls, rock revetments and a shingle beach at Kingston Beach.

The previous SFRA stated, "The standard of protection along the River Adur ranges from 0.2% annual probability event (1 in 500 year chance of flooding) from the Old Toll Bridge to the A27 to a considerably lower standard for the remainder of the defences". Yet the "coastal defences are in the main part constructed to offer protection from the 0.5% annual probability of exceedance event (1 in 200 year)". Table 4.4, provides a detailed breakdown of those defences, which prevent flooding from the sea.

The location of the extensive tidal flood defences in Adur and Worthing is shown on Map 8 and 16 (Appendix A).

Table 4.4: Defences to prevent flooding from the sea

Source: SFRA (2008) Volume 2, Table 4.4

River/Coastal Section	Main Defence	Design Standard	Standard of protection assessed from modelling
Toll Bridge – A27 Flyover	Concrete floodwalls and flood gate	0.20% (1 in 500)	Right Bank - > 0.1% (1 in 100 year) Left Bank - < 5% (1 in 20 year)
Shoreham Airport boundary with River Adur	Earth embankments and pre-cast concrete slab along crest in places.	5% (1 in 20)	< 5% (1 in 20 year)
Shoreham Harbour/Adur Estuary	Harbour arms Piecemeal defences consisting of sections of steel sheet piling, concrete wall, shingle beach, groynes and quaysides.	Variable but design standard approximately 2% (1 in 50)	< 5% (1 in 20 year)
Lancing Brook at Shoreham Harbour	Two flapped outfalls	2% (1 in 50 year)	< 5% (1 in 20 year)
Norfolk Bridge to Railway viaduct	The new Ropetackle development in Shoreham involved new defences being constructed along this section of the river	unknown	> 0.1% (1 in 100 year)
Emerald Quay to footbridge	Rear boundary walls of residential properties along Riverside Road. Mix of brick, concrete, timber and sheet steel piled walls.	50% (1 in 2)	< 5% (1 in 20 year)
Worthing and Adur Coastline	Coastal defence consists mainly of shingle beach, groynes, rock revetment and the western harbour arm.	0.5% (1 in 200)	> 0.1% (1 in 1000 year)
Teville Stream – River Adur	Groyne stabilised shingle beach Harbour arms prevent beach loss by longshore drift.	1%	> 0.1% (1 in 1000 year)
Eastern edge of Southwick to Arun river mouth	Coastal defence consists mainly of shingle beach, groynes, rock revetment and the western harbour arm.	0.5% (1 in 200)	> 0.1% (1 in 1000 year)
Ferring Rife – Teville Stream	Groyne stabilised beach Sea wall Grand Ave – George V Ave Sea wall at Splash Point Sea wall at New Parade Sea wall Ham Rd Tide flapped outfall on Ferring Rife and Teville Stream	0.5 % 0.5% 0.5% 0.5% 0.5%	> 0.1% (1 in 1000 year)

New Proposed Defences - Adur Tidal Walls

The Adur tidal walls are proposed to cover a long stretch of the west bank of the River Adur from the A27 road bridge in the north through to Shoreham Fort. It is suggested that these walls will be continuous apart from a short section close to the Adur Recreation Ground, where the Brighton Road embankment is high enough to form part of the defence line. It is proposed that the Adur Tidal Walls will be constructed to a height which will provide a SoP of 0.5% (1 in 200 year). As a consequence the land currently designated Flood Zone 3b may be changed to Flood Zone 3a (See Section 4.3.3). From information provided during the preparation of this SFRA it is suggested that the SoP of these defences will decrease under the impacts of climate change with some inundation of the floodplain behind the defences expected in a future (2115) 1 in 200 year return period event. Although it has been suggested that this inundation *"results principally from "back door flooding" over the A27 road embankment rather than significant overtopping of the Adur tidal walls themselves*.

New Proposed Defences - Other

A series of "redevelopment walls" will potentially be constructed in the Shoreham Harbour Regeneration area to protect the development areas under consideration as part of the Shoreham Harbour Regeneration Scheme. It is suggested that these walls will be built to provide a SoP to protect the areas from flooding during a 200-year return period extreme sea-level event based in the year 2115.

Further defences are proposed as part of the Ropetackle North development in Shoreham. These "Ropetackle defences" are suggested to provide flood protection for the site, areas on the east bank of the river in the vicinity of West Lake and The Meads, and some parts of Shoreham Town. The Ropetackle defences will not mitigate flooding to the town which might arise as a result of the overtoppping of the embankments north and south of Ropetackle.

Also a newsletter released by the Environment Agency[11] in October 2011 states that they are looking into how they "will improve the flood defences on the east bank of the River Adur at Shoreham".

4.3.5 Tidal residual risk

'Residual risk' is defined as the flood risk remaining with flood mitigation measures in place. The land behind the defences is only at risk of flooding through failure or overtopping of the defences.

Failure of flood defences

Flood zones represent the undefended situation and so allow consideration as to the extent of residual risk arising from failure of a defence. Map 8 (Appendix A) shows the comparison between the defended 1 in 200 year flood extent and the undefended flood extent (Flood Zone 3a).

In Worthing the main areas to be shown at residual flood risk are the Brooklands Pleasure Ground and the area from Alinora and Marine Crescent to West Parade.

In Adur, the only area along the coastal frontage shown to be at residual flood risk is the recreation ground to the east of Pen Hill south of the Brighton Road. The remainder of residual risk in Adur is associated with the extensive formal defences along the length of the River Adur.

The impact of a failure in the defences has not been modelled as part of this SFRA. The SFRA (2008) looked at two breach locations in Worthing consistent with the two areas shown to be at residual risk mentioned above. The extents from these breach analyses were consistent with the Flood Zone 3a outline.

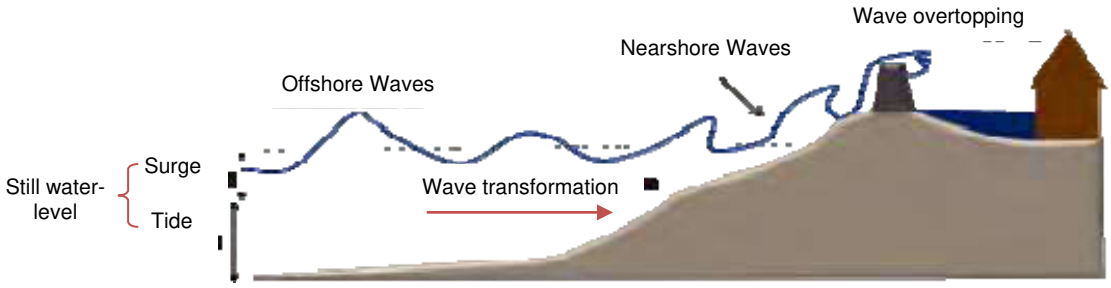
Any future development proposal shown to be in an area of residual risk should fully assess the risk as part of an FRA.

11 EA (October 2011) Shoreham east bank newsletter http://www.environment-agency.gov.uk/static/documents/Leisure/Adur_newsletter-oct_2011FINAL.pdf

Wave Overtopping

Tidal flooding along much of the south coast is characterised by the presence of risk associated with wave overtopping. In exposed locations along the coast, landward flooding is more likely to occur because of wave overtopping over inundation. Wave overtopping is a term, which encompasses a number of complex physical processes, which result in the transfer of water from the sea onto the coastal floodplain. The amount of wave overtopping that occurs during an extreme event is dependent on the local water depth, the properties of incoming waves and the geometry of local flood defences. Figure 4.1 outlines the process of wave overtopping in relation the Extreme Still Water Sea-level.

Figure 4.1: Illustration of residual risk associated with wave overtopping



Wave overtopping is one of the principal mechanisms of flooding for the coastal frontage. The Shoreham Harbour and Adur to Arun Study undertook modelling to identify the effect of wave-overtopping. Maps 10 and 11 (Appendix A) compare the effect of wave overtopping in the 1 in 20 year and 1 in 200 year events. The outlines for both return periods are significantly more extensive along the entire coastal frontage of Adur and Worthing. The effect of wave overtopping has not been included in the flood zone delineation. However, wave overtopping is of material concern to the coastal frontage, therefore any future development proposal should be accompanied by a flood risk assessment which appropriately considers the effects of wave overtopping.

4.3.6 Recent Coastal Flood Boundary study

Since the SFRA was completed a new Defra/Environment Agency project has been undertaken to determine extreme sea levels for the UK, published by the EA in February 2011 as "Coastal Flood Boundary Conditions for UK Mainland and Islands". Table 4.5 shows how the levels have changed from those used in the EA Adur to Arun Flood Mapping Study.

Table 4.5 shows that in general the new extreme sea-levels are lower than those used for the Adur to Arun study. However the differences between them is not thought to be significant enough to warrant remodelling the flood risk as the new levels are within the confidence level of ±300mm.

Table 4.5: Difference in Extreme Sea Level (mAOD)

2011[12] (new) minus 2010[13] (previous)

Return Period	Littlehampton	Worthing	Shoreham
20	-0.15	-0.14	-0.10
75	-0.21	-0.10	-0.06
200	-0.19	-0.08	-0.04
1000	-0.19	-0.08	0.05

4.3.7 Effects of climate change on tidal flood risk

The Arun to Adur Flood Modelling and the Shoreham Harbour Regeneration: Design and Flood Risk Study (2011) undertook detailed modelling of the effect of climate change on tidal

[12] Coastal Flood Boundary Conditions for UK Mainland and Islands, Project: SC060064/TR2: Design sea levels, February 2011

[13] Extreme Sea-levels: Kent, Sussex, Hampshire and the Isle of Wight, Updated Summary Report, July 2003

flood risk through Adur and Worthing. Details of the climate change effect on tidal flood risk within Adur and Worthing are shown in Map 9 (Appendix A).

In Worthing the coastal frontage from Arlington Avenue in the east to Bernard Road in the west and the Marine Parade from South Street to Warwick Road are shown to be at risk of flooding in the future (2115). The modelled outputs shown on Map 9 (Appendix A) take account of defences therefore it can be assumed this inundation would be because of the sea level exceeding the level of the coastal defences.

In Adur the present day 1in 200 year defended extent is extensive due to the current standard of protection of the defences being exceeded. In the future this extent increases further (see Map 9, Appendix A). The areas shown to be at risk in the future are:

- Lancing area bounded by the railway, A2025 (Grinstead Lane) and the A27;
- north of Old Shoreham Road;
- Old Shoreham around Connaught Avenue, Victoria Road and Ropetackle; and
- Shoreham Harbour, around Shoreham town centre, Southwick and Shoreham Beach.

The effect of climate change on wave overtopping has not been looked at as part of the existing studies. Given that the region is highly susceptible to wave overtopping, it should be noted that the true risk of future climate change is only partially presented.

New climate change guidance

The new climate change advice note is described in the Section 4.2.6.

The existing estimates of climate change are within the bounds of this new guidance. However, it should be noted that the guidance recommends that "when considering climate change a full appreciation of emission scenario and climate uncertainty is taken into account. The upper and lower end estimates are designed to achieve this within flood and coastal erosion risk management applications." It would be appropriate to consider the upper H++ scenario when reviewing some planning applications, for example critical infrastructure which could not readily be moved or protected in the event of climate change occurring at a rate beyond what is expected.

The sea level rise calculated for 2070 and 2115 as part of the recent EA studies in the SFRA (2008) are equivalent to the change factor suggested and only slightly less than the upper end estimate in Table 4.2. For the purposes of this SFRA it was felt that the existing estimates were sufficient to provide an overview of the potential future risk posed to the area and to inform the Sequential Test of proposed sites.

4.3.8 Flood warning systems

The Environment Agency operates a flood warning service covering tidal flooding for Adur and Worthing using its Flood Warnings Direct system. These areas are currently under revision by the Environment Agency to bring them up to date with guidance released in the last few years by making them more community orientated.

There are currently four flood warning areas covering tidal flood risk in Adur and Worthing:

- 073FWC11A - coastline at Portslade, Shoreham by-Sea, Hove and Brighton, including Shoreham Port and Brighton Marina.
- 071FWC3001 - coastal areas of Shoreham by Sea, including Shoreham beach, Shoreham Airport, Shoreham Harbour, Old Shoreham Road, and Ropetackle.
- 071FWC2901 - coastal areas of Lancing, including Broadway and Willowbrook caravan park, and Lancing Business Park.
- 071FWC2801 - coastal areas of East Worthing, including Brooklands Pleasure Park, and Harrison Road trading estates.

4.4 Surface water flood risk

The Adur and Worthing area is subject to surface water flooding originating from run-off from the steep slopes of the South Downs. In some instances this type of flooding will be a

combination of seasonal spring flow and field runoff, however the latter can occur in isolation and is often associated with changes to the way that the land is farmed.

The historic surface water flooding records generally correspond with the identified flood risk regions, with a greater number of surface water flooding records in the River Adur Valley, north Lancing, north west of Shoreham-by-Sea, and throughout Worthing.

Several studies have documented that increased grazing intensity coupled with changing cropping practices have caused a change in soil conditions reducing the amount of infiltration. Rills and gullies formed by the use of heavy farm machinery provide conduits for surface water, enabling water to easily run off often moving large volumes of soil in the process. This is termed 'muddy flooding' and has occurred in Lancing, Sompting, Findon and other local areas along the base of the South Downs outside the study area.

Sompting and Findon in particular have long history of surface water flooding. Whilst Findon is outside the study area the Findon Valley area has the potential to be affected by flooding flowing into the study area across the boundary. There were also numerous reports of surface water flooding in Worthing, Lancing, north west Shoreham and Southwick. A number of pluvial events have occurred in Worthing town centre.

An assessment for the potential for surface water flooding in Adur and Worthing has been included in Maps 12 to 14 (Appendix A). This uses Environment Agency surface water datasets including Areas Susceptible to Surface Water Flooding (AStSWF) and Flood Map for Surface Water (FMfSW).

The locally agreed surface water information for Adur and Worthing will be the FMfSW according to the West Sussex PFRA report. The general flow paths are consistent across both the AStSWF and the FMfSW, however they do differ in the spatial extent of flooding and depth of flooding. The extent of flooding shown by the AStSWF is larger than that shown in the FMfSW. This is because the AStSWF was modelled using a longer storm duration and assumed there was no drainage capacity within the sewer network, consequently the flood extent is larger compared to FMfSW. Therefore, the AStSWF should be considered as the 'worse case', with the more realistic FMfSW highlighting those areas where flood risk is more prominent.

There are well-defined flow routes within Adur and Worthing according to the FMfSW. The largest affected areas are north of the A2032 in Worthing. The most obvious flow route follows along the Findon Road southwards to Warren Road. Another flow path runs north to south from the Worthing golf course to the A27 where both flow paths join and spread and pond along the streets in Broadwater. The most affected areas in the north west side of Worthing clearly follow the ditch along Forest Lane. There is also a large ponded area between New Road and Slavington Road in West Durrington. In the south of Worthing, south of A2032, there are many small areas shown to experience ponding.

There are four clear flow routes within Adur which are north of the A27. The most obvious flow route runs north to south from Stamp Bottom passing Lychpole Farm along the Titch Hill Road ponding to the east of Sompting along the Busticle Lane. Another clear flow path follows the Lady Stream east to west from the River Adur Valley. The rest of the flow routes are at the east of the River Adur Valley and run north to south ponding in the area north of the A27.

The area to the south of the A27 is affected by surface water ponding along roads and streets. The significant areas include, immediately south of the Old Shoreham Road in North Lancing, the area between George Parade and A259 in Kingston-by-Sea, the green and the cricket ground in Southwick.

The Lancing Brook Flood Investigation report (2010) also assessed the potential consequences of flooding from surface water sources in the Lancing area. The areas at shown to be at risk in the Lancing Brook study largely agreed with the area identified in the FMfSW. The receptors that were highlighted as having experienced flooding were mainly agricultural and scrub land, local residential roads and the gardens of a small number of residential properties. However, it was highlighted that anticipated changes in climate may increase the risk of localised flooding and may increase the flood risk to Shoreham Dogs Trust and several residential properties. An update to this report stated that the cause of flooding referred to in the report was identified during dredging to be a man made dam immediately

east of the northeast property in Willowbrook Park, which was erected to hold water in the ditches of Willowbrook Park as a water feature and as a consequence raised water levels considerably upstream.

4.5 Groundwater flood risk

Adur and Worthing are positioned at the base of the South Downs and have suffered flooding from groundwater in the past. The geology within the administrative areas of Adur and Worthing is dominated by the chalk of the South Downs, with stripes of clay, silt and sand lying in the centre of the Worthing study area and along the coastline in Adur (Map 2, Appendix A).

A few occurrences of groundwater flooding have been noted during the period of 1960 to 1990 across the study area. Groundwater flooding across West Sussex was recorded during 1974, notably in the River Adur catchment up to and above the chalk band. Significant groundwater flooding was also observed during 1993/94, 2000/01 and 2002/03.

An assessment of groundwater flood risk in Adur and Worthing has been undertaken using the Environment Agency's 'Areas Susceptible to Groundwater Flooding' data. Map 15 (Appendix A) shows how the risk varies across Adur and Worthing. The majority of the Worthing area is susceptible to groundwater flooding. The only area that doesn't appear to be susceptible to groundwater flooding is in the north east of Worthing around the Findon Valley and Worthing Golf course. The central area of Worthing along A2032 is shown to be more susceptible to groundwater flooding with a high-risk category (>=75%); the rest of the area is covered by a range of risk categories (< 25% to <75%).

The majority of Adur District is susceptible to groundwater flooding. The only areas that don't appear to be susceptible to groundwater flooding are the north west and north east parts of the district which are mainly rural. The central area of the district between the A27 and to Shoreham-by-Sea is more susceptible to groundwater flooding with a high-risk category (>=75%); the rest of the area is covered by a range of risk categories (< 25% to <75%).

4.6 Sewer flood risk

Sewer flooding can occur where sewer systems become overloaded with surface runoff. There are two mechanisms of flooding to properties; surcharge flooding, where flood waters back up pipes and enter directly into low-lying properties through toilets and sinks, and surface flooding, where storm sewage exceeds the system capacity, spills from manholes then runs overland and into properties. In Adur and Worthing, storm water is generally drained by the sewer infrastructure; the system is at risk of becoming overloaded in storm conditions. The infrastructure is also at risk of becoming inundated with groundwater when groundwater levels rise.

There have been recorded incidences of sewer flooding in Adur and Worthing. The lack of any significant gradient in the low-lying coastal areas means that sewer networks often rely on pumping to drive flow. Consequently, failure of pumping stations can lead to rapid sewer flooding. The assessment of surface water pumping systems is too detailed for the SFRA, however where relevant, should be investigated further in detailed flood risk assessments.

Records of incidents were obtained from the Environment Agency and Southern Water as part of the SFRA (2008), and were summarised in the 2008 SFRA report, Appendix A. These records have been plotted on Map 3 (Appendix A).

4.7 Flood risk from artificial sources

4.7.1 Reservoirs

There are no reservoirs storing water above ground level in Adur and Worthing. We were not provided with any details of the capacity of Fulbeck Avenue pond (Somerset Lake) although according to the EA, the pond could be large enough to be considered a reservoir (>10,000m^3).

4.7.2 Other water bodies

There are several storage water ponds identified in the SFRA (2008), two of them are located in the Durrington area of Worthing, one is south of the A2032 and the other one is at East Worthing. The two storage ponds appear to be susceptible to both surface water and groundwater flooding. The impact of flooding from these storage ponds has not been assessed due to lack of data.

4.7.3 Canals and other artificial sources

There are no known canals or 'other' potential artificial sources of flooding in Adur and Worthing.

4.7.4 IDB Watercourses

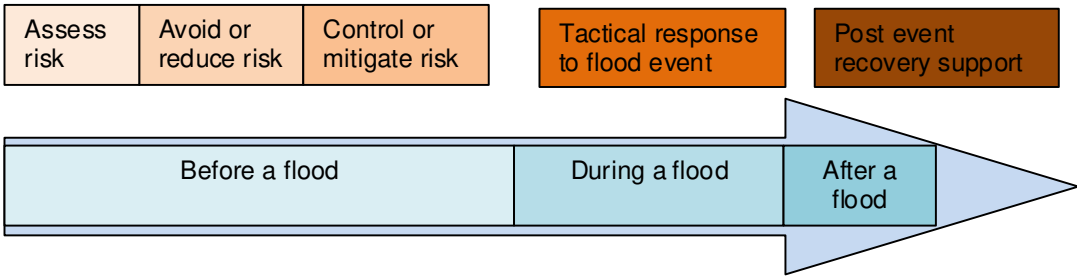
There are several watercourses which are regularly maintained by the Internal Drainage Board including the Pad Stream, Ladywell Stream, Applesham Sewer, Coombes Sewer, Annington Sewer and Shoreham Waterworks Sewer. The IDB also maintains and operates numerous control structures within the District to control water levels.

6 Recommendations and Guidance

6.1 Using SFRA risk information

The SFRA contains information that can be used at strategic, operational and tactical levels as shown in Figure 6.1. The flood risk data contained within this SFRA should be updated following flood events.

Figure 6.1: Use of SFRA information



6.2 For Adur District and Worthing Borough Councils

One of the key objectives of the SFRA is to provide an evidence base which will inform the preparation of the Local Development Framework for Adur and Worthing with respect to local flood risk issues and the location of future development.

The Councils will have regard to PPS25 Development and Flood Risk and to the most recent Strategic Flood Risk Assessment in assessing the suitability of land for development at all levels of the planning process. It will apply the Sequential Test and Exception Test set out in Annex D of PPS25 in master planning, allocating sites for development and assessing individual planning applications by ensuring that there are no other suitable sites in areas with a lower risk of flooding. The Councils will also have regard to the emerging National Planning Policy Framework and any changes that may bring with it.

The local planning authority can play an important role in strategic flood risk management. The overall aim should be to direct development to areas of lower flood risk wherever possible and resist development in areas of flood risk unless the type of development is commensurate with the type of flood risk.

The Councils should also seek flood risk reduction in every new development and redevelopment through design, changes in land use and drainage requirements.

6.2.1 Requirements for flood risk assessment

The Councils should require that all development, including changes of use, have at least an initial assessment of flood risk using this SFRA with a requirement for a detailed site specific flood risk assessment to be submitted with planning applications for:

- Major developments located in Flood Zone 1 (>1ha);
- All development in Flood Zones 2 and 3;
- All development or change of use, regardless of flood zone or size, where flood risk from other sources (surface water, sewer, groundwater) is identified by the SFRA.

Flood Risk Assessments should identify and assess the risks of all forms of flooding to and from the development and demonstrate how these flood risks will be managed, taking climate change into account.

An FRA should demonstrate:

- whether any proposed development is likely to be affected by current or future flooding from any source;

- satisfying the LPA that the development is safe and where possible reduces flood risk overall;
- whether it will increase flood risk elsewhere; and
- the measures proposed to deal with these effects and risks. Any necessary flood risk management measures should be sufficiently funded to ensure that the site can be developed and occupied safely throughout its proposed lifetime.

6.2.2 Surface Water runoff

The Councils should require that surface water runoff from a development should be controlled as close to the source as possible. In addition, where the development site is 'greenfield', runoff must be controlled to maintain the 'greenfield' runoff rates. If the site is 'brownfield' developers should strive to achieve 'greenfield' runoff rates but as a minimum reduce existing runoff by 50%.

The use of Sustainable Drainage Systems (SuDS) should be required on all new developments. If SuDS are not used, the developer must provide a valid reason why they are not suitable.

6.2.3 Surface Water flooding

There is a history and recognised risk of surface water flooding in Adur and Worthing (Section 4.4).

The Councils should require a flood risk assessment for all development or change of use, regardless of flood zone or size, where flood risk from surface water is identified by the SFRA. The FRA should clearly state the degree of risk and how the risk to the development will be mitigated against.

Given the level of surface water flood risk in the study area developments should seek to reduce surface water flood risk downstream by capturing the rainwater. Once captured this water should either be:

- Re-used for a range of purposes, such as toilet flushing and garden watering: or
- Infiltrated back to the ground. The permeable nature of the underlying chalk means infiltration is possible, however consultation will be needed with the EA regarding groundwater protection zones (Figure C-6.2: Groundwater source protection zones across Adur and Worthing) as restrictions on infiltration may apply.

6.2.4 Groundwater flooding

Situated on the South Downs, the underlying geology of Adur and Worthing is predominantly chalk. Consequently, there is a history and recognised risk of groundwater flooding (Section 4.5).

The Councils should require a flood risk assessment for all development or change of use, regardless of flood zone or size, where flood risk from groundwater is identified by the SFRA. The FRA should clearly state the degree of risk and how the risk to the development will be mitigated against.

The Councils should ensure that any subterranean development proposals consider the risk from groundwater or other sources of flooding, and should prove that groundwater flow paths are maintained so as not to increase the flood risk elsewhere. The design of any new subterranean development should ensure that flood risk is not increased for existing adjacent subterranean developments by changes to groundwater flow paths.

6.2.5 Failure of defences

The Adur and Worthing seafront is heavily protected by a series of coastal defences. Although their standard of protection is high, there remains a residual risk in the incidence of failure (Section 4.3.5). There is also a risk of defence failure along the length of the River Adur which has raised defences along both banks throughout Adur.

Where flood risk exists from failure of defences, all developments should be required to demonstrate that:

- 'Safe' access includes the ability to escape to higher levels without having to pass through flood waters.
- The Councils' emergency planner is consulted on the proposals.
- The emergency services are consulted on the proposals.
- A robust emergency/evacuation plan should be developed and communicated.
- The development would be structurally safe against the effects of breach flood waters.
- For major highly vulnerable development and essential infrastructure safety will also need to be ensured through demonstration that a robust evacuation plan to dry land is developed.

6.2.6 Wave overtopping

Wave overtopping is a significant risk along the south coast. Wave overtopping is one of the principal mechanisms of flooding for the coastal frontage (Section 4.3.5). In line with the approach agreed for the recent Arun to Adur Flood Risk Mapping Study, wave overtopping has been considered in this SFRA update within the assessment of actual risk or residual risk, not within the flood zone delineation. This approach balances the predominance of redevelopment and regeneration in the coastal frontage of the study area with the need to consider flood risk from all sources. Allowing for wave-overtopping increases the extent of flooding. In some instances, this can mean the defended 1 in 200 year outline with the effect of wave overtopping would be larger than Flood Zone 3a. Therefore, any future development proposal along the coastal frontage should be required to thoroughly consider the effects of wave overtopping through detailed hydraulic modelling.

Where flood risk exists from wave overtopping, all developments should be required to demonstrate that:

- The residual risk is being mitigated.
- The development would be structurally safe.
- The development has 'Safe' access and egress to dry land, or includes the ability to escape to higher levels without having to pass through flood waters.
- Both the Council's emergency planners are consulted on the proposals.
- The emergency services are consulted on the proposals.
- A robust emergency/evacuation plan should be developed and communicated.

6.2.7 Functional Floodplain

Section 4.3.2 detailed the approach to functional floodplain in the Adur and Worthing plan areas. In line with the discussions in Section 4.3.2, where the question of functionality arises then it will be the responsibility of the developer to challenge this designation through detailed hydraulic modelling.

6.3 For Developers

Developers should consider flood risk at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development. Recommendations of how to reduce flood risk through design and site layout are detailed in Appendix C.1.

In general all future developments should demonstrate:

- That the probability and consequences of flooding will be reduced.
- How actual and residual flood risk to the development and flood risk to others from all sources will be managed over the lifetime of the development, taking into account climate change.
- That development will be safe through the layout, form and floor levels of the development and mitigation measures.
- Surface water runoff is being managed.

A development will have certain requirements to fulfil, dependent upon which flood zone it is located within. The minimum requirements for future development are summarised Appendix D.

The following subsections contain information to assist developers where flood risk to and from a development is identified.

6.3.1 Managing surface water runoff

As standard, SuDS techniques should be used on all new developments to control the surface water runoff from the site. Any surface water runoff from a development should be controlled as close to the source as possible. Details of application of SuDS techniques can be found in Appendix C.3.

Where the development site is 'greenfield', runoff must be controlled to maintain the 'greenfield' runoff rates. If the site is 'brownfield' developers should strive to achieve 'greenfield' runoff rates but as a minimum reduce existing runoff by 50%.

6.3.2 Managing flood risk from sewer flooding

There should not be the presumption that the existing sewer drainage network has enough capacity to accommodate the flows from new developments. Consultation with Southern Water Services Ltd should be undertaken prior to development commencing. (See Appendix C.2)

Where there is an evidenced history of sewer flooding in an area, resilience measures e.g. non return valves should be considered in development design.

6.3.3 Managing flood risk from surface water flooding

Where a site is shown to be at risk of surface water flooding the design and layout of the property should be such that the risk is reduced.

Where risk remains, the likely flow routes and depths across the site should be modelled. The site should be designed so that these flow routes are maintained, and building design should provide resilience against the risk of surface water flooding. (Appendix C.1 details potential resilience measures).

Developments should seek to reduce surface water flood risk downstream by capturing the rainwater. Once captured this water should either be:

- Re-used for a range of purposes, such as toilet flushing and garden watering: or
- Infiltrated back to the ground. The permeable nature of the underlying chalk means infiltration is possible. However, consultation will be needed with the Environment Agency's groundwater protection zones (Figure C-6.2) as restrictions on infiltration may apply.

At the present time there is no policy for what constitutes the thresholds for 'locally significant flood risk'. This policy will be determined and set out in West Sussex's Local Flood Risk Management Strategy (LFRMS) which is due to start later in 2011. The West Sussex LFRMS will collect and assess information on surface water , groundwater and ordinary water courses flood risk of local significance and will map flood hazards and flood risk of local significance, as well as considering a flood risk management plan for the county. For example, the PFRA process has identified 2631 incidents of past local flooding within the county. These areas will be addressed in the LFRMS.

6.3.4 Managing flood risk from groundwater flooding

Groundwater flooding has a very different flood mechanism to any other form of flooding. As it rises up from below ground level, many conventional flood defence and mitigation methods are not suitable. A large proportion of the county has the potential to be affected by emergent groundwater due to its underlying geology, current modelling is not detailed enough to accurately predict where flooding may occur. Further analysis of this flood source will be investigated in the LFRMS.

The only way to fully reduce flood risk would be through building design, ensuring that floor levels are raised above the water levels caused by a 1% annual probability plus climate change event. Site design would also need to preserve any overland or subterranean flow routes followed by the groundwater and make sure flood risk is not increased elsewhere.

Where subterranean development is proposed the developer will need to ensure there is no risk from groundwater (or other sources of flooding). The development will also need to ensure no underground groundwater flow paths are impeded, so as not to increase the flood risk to existing adjacent basements by changes to groundwater flow patterns.

When redeveloping existing buildings it may be acceptable to install pumps in basements as a resilience measure. However for new development this is unlikely to be considered an acceptable solution.

North

ADUR DISTRICT COUNCIL

Worthing BOROUGH COUNCIL

LEGEND

Adur and Worthing Boundary

Flood Defence Type

- coastal protection (man-made)
- coastal protection (natural)
- culverted channel
- maintained channel
- raised defence (man-made)
- raised defence (natural)
- sea defence (man-made)
- sea defence (natural)

JBA consulting

Map 16
Flood Defences

Scale 1:55,000

North

ADUR DISTRICT COUNCIL

Worthing BOROUGH COUNCIL

LEGEND

- Defences
- Adur and Worthing Boundary
- 1% AEP Defended
- Flood Zone 3

Note: New data from the Shoreham Harbour Regeneration: Design and Flood Risk Study (June 2011) has been incorporated to update the 1% AEP defended fluvial flood extent for this SFRA update (2011).

JBA consulting

Map 5
Actual Fluvial Flood Risk
(with defences)

Scale 1:55,000

North

ADUR DISTRICT COUNCIL

Worthing BOROUGH COUNCIL

LEGEND

- Adur and Worthing Boundary
- Flood Zone 3b
- Flood Zone 3a
- Flood Zone 2

Note: New data from the Shoreham Harbour Regeneration: Design and Flood Risk Study (June 2011) has been incorporated to update the Fluvial Flood Zone 3b for this SFRA update (2011).

JBA consulting

Map 4
Fluvial Flood Risk - Floodplain Delineation (undefended)

Scale 1:55,000

North

LEGEND

Adur and Worthing Defences

Adur and Worthing Boundary

1% AEP Defended

Present Day

Climate Change (2056)

Climate Change (2106)

Note: New data from the Shoreham Harbour Regeneration: Design and Flood Risk Study (June 2011) has been incorporated to update the fluvial 1% AEP defended present day outline for this SFRA update (2011).

Map 6
Future Fluvial Flood Risk
(with defences)

Scale 1:55,000

North

LEGEND

Adur and Worthing Boundary

AStGWF

>= 75%

>= 50% <75%

>= 25% <50%

< 25%

Areas Susceptible to Groundwater Flooding is a strategic scale map showing groundwater flood areas on a 1km square grid. The data is annotated to show what percentage of the 1km area is susceptible to groundwater flood emergence.
This provides an indication as to the degree of risk from groundwater flood risk within an area.

Scale 1:55,000

Map 15
Indicative Groundwater Flood Risk (Areas Susceptible to Groundwater Flooding)

North

ADUR DISTRICT COUNCIL

Worthing BOROUGH COUNCIL

LEGEND

- Adur and Worthing Boundary
- Main River
- EA Historic Flood Map
- Fluvial Flooding
- Sewer Flooding
- Unknown Flooding
- Groundwater Flooding
- Coastal Flooding
- Surface Water Flooding
- Surface Water Flooding
- Surface Water Flooding
- Tidal Flooding
- Tidal Flooding
- Tidal Flooding
- Flooding from failure
- Flooding from failure

Note: Failure relates to a blockage or bank/structure failure and according to the SFRA 2008 this is usually related to flooding from rivers.

JBA consulting

Map 3
Historical Flooding

Scale 1:55,000

North

LEGEND

Adur and Worthing Boundary

FMfSW 1 in 30yr - Depth

> 0.1m

> 0.3m

Map 12
Surface Water Flood Risk
(Flood Map for Surface Water - 1 in 30 year)

Scale 1:55,000

North

LEGEND

Adur and Worthing Boundary

FMfSW 1 in 200yr - Depth

> 0.3m

> 0.1m

Map 13
Surface Water Flood Risk
(Flood Map for Surface Water - 1 in 200 year)

Scale 1:55,000

North

LEGEND

Adur and Worthing Boundary

AStSWF

More

Intermediate

Less

Map 14
Surface Water Flood Risk
(Areas Susceptible to Surface Water Flooding)

Scale 1:55,000

Appendix H MicroDrainage Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years) 100 SAAR (mm) 715 Urban 0.000
Area (ha) 19.960 Soil 0.400 Region Number Region 7

Results l/s

QBAR Rural 69.6
QBAR Urban 69.6

Q100 years 222.1

Q1 year 59.2
Q30 years 157.8
Q100 years 222.1

Greenfield Runoff Volume

FSR Data

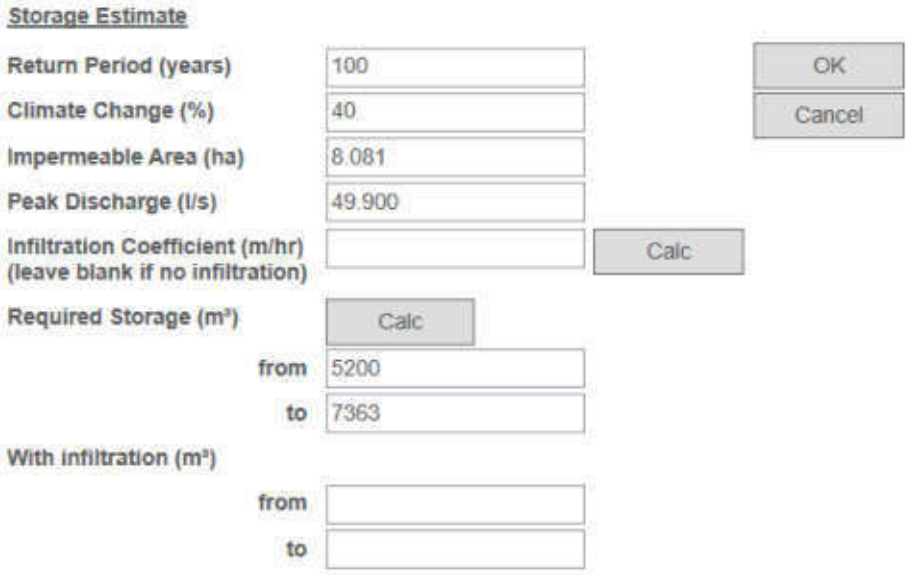
Return Period (years)	100
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	19.600
Ratio R	0.350
Areal Reduction Factor	1.00
Area (ha)	19.960
SAAR (mm)	715
CWI	106.935
Urban	0.000
SPR	37.000

Results

Percentage Runoff (%)	36.73
Greenfield Runoff Volume (m^3)	4745.873

23/07/2020

Causeway Flow Quick Storage Estimate



- Existing Greenfield Run-off calculated as being **69.60l/s (3.49l/s per hectare)**

- Preliminary calculations have been run in order to provide **betterment**, i.e. a **reduction** in the rate of run-off leaving the site.

- Based on **2.5l/s per hectare (49.90l/s)** and an indicative impermeable area of 8.081Ha (as demonstrated on drawing D1586-PL500 – inclusive of 10% Urban Creep allowance) initial calculations suggest storage to the volume of **5,200m^3 to 7,363m^3** will be required in order to support the development.

Appendix I Soils Limited Geotechnical & Environmental Consultants Phase II Ground Investigation Report

Ground Investigation

soils LIMITED

Geotechnical & Environmental Consultants

Phase II Ground Investigation Report

At

Goring Street, Goring-By-Sea, West Sussex BN12 5DQ

For

Persimmon Homes (South Coast)

Soils Limited
Newton House
Cross Road
Tadworth
Surrey KT20 5SR
☎ 01737 814221

REPORT 14131/GIR

Phase II Ground Investigation Report

Job Title: Goring Street, Goring-By-Sea, West Sussex BN12 5DQ

Client: Persimmon Homes (South Coast)

CONTROL DOCUMENT

SOILS LIMITED DOCUMENT REFERENCE NUMBER:
14131/GIR

DOCUMENT TYPE:
Phase II Ground Investigation Report

DOCUMENT STATUS: FINAL REVISION: 1.00

DATE: January 2015

Note: This is not a valid document for use in the design of the project unless it is titled **Final** in the Document Status box.

	Name	Signature
Prepared by:	T. Rees-Blanchard *(trb@soilslimited.co.uk)*	
Checked by:	C. Morrison	
Approved by:	R. B. Higginson	

Current regulations and good practice were used in the preparation of this report. The recommendations given in this report must be reviewed by an appropriately qualified person at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

Soils Limited
Newton House
Tadworth
Surrey KT20 5SR
Phone 01737 814221

Phase II Ground Investigation Report

At

Goring Street, Goring-By-Sea, West Sussex, BN12 5DQ

For

Persimmon Homes (South Coast)

Commission

Soils Limited was commissioned by Persimmon Homes (South Coast) to undertake a Phase II Ground Investigation on land at Goring Street, Goring-By-Sea, West Sussex BN12 5DQ. The scope of the investigation was outlined in the Soils Limited quotation reference Q15101 dated 31st January 2014.

This document comprises the Phase II Ground Investigation Report and incorporates the results, discussion and conclusions to this intrusive works.

This Phase II report must be read in conjunction with the Phase I Desk Study undertaken on the above site by Soils Limited, Report ref: 14131/DS, dated May 2014).

Section 2 Site Works

2.1 Proposed Works

The proposed intrusive investigation was designed to provide information on the ground conditions and to aid the design of foundations for the proposed commercial development. The intended investigation, as outlined within the Soils Limited quotation (Q15101 dated 31st January 2014), was therefore to comprise the following items:

- Two days windowless sampler boreholes and dynamic probes;
- Installation of combined groundwater and soil gas monitoring wells;
- One days trial Pitting;
- Four soakage tests;
- Geotechnical laboratory testing;
- Contamination laboratory testing.

2.1.1 Site Works Undertaken

The site works were undertaken on the 4th and 5th September 2014 (inclusive) and comprised:

- Two days windowless sampler boreholes and dynamic probing (WS1, WS6, WS8, WS10 and DP1-10);
- Two days trial pitting;
- Four soakage tests;
- Three combined groundwater and soil gas monitoring wells;
- Geotechnical laboratory testing;
- Contamination laboratory testing.

During the intrusive investigation Soils Limited decided that an additional trial pitting would be required to achieve an adequate coverage across the site and give information about trench stability and shallow groundwater ingress.

The majority of trial holes were backfilled with arisings, though gravel and bentonite were used when installing wells. All trial hole locations have been presented in Figure 2.

Following completion of site works, soil cores were logged and sub sampled so that samples could be sent to the laboratory for both contamination and geotechnical testing.

Disturbed samples were collected form the trial pits as excavation proceeded.

2.2 Ground Conditions

On 5th September 2014, four windowless sampler boreholes were drilled, using a terrier type drilling rig, to depths of between 4.00 and 5.00m bgl at locations selected by Soils Limited prior to mobilisation. Ten super heavy dynamic probes (DP1 to DP10) were driven to depths of between 4.00 and 7.00m bgl. Following completion of windowless sampler boreholes, three monitoring wells were installed within windowless sampler boreholes (WS1, WS6 and WS10) to allow groundwater and soil gas monitoring.

On the 4th and 5th September 2014, 18 Machine excavated trial holes (TP1-8, TP10-15 and TP17-20) were created using a JCB 3CX type excavator to depths of between 1.00 and 3.00m bgl. Upon completion of excavations TP3, TP4, TP7 and TP14 where used to carry out soakage testing in accordance with the principles of BRE 365. TP17 - TP20 where shallow trial pits purely to allow for contamination screening of the planned open spaces across the northern half of the site.

All trial holes were scanned with a Cable Avoidance Tool (C.A.T.) prior to excavation to ensure the health and safety of the operatives.

The depths of trial holes excavated are provided in Table 2.1.

Table 2.1
Final Depth of Trial Holes

Window Sample	Depth (m bgl)	Trial Pit	Depth (m bgl)	DP	Depth (m bgl)
WS1(w)	5.00	TP1	3.00	DP1	7.00
WS6(w)	5.00	TP2	3.00	DP2	7.00
WS8	4.00	TP3	3.00	DP3	6.00
WS10(w)	5.00	TP4	3.00	DP4	7.00
		TP5	3.00	DP5	4.00
		TP6	3.00	DP6	7.00
		TP7	3.00	DP7	6.00
		TP8	3.00	DP8	6.00
		TP10	3.00	DP9	7.00
		TP11	3.00	DP10	5.00
		TP12	3.00		
		TP13	3.00		
		TP14	3.00		
		TP15	3.00		
		TP17	1.00		
		TP18	1.00		
		TP19	1.00		
		TP20	1.00		

Note: (w) – well installation.

The approximate trial hole locations are shown on Figure 2.

The soil conditions encountered were recorded and soil sampling commensurate with the purposes of the investigation was carried out. The depths given on the trial hole logs and quoted in this report were measured from ground level.

The soils encountered from immediately below ground surface have been described in the following manner. Where man has clearly either placed the soil, or the composition altered with say greater than an estimated 5% of a non-natural constituent, it has been referred to as Made Ground both on the log and within this report.

For more complete information about the soils encountered within the general area of the site reference should be made to the detailed records given within Appendix A, but for the purposes of discussion, the succession of conditions encountered in the trial holes in descending order can be summarised:

Topsoil (TS)
Made Ground (MG)
Alluvium (ALV)
River Terrace Deposits (RTD)
White Chalk Subgroup (WCSG)

The ground conditions encountered in the trial holes are summarised in Table 2.2.

Table 2.2
Ground Conditions

Strata	Age	Depth Encountered (m bgl)		Typical Thickness (m)	Typical Description
		Top	Bottom		
MG	Recent	G.L	0.40	0.40	Soft dark grey brown sandy CLAY with rootlets, rare brick fragments and occasional fine, sub-angular gravel.
TS	Recent	G.L	0.30 – 0.40	0.40	Soft dark to light, brown, sandy CLAY with rootlets and occasional fine, angular to sub-angular gravel.
ALV	Recent	Not encountered during the investigation.			
RTD	Quaternary	0.30 – 0.40	1.90 – >4.00*	>2.60*	Dark to light orange brown, clayey fine to medium SAND with rare rootlets and rare fine sub-angular to sub-rounded gravel. Or firm, dark to light, orangeish brown sandy CLAY with occasional fine, sub-angular gravel.
WCSG	Cretaceous	1.90 – 3.50	>5.00*	Not Proven*	Pale off-white structureless CHALK. Recovered as comminuted matrix of sand sized intact chalk with occasional fine to coarse, sub-angular to angular gravel sized intact chalk and flint fragments.

Note - * The base of the strata was not encountered in any of the sampler boreholes.

2.3 Ground Conditions Encountered in Trial Holes

The ground conditions encountered in trial holes have been described below in descending order.

2.3.1 Made Ground

Soils described as Made Ground were encountered in a one out of the twenty-two trial hole locations from ground level to a depth of 0.40m bgl. The Made Ground was encountered in a single location (WS10) in the south eastern corner of the plot. The Made Ground was described as soft dark grey brown sandy CLAY with rootlets, rare brick fragments and occasional fine, sub-angular gravel.

2.3.2 Topsoil

Soils described as Topsoil were encountered in twenty-one out of the twenty-two trial hole locations from ground level to depths of between 0.30 and 0.40m bgl. The Topsoil typically comprised soft dark to light, brown, sandy CLAY with rootlets and occasional fine, angular to sub-angular gravel.

The depths of Topsoil as encountered in the trial holes are given in Table 2.3.

Table 2.3
Depth of Topsoil

Trial Hole	Depth (m bgl)
TP1	0.40
TP2	0.36
TP3	0.30
TP4	0.34
TP5	0.36
TP6	0.40
TP7	0.40
TP8	0.40
TP10	0.30
TP11	0.50
TP12	0.30
TP13	0.40
TP14	0.30
TP15	0.40
TP17	0.40
TP18	0.36
TP19	0.35
TP20	0.32
WS1	0.40
WS6	0.40
WS8	0.40
WS10	Not Encountered

2.3.3 Alluvium

Alluvium was shown on the BGS 1:50 000 map sheet in the northern half of the site surrounding Ferring Rife. This land has been designated as open space end-use on drawing HP13049/0003a drawn by White Young Green and supplied to Soils Limited by the client.

Alluvium was not encountered within any of the trial holes however its presence should be assumed in proximity to Ferring Rife. If any structures were to be placed within close proximity to Ferring Rife the nature of and extent of the alluvium must be ascertained prior to construction by a further phase of investigation, preferably with trial trenches perpendicular to the course of the river.

2.3.4 River Terrace Deposits

Soils described as River Terrace Deposits were encountered in all trial hole locations directly below Topsoil/Made Ground and were observed to depths of between 1.90 and 4.00m bgl. The River Terrace Deposits comprised interbedded cohesive and granular soils.

The **cohesive** soils of the River Terrace Deposits typically comprised firm, dark to light, orangeish brown sandy CLAY with occasional fine, sub-angular gravel.

The **granular** soils of the River Terrace Deposits typically comprised dark to light orange brown, clayey fine to medium SAND with rare rootlets and rare fine sub-angular to sub-rounded gravel.

The depths of River Terrace Deposits as encountered in the trial holes are given in Table 2.4.

Table 2.4
Depth of River Terrace Deposits

Trial Hole	Depth (m bgl)
TP1	3.00*
TP2	3.00*
TP3	3.00*
TP4	2.40
TP5	3.00*
TP6	3.00*
TP7	2.00*
TP8	2.70
TP10	2.30
TP11	2.80
TP12	3.00*
TP13	3.00*
TP14	3.00*
TP15	3.00*
TP17	1.00*
TP18	1.00*
TP19	1.00*
TP20	1.00*
WS1	1.90
WS6	2.90
WS8	4.00*
WS10	3.50

Note: *Unit present to the base of trial hole

2.3.5 White Chalk Subgroup

Soils described as the White Chalk Subgroup were encountered in eight out of the twenty-two trial holes directly below the River Terrace Deposits and were observed to the full depth of the investigation, 5.00m bgl. The White Chalk Subgroup typically comprised pale off-white structureless CHALK. Recovered as comminuted matrix of sand sized intact chalk with occasional fine to coarse, sub-angular to angular gravel sized intact chalk and flint fragments.

The depths of the White Chalk Subgroup as encountered in the trial holes are given in Table 2.5.

Table 2.5
Depth of White Chalk Subgroup

Trial Hole	Depth (m bgl)
TP1	Not Encountered
TP2	
TP3	
TP4	3.00*
TP5	Not Encountered
TP6	
TP7	3.00*
TP8	3.00*
TP10	3.00*
TP11	3.00*
TP12	Not Encountered
TP13	
TP14	
TP15	
TP17	
TP18	
TP19	
TP20	
WS1	5.00*
WS6	5.00*
WS8	Not Encountered
WS10	5.00*

Note: *Unit present to the base of trial hole

2.4 Roots

Roots were encountered during the intrusive investigation within each of the twenty-two trial holes to a maximum recorded depth of 2.20m bgl within WS6. It is not possible to accurately assess the depth of root penetration through a narrow diameter borehole. The depth of root penetration as encountered within each trial hole is given in Table 2.6.

Table 2.6
Depth of Root Penetration

Trial Hole	Depth (m bgl)
TP1	2.10
TP2	0.65
TP3	1.90
TP4	0.65
TP5	0.70
TP6	2.00
TP7	0.70
TP8	0.70
TP10	0.70
TP11	0.60
TP12	0.70
TP13	0.70
TP14	1.90
TP15	0.65
TP17	0.60
TP18	0.60

Table 2.6
Depth of Root Penetration

Trial Hole	Depth (m bgl)
TP19	0.60
TP20	0.65
WS1	0.90
WS6	2.20
WS8	1.00
WS10	1.00

2.5 Groundwater

Groundwater was encountered within two out of the twenty-two trial holes, groundwater was only encountered within the windowless sampler boreholes (WS1 and WS6). True Groundwater level may be represented by the level of water within Ferring Rife. Perched water may be present within the granular soils of the River Terrace Deposits.

Table 2.7 shows the groundwater strikes during the investigation.

Table 2.7
Groundwater Strikes

Trial Hole	Depth (m bgl)	Stratum
TP1	Not Encountered	
TP2		
TP3		
TP4		
TP5		
TP6		
TP7		
TP8		
TP10		
TP11		
TP12		
TP13		
TP14		
TP15		
TP17		
TP18		
TP19		
TP20		
WS1	4.90	WCSG
WS6	2.70	RTD (Granular)
WS8	Not Encountered	
WS10		

Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. The investigation was conducted in September (2014), when groundwater levels should be approaching their annual minimum (lowest) elevation, this typically occurs during September.

Further groundwater monitoring was conducted following completion of site works and has been presented in Table 2.8.

Table 2.8
Groundwater Monitoring Results

Monitoring Date	Trial Hole	Depth to water (m bgl)	Depth of Hole (m bgl)
26/09/2014	WS1	3.48	5.00
	WS6	2.54	3.98
	WS10	4.28	4.98
08/10/2014	WS1	3.14	5.03
	WS6	2.45	3.95
	WS10	4.28	5.06
15/10/2014	WS1	2.67	5.03
	WS6	**2.15**	3.86
	WS10	3.86	5.03
22/10/2014	WS1	2.97	5.04
	WS6	2.24	3.83
	WS10	4.02	5.01
31/10/2014	WS1	3.03	5.05
	WS6	2.36	3.80
	WS10	4.11	5.00

Groundwater was increasing from its lowest depth recorded at 4.28 (WS10) in September 2014. Groundwater levels increased to a minimum depth of 2.15m bgl (WS6) in October 2014, for the remaining readings the levels dropped, although this is likely to be in response to the relatively dry period at the end of October. Further groundwater monitoring may be required to during the winter months and could be achieved using the installed monitoring wells.

NHBC Volume Change Potential refers to NHBC Standards Chapter 4.2 Building near trees (based on Atterberg results)
Soil Classification based on British Soil Classification System

The most common use of the term clay is to describe a soil that contains enough clay-sized material or clay minerals to exhibit cohesive properties. The fraction of clay-sized material required varies, but can be as low as 15%. Unless stated otherwise, this is the sense used in Digest 240.

The term can be used to denote the clay minerals. These are specific, naturally occurring chemical compounds, predominately silicates.

The term is often used as a particle size descriptor. Soil particles that have a nominal diameter of less than 2 µm are normally considered to be of clay size, but they are not necessarily clay minerals. Some clay minerals are larger than 2 µm and some particles, 'rock flour' for example, can be finer than 2 µm but are not clay minerals.

The results from the Atterberg Limits Tests showed that the soils of the River Terrace Deposits had **low to medium volume change potential**, therefore a **medium volume change potential should be adopted** in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2.

The test results are given in Appendix B.

3.4 Infiltration tests

Infiltration tests were undertaken in four trial pits (TP3, TP4, TP7 and TP14) within the River Terrace Deposits and the White Chalk Sub Group, following the principles of BRE Digest 365 Soakaway Design: 1991. BRE 365 states that for an accurate infiltration rate to be obtained a soakage pit needs to be filled three times in quick succession. Each test can only be ended once 75% of the water present has drained away. Infiltration tests were not repeated three times due to time restrictions and the limitations on water available. The results of the infiltration tests are presented within Table 3.5.

Table 3.7
Summary of Infiltration Tests

Trial Hole	Test Depth (m bgl)	Stratum	Indicative Infiltration Rate (m/sec)	Notes
TP3	2.74	RTD – sandy CLAY	8.9×10^{-6}	Extrapolated 240 – 310 min
TP4	2.74	WCSG	NC	Negligible infiltration after 180 min
TP7	2.97	WCSG	NC	Negligible infiltration after 240 min, Partial collapse after 90 min
TP14	2.98	RTD – sandy CLAY	NC	Insufficient infiltration after 240 min

The results from the Infiltration Testing suggest that the majority of the site will exhibited low infiltration characteristics and alternative means of surface water disposal will be required.

3.5 Sulphate and pH Tests

Four samples were taken from the River Terrace Deposits for water soluble sulphate (2:1) and pH testing in accordance with Building Research Establishment Special Digest 1, 2005, 'Concrete in Aggressive Ground'.

narrow diameter borehole. The depth of root penetration as encountered within each trial hole is given in Table 2.6.

4.1.5 Groundwater

Groundwater was encountered within two out of the twenty-four trial holes during the intrusive investigation at a minimum depth of 2.70m bgl within WS6. Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. The investigation was conducted in September (2014), when groundwater levels should be approaching their annual minimum (lowest) elevation, as this typically occurs during September.

Further groundwater monitoring was conducted following completion of site works and has been presented in Table 2.8. Groundwater increased from its greatest recorded depth at 4.28 (WS10) in September 2014 to a minimum depth of 2.15m bgl (WS6) in October 2014, for the remaining readings the levels dropped, although this is likely to in response to the relatively dry period at the end of October 2014.

Localised perched groundwater is also likely to be found within isolated pockets of the granular River Terrace Deposits. If intersected by foundation trenches the perched water is likely to cause the gravels to run into the trench, causing partial or total collapse.

Groundwater is expected to rise to its highest elevation, which typically occurs around March, during the winter months. Therefore, if shallow foundations are adopted and constructed in wet seasons founding level may be below the groundwater table. Trenches will be difficult to bottom out and soils are likely to run in and collapse as a result on groundwater ingress.

It is recommended that a further winter groundwater monitoring regime is undertaken in order to determine the variation in groundwater through different seasons and that test trenches are dug to investigate the practicality of construction.

4.2 Foundation Scheme

At the time of writing this report the proposed redevelopment of the site was understood to comprise the construction of a number of residential properties. Exact proposals were not available at the time of writing this report, however, it has been assumed that both communal and private soft landscaping would form part of the proposals, along with access roads and service runs.

4.2.1 Guidance on Shrinkable Soils

The Building Research Establishment (BRE) Digests 240, 241 and 242 provide guidance on 'best practice' for the design and construction of foundations on shrinkable soils.

The results from the Atterberg Limits Tests confirmed that the soils of the River Terrace Deposits had **low to medium volume change potential**, therefore a **medium volume change potential should be adopted** in

Project: Goring Street, Goring-By-Sea, West Sussex	
Client: Persimmon Homes (South Coast)	**Date:** January 2015
Trial Hole Location Plan	**Job Number:** 14131

- Windowless sampler
- Trial Pit
- Dynamic Probe

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Borehole Log

Borehole No. **WS1**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: -	Hole Type WS
Location: Goring-by-Sea, West Sussex		Level:	Scale 1:50
Client: Persimmon Homes (South Coast)		Dates: 05/09/2014 - 05/09/2014	Logged By GB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	D		0.40			Barley crop over soft dark to light brown sandy CLAY with occasional rootlets and occasional fine angular to sub-angular gravel. TOPSOIL
		0.50	D					Dark to light orange brown clayey fine to medium SAND with rare rootlets and rare fine sub-angular to sub-rounded gravel. RIVER TERRACE DEPOISTS
		1.00	D		0.90			Firm dark to light orange brown sandy CLAY with occasional fine sub-angular to angular gravel. RIVER TERRACE DEPOISTS
		2.00	D		1.90			Weakly cemented moderately weak off white slightly brown stained CHALK. WHITE CHALK SUB-GROUP
		3.00	D					
		4.00	D					
	▼	5.00	D		5.00			End of borehole at 5.00 m

Remarks

Roots observed to 0.90m bgl. Groundwater strike at 4.90m bgl.

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Borehole Log

Borehole No. **WS6**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: -	Hole Type WS
Location: Goring-by-Sea, West Sussex		Level:	Scale 1:50
Client: Persimmon Homes (South Coast)		Dates: 05/09/2014 - 05/09/2014	Logged By GB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	D		0.40			Barley crop over soft dark grey brown CLAY with frequent rootlets and occasional fine angular to sub-angular gravel. TOPSOIL
		0.50	D					Soft to firm dark to light grey brown very sandy CLAY with occasional rootlets and fine to medium angular to rounded gravel. RIVER TERRACE GRAVEL
		1.00	D		1.00			Firm to stiff light to dark orange brown sandy CLAY with occasional fine to medium sub-angular to angular gravel, fine to medium weak chalk fragments and rare rootlets. RIVER TERRACE GRAVEL
		2.00	D		2.20			Light grey brown clayey fine to medium SAND with frequent fine to medium weak chalk fragments and occasional fine flint. RIVER TERRACE GRAVEL
	▼	2.50	D					
		3.00	D		2.90			Weakly cemented moderately weak off white slightly brown stained CHALK. WHITE CHALK SUB-GROUP
		4.00	D					
		5.00	D		5.00			End of borehole at 5.00 m

Remarks

Roots observed to 2.20m bgl. Groundwater strike at 2.70m bgl. Hole collapsed back to 4.70m bgl.

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Borehole Log

Borehole No. **WS8**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: -	Hole Type WS
Location: Goring-by-Sea, West Sussex		Level:	Scale 1:50
Client: Persimmon Homes (South Coast)		Dates: 05/09/2014 - 05/09/2014	Logged By GB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	D		0.40			Barley crop over soft dark to light grey brown sandy CLAY with abundant rootlets, occasional fine angular to sub-angular gravel. TOPSOIL
		0.50	D					Dark to light orange brown clayey fine to medium SAND with rare rootlets and fine roots. RIVER TERRACE GRAVEL
		1.00	D		1.00			Firm to soft dark to light orange brown sandy CLAY. Clay is firm becoming soft with depth with rare fine to medium angular to sub-angular gravel. RIVER TERRACE GRAVEL
		2.00	D					
		3.00	D					
								Between 3.80-4.00m bgl: Chalk fragments present.
		4.00	D		4.00			End of borehole at 4.00 m

1 2 3 4 5 6 7 8 9 10

Remarks

Roots observed to 1.00m bgl. No groundwater encountered.

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Borehole Log

Borehole No. **WS10**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: -	Hole Type WS
Location: Goring-by-Sea, West Sussex		Level:	Scale 1:50
Client: Persimmon Homes (South Coast)		Dates: 05/09/2014 - 05/09/2014	Logged By GB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	D					Barley crop over soft dark grey brown sandy CLAY with occasional rootlets, rare brick fragments and occasional fine sub-angular to angular gravel. MADE GROUND
		0.50	D		0.40			Dark to light orange brown clayey fine to medium SAND with occasional rootlets. RIVER TERRACE GRAVEL
		1.00	D		1.00			Soft to firm, dark to light orange brown sandy CLAY with occasional fine to medium sub-angular to angular gravel. RIVER TERRACE GRAVEL
		1.50	D					*At 1.50m bgl: Frequent fine to medium moderately weak chalk fragments.*
		2.00	D					
		3.00	D					
		3.60	D		3.50			Moderately weak, weakly cemented off white slightly yellow brown stained CHALK with fine to medium light grey sandy residue and rare sub-angular to angular gravel and flint. WHITE CHALK SUB-GROUP
		4.00	D					
		5.00	D		5.00			End of borehole at 5.00 m

Remarks

Roots obseved to 1.00m blg. No groundwater encountered.

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Trial Pit Log

Trialpit No **TP1**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: - Level:	Date 04/09/2014
Location: Goring-by-Sea, West Sussex		Dimensions (m): Depth 3.00	Scale 1:25
Client: Persimmon Homes (South Coast)			Logged GB

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.25	J					Barley crop over soft dark orange brown sandy CLAY with occasional rootlets and fine sub-angular to angular gravel. TOPSOIL
				0.40			
	0.50	B					Soft to firm dark to light orange brown sandy silty CLAY with occasional fine to medium sub-angular gravel and rare rootlets. RIVER TERRACE DEPOSITS
	1.00	D					
	1.50	D					
	2.00	D					
				2.10			
	2.50	D					Soft light grey orange very sandy gravelly CLAY with frequent fine to medium chalk fragments and sub-angular to sub-rounded gravel. RIVER TERRACE DEPOSITS
	3.00	D		3.00			End of pit at 3.00 m

1 2 3 4 5

Remarks: Roots observed to 2.10m bgl. No groundwater encountered

Stability: Stable

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Trial Pit Log

Trialpit No **TP2**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: - Level:	Date 04/09/2014
Location: Goring-by-Sea, West Sussex		Dimensions (m): Depth 3.00	Scale 1:25
Client: Persimmon Homes (South Coast)			Logged GB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.25	D					Barley crop over soft dark brown sand with frequent rootlets and occasional fine sub-angular to sub-rounded gravel. TOPSOIL
	0.25	J		0.36			
	0.50	B					Soft to firm dark to light orange brown sandy CLAY with rare rootlets and occasional fine sub-angular to sub-rounded gravel. RIVER TERRACE DEPOSITS
	1.00	D					
	1.50	D					
	2.00	D		2.00			Soft light grey orange brown sandy CLAY with frequent fine to medium chalk fragments and sub-angular to sub-rounded gravel and flint. RIVER TERRACE DEPOSITS
	2.50	D					
	3.00	D		3.00			End of pit at 3.00 m

Remarks: Roots observed to 0.65m bgl. No groundwater encountered

Stability: Stable

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Trial Pit Log

Trialpit No **TP3**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: - Level:	Date 04/09/2014
Location: Goring-by-Sea, West Sussex		Dimensions (m): Depth 3.00	Scale 1:25
Client: Persimmon Homes (South Coast)			Logged GB

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.25	D		0.30			Barley crop over dark brown sandy with frequent rootlets and occasional fine to medium sub-angular to sub-rounded gravel. TOPSOIL
	0.25	J					
	0.50	B					Soft dark to light orange slightly sandy silty CLAY with occasional fine sub-angular to sub-rounded gravel and rare rootlets. RIVER TERRACE DEPOSITS
	1.00	D					
	1.50	D					
	2.00	D		1.90			Soft light grey orange brown sandy CLAY with frequent fine to medium chalk fragments and occasional sub-angular gravel. RIVER TERRACE DEPOSITS
	2.50	D					
	3.00	D		3.00			End of pit at 3.00 m

1 2 3 4 5

Remarks: Roots observed to 1.90m bgl. No groundwater encountered

Stability: Stable

Trial Pit Log

Trialpit No **TP4**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: - Level:	Date 04/09/2014
Location: Goring-by-Sea, West Sussex		Dimensions (m): Depth 3.00	Scale 1:25
Client: Persimmon Homes (South Coast)			Logged GB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.25	J					Barley crop over soft dark brown sandy CLAY with occasional rootlets and occasional fine sub-angular to sub-rounded gravel. TOPSOIL
	0.25	D		0.34			
	0.50	B					Soft to firm light to dark orange brown slightly sandy gravelly silty CLAY with occasional rootlets with frequent sub-angular to sub-rounded fine to medium gravel and flint. RIVER TERRACE DEPOSITS
	1.00	D					
	1.50	D					
	2.00	D					
	2.50	D		2.40			Light grey structureless CHALK. Recovered as comminuted clay matrix of intact Chalk with occasional fine to medium gravel sized sub-rounded to sub-angular intact chalk and flint fragments. WHITE CHALK SUB-GROUND
	3.00	D		3.00			End of pit at 3.00 m

Remarks: Roots observed to 0.65m bgl. No groundwater encountered

Stability: Stable

Trial Pit Log

Trialpit No **TP5**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: - Level:	Date 04/09/2014
Location: Goring-by-Sea, West Sussex		Dimensions (m): Depth 3.00	Scale 1:25
Client: Persimmon Homes (South Coast)			Logged GB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.25	J					Barley crop over soft dark brown sandy CLAY frequent rootlets, occasional fine sub-angular to angular gravel. TOPSOIL
	0.25	D		0.36			
	0.50	B					Soft to firm dark to light orange brown slightly sandy silty CLAY with rare rootlets and occasional fine to medium sub-angular to sub-rounded gravel. RIVER TERRACE DEPOSITS
	1.00	D					
	1.50	D					
	2.00	D		2.00			Soft to firm light orange yellow brown sandy CLAY with frequent fine to medium chalk fragments and sub-angular to sub-rounded gravel with black staining. RIVER TERRACE DEPOSITS
	2.50	D					
	3.00	D		3.00			End of pit at 3.00 m

Remarks: Roots obseved to 0.70m bgl, No groundwater encountered

Stability: Stable

Trial Pit Log

Trialpit No **TP6**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: - Level:	Date 04/09/2014
Location: Goring-by-Sea, West Sussex		Dimensions (m): Depth 3.00	Scale 1:25
Client: Persimmon Homes (South Coast)			Logged

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.25	J					Barley crop over soft dark orange brown sandy CLAY with occasional rootlets and fine sub-angular to angular gravel. TOPSOIL
	0.25	D					
				0.40			
	0.50	B					Soft to firm gravelly slightly sandy silty CLAY with rare rootlets and occasional fine to medium sub-angular to gravel. RIVER TERRACE DEPOSITS
	1.00	D					
	1.50	D					
	2.00	D		2.00			Soft light grey yellow brown sandy very sandy CLAY with frequent fine to medium flint, sub-angular to sub-rounded gravel and fine to medium chalk fragments. RIVER TERRACE DEPOSITS
	2.50	D					
	3.00	D		3.00			End of pit at 3.00 m

1 2 3 4 5

Remarks: Roots observed to 2.00m bgl. No groundwater encountered.

Stability: Stable

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Trial Pit Log

Trialpit No **TP7**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: - Level:	Date 04/09/2014
Location: Goring-by-Sea, West Sussex		Dimensions (m): Depth 3.00	Scale 1:25
Client: Persimmon Homes (South Coast)			Logged GB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.25	J					Barley crop over soft dark brown sandy CLAY with occasional rootlets and fine sub-angular to angular gravel. TOPSOIL
	0.25	D		0.40			
	0.50	B					Soft dark to light orange brown sandy CLAY with rare to occasional rootlets and fine to medium sub-angular to sub-rounded gravel. RIVER TERRACE DEPOSITS
	1.00	D					
	1.50	D					
	2.00	D		2.00			Light grey orange brown structureless CHALK. Recovered as comminuted clay matrix of intact Chalk with occasional fine to medium gravel sized sub-rounded to sub-angular intact chalk and flint fragments. WHITE CHALK SUB-GROUND
	2.50	D					
	3.00	D		3.00			End of pit at 3.00 m

Remarks: Roots observed to 0.70m bgl. No groundwater encountered.

Stability: Stable

Trial Pit Log

Trialpit No **TP8**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: - Level:	Date 04/09/2014
Location: Goring-by-Sea, West Sussex		Dimensions (m): Depth 3.00	Scale 1:25
Client: Persimmon Homes (South Coast)			Logged GB

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.25	D					Barley crop over soft dark orange brown sandy CLAY with frequent rootlets and occasional fine sub-angular gravel. TOPSOIL
	0.25	J					
				0.40			
	0.50	B					Soft to firm orange brown slightly sandy silty CLAY with rare rootlets and occasional fine to medium sub-angular to sub-rounded gravel. RIVER TERRACE DEPOSITS
	1.00	D					
	1.50	D					
	2.00	D					
	2.50	D					
				2.70			Light orange brown structureless CHALK. Recovered as comminuted clay matrix of intact Chalk with occasional fine to medium gravel sized sub-rounded to sub-angular intact chalk and flint fragments. WHITE CHALK SUB-GROUND
	3.00	D		3.00			End of pit at 3.00 m

Remarks: Roots observed to 0.70m bgl. No groundwater encountered.

Stability: Stable

Trial Pit Log

Trialpit No **TP10**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: - Level:	Date 04/09/2014
Location: Goring-by-Sea, West Sussex		Dimensions (m): Depth 3.00	Scale 1:25
Client: Persimmon Homes (South Coast)			Logged GB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.25	D					Barley crop over dark brown sandy CLAY with frequent rootlets and occasional fine sub-angular to sub-rounded gravel. TOPSOIL
	0.25	J		0.30			
	0.50	B					Soft to firm dark to light orange brown slightly sandy silty CLAY with rare rootlets and rare sub-angular to sub-rounded gravel. RIVER TERRACE DEPOSITS
	1.00	D					
	1.50	D					
	2.00	D					
				2.30			Light orange brown structureless CHALK. Recovered as comminuted clay matrix of intact Chalk with occasional fine to medium gravel sized sub-rounded to sub-angular intact chalk and flint fragments. WHITE CHALK SUB-GROUND
	2.50	D					
	3.00	D		3.00			End of pit at 3.00 m

Remarks: Roots observed to 0.70m bgl. No groundwater encountered.

Stability: Stable

Trial Pit Log

Trialpit No **TP11**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: - Level:	Date 04/09/2014
Location: Goring-by-Sea, West Sussex		Dimensions (m): Depth 3.00	Scale 1:25
Client: Persimmon Homes (South Coast)			Logged GB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.25	J					Barley crop over soft dark orange brown sandy CLAY with frequent rootlets and occasional fine sub-angular to angular gravel. TOPSOIL.
	0.25	D		0.35			
	0.50	B					Soft to firm dark to light orange brown sandy CLAY with rare rootlets, occasional fine to medium sub-angular to sub-rounded gravel and frequent black staining. RIVER TERRACE DEPOSITS
	1.00	D					
	1.50	D					
	2.00	D					
	2.50	D					
				2.80			Light orange brown structureless CHALK. Recovered as comminuted clay matrix of intact Chalk with occasional fine to medium gravel sized sub-rounded to sub-angular intact chalk and flint fragments. WHITE CHALK SUB-GROUND
	3.00	D		3.00			End of pit at 3.00 m

Remarks: Roots observed to 0.60m bgl. No groundwater encountered

Stability: Stable

Trial Pit Log

Trialpit No **TP12**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: - Level:	Date 04/09/2014
Location: Goring-by-Sea, West Sussex		Dimensions (m): Depth 3.00	Scale 1:25
Client: Persimmon Homes (South Coast)			Logged GB

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.25	D		0.30			Barley crop over dark orange brown sandy CLAY with occasional rootlets and fine sub-angular to sub-rounded gravel. TOPSOIL
	0.25	J					
	0.50	B					Soft to firm dark to light orange brown sandy CLAY with rare rootlets, occasional fine to medium sub-angular to sub-rounded gravel and black staining. RIVER TERRACE DEPOSITS
	1.00	D					
	1.50	D					
	2.00	D		2.00			Soft light grey orange sandy CLAY with frequent fine to medium weak chalk fragments, occasional fine to medium sub-angular to sub-rounded flint gravel. RIVER TERRACE DEPOSITS
	2.50	D					
	3.00	D		3.00			End of pit at 3.00 m

Remarks: Roots observed to 0.70m bgl. No groundwater encountered.

Stability: Stable

soils LIMITED Geotechnical & Environmental Consultants

Trial Pit Log

Trialpit No **TP13**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: - Level:	Date 04/09/2014
Location: Goring-by-Sea, West Sussex		Dimensions (m): Depth 3.00	Scale 1:25
Client: Persimmon Homes (South Coast)			Logged GB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.25	D					Barley crop over soft dark brown sandy CLAY with occasional rootlets and sub-angular to angular fine gravel. TOPSOIL
	0.25	J		0.40			
	0.50	B					Soft to firm light to dark orange brown slightly gravelly slightly sandy silty CLAY with occasional fine sub-angular to sub-rounded gravel, rare black staining. RIVER TERRACE DEPOSITS
	1.00	D					
	1.50	D					
	2.00	D					
	2.50	D					
	3.00	D		3.00			End of pit at 3.00 m

1 2 3 4 5

Remarks: Roots observed to 0.70m bgl. No groundwater encountered.

Stability: Stable

AGS

Trial Pit Log

Trialpit No **TP14** Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: - Level:	Date 04/09/2014
Location: Goring-by-Sea, West Sussex		Dimensions (m): Depth 3.00	Scale 1:25
Client: Persimmon Homes (South Coast)			Logged GB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.25	J					Soft dark brown sandy CLAY with frequent rootlets and occasional fine sub-angular to sub-rounded gravel. TOPSOIL
	0.25	D		0.30			
	0.50	B					Soft dark to light orange brown sandy CLAY with rare rootlets and occasional fine to medium sub-angular to sub-rounded gravel. RIVER TERRACE DEPOSITS
	1.00	D					
	1.50	D					
	2.00	D		1.90			Soft dark to light orange grey brown sandy CLAY with frequent fine to medium sub-angular to sub-rounded gravel and fine chalk fragments. RIVER TERRACE DEPOSITS
	2.50	D					
	3.00	D		3.00			End of pit at 3.00 m

Remarks: Roots observed to 1.90m bgl. No groundwater encountered.

Stability: Stable

soils LIMITED Geotechnical & Environmental Consultants

Trial Pit Log

Trialpit No **TP15**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: - Level:	Date 04/09/2014
Location: Goring-by-Sea, West Sussex		Dimensions (m): Depth 3.00	Scale 1:25
Client: Persimmon Homes (South Coast)			Logged GB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.25	D					Barley crop over soft dark brown sandy CLAY with frequent to occasional rootlets and occasional fine to medium sub-angular to sub-rounded gravel. TOPSOIL
	0.25	J		0.40			
	0.50	B					Soft to firm dark to light orange brown slightly sandy silty CLAY with occasional fine to medium sub-angular to sub-rounded gravel flint. RIVER TERRACE DEPOSITS
	1.00	D					
	1.50	D					
	2.00	D		2.00			Soft light grey brown gravelly sandy CLAY with frequent fine to medium chalk fragments, fragments of fine to coarse sub-angular to sub-rounded flint gravel. RIVER TERRACE DEPOSITS
	2.50	D					
	3.00	D		3.00			End of pit at 3.00 m

1 2 3 4 5

Remarks: Roots observed to 0.65m bgl. No groundwater encountered

Stability: Stable

AGS

Trial Pit Log

Trialpit No **TP17**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: - Level:	Date 04/09/2014
Location: Goring-by-Sea, West Sussex		Dimensions (m): Depth 1.00	Scale 1:25
Client: Persimmon Homes (South Coast)			Logged GB

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.25 0.25	D J		0.40			Barley crop over soft to firm dark grey brown sandy CLAY with occasional rootlets, fine to medium sub-angular to sub-rounded gravel and rare fine to medium angular flint. TOPSOIL
	0.50	B					Firm dark to light orange brown slightly sandy slightly gravelly CLAY with rare rootlets, occasional fine to medium sub-angular to sub-rounded chalk fragments, gravel and frequent grey staining. RIVER TERRACE DEPOSITS
	1.00	D		1.00			End of pit at 1.00 m

Remarks: Roots observed to 0.60m bgl. No groundwater encountered

Stability: Stable

Trial Pit Log

Trialpit No **TP18** Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: - Level:	Date 04/09/2014
Location: Goring-by-Sea, West Sussex		Dimensions (m): Depth 1.00	Scale 1:25
Client: Persimmon Homes (South Coast)			Logged GB

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.25	J					Barley crop over soft dark orange brown sandy CLAY with frequent rootlets and occasional fine sub-angular gravel. TOPSOIL
	0.25	D		0.36			
	0.50	B					Soft to firm dark to light orange brown sandy CLAY with rare rootlets, frequent sub-angular to sub-rounded fine to medium angular gravel and flint. RIVER TERRACE DEPOSITS
	0.80	D					
	1.00	D		1.00			End of pit at 1.00 m

Remarks: Roots observed to 0.60m bgl. No groundwater encountered

Stability: Stable

Trial Pit Log

Trialpit No **TP19**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: - Level:	Date 04/09/2014
Location: Goring-by-Sea, West Sussex		Dimensions (m): Depth 1.00	Scale 1:25
Client: Persimmon Homes (South Coast)			Logged GB

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.25	D					Barley crop over soft dark orange brown sandy CLAY with frequent rootlets, occasional sub-angular to angular fine to medium gravel flint. TOPSOIL
	0.25	J		0.35			
	0.50	B					Soft to firm dark to light orange brown sandy CLAY with rare rootlets, occasional sub-angular to angular fine to medium flint gravel. RIVER TERRACE DEPOSITS
	0.80	D					
	1.00	D		1.00			End of pit at 1.00 m

Remarks: Roots observed to 0.60m bgl. No groundwater encountered

Stability: Stable

Trial Pit Log

Trialpit No **TP20**

Sheet 1 of 1

Project Name: Goring Street,	Project No. 14131	Co-ords: - Level:	Date 04/09/2014
Location: Goring-by-Sea, West Sussex		Dimensions (m): Depth 1.00	Scale 1:25
Client: Persimmon Homes (South Coast)			Logged GB

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.25	D					Barley crop over dark orange brown sandy CLAY with frequent rootlets, occasional fine to medium angular flint and occasional fine sub-angular to angular gravel. TOPSOIL
	0.25	J		0.32			
	0.50	B					Soft to firm dark to light orange brown sandy CLAY with occasional fine to medium sub-angular to sub-rounded flint gravel and occasional black and red staining. RIVER TERRACE DEPOSITS
	0.80	D					
	1.00	D		1.00			End of pit at 1.00 m

Remarks: Roots observed to 0.65m bgl. No groundwater encountered

Stability: Stable

Appendix J Informal Pre-App Advice – EA and WBC

From: PlanningSSD <PlanningSSD@environment-agency.gov.uk>
Sent: 29 November 2019 11:10
To: Stuart Burnett
Subject: Ref: 191126/KT10 - FW: D1586 Land at Chatsmore Farm, Goring BN12 6NT

Dear Stuart,

Thank you for consulting the Environment Agency on the above pre-application.

Having reviewed your proposal we are providing you with a preliminary opinion, which outlines the key environmental issues within our remit and provides guidance on any actions you need to undertake. It also provides hyperlinks to where you can obtain further information and advice to support your planning application. We offer one free preliminary opinion per site, per applicant /developer.

The Environmental Constraints identified on the site include:

- Flood Zone 3
- Statutory Main River
- Principal Aquifer

Based on the information currently available, the development raises some environmental concerns that you will need to address as part of your planning application. Further work will be needed to show how these issues can be satisfactorily addressed to ensure no environmental impacts.

Should you wish us to review any technical documents or want further advice to address the environmental issues, we can do this as part of our charged for service.

Further engagement at the pre-application stage will speed up our formal response to your planning application and provide you with certainty as to what our response to your planning application will be. It should also result in a better quality and more environmentally sensitive development. As part of our charged for service we will provide a dedicated project manager to act as a single point of contact to help resolve any problems.

We currently charge £100 per hour plus VAT. We will provide you with an estimated cost for any further discussions or review of documents. The terms and conditions of our charged for service are available here.

Please note: This response is based on the information you have made available at this time. It is based on current national planning policy, associated legislation and environmental data / information. If any of these elements change in the future then we may need to reconsider our position.

We trust that the above information is of assistance. If you'd like further detailed advice, please don't hesitate to contact me using the details below.

Kind regards,

Sustainable Places Team

Environmental Planning and Engagement | Solent and South Downs

From: Stuart Burnett
Sent: 25 November 2019 16:56
To: Enquiries, Unit <enquiries@environment-agency.gov.uk>
Subject: Ref: 191126/KT10 - FW: D1586 Land at Chatsmore Farm, Goring BN12 6NT

Dear Sir/Madam,

We have been appointed by our client, Persimmon Homes, to assist with the proposed development of Chatsmore Farm, also referred to as Land adjacent to Goring Station (location plan attached). Our remit specifically relates to drainage and flood risk matters – we are their appointed Drainage and Flood Risk Consultant(s). Persimmon are looking to submit a planning application on 31st January 2020, and currently have a pre-app running with the Council. Prior to submission, Persimmon have stated that they would like to have a positive response from statutory consultees – specifically where drainage matters are concerned.

In view of this, please find attached (via WeTransfer link - https://we.tl/t-ex6mHXk5KP) our current draft FRA and Drainage Strategy. As you will see from this, we are currently working at quite a high level in the sense that a proposed site layout has not been fully developed – the current plans are more conceptual.

It would be appreciated if you could review this and provide any initial comments on our anticipated approach, as detailed within the report.

The areas of the site which are proposed for development fall entirely within Flood Zone 1, however, with Ferring Rife passing through the site, the adjacent land within the vicinity of this Main River is classified as Flood Zone(s) 2 and 3. As you will see from our report, Product 4 data has been requested, and received, from yourselves.

At present, infiltration testing and winter groundwater monitoring has not yet been undertaken and of course, eventually we would request that this is undertaken to fully support a sustainable development where drainage is concerned. Information currently available to us would suggest that groundwater may be restrictive in terms of implementing infiltration based features, however this will be confirmed further to on-site investigation, testing and monitoring. There is sufficient open space available on site to introduce above-ground attenuation in the form of a pond (or ponds), whilst we would envisage a connection (outfall) to Ferring Rife if infiltration methods and techniques are not viable.

Whilst I appreciate that, as mentioned above, we are working at quite a high level at present in terms of solid proposals (specifically in terms of a site layout), what we would like to try and do is

establish that, fundamentally, the core principles of what we are proposing will be acceptable. Additional investigation and testing will be required in order to fully develop proposals – either later in the planning process or indeed further down the line at detailed design, however by acknowledging and respecting drainage hierarchy whilst also looking to engage with your early on this, I hope that we can reach an 'approval in principle' or confirmation that we are on the right track, and that there are no 'show stoppers' in terms of concerns which you may have.

I'd be more than happy to discuss this with you in greater detail, therefore please feel free to give me a call should you wish to run through any particular aspects.

Thank you in advance, we look forward to hearing from you.

Kind regards

Stuart Burnett
Engineer

01243 210418

www.bpcivils.co.uk

Bright Plan Civils, Transport Planning and Civil Engineering Consultants

Bright Plan Civils, 2 West Barn, Norton Lane, Chichester, PO20 3AF

From: Laura Gibbons
Sent: 26 November 2019 14:18
To: Stuart Burnett
Cc: Paul Cann
Subject: Re: D1586 Land at Chatsmore Farm, Goring BN12 6NT

Good afternoon Stuart,

Thanks for your email. I have had a look over the FRA you have provided and have the following comments:
1. Due to the coarse nature of JFlow and the flood extents it creates we will require flood extents to be provided based upon product 4 modelled flood elevations and topographic survey results. We would usually ask for the 1 in 100 year plus climate change predicted flood outline to be provided, but it is evident that this will not be possible just using product 4 data.
2. SuDS features must be located outside of predicted flood extents.
3. Surcharged outfalls will need to be included within design calculations to ensure that adequate storage capacity is provided. The surcharged water elevation should be agreed with us.
4. The overall proposals including the investigation of infiltration potential and its proposed use where possible are acceptable and in line with policies. Please ensure that when groundwater monitoring is completed that it is completed at the proposed locations of SuDS features.

Kind regards,

On Mon, 25 Nov 2019 at 16:43, Stuart Burnett wrote:

Good afternoon Laura/Paul,

I hope you're both well – Laura, I hope you are settling into your new role well, too.

Apologies for the email – we have been appointed by Persimmon to assist with the proposed development of Chatsmore Farm, also referred to as Land adjacent to Goring Station (location plan attached). Persimmon are looking to submit their planning application on 31st January 2020, and currently have a pre-app running with the Council. Prior to submission, Persimmon have stated that they would like to have a positive response from statutory consultees – specifically Drainage and Highways.

In view of this, please find attached (via WeTransfer link - https://we.tl/t-ex6mHXk5KP) our current draft FRA and Drainage Strategy. As you will see from this, we are currently working at quite a high level in the sense that a proposed site layout has not been fully developed – the current plans are more conceptual.

It would be appreciated if you could review this and provide any initial comments on our anticipated approach, as detailed within the report.

At present, infiltration testing and winter groundwater monitoring has not yet been undertaken and of course, eventually we would request that this is undertaken to fully support a sustainable development where drainage is concerned. Information currently available to us would suggest that groundwater may be restrictive in terms of implementing infiltration based features, however this will be confirmed further to on-site investigation, testing and monitoring. There is sufficient open space available on site to introduce above-ground attenuation in the form of a pond (or ponds),

whilst we would envisage a connection (outfall) to Ferring Rife, something which I will be discussing separately with the EA.

Whilst I appreciate that, as mentioned above, we are working at quite a high level at present in terms of solid proposals (specifically in terms of a site layout), what we would like to try and do is establish that, fundamentally, the core principles of what we are proposing will be acceptable. Additional investigation and testing will be required in order to fully develop proposals – either later in the planning process or indeed further down the line at detailed design, however by acknowledging and respecting drainage hierarchy whilst also looking to engage with your early on this, I hope that we can reach an 'approval in principle' or confirmation that we are on the right track, and that there are no 'show stoppers' in terms of concerns which you may have.

I'd be more than happy to discuss this with you in greater detail, therefore please feel free to give me a call should you wish to run through any particular aspects.

Thank you in advance, as always, for your assistance – it genuinely is very much appreciated.

Kind regards

Stuart Burnett
Engineer

01243 210418

www.bpcivils.co.uk

Bright Plan Civils, Transport Planning and Civil Engineering Consultants

Bright Plan Civils, 2 West Barn, Norton Lane, Chichester, PO20 3AF

Appendix K Ambiental Environmental Assessment Modelling References

AMBIENTAL

ENVIRONMENTAL ASSESSMENT

Hydraulic Model Report

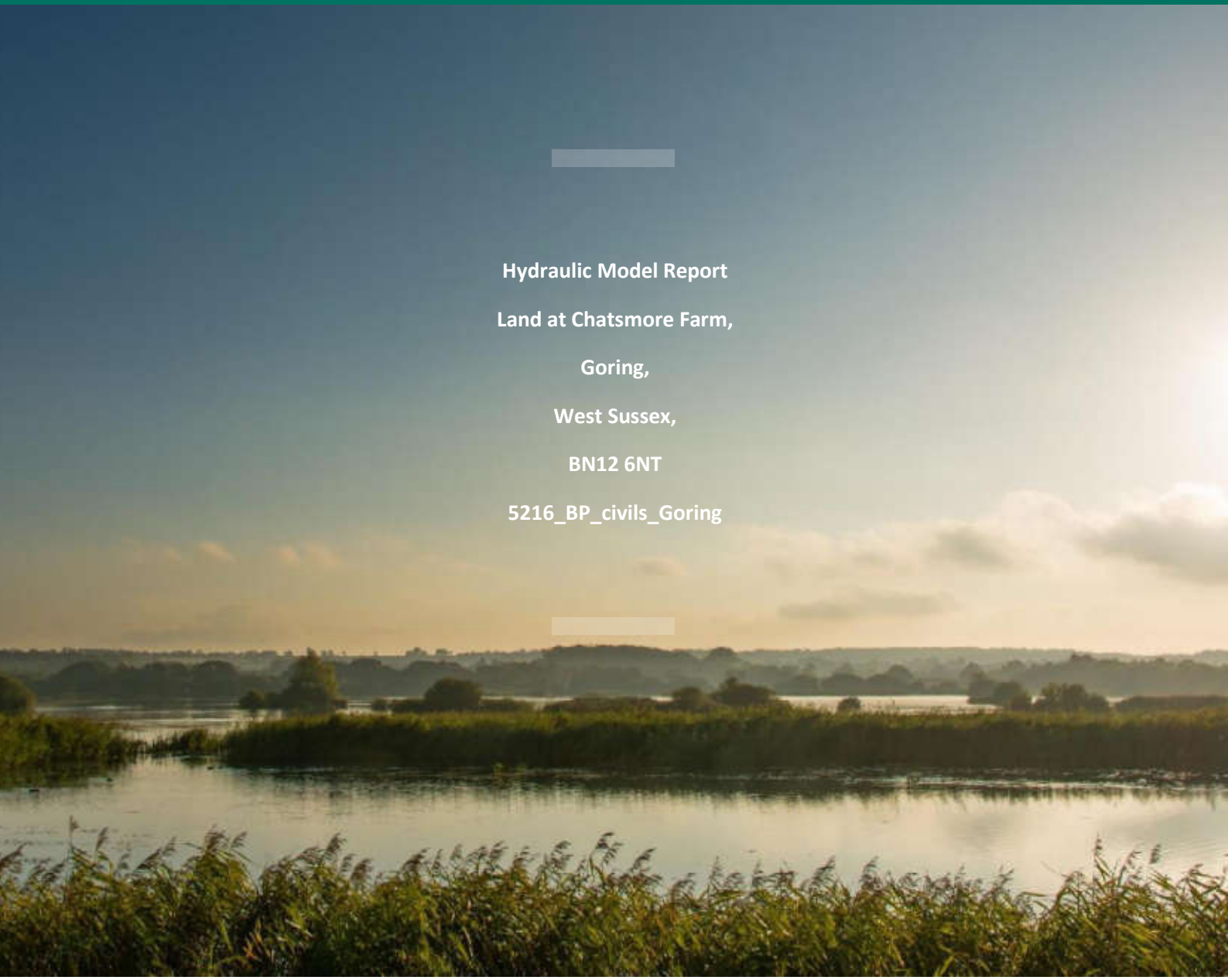
Land at Chatsmore Farm,

Goring,

West Sussex,

BN12 6NT

5216_BP_civils_Goring



Key

Site Location Boundary

Flood Depth (m)

- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- 0.9 - 1.0
- > 1.0

PRELIMINARY FLUVIAL FLOOD MODEL

1:1000 Year Flood Event
720 Minute Storm

AMBIENTAL
ENVIRONMENTAL ASSESSMENT
a company of Royal HaskoningDHV

GORING-BY-SEA MODEL FLOOD LEVELS

Return Period	Flood Level (mAOD)	
	Node 1	Node 2
Q0002	-	-
Q0030	-	-
Q0100	6.765	-
Q1000	6.859	5.464
Q0100_45CC	6.837	5.369
Q0100_105CC	6.895	5.641

Key

Site Location Boundary

Flood Depth (m)

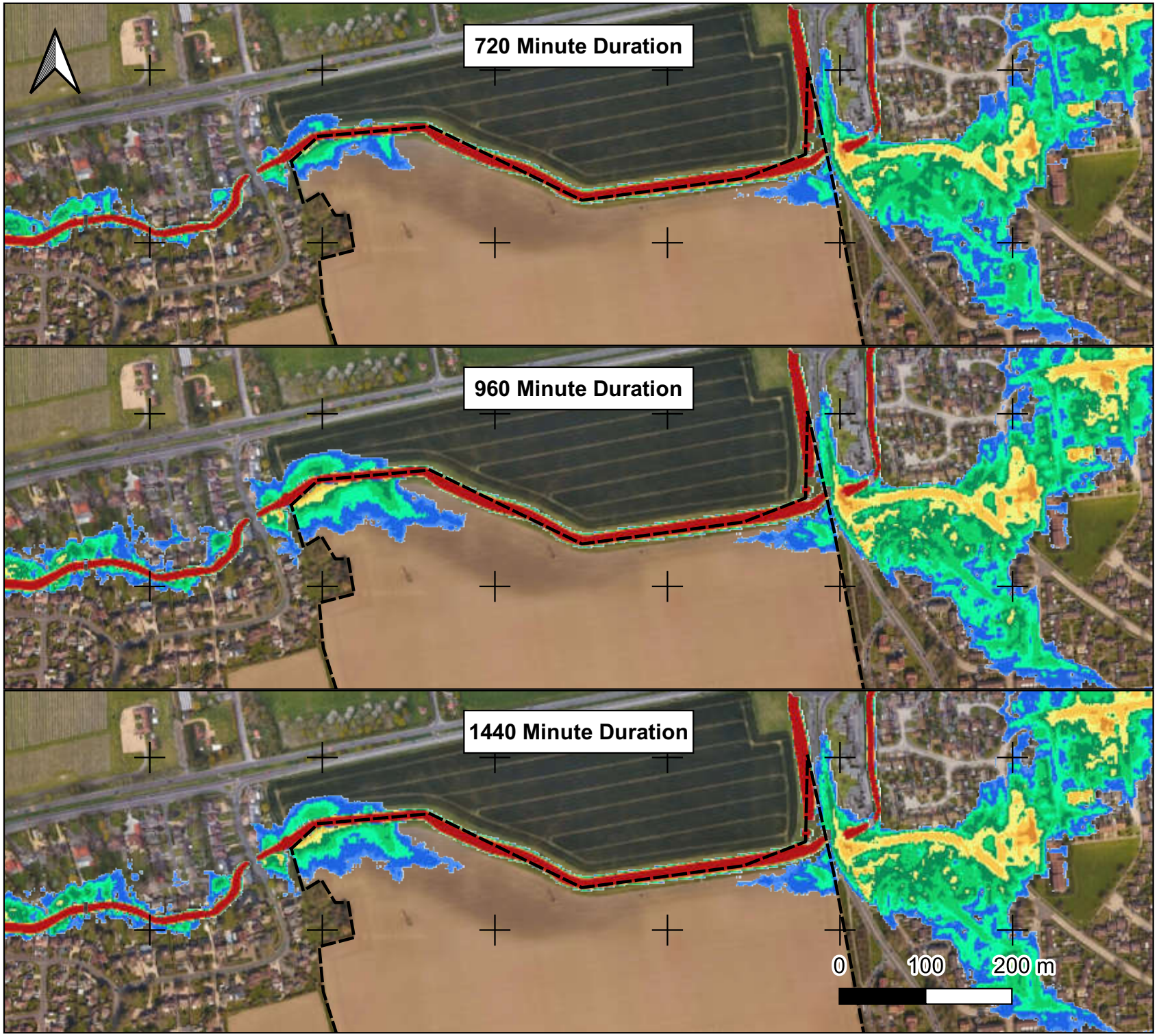
- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- 0.9 - 1
- > 1

PRELIMINARY DIRECT RAINFALL FLOOD MODEL

Storm Duration Comparison

1:100 Year plus 40% Climate Change Flood Event

AMBIENTAL
ENVIRONMENTAL ASSESSMENT
a company of Royal HaskoningDHV



Key

Site Location Boundary

Flood Depth (m)

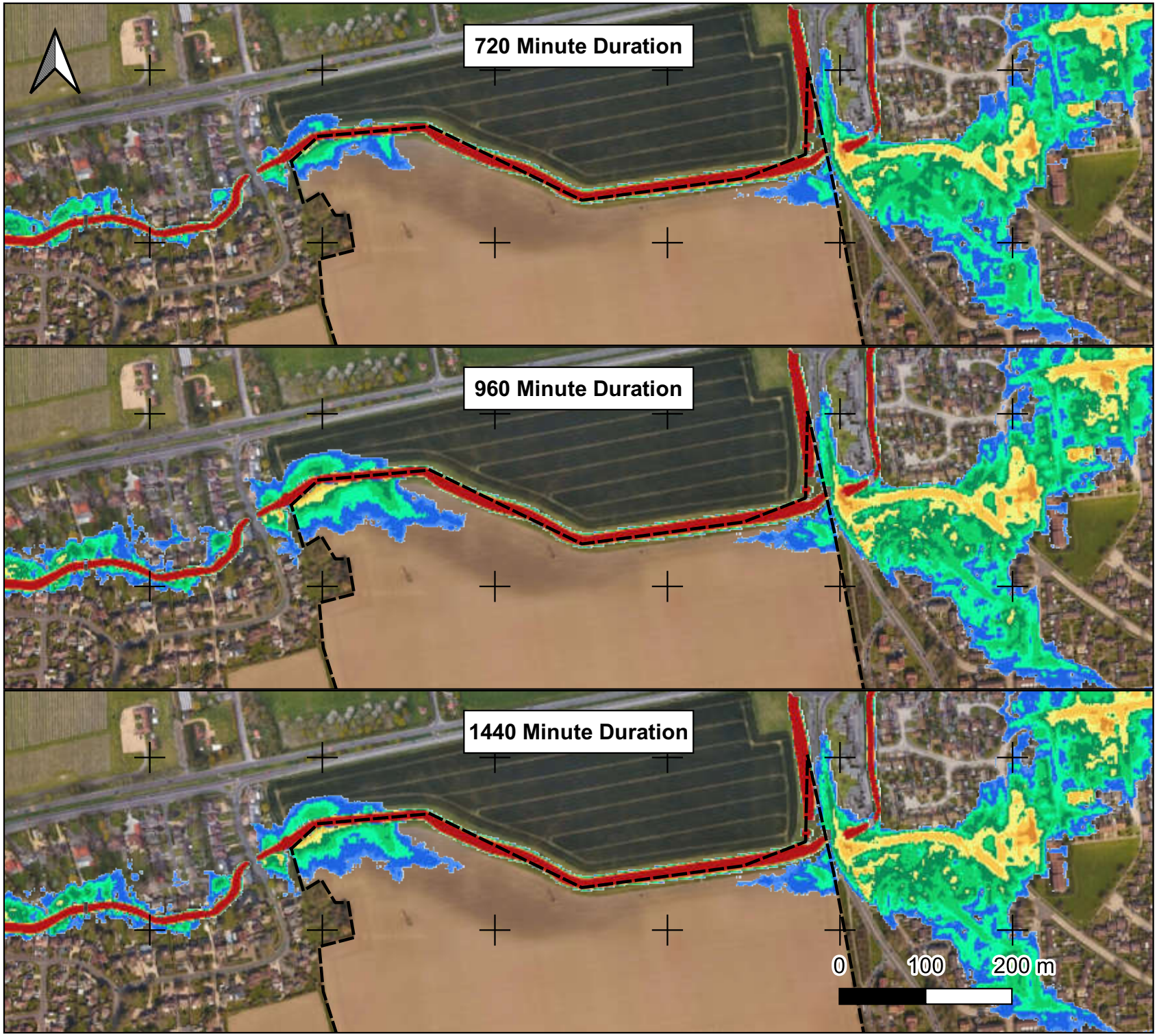
- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- 0.9 - 1
- > 1

PRELIMINARY FLUVIAL FLOOD MODEL

Storm Duration Comparison

1:100 Year plus 105% Climate Change Flood Event

AMBIENTAL
ENVIRONMENTAL ASSESSMENT
a company of Royal HaskoningDHV



Key

Site Location Boundary

Flood Depth (m)

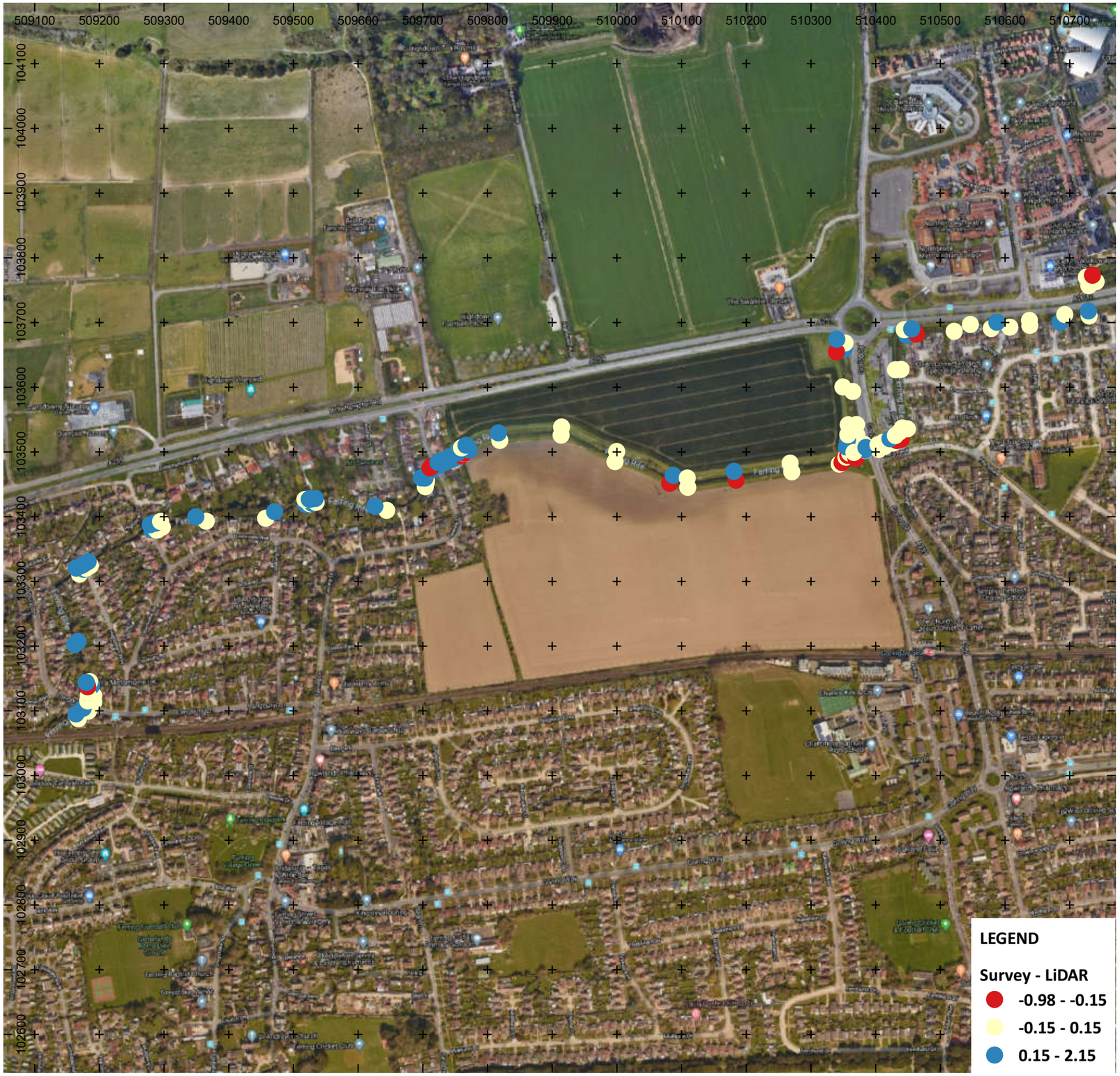
- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- 0.9 - 1
- > 1

PRELIMINARY FLUVIAL FLOOD MODEL

Storm Duration Comparison

1:100 Year plus 105% Climate Change Flood Event

AMBIENTAL
ENVIRONMENTAL ASSESSMENT
a company of Royal HaskoningDHV



Easting	Northing	Survey [A]	LiDAR [B]	[a]-[b]
509167.601	103087.925	4.109	4.195	-0.09
509182.985	103099.778	4.527	4.55	-0.02
509191.369	103113.777	4.428	4.407	0.02
509191.095	103124.099	4.097	4.122	-0.02
509187.675	103138.434	3.842	3.295	0.55
509187.443	103140.615	3.843	3.675	0.17
509184.932	103145.445	3.672	3.642	0.03
509167.024	103207.631	4.581	3.075	1.51
509169.321	103311.431	4.773	4.623	0.15
509176.067	103318.818	5.059	4.46	0.6
509179.055	103320.47	5.021	4.973	0.05
509186.007	103324.818	4.814	4.738	0.08
509281.377	103379.845	4.974	4.555	0.42
509288.223	103379.421	5.012	5.1	-0.09
509290.004	103379.758	5.095	5.16	-0.07
509297.223	103384.171	5.065	5.118	-0.05
509365.194	103393.264	4.653	4.698	-0.05
509457	103397.783	4.626	4.715	-0.09
509518.955	103419.159	4.892	4.645	0.25
509525.138	103420.445	4.992	5.09	-0.1
509526.313	103420.604	5.036	5.035	0
509527.869	103420.662	4.942	5.035	-0.09
509529.162	103420.861	5.069	4.245	0.82
509534.955	103422.381	4.96	4.845	0.12
509644.164	103410.026	5.165	5.238	-0.07
509703.857	103446.46	5.217	5.073	0.14
509705.316	103452.707	5.232	5.213	0.02
509705.891	103456.223	5.56	5.463	0.1
509703.401	103459.903	5.598	4.051	1.55
509712.113	103471.879	5.578	5.643	-0.06
509712.444	103471.999	7.453	5.643	1.81
509716.616	103475.587	7.498	6.061	1.44
509725.55	103480.166	6.873	5.598	1.28
509726.109	103480.452	6.873	5.276	1.6
509726.219	103480.495	5.882	5.276	0.61
509732.689	103483.461	5.895	4.591	1.3
509733.838	103483.954	5.893	4.591	1.3
509733.805	103484.131	6.742	4.591	2.15
509743.31	103488.433	6.714	5.111	1.6
509743.375	103488.497	5.94	5.111	0.83
509744.527	103489.174	5.931	4.438	1.49
509748.249	103490.237	5.943	4.956	0.99
509755.542	103493.585	5.927	4.706	1.22
509755.561	103493.563	5.85	4.706	1.14
509755.699	103493.533	5.853	4.706	1.15
509755.725	103493.497	5.242	4.706	0.54
509759.65	103494.555	5.378	5.861	-0.48
509764.714	103498.013	5.056	5.168	-0.11
509764.846	103497.956	5.104	5.168	-0.06
509764.834	103498.231	5.016	5.168	-0.15
509771.667	103503.223	4.948	4.448	0.5

NOTE:
Contains data © Google. Data has been relied upon in the format provided and has not been independently validated.

LiDAR Accuracy is typically +/- 150 mm

Easting	Northing	Survey [A]	LiDAR [B]	[A]-[B]
510369.572	103490.234	6.778	6.974	-0.2
510383.87	103502.664	6.871	6.799	0.07
510383.858	103503.138	6.892	6.411	0.48
510385.252	103505.076	7.263	5.869	1.39
510405.019	103504.197	6.94	7.001	-0.06
510413.97	103508.697	6.692	6.826	-0.13
510427.178	103514.049	7	7.081	-0.08
510432.74	103517.927	6.922	7.209	-0.29
510440.04	103519.862	7.197	7.368	-0.17
510449.15	103535.986	7.716	7.75	-0.03
510439.471	103627.922	8.234	8.328	-0.09
510447.688	103680.874	8.38	7.92	0.46
510463.112	103682.434	8.474	8.673	-0.2
510521.541	103686.8	8.168	8.273	-0.11
510578.863	103691.048	7.738	7.642	0.1
510607.618	103693.121	7.672	7.752	-0.08
510638.489	103695.744	7.706	7.719	-0.01
510685.403	103700.822	7.623	7.036	0.59
510730.142	103710.399	7.59	7.507	0.08
510366.499	103499.512	6.704	6.622	0.08
510381.941	103511.928	6.907	7.046	-0.14
510382.623	103511.964	6.883	6.796	0.09
510385.059	103507.218	7.156	6.589	0.57
510403.776	103511.545	7.049	6.964	0.08
510411.952	103515.395	6.871	6.804	0.07
510422.225	103520.701	7.219	6.871	0.35
510430.621	103525.573	7.307	7.322	-0.01
510436.921	103531.136	7.508	7.474	0.03
510441.36	103537.445	7.491	7.554	-0.06
510430.802	103627.367	8.218	8.149	0.07
510444.239	103689.145	8.557	8.521	0.04
510455.832	103690.453	8.577	7.936	0.64
510546.574	103697.301	8.005	7.944	0.06
510587.462	103700.69	7.789	7.589	0.2
510637.935	103703.558	7.832	7.816	0.02
510692.527	103712.654	7.745	7.691	0.05
510729.125	103718.223	7.544	7.297	0.25

Project No.

5216

SURVEY TO LIDAR COMPARISON

AMBIENTAL
ENVIRONMENTAL ASSESSMENT
a company of Royal HaskoningDHV

Appendix L Adur District Council and Worthing Borough Council DRAFT Level 2 SFRA Extracts

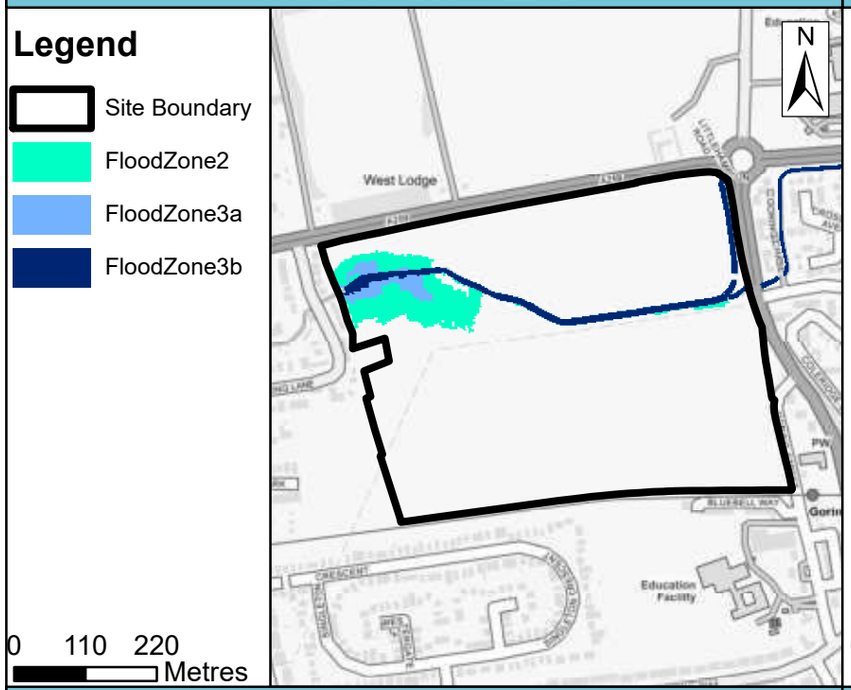
Site name	Local Green Space (LGS): Chatsmore Farm
Site area (ha)	28.5

Adur and Worthing Level 2 Strategic Flood Risk Assessment Site Summary Sheet mapping

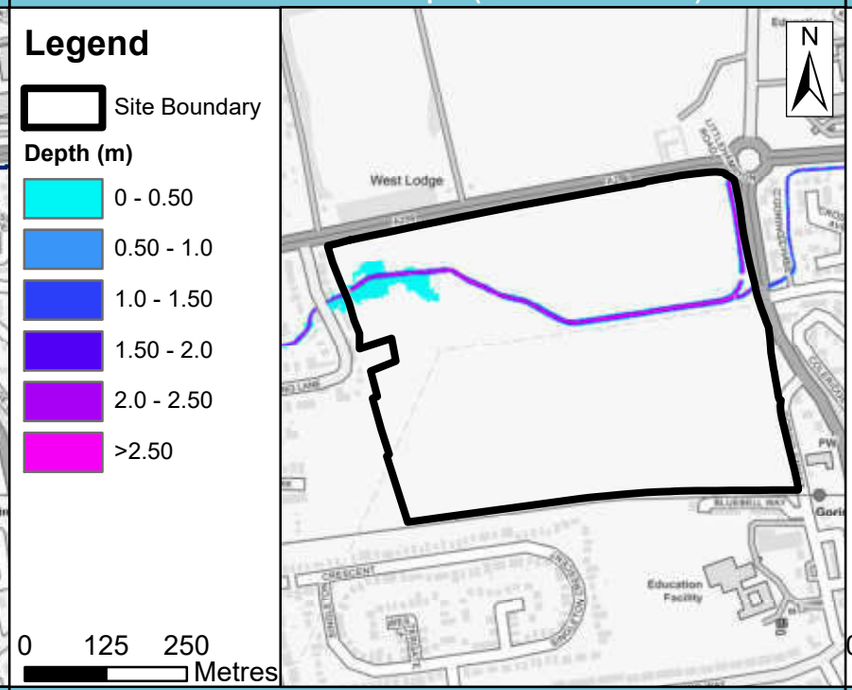
ADUR & WORTHING COUNCILS

JBA consulting

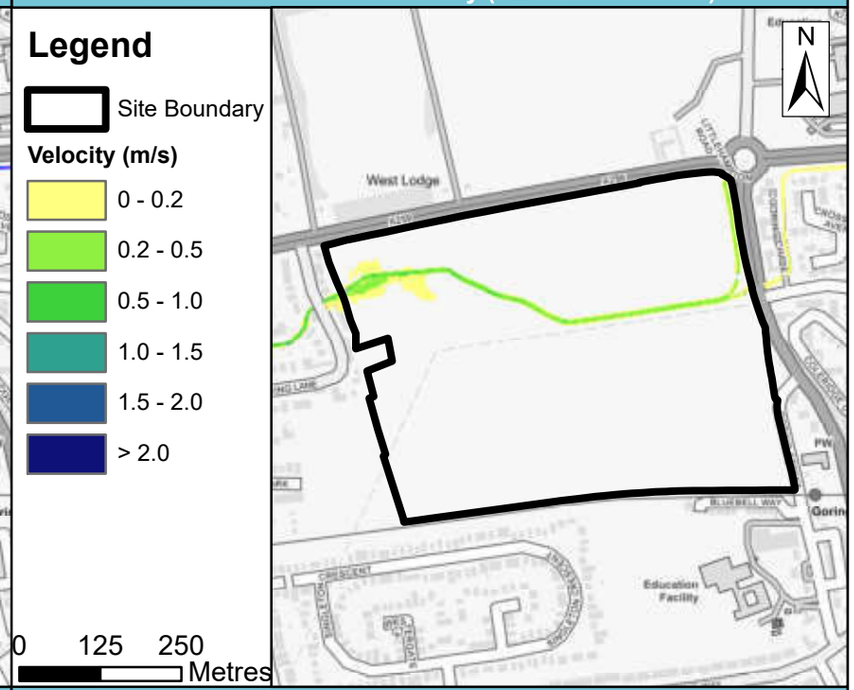
Fluvial / Tidal Flood Extent



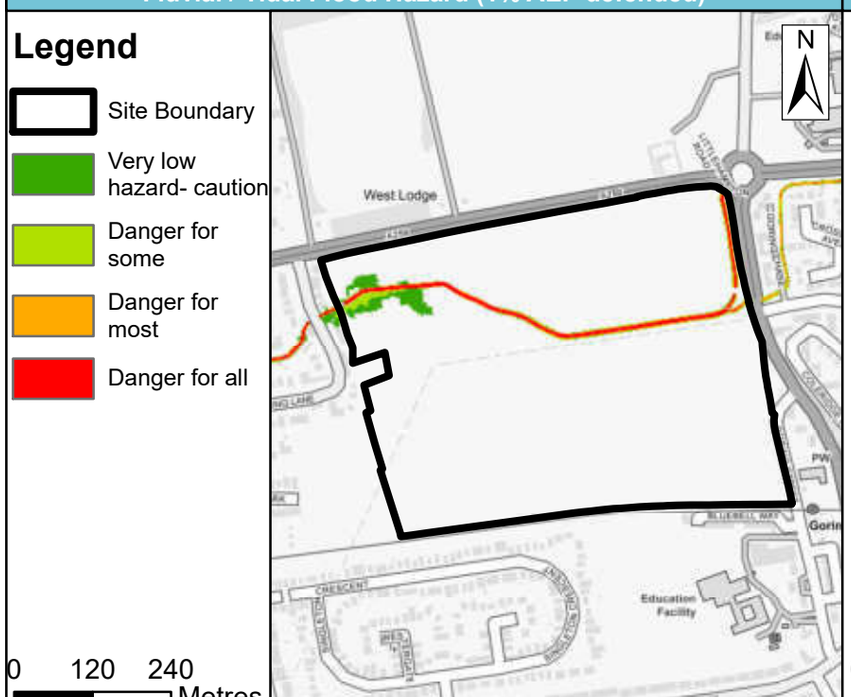
Fluvial / Tidal Flood Depth (1% AEP defended)



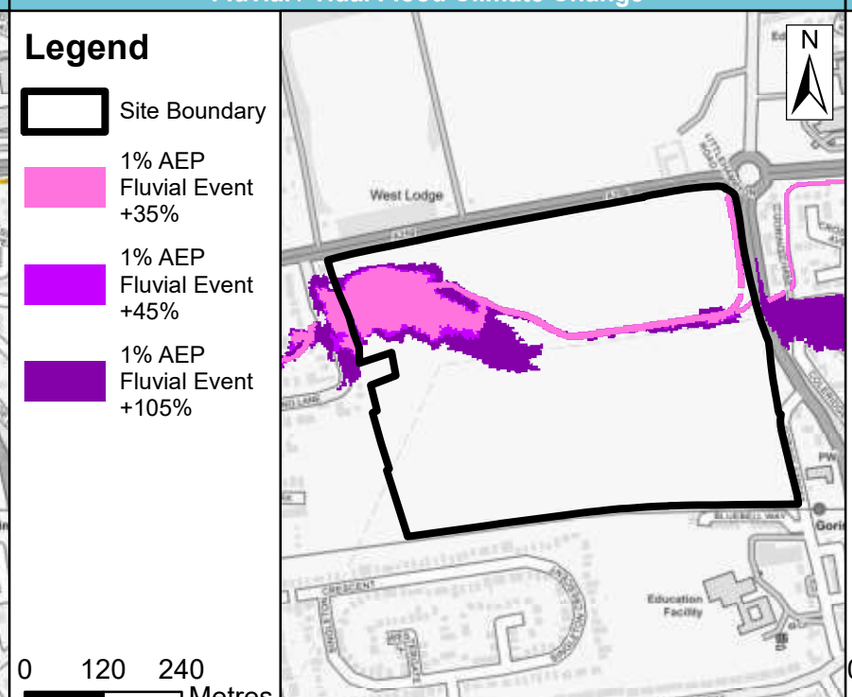
Fluvial / Tidal Flood Velocity (1% AEP defended)



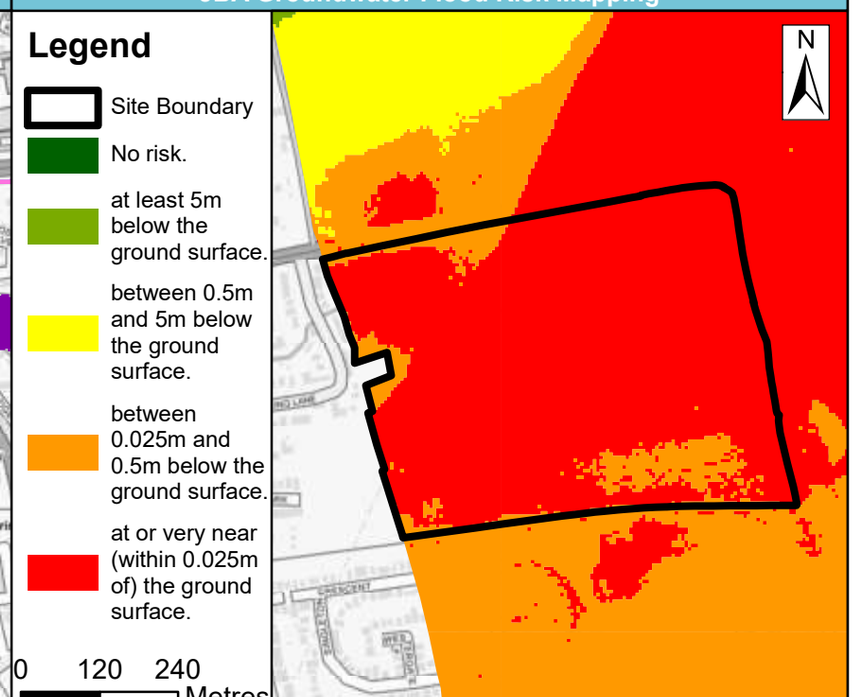
Fluvial / Tidal Flood Hazard (1% AEP defended)



Fluvial / Tidal Flood Climate Change



JBA Groundwater Flood Risk Mapping



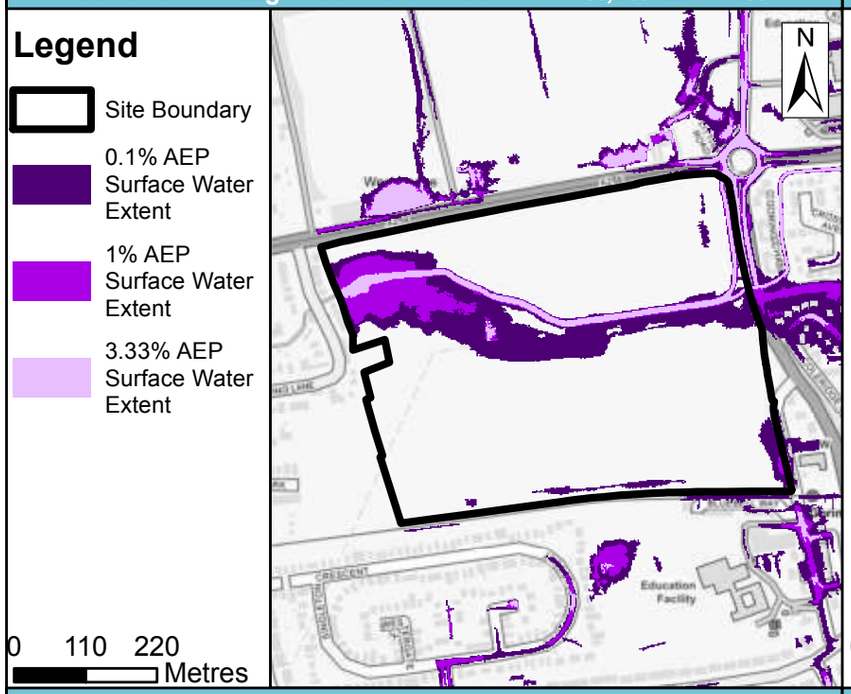
Site name	Local Green Space (LGS): Chatsmore Farm
Site area (ha)	28.5

Adur and Worthing Level 2 Strategic Flood Risk Assessment Site Summary Sheet mapping

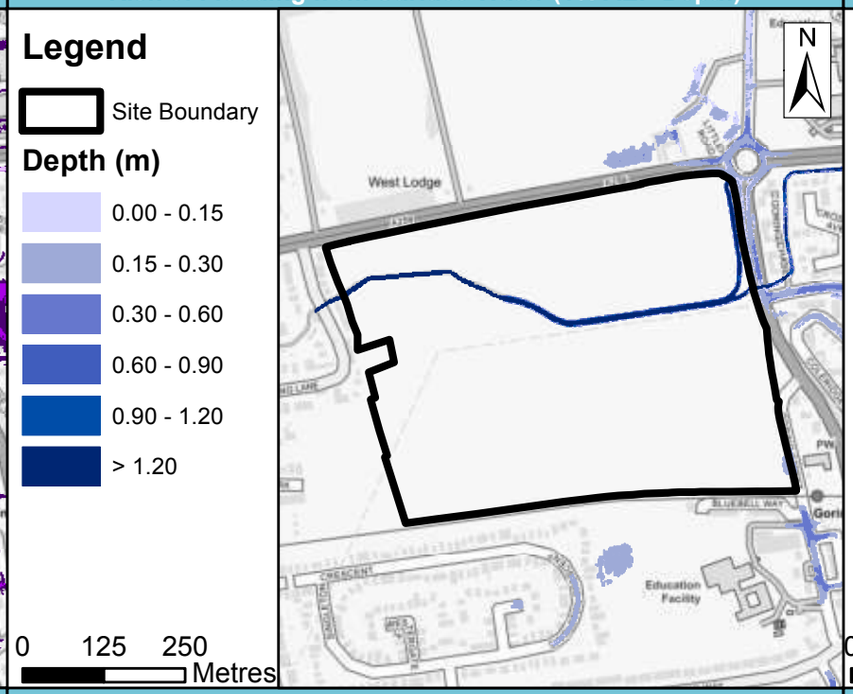
ADUR & WORTHING COUNCILS

JBA consulting

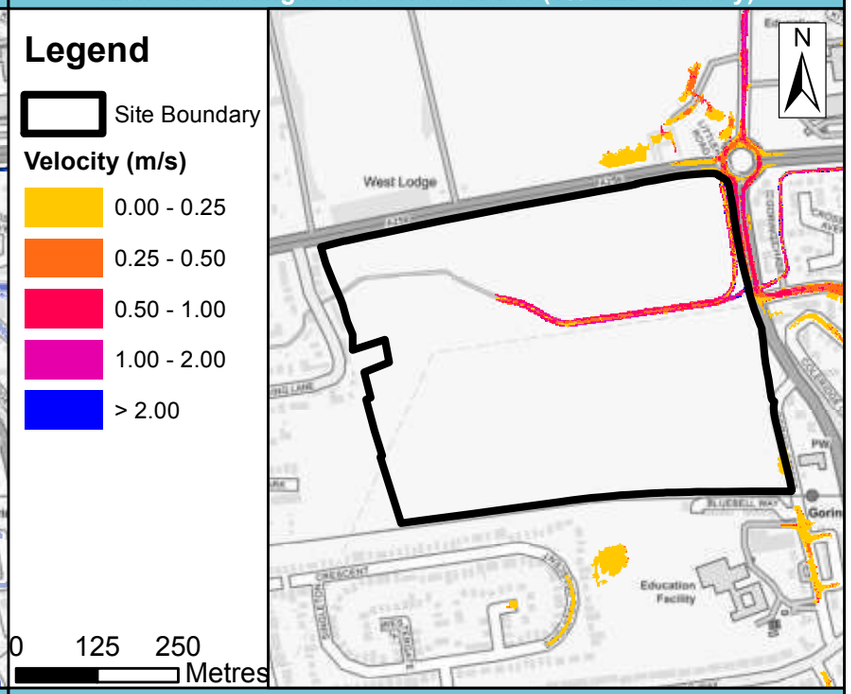
Risk of Flooding from Surface Water- 3.33%,1% and 0.1%



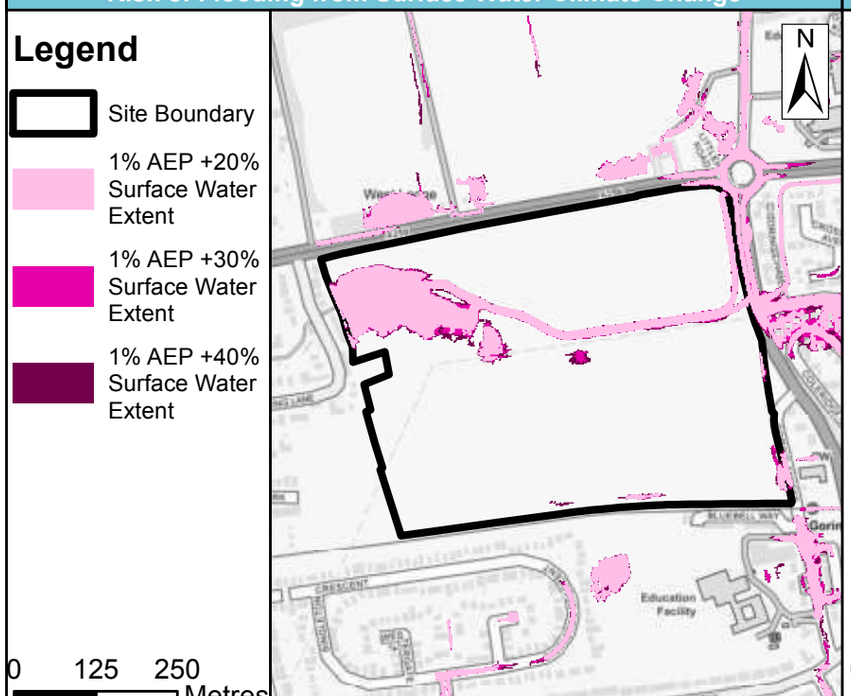
Risk of Flooding from Surface Water (1% AEP Depth)



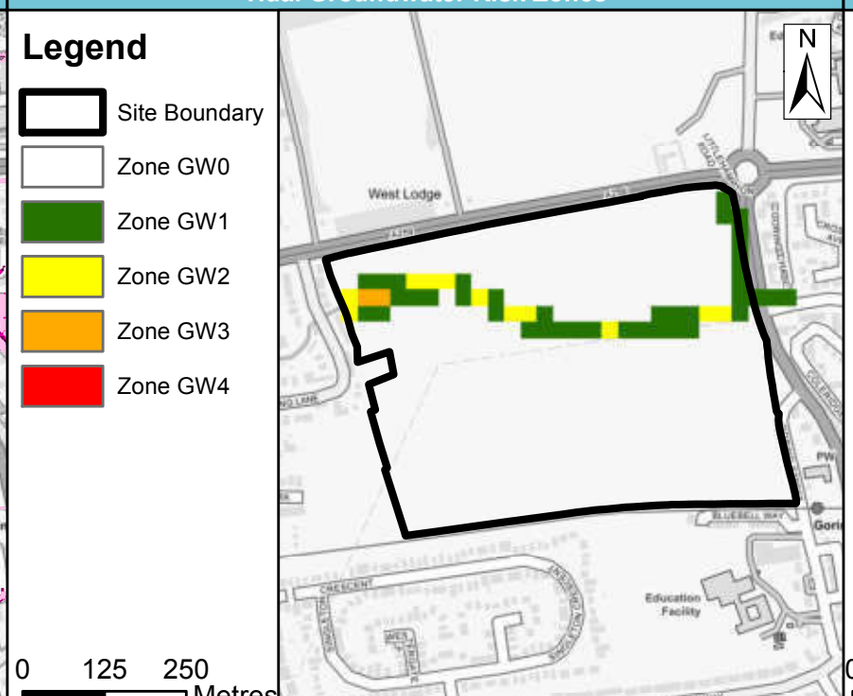
Risk of Flooding from Surface Water (1% AEP Velocity)



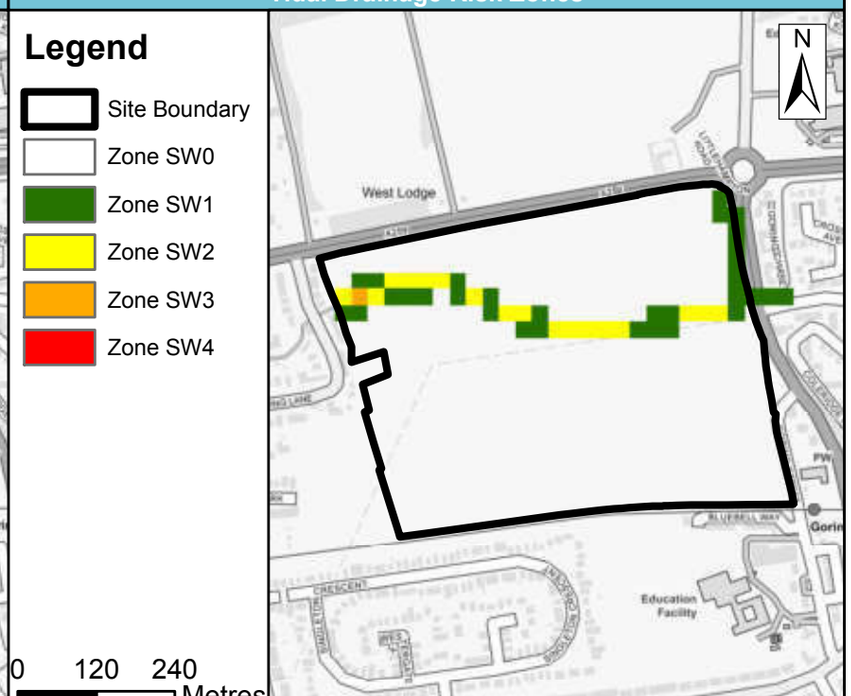
Risk of Flooding from Surface Water Climate Change



Tidal Groundwater Risk Zones



Tidal Drainage Risk Zones



Site name	Local Green Space (LGS): Chatsmore Farm
Site area (ha)	28.5

Adur and Worthing Level 2 Strategic Flood Risk Assessment Site Summary Sheet mapping

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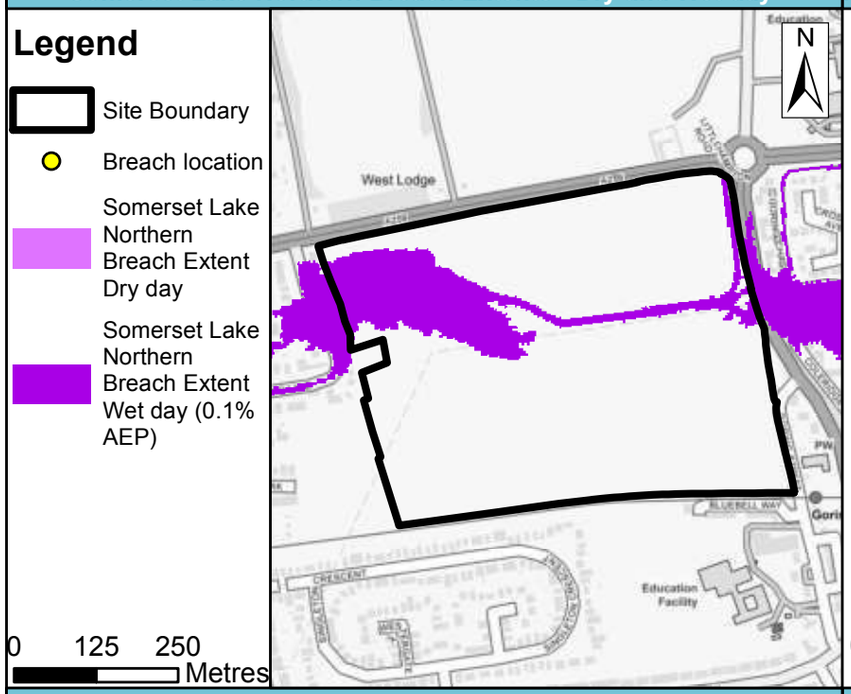
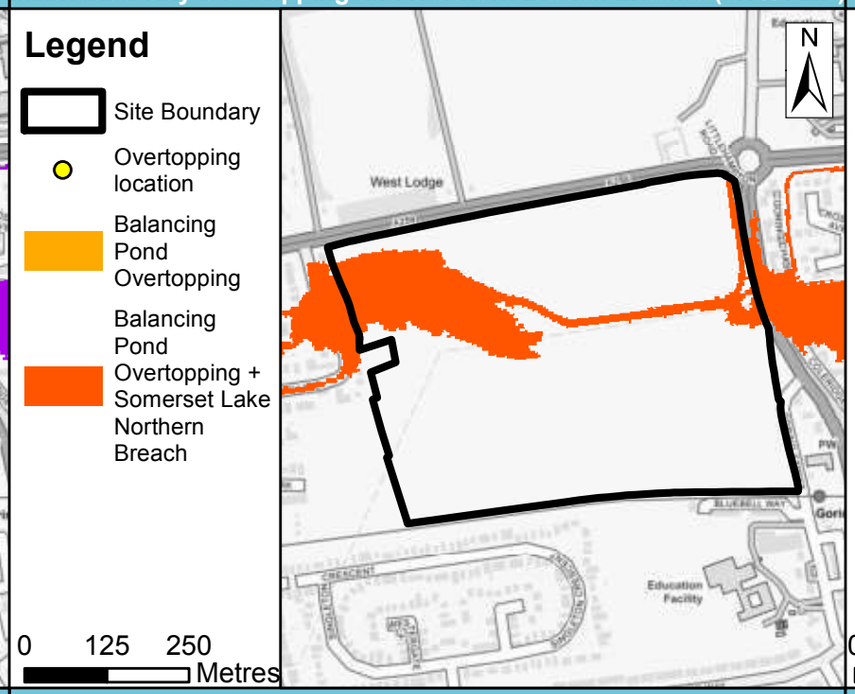
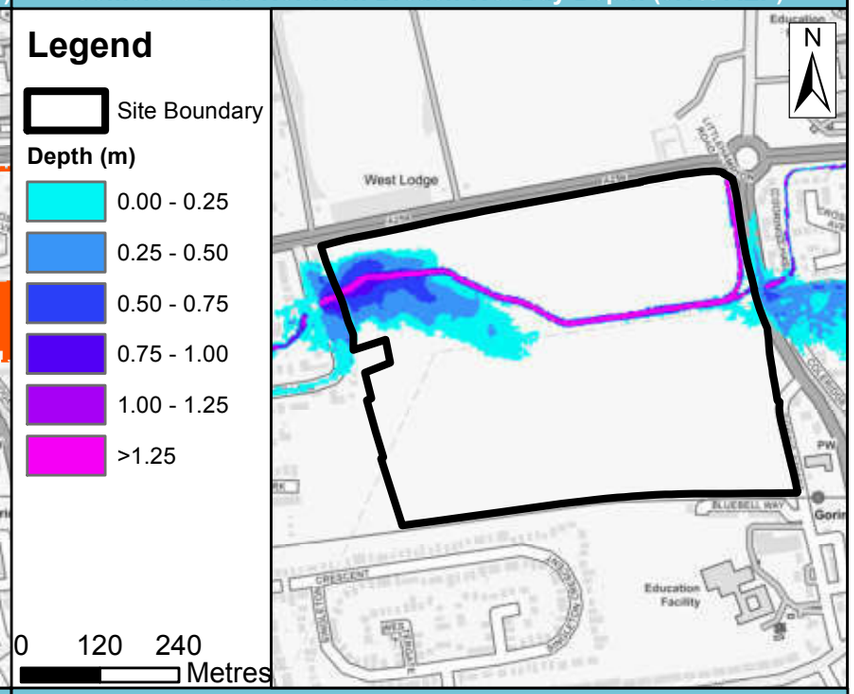
Somerset Lake Northern Breach Extents - Dry and Wet day



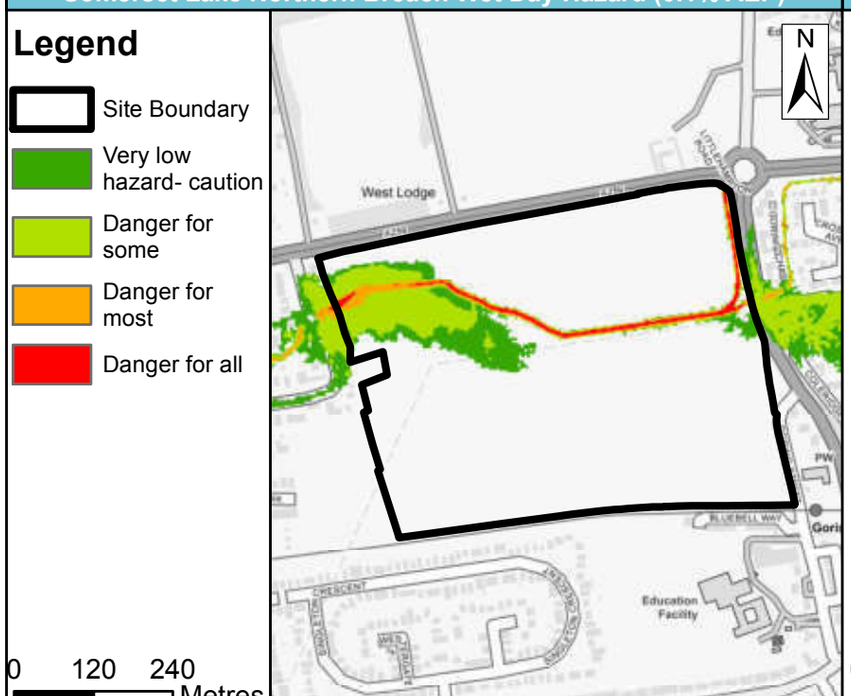
Malthouse Way Overtopping and Northern Breach Extents (0.1% AEP)



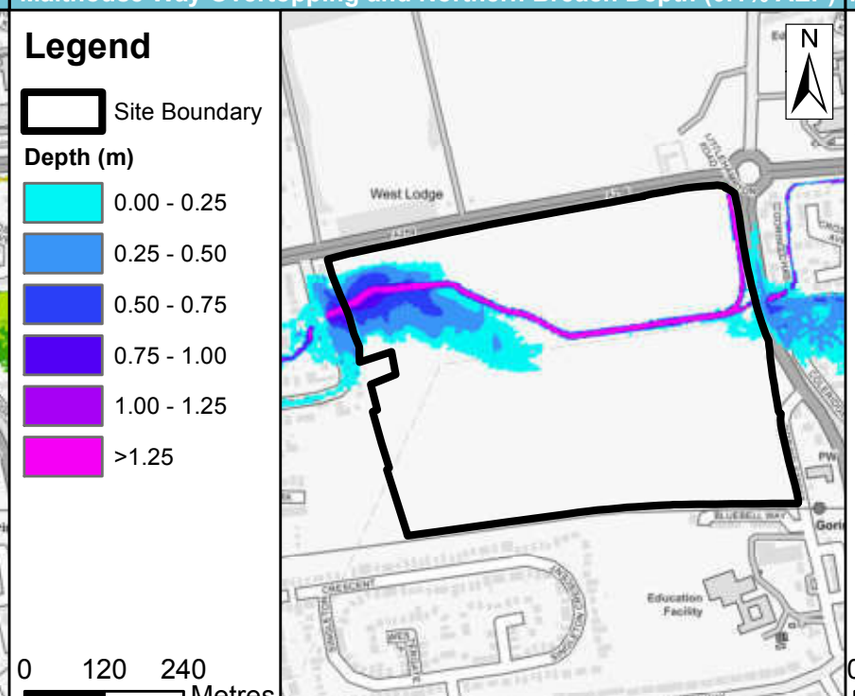
Somerset Lake Northern Breach Wet Day Depth (0.1% AEP)



Somerset Lake Northern Breach Wet Day Hazard (0.1% AEP)



Malthouse Way Overtopping and Northern Breach Depth (0.1% AEP)



Malthouse Way Overtopping and Northern Breach Hazard (0.1% AEP)