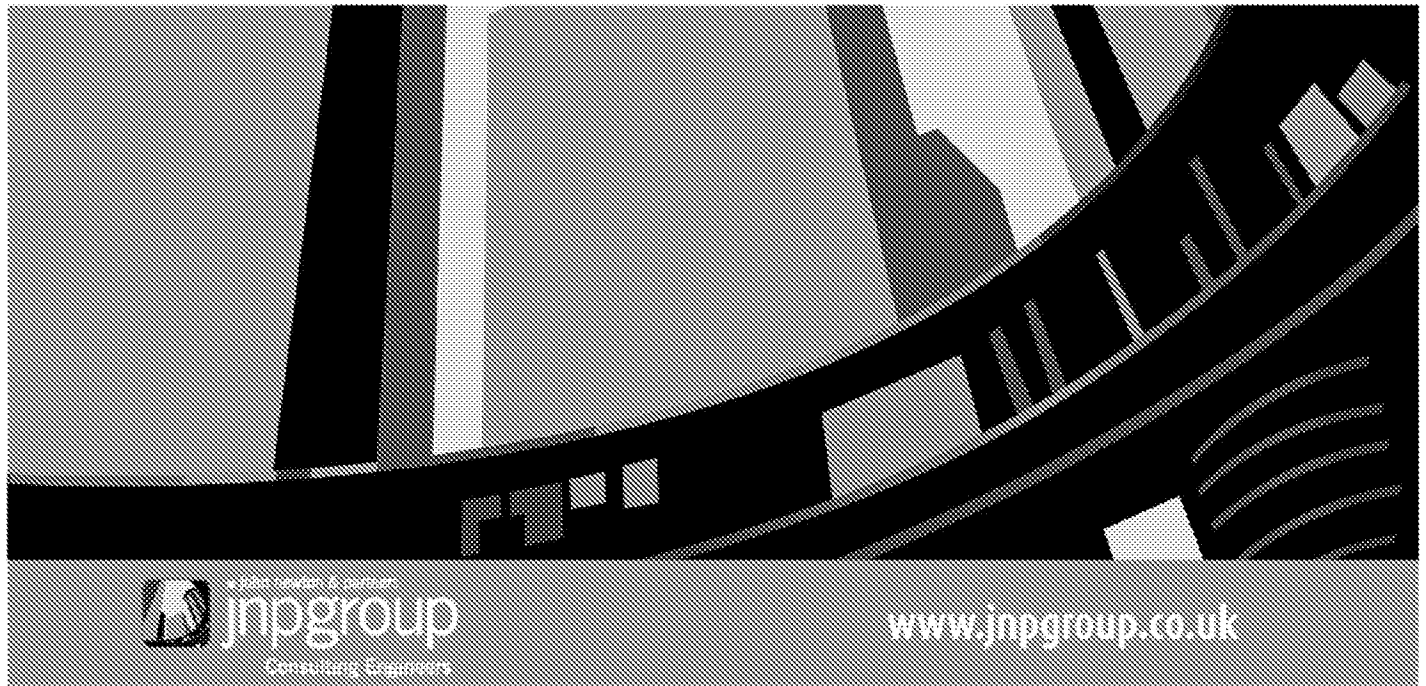




Flood Risk Assessment And Drainage Strategy

Project: Ford Airfield Market

Client: Ford Airfield Market Applicants

Reference: C85228/ R002E

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DOCUMENT CONTROL SHEET

Flood Risk Assessment and Drainage Strategy

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Contents Page

1	EXECUTIVE SUMMARY	4
2	INTRODUCTION	5
3	LOCATION AND SITE DESCRIPTION.....	6
4	GEOLOGY	8
5	HYDROLOGY AND HYDROGEOLOGY	10
	5.1 Hydrology.....	10
	5.2 Hydrogeology.....	10
6	EXISTING SURFACE WATER FEATURES	11
7	EXISTING FLOOD RISK.....	12
	7.1 Flood Risk Guidance.....	12
	7.2 National Planning Policy	12
	7.3 Climate Change	12
	7.4 Sequential Test and Exception Test	12
	7.5 Flood Risk from Rivers (Fluvial).....	13
	7.6 Coastal and Tidal Flood Risk	13
	7.7 Groundwater Flood Risk	13
	7.8 Surface Water Flood Risk (Overland Flows).....	13
	7.9 Sewer / Drainage Flood Risk	14
	7.10 Reservoir Flood Risk.....	14
8	GREENFIELD RUNOFF ASSESSMENT	15
	8.1 Existing Site Surface Water Run-off.....	15
	8.2 Existing Greenfield Run-Off Rates.....	15
9	PROPOSED DEVELOPMENT ASSESSMENT	16
10	SURFACE WATER DRAINAGE ASSESSMENT	17
	10.1 Surface Water Drainage Assessment.....	17
	10.2 SuDS Management Train Approach	17
	10.3 Source Control	17
	10.4 Infiltration To Ground	17
	10.5 Connection to Watercourse	18
	10.6 Connection to Sewer.....	18
11	PROPOSED SURFACE WATER STRATEGY	19
	11.1 Surface Water Drainage Strategy.....	19
	11.2 Flood Exceedance Routing.....	19
	11.3 Ground Level Raising Onsite	20
	11.4 Sustainable Drainage Systems.....	20
12	WATER QUALITY	21
13	MAINTENANCE AND ADOPTION	24
14	CONCLUSIONS	25
15	LIMITATIONS.....	27

List of Appendices

Appendix A	Existing Drainage Plan and Topographical Survey
Appendix B	Greenfield Runoff Rate Assessment
Appendix C	Ford Airfield Market Overspill Car Park Drainage Strategy
Appendix D	Ford Airfield Market Overspill Car Park Drainage Calculations
Appendix E	Flood Exceedance Routing Plan
Appendix F	Groundwater Monitoring and Infiltration Rate Test Results

1 EXECUTIVE SUMMARY

- 1.1 This Flood Risk Assessment (FRA) and Drainage strategy supports a detailed planning application for the Ford Airfield Market Site and Overspill Car Park.
- 1.1 The proposed development area is 7.12 ha. The existing impermeable area onsite is approximately 5 ha and comprises of the existing access road and former airfield runways. The remaining 2.12 ha is permeable land which includes the road verge and part of a field which is used for arable farming.
- 1.2 The existing site has a low flood risk. A flood risk assessment has been carried out for fluvial, tidal, surface water, groundwater, sewerage and reservoir flooding.
- 1.3 The proposed market site comprises of three areas
-  The existing private site access road off Ford Road. No changes to the road are proposed.
 -  The existing former runway. No changes to the runway are proposed.
 -  A new overspill car park which will be constructed in part of an existing field used for arable farming.
- 1.4 The access road to the market site and the former airfield runways are not affected by the proposed development. Therefore, the existing drainage systems which serve these areas will be retained and reused.
- 1.5 The overspill car park will discharge surface water runoff to cellular storage soakaways provided onsite.
- 1.6 Soil infiltration rate testing at the site of the overspill car park shows that it is underlain by gravelly SAND / sandy CLAY at approximately 2.60m below existing ground level. During the test water infiltrated into the ground with an infiltration rate of 4.76×10^{-6} m/s. The highest monitored groundwater level recorded over winter 2018/19 and winter 2019/20, close to this location, was 3.90m below existing ground level.
- 1.7 The soakaways will be constructed at a similar level in the stratum underlying the site, where the soil infiltration rate test proved that the ground is suitable for soakaways at this depth.
- 1.8 The soakaways will provide attention for the 1 in 100 year + 40% climate change storm event. Calculations show the soakaways can achieve half drain down of storage volume within 24 hours in readiness for repeated storm events.
- 1.9 The proposed car park design specifies that the car parking bays will fall towards the car park access roads and surface water runoff will flow onto the road surface. The car park roads will have a permeable surface with a tanked sub base. This provides treatment by filtration as water passes through the road subbase layer. The water will then discharge to cellular soakaways located deeper in the gravelly sand / sandy clay underlying the site which enables water to discharge into the ground.

2 INTRODUCTION

- 2.1 JNP Group (JNP) were commissioned by Redrow Homes and Wates Developments to provide a FRA and Drainage Strategy for a market site and overspill car park located at Ford Airfield, Arundel, West Sussex
- 2.2 A market is currently held at Ford Airfield, on the former runways, which provides onsite car parking for visitors. However, part of the airfield is an allocated strategic housing site (Reference SD8) in the Adoption Arun Local Plan 2011 – 2031 (July 2018). It is proposed that part of the existing market site will be developed for housing.
- 2.3 The FRA report forms part of the detailed planning application which defines the boundaries of the new market site and includes proposals to improve transport and access links to the site. It also includes a new overspill car park for the market site.
- 2.4 This report is based on information available from the Environment Agency (EA), Southern Water (SW), West Sussex County Council (WSCC), Arun District Council (ADC) and information available within the public domain, including the Strategic Flood Risk Assessment (SFRA) Final Report by JBA Consulting (November 2016) commissioned by ADC.
- 2.5 This report aims to manage flood risk issues for new development in accordance with the requirements of The National Planning Policy Framework (NPPF) and ensure that there is no increase in flood risk both onsite and offsite as a result of the proposed development.

3 LOCATION AND SITE DESCRIPTION

- 3.1 The site is located west of Ford Road, Ford, Arundel, West Sussex, BN18 0FL at approximate National Grid Reference SU 996 027. The site location is shown in Figure 1 below, enclosed by the red line boundary. The Ordnance Survey coordinates for the site are:

 E499211

 N102986

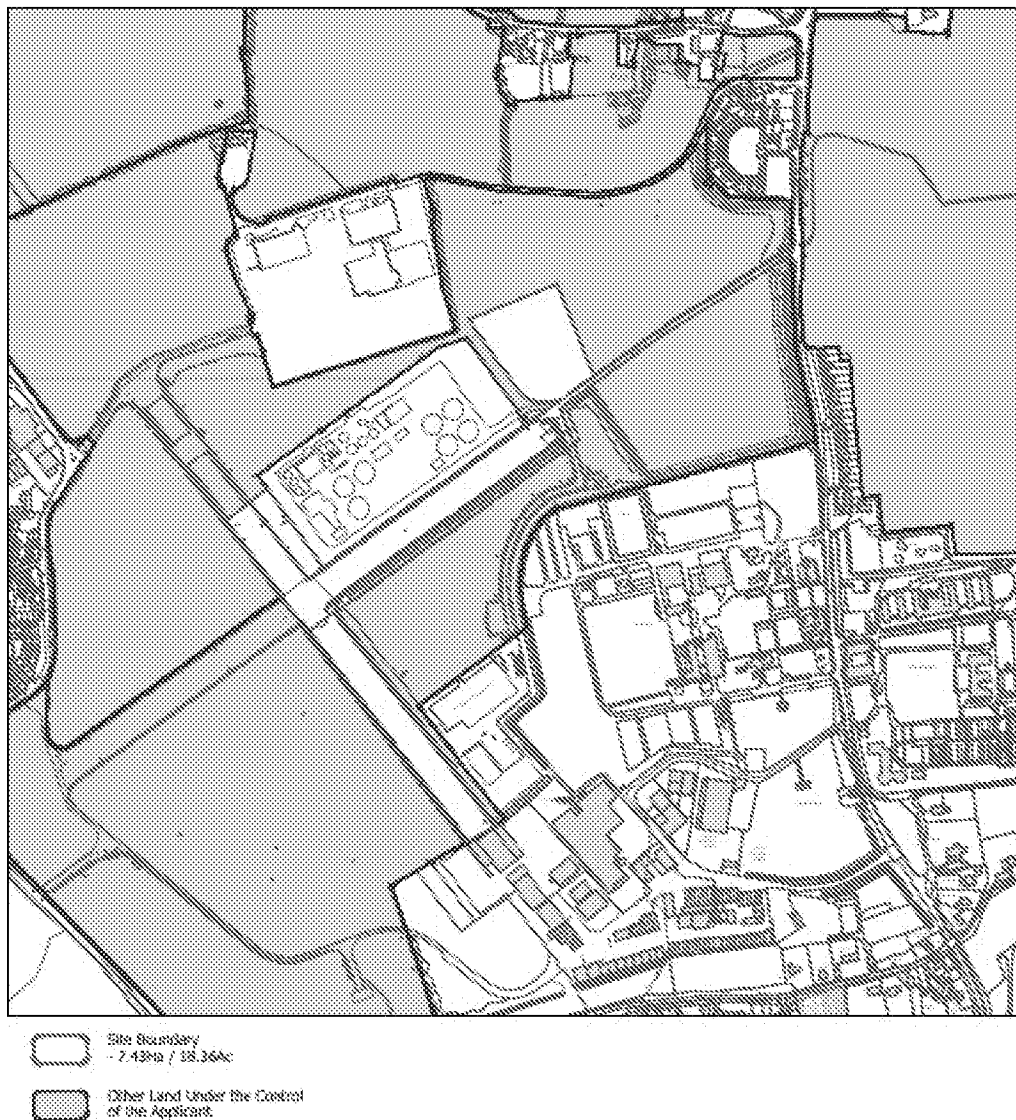


Fig 1 Site Location. Not to Scale.

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- 3.2 The proposed development area is 7.12 ha. The existing impermeable area onsite is approximately 5 ha

and comprises of the existing access road and former airfield runways. The remaining 2.12 ha is permeable land which includes the road verge and part of an agricultural field.

- 3.3 The existing market site and car parking facilities extend further into former airfield and occupy the runways which lie outside the proposed redline development boundary. The existing site has 2 no vehicular entrances and is accessed from Ford Road on the eastern site boundary and Yapton Road which is located on the western side of the existing airfield.
- 3.4 The proposed housing development will occupy the former airfield runways and fields to the west of the proposed market site. Therefore, future vehicular access to enter and leave the market will be from Ford Road to the east.
- 3.5 The proposed market site comprises of 3 areas:
-  The existing private site access road off Ford Road.
 -  The existing former runway
 -  A new overspill car park
- 3.6 The new overspill car park, to serve the proposed market, will be located on land which is currently part of an agricultural field to the north of the access road off Ford Road.
- 3.7 Immediately north of the development site is Southern Water's Ford Wastewater Treatment Works. The Rudford Industrial Estate and Ford Materials Recycling Facility lie to the southeast.
- 3.8 The former airfield runways are gently sloping and range between 7.500m AOD to 6.500m AOD. The ground level of the existing field, where the overspill car park will be located, varies between 6.960m AOD to 6.000m AOD and falls towards the northeast corner at approximately 1 in 160 gradient.

4 GEOLOGY

- 4.1 British Geological Survey (BGS) maps show that the bedrock geology onsite comprises of Lewes Nodular, Seaford, Newhaven, Culver and Portsdown Chalk Formations. Superficial geology of River Terrace Deposits, comprising of sand, silt and clay are shown towards the surface of the site.
- 4.2 A Geo-environmental and Geotechnical Site Investigation was carried out by RSK Environmental Limited (RSK) in August 2018. The findings are provided in RSK's Geo- environmental and Geotechnical Site Assessment Report, Report Reference 29228-R01 (00), dated 06 November 2018.
- 4.3 The site investigation included trial holes and window sampling testing carried out adjacent to the former airfield runways. A borehole (BH4) and soakaway test (S4) was carried out adjacent to the runway towards the north of the proposed market site. The locations are shown on Figure 2 below.
- 4.4 A borehole (BH5) and soakaway test (S5) was carried out in the agricultural field where the overspill car park will be located. Additional trial pits were carried out to the north of the site.
- 4.5 The onsite geology recorded in boreholes BH4 and BH5 onsite was similar and supports the information provided on the BGS maps. The borehole logs recorded:

Borehole BH4 – Depth below existing ground level (m)

	0.00m to 0.40m	TOPSOIL
	0.40m to 2.75m	Brown slightly sandy CLAY (BRICKEARTH)
	2.75m to 4.30m	Brown slightly gravelly sandy CLAY (BRICKEARTH)
	4.30m	Structureless CHALK (WHITE CHALK SUB GROUP)

Borehole BH5 – Depth below existing ground level (m)

	0.00 to 0.40m	TOPSOIL
	0.4 to 1.50m	Brown slightly sandy CLAY becoming gravelly sandy CLAY with depth (BRICKEARTH)
	1.50m to 3.00m	Brown slightly gravelly sandy CLAY (BRICKEARTH)
	3.00m to 4.50m	Weathered CHALK (WHITE CHALK GROUP)
	4.50m	Structureless CHALK (WHITE CHALK GROUP)

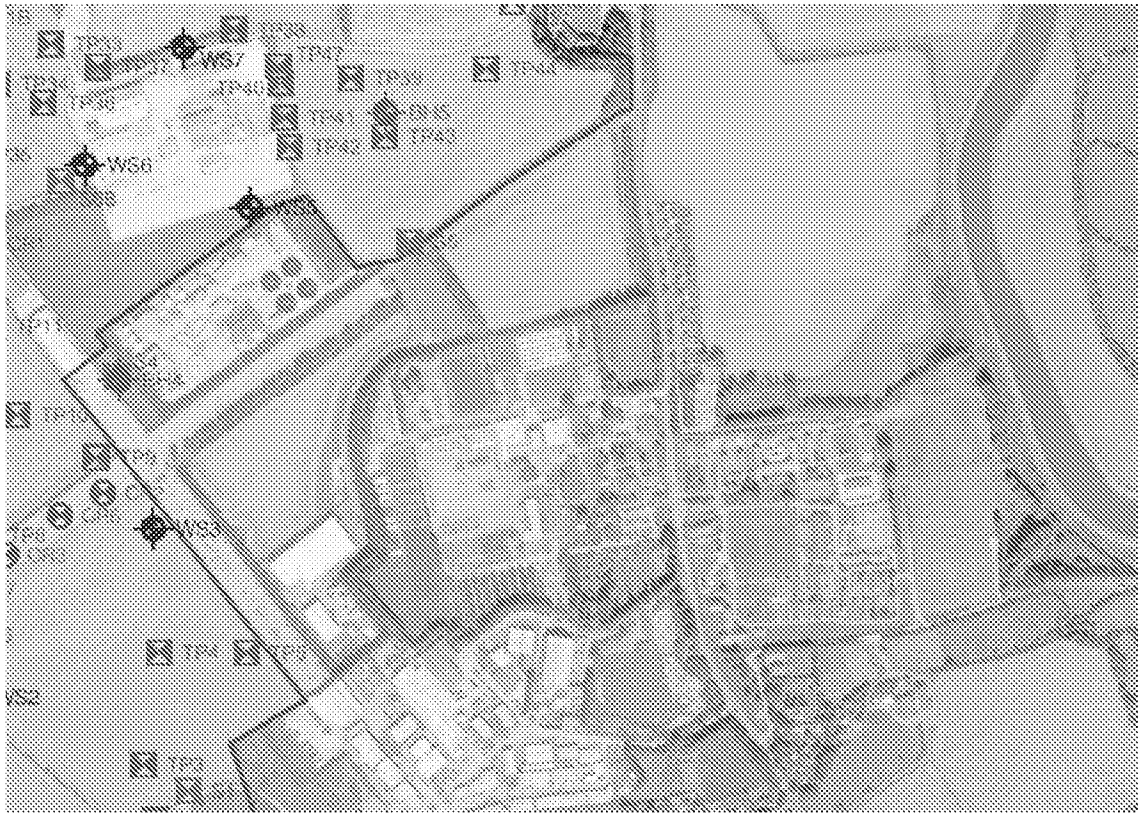


Fig 2 Extract of Site Investigation Exploratory Hole Location Plan as taken from RSK's Geo- environmental and Geotechnical Site Assessment Report, Report Reference 29228-R01 (00), dated 06 November 2018.

5 HYDROLOGY AND HYDROGEOLOGY

5.1 Hydrology

- 5.1.1 The River Arun lies 0.5km east of the development site.
- 5.1.2 A large deep channel is located adjacent to the site entrance off Ford Road. The channel enters a culvert under Ford Road and then flows eastwards as an open channel watercourse to the River Arun.
- 5.1.3 There are no watercourses or ditches within the development site boundary.

5.2 Hydrogeology

- 5.2.1 The chalk bedrock underlying the site is classified as a Principal aquifer meaning that it may support water on a strategic scale.
- 5.2.2 The site is not within a groundwater source protection zone as defined by the EA.
- 5.2.3 The 2016 Strategic Flood Risk Assessment (SFRA) for ADC shows site to be <25% susceptible to groundwater flooding.
- 5.2.4 The historic flooding records map in the 2016 SFRA for ADC shows no records of groundwater flooding onsite.
- 5.2.5 As part of the groundwater assessment for the proposed housing development and the market site the groundwater level in borehole wells across the site have been monitored by RSK. The readings were first measured in August 2018 and monitored for more than 12 months over 2018 to 2020.
- 5.2.6 Groundwater levels vary across the site and increased by more than 1m as a result of seasonal variation. The groundwater flows in an eastern / north eastern direction.
- 5.2.7 To date the highest groundwater level recorded at Borehole BH5, which is located at the proposed overspill car park, occurred on 19 December 2019 and was 3.90m below existing ground level (1.5m AOD).
- 5.2.8 For comparison the groundwater level at Borehole BH4, which is north of the former runway, on 19 December 2019 was 3.03m below existing ground level (3.54m AOD).
- 5.2.9 Soil Infiltration rate testing was carried out at soakaway test S4 (runway) and S5 (proposed overspill car park) on 15th and 16th August 2018. Refer to Figure 2 for the locations of the tests. The following infiltration rates were calculated.

	S4	Failed to achieve infiltration in accordance with BRE 365 Soakaway Design
	S5	4.76×10^{-6} m/s
- 5.2.10 Further soil infiltration rate testing will be carried out in February 2020 at the proposed location and depth of the soakaway to confirm the soil infiltration rate which will be used to design the soakaway for construction.
- 5.2.11 The feasibility of using soakaways and infiltration drainage to serve the overspill car park is discussed in Sections 10 and 11.

6 EXISTING SURFACE WATER FEATURES

6.1 Review of Geographic Information System (GIS) Data

- 6.1.1 GIS information for the development has been overlaid on to the topographical survey and Ordnance Survey mapping. Refer to drawing no. C85229 – SK144, titled Existing Drainage Plan, in Appendix A which shows the historic surface water sewers and ordinary watercourse routes in the vicinity of the site.
- 6.1.2 The drawing shows that the former runways, which lie within the development site, are served by private surface water sewers which receive water from the gullies located at the edge of the paved surface. There are no incoming surface water drainage connections upstream of the airfield runways.
- 6.1.3 The sewers flow southwards through the site and connect to the private surface water sewers which serve the Rudford Industrial Estate. This sewerage system continues westwards and discharges into the River Arun.
- 6.1.4 There are no other surface water features which serve the development site.

7 EXISTING FLOOD RISK

7.1 Flood Risk Guidance

- 7.1.1 The Level 1 and Level 2 SFRA Final Report by JBA Consulting (November 2016) commissioned by ADC has been used to obtain flood risk information for the development site and the localised surrounding area.
- 7.1.2 The Level 2 SFRA includes a detailed assessment of the Ford Airfield housing development site which is immediately adjacent to the market site. The assessment supports its inclusion as a strategic housing site (Reference SD8) in the Adoption Arun Local Plan 2011- 2031 (July 2018).
- 7.1.3 The information provided for the housing development site is also relevant to the market site. Further site specific ground investigation has been carried out to assess the market site in more detail.

7.2 National Planning Policy

- 7.2.1 The PPG, which supports NPPF, defines three Flood Zones in relation to river flooding. These are defined as:
 -  Flood Zone 1 (Low Probability): This zone comprises land assessed as having less than a 1in1000 annual probability of river flooding;
 -  Flood Zone 2 (Medium Probability): This zone comprises land assessed as having between a 1in100 and 1in1000 annual probability of river flooding; and
 -  Flood Zone 3 (High Probability): 1 This zone comprises land assessed as having greater than 1in100 annual probability of river flooding.
- 7.2.2 The EA's Flood Map for Planning shows the site to be entirely within Flood Zone 1. As a result, the site is considered to be at low risk of fluvial flooding, as defined above.

7.3 Climate Change

- 7.3.1 In accordance with the PPG, a site-specific flood risk assessment must consider the following question:
"How is flood risk at the site likely to be affected by climate change?"
- 7.3.2 The EA in February 2016 provided guidance on the predicted impacts of climate change on peak river flow and rainfall intensity over the next 100 years. The site is located in the South East Basin District, where peak river flow is predicted to increase by 25-105% by 2115. Peak rainfall intensity is predicted to increase by up to 40% by 2115.
- 7.3.3 The market site does not comprise of any permanent habitable buildings or office and retail structures. Therefore, the flood risk assessment considers how climate change could affect the land at the market site throughout its lifetime. The below assessment takes account of the forecasted effects of climate change on all possible sources of flood risk (fluvial, tidal and surface water drainage).

7.4 Sequential Test and Exception Test

- 7.4.1 In accordance with the NPPF:

"The aim of the sequential Test is to steer new developments to areas with the lowest probability of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding."

7.4.2 Where areas of lower risk are not available, the Exception Test, as set out in paragraph 102 of the NPPF can be applied, to ensure flood risk management for people and property meets the required level of standard.

7.4.3 The SFRA Level 2 Detailed Site Summary Table for the adjacent Ford Airfield residential development site advises " the Exception Test would not be required for this site as it is entirely located within Flood Zone 1". Therefore, it is considered the proposed site for the market is also suitably located.

7.5 Flood Risk from Rivers (Fluvial)

7.5.1 The development is located in Flood Zone 1 and therefore has low risk of flooding from fluvial sources (less than 0.1% annual probability).

7.5.2 It is noted that two short localized sections of public road, Ford Lane to the north and Ford Road to the east, which are outside the site boundary, are located inside Flood Zone 3. This would only impact on access to the market site during an extreme event.

7.6 Coastal and Tidal Flood Risk

7.6.1 The River Arun is a Tidal River. Based on the EA flood map the development site is not at risk of tidal flooding.

7.7 Groundwater Flood Risk

7.7.1 The 2016 SFRA for ADC shows the site is <25% susceptible to groundwater flooding.

7.7.2 RSK commenced groundwater monitoring of the market site and the adjacent residential development site in August 2018 to obtain at least 12 months of groundwater level data. The groundwater monitoring test results are provided in Appendix F.

7.7.3 Borehole monitoring wells are located at the former airfield runway (Borehole BH4) and the proposed location of the overspill car park (Borehole BH5).

7.7.4 To date the worst case groundwater levels occurred on 13 February 2019. The groundwater levels were:

	BH4	3.03m below existing groundwater level / 3.54m AOD
	BH5	3.90m below existing groundwater level / 1.75m AOD

7.7.5 Based on current site investigation findings the site has a low risk of groundwater flooding.

7.8 Surface Water Flood Risk (Overland Flows)

7.8.1 Surface water flooding occurs when rainwater does not drain away through the normal drainage system or infiltrate into the ground, but instead lies on or flows over the ground.

7.8.2 Surface water flood risk maps have been obtained from the EA. The maps were produced using 'direct rainfall' modelling. Although they take into account local drainage capacity, non-surface water influences such as rivers, sea or groundwater are not considered. The map is based on LiDAR topographic data which is not suitable for site specific assessment and therefore, where available, site specific topographic survey data should be used to provide a more accurate understanding of potential flow paths.

- 7.8.3 The EA Surface Water Flood Risk Map shows the site is not at risk of surface water flooding. It suggests that a small area of localised low risk flooding might occur in an area of soft landscaping in between the runway and northwest corner of the Ford Wastewater Treatment Works (WTW). This is considered to be runoff to a low lying area of ground. This is shown in Figure 3 below.

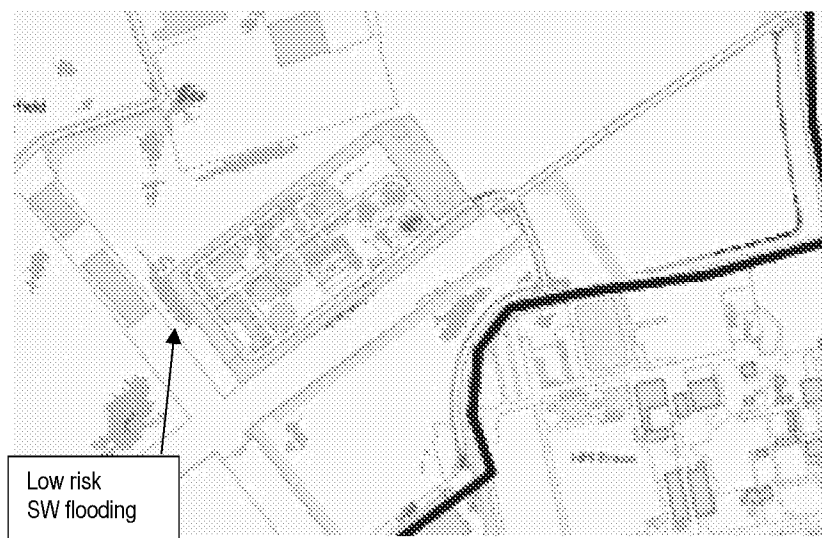


Fig 3 Extract from the EA Flood Risk from Surface Water Map.

- 7.8.4 The likelihood of low risk surface water flooding is defined as less than 1% (1 in 100) but greater than or equal to 0.1% (1 in 1000) chance in any given year.
- 7.8.5 The existing ground levels within the market site across the airfield will not be amended. The overspill car park surface will be constructed with falls to direct surface water towards the onsite drainage components. This is discussed in more detail in Section 11.
- 7.8.6 The proposed drainage strategy for the adjacent housing development has been designed to prevent surface water overland flow on to the market site for the 1 in 100 year + 40% CC event.
- 7.9 **Sewer / Drainage Flood Risk**
- 7.9.1 Sewer flooding occurs when excess surface water run-off enters the drainage network and the surface/foul water network is insufficient to deal with the influx of water. Sewer flooding can also occur due to 'one off' events such as blockages in the network.
- 7.9.2 The market site is served by private surface water sewers which serve the former airfield runways. There is no known history of the sewers surcharging in the past.
- 7.9.3 The airfield site is generally flat. If the sewers were to surcharge water would pond locally onsite rather than runoff and affect neighbouring areas. The water would eventually escape via the existing gullies onsite.
- 7.10 **Reservoir Flood Risk**
- 7.10.1 The EA's Reservoir Flood Map shows no risk to the site.

8 GREENFIELD RUNOFF ASSESSMENT

8.1 Existing Site Surface Water Run-Off

8.1.1 The market site comprises of 3 areas.

- The access road off Ford Road – the road has a central camber and surface water runs off the surface to soft landscaped verges in land which is under the control of the market site applicant. No changes to the road are proposed.
- The former runway and associated road junction – surface water runoff discharges to existing underground sewerage systems which will be retained. No changes to the former runway are proposed.
- The proposed overspill car park – the new car parking area will be located on an area which is currently arable farming land. The proposed size of the car park is approximately 1.65 ha. The drainage infrastructure for the car park will be designed to discharge to the ground or not to exceed the existing greenfield runoff from this part of the site.

8.2 Existing Greenfield Run-Off Rates

8.2.1 To inform the design and ensure there is no increase in surface water from the site, the existing run-off rates for a variety of return periods have been calculated per hectare using the HR Wallingford Greenfield Runoff Tool based on the Flood Estimation Handbook (FEH) Statistical Method. The calculations are provided in Appendix B.

8.2.2 The calculated Greenfield run off rates are provided below.

Storm Event	Run-Off (l/s/Ha)
QBAR	1.14
1 in 1 year	0.97
1 in 30 year	2.61
1 in 100 year	3.62

Fig 4 Greenfield Runoff Rates for the site

9 PROPOSED DEVELOPMENT ASSESSMENT

- 9.1 The development will comprise of a market site and overspill car park with no associated buildings.
- 9.2 In accordance with Table 2 of the Planning Practice Guidance (PPG) on Flood Risk and Coastal Change the flood risk vulnerability classification for the market site is water compatible development.

Site Use	Flood Risk Vulnerability Classification
Buildings used for shops, offices, general industry and leisure	Less Vulnerable
Amenity open space	Water Compatible Development

Fig 5 Flood risk vulnerability classification in accordance to Table 2 of PPG Flood Risk and Coastal Change

- 9.3 Appropriate uses of land within classified flood zones can be summarised below in accordance with Table 3 of PPG Flood Risk and Coastal Change titled Flood Risk Vulnerability and Flood Zone Compatibility. Amenity open space is appropriate development to be located within Flood Zone 1.

Table 3: Flood risk vulnerability and flood zone 'compatibility'

Flood risk vulnerability classification (see table 2)	Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception Test required	✓	✓
Zone 3a	Exception Test required	✓	*	Exception Test required	✓
Zone 3b functional floodplain	Exception Test required	✓	*	*	*

Key: ✓ Development is appropriate.
* Development should not be permitted.

Fig 6 Flood risk vulnerability and flood zone compatibility taken from Table 3 of PPG Flood Risk and Coastal Change

10 SURFACE WATER DRAINAGE ASSESSMENT

10.1 Surface Water Drainage Assessment

- 10.1.1 The planning application for the new Ford Airfield Market requires no significant amendments or additions to the existing access road off Ford Lane or the former airfield runways which are used for the market stalls and vehicle parking. The rate of surface water runoff will not increase.
- 10.1.2 The existing surface water drainage systems which serve these areas will not be affected by the development and will be retained.
- 10.1.3 The planning application includes an overspill car park which will be located in land which is currently a field used for arable farming. The proposed size of the car park is approximately 1.65ha and therefore the proposed drainage solution for this part of the development will be designed with no increase in surface water peak discharge rate and runoff volume for the 1 in 100-year storm event including an allowance for climate change.
- 10.1.4 In accordance with NPPF2 and Building Regulations: Part H, Sustainable Urban Drainage (SUDs) techniques should be the primary method to be considered for the disposal of surface water at source, followed by discharge to a watercourse or finally to a public sewer. This is covered in more detail below.

10.2 SuDS Management Train Approach

- 10.2.1 The SUDs Management Train approach, based on guidance within CIRIA C753 The SUDS Manual, should be adopted to manage and control peak discharge and treating flows to limit the impact on the environment. The management train incorporates a hierarchy of techniques:
-  Source control including soakaways, permeable paving, infiltration basins, water butts
 -  Site control including swales, pervious paving, pervious tanked paving, detention basins, ponds and attenuation systems
 -  Regional control using wetlands and large retention basins

10.3 Source Control

- 10.3.1 Infiltration to ground is the primary source control technique to delay, store and potentially improve water quality. These techniques include the use of traditional soakaways, infiltration basins, permeable and tanked pavements, swales and water butts.
- 10.3.2 Soakaways are the most commonly used type of infiltration device in the UK. They store rapid runoff from a development and allow its efficient infiltration into the surrounding soil. Typical soakaways include rubble filled pits, precast concrete porous chambers or geocellular tanks.
- 10.3.3 Permeable pavements not only deal with surface water runoff at source, by slowing the rate of runoff and providing temporary storage but are also widely acknowledged to improve water quality. Parking courts and shared access areas lend themselves well to the use of permeable pavements.

10.4 Infiltration to Ground

- 10.4.1 A soakaway test, in accordance to BRE 365 Soakaway Design, was carried out at the proposed location of the of the overspill car park on 21 August 2018.
- 10.4.2 The soakaway test was carried out in trial hole S5 which was 2.65m below existing ground level. A soil infiltration rate of 4.76×10^{-6} m/s was recorded. The soakaway test results are provided in Appendix F.

- 10.4.3 The trial pit log for excavation S5 advises that the ground conditions comprised of:
- 0m to 0.25m – TOPSOIL, brown slightly gravelly sandy CLAY.
 - 0.25m to 2.40m – Firm friable slightly gravelly sandy CLAY. (BRICKEARTH)
 - 2.40m to 2.80m – Stiff orangish brown gravelly fine to medium SAND. (RIVER TERRACE DEPOSITS)
 - 2.80m to 2.90m – Structureless CHALK recovered as sandy clayey GRAVEL. (WHITE CHALK SUBGROUP)
- 10.4.4 Based on the above information the soakaway test was carried out in the sand strata which underlies this part of the site.
- 10.4.5 The soil infiltration rate recorded at this location is considered to be a slow rate but allows for further investigation of using infiltration drainage to discharge water which falls on to the overspill car park into the ground.
- 10.4.6 Two boreholes are located close to the proposed location of the overspill car park.
- Borehole BH5 is located 40m north of the northern boundary of the overspill car park. The worst case (highest) monitored ground water level was recorded on 13 February 2018 and was 4.11m below existing ground level (1.5m AOD).
 - Borehole BH4 is located 360m west of the western boundary of the overspill car park. The worst case (highest) monitored ground water level was recorded on 13 February 2018 and was 3.59m below existing ground level (3.0m AOD).
- 10.4.7 Based on the above information the maximum anticipated groundwater level is sufficiently below the base of the proposed infiltration drainage component.
- 10.5 **Connection to Watercourse**
- 10.5.1 If it is not feasible to discharge water directly to the ground the next preferred option is to discharge to watercourse.
- 10.5.2 There are no watercourses or ditches within the red line development site boundary. However, there is a large channel located 80m south of the overspill car park in land which is owned by the Ford Airfield market site applicant.
- 10.5.3 The channel connects to a culvert which passes eastwards under Ford Road and continues as an open channel ordinary watercourse for approximately 0.5km until it discharges into the River Arun.
- 10.5.4 The rate of runoff from the overspill car park would be restricted to Greenfield runoff rate and attenuation provided onsite.
- 10.6 **Connection to Sewer**
- 10.6.1 The former airfield runways discharge onsite to an existing surface water sewerage system that continues offsite, in a south easterly direction, before discharging into the River Arun.
- 10.6.2 A connection to the watercourse discussed in Section 10.5 above is preferred over a connection to the onsite sewer.

11 PROPOSED SURFACE WATER DRAINAGE STRATEGY

11.1 Surface Water Drainage Strategy

- 11.1.1 The access road to the market site and the former airfield runways are not affected by the proposed development. Therefore, the existing drainage systems which serve these areas will be retained and reused as discussed in the previous sections of this report.
- 11.1.2 The planning application includes providing a new overspill car park at the entrance to the market site located in part of an existing arable field.
- 11.1.3 Soil infiltration rate testing shows that the gravelly SAND / sandy CLAY approximately 2.60m below existing ground level enables water to infiltrate into the ground with an infiltration rate of 4.76×10^{-6} m/s. The highest monitored groundwater level recorded over winter 2018/19 and winter 2019/20, close to this location, was 3.90m below existing ground level.
- 11.1.4 The overspill car park will discharge surface water runoff to a soakaway which is constructed at a similar level in the stratum underlying the site, where the soil infiltration rate test proved that the ground is suitable for soakaways at this depth.
- 11.1.5 The overspill car park drainage strategy, shown on JNP drawing no. C85228 SK145 in Appendix C and the Micro Drainage soakaway calculations in Appendix D, confirms that deep soakaways are feasible. The soakaways have been sized based on receiving surface water runoff from the car park access roads and parking areas.
- 11.1.6 The drainage strategy shows that underground cellular storage tanks are required to provide attenuation for the 1 in 100 year + 40% climate change storm event and there is sufficient area within the car park to provide soakaways which can achieve half drain down of storage volume within 24 hours in readiness for successive storm events.
- 11.1.7 The soakaway arrangement shown on drawing C85228 SK145 in Appendix C locates the soakaways under the car parking bays. The design specifies different surfacing to be used for the access roads and car parking bays to demarcate the parking areas. The car park access roads will have a permeable surface which will drain the site.
- 11.1.8 The parking bays will be constructed with a cross fall and allow surface water to runoff on to the access roads which will be constructed using a permeable surface with a tanked sub base. This provides water quality improvements before the water enters the soakaway and discharges to the ground. This is discussed in more detail in Section 12 below.

11.2 Flood Exceedance Routing

- 11.2.1 The information discussed below is shown on the Flood Exceedance Plan, drawing no. C85228 SK146, in Appendix E.
- 11.2.2 The lowest lying road gullies within the former airfield runways are located at the end of the southern runway, adjacent to the boundary with the Rudford Industrial Estate. It is likely that if the onsite underground sewerage system was to surcharge water, would first emerge from the gullies at this location.
- 11.2.3 This section of the market site is adjacent to a large area of green open space that will be retained as part of the Ford Airfield residential development where it is proposed to provide an attenuation basin. The existing ground levels adjacent to the former runway fall in the direction of the open space and the attenuation basin. Although it is proposed to provide planting along the boundary in this area, the ground levels will not be changed and this overland flow route will be retained.

- 11.2.4 The proposed soakaways at the overspill car park have been designed to contain water underground for the 1 in 100 year + 40% climate change storm event. It is envisaged any exceedance flow would first emerge from the permeable surfaced tanked road construction where ground levels are lowest. This would occur along the northern boundary of the overspill car park.
- 11.2.5 Initially the exceedance flows would pond on the surface of the car park because the proposed finished ground level of the car park access roads will be generally flat (1 in 200 gradient maximum).
- 11.2.6 Eventually the water level onsite would rise and water would flow on to the adjacent arable farm land which is owned by the market site applicants.
- 11.3 **Ground Level Raising Onsite**
- 11.3.1 No works are being carried out at the existing access road to the market site or the former runways.
- 11.3.2 The overspill carpark requires the surface of the existing field to be graded to provide crossfalls to manage and direct surface water runoff to the permeable car park access roads. The proposed ground levels onsite are no greater than 300mm above or below existing ground levels.
- 11.4 **Sustainable Drainage Systems (SuDS)**
- 11.4.1 As part of the drainage design SuDS will be provided to manage and control peak discharge and treat flows to improve water quality. This limits the impact to the water environment.
- 11.4.2 The overflow car park will include access roads constructed using tanked permeable surfacing to capture surface water runoff and provide treatment as water filtrates through the road subbase layer. The water will then discharge to cellular soakaways located deeper in the gravelly SAND / sandy CLAY underlying the site which enables water to discharge into the ground.

12 WATER QUALITY

12.1 Water Quality

12.1.1 Managing pollution close to the source can help keep pollutant levels and accumulation rates low, essentially allowing natural treatment processes to be effective. This in turn can help maximise the amenity and biodiversity value of downstream surface SuDS components and keep maintenance activities straightforward and cost-effective.

12.1.2 The proposed development requires an overspill car park. The land use is classified as having very low and low hazard pollution levels, respectively. As per Table 4.3 of the 2015 SuDS Manual (C753), the minimum water quality management requirement for discharges to surface water requires the Simplified Index Approach to be applied, which has replaced the previous requirement to provide 'treatment stages'. The Simplified Index Approach uses the following steps:

- **Step 1:** Allocate suitable pollution hazard indices for the proposed land use
- **Step 2:** Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index
- **Step 3:** Where the discharge is to protected groundwater, consider the need for a more precautionary approach.

12.1.3 **Step 1:** Table 26.2 of the 2015 SuDS Manual (C753) sets out the required pollution hazard indices for various land uses. The pollution hazard indices for the total suspended solids (hereon referred to as TSS), metals and hydro-carbons is 0.5, 0.4 and 0.4, respectively, for property driveways / non residential car parks with infrequent change / low traffic roads. This table is provided below in Figure 7.

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, horrazones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) is < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways	High	0.9	0.8	0.9

Fig 7 – Summary of Surface Water Drainage Systems for the Proposed Development

12.1.4 **Step 2:** The detailed drainage design utilises the following SuDS features to address water quality:

-  Permeable pavements to capture surface water runoff at source for access roads and all car parking areas.

12.1.5 The indicative SuDS mitigation indices for discharges to groundwater are provided in Table 26.4 of the 2015 SuDS Manual (C753) for the proposed SuDS components. This table is provided below.

TABLE 26.4 Indicative SuDS mitigation indices for discharges to groundwater			
Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates	TSS	Metals	Hydrocarbons
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential ^a of at least 300 mm in depth ^b	0.6 ^c	0.5	0.6
A soil with good contaminant attenuation potential ^a of at least 300 mm in depth ^b	0.4 ^c	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment, ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20 mm gravel) underlain by a soil with good contaminant attenuation potential ^a of at least 300 mm in depth ^b	0.4 ^c	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential ^a of at least 300 mm in depth ^b	0.7	0.6	0.7
Concrete underlain by a soil with good contaminant attenuation potential ^a of at least 300 mm in depth ^b	0.8 ^c	0.8	0.8
Proprietary treatment systems ^{a,c}	These must demonstrate that they can address each of the contaminant types to acceptable levels for inflow concentrations relevant to the contributing drainage area.		

Fig 8 . Indicative SuDS Mitigation Indices for Discharges to Groundwater 2015 SuDS Manual (C753)

12.1.6 To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type), as follows:

Total SuDS mitigation index $\geq$ pollution hazard index

(for each contaminant type) (for each contaminant type)

12.1.7 For each type of land-use, the pollution hazard indices, mitigation indices and concluding hazard have been outlined in Figure 9 below.

Property driveways/ non-residential car parks/low traffic roads				SuDS Manual Reference
	TSS	Metals	Hydrocarbons	
Pollution Hazard Index	0.5	0.4	0.4	Table 26.2
Mitigation Index	0.7	0.6	0.7	Table 26.4
Permeable Pavement				
Result	Total SuDS mitigation index $\geq$ pollution hazard index and therefore hazard is exceeded			

Fig.9 Permeable Paved Roads / Car park Water Quality Mitigation Summary

- 12.1.8 Therefore, the provision of permeable paving/ permeable surfacing for the car park exceeds the required pollution mitigation indices and provides sufficient treatment as part of the surface water management train, in accordance with the 2015 SuDS Manual (C753).
- 12.1.9 The proposed design provides at least 1.0m clearance between the base of the SuDS component and the maximum likely groundwater level as recommended in the CIRIA SuDS Manual C753.
- 12.1.10 **Step 3:** The development site is located outside a Source Protection Zone. The water quality approach exceeds requirements. Given this, there is no need for a more pre-cautionary approach.

13 MAINTENANCE AND ADOPTION

- 13.1 The drainage infrastructure which will serve the Ford Airfield market site will comprise of:
-  Surface water manholes and sewers.
 -  Permeable surfaced roads with a tanked sub base in the car park.
 -  Cellular soakaways in the car park
- 13.2 The drainage infrastructure will be private and will be maintained by the owners of the market site.

14 CONCLUSIONS

- 14.1 The proposed development area is 7.12 ha. The existing impermeable area onsite is approximately 5 ha and comprises of the existing access road and former airfield runways. The remaining 2.12 ha is permeable land which includes the road verge and part of an agricultural field.
- 14.2 The proposed market site comprises of 3 areas:
-  The existing private site access road off Ford Road. No changes to the road are proposed.
 -  The existing former runway. No changes to the runway are proposed.
 -  A new overspill car park.
- 14.3 The site has been assessed as follows for flood risk:
-  Fluvial – Low Risk
 -  Tidal – Low Risk
 -  Surface Water (overland flows) – Low Risk
 -  Groundwater – Low Risk
 -  Sewer / Drainage – Low Risk
 -  Reservoir – No Risk
- 14.4 The access road to the market site and the former airfield runways are not affected by the proposed development. Therefore, the existing drainage systems which serve these areas will be retained and reused.
- 14.5 The planning application includes providing a new overspill car park at the entrance to the market site located in part of an existing arable field.
- 14.6 Soil infiltration rate testing at the site of the overspill car park shows that it is underlain by gravelly SAND / sandy CLAY at approximately 2.60m below existing ground level. During the test water infiltrated into the ground with an infiltration rate of 4.76×10^{-6} m/s. The highest monitored groundwater level recorded over winter and spring 2018/19 and winter 2019/20, close to this location, was 3.90m below existing ground level.
- 14.7 The overspill car park will discharge surface water runoff to soakaways which are constructed at a similar level in the stratum underlying the site, where the soil infiltration rate test proved that the ground is suitable for soakaways at this depth.
- 14.8 The soakaways will be constructed using cellular storage tanks and provide attenuation for the 1 in 100 year + 40% climate change storm event. Calculations show the soakaways can achieve half drain down of storage volume within 24 hours in readiness for successive storm events.
- 14.9 The proposed car park design specifies that the car parking bays will fall towards the car park access roads and surface water runoff will flow onto the road surface. The car park roads will have a permeable surface with a tanked sub base. This provides treatment as water filtrates through the road subbase layer. The water will then discharge to cellular soakaways located deeper in the gravelly sand / sandy clay underlying the site which enables water to discharge into the ground.
- 14.10 In the event that the flooding occurs from the underground drainage systems the proposed design

ensures the exceedance flows are routed to neighbouring green open spaces or arable farm land.

- 14.11 The drainage infrastructure on the market site will be private and will be maintained by the owners of the site.

15 LIMITATIONS

Discussions and information presented within this report is deemed to be current at the time of undertaking the report. No guarantee can be given to the status of this information other than the time at which this report was written. Where necessary, the user shall confirm the status of any applicable consents and assessments.

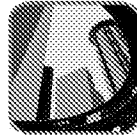
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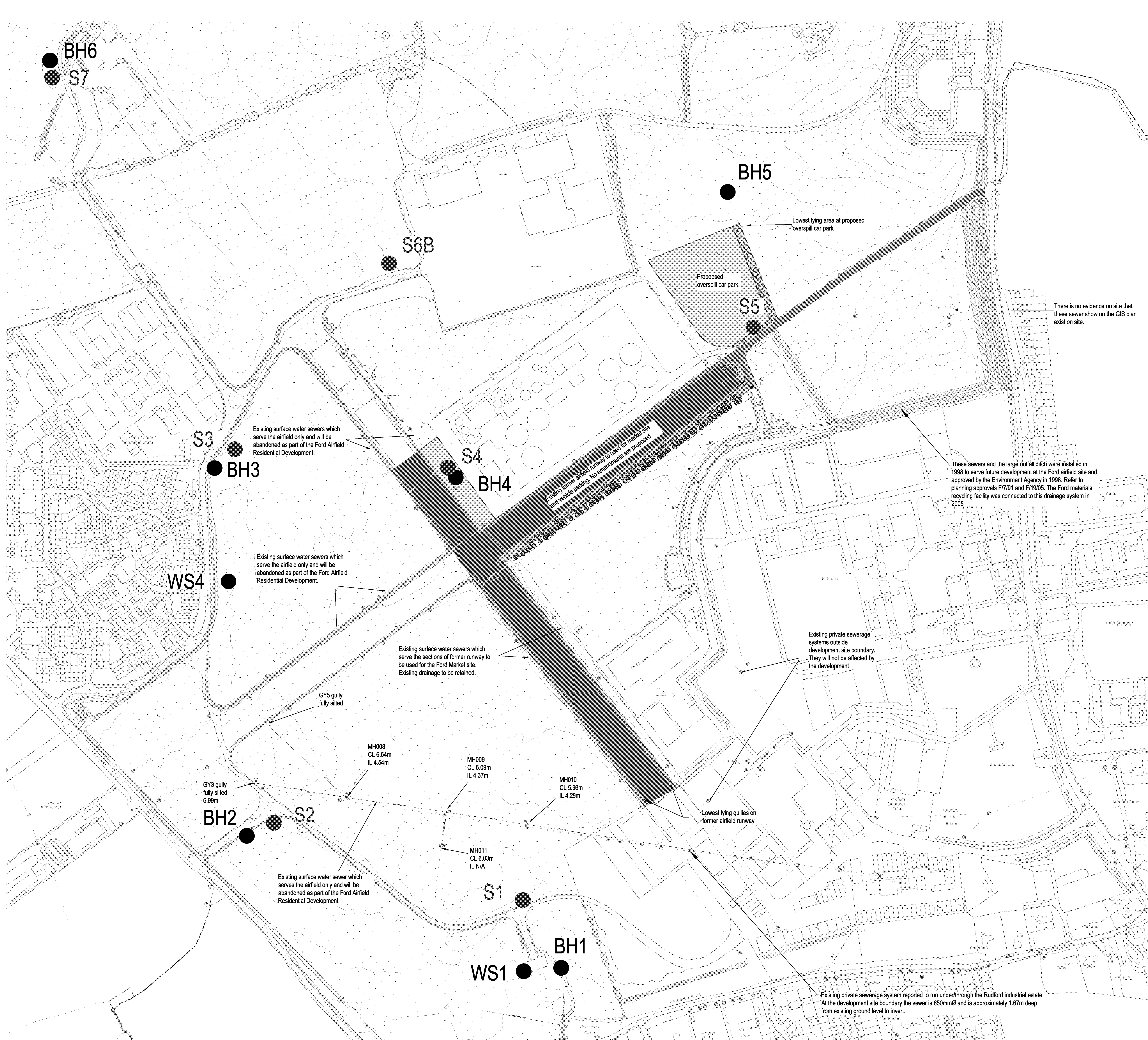
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Appendix A

Existing Drainage Plan and Topographical Survey





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- Legend
- Site Boundary
 - Groundwater monitoring well. The worst case winter ground water levels were recorded on 13 February 2019
 - Soil infiltration rate test location. Testing carried out 2.1m and 2.8m below existing ground level
- Legend - GIS data provided by Arun District Council (ADC) on 8 March 2019
- Surface water sewer
 - Ordinary watercourse
 - Watercourse
 - Ordinary watercourse culverted

A	24.10.19	Market land use plan updated	IS	AM	
Rev.	Date	Amendment	By	Chk.	
Status					
Indicative					

Wates REDROW HOMES

REDROW HOMES Wates

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Client	Wates Redrow
Job	Ford Airfield Market
Title	Existing Drainage Plan
Scale	1:2500 @ A1 Date April 2019
Drawn by	AM
Checked by	
Approved by	

BMTRADA UKAS Constructionline

Accredited Contractor

Supplier No. 000024

Drawing No.	C85228-SK144	Rev.	A
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Appendix B

Greenfield Runoff Rate Assessment



Calculated by: Anthony McNevin

Site name: Ford Airfield (FEH)

Site location: Ford Arundel, BN18 0FL

Site coordinates

Latitude: 50.81915° N

Longitude: 0.59118° W

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", WS-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Reference: 6514889

Date: 2019-01-11T12:04:44

Methodology	FEH Statistical
-------------	-----------------

Site characteristics

Total site area (ha)	1
----------------------	---

Methodology

Qmed estimation method	Specify QMed manually
BFI and SPR estimation method	Calculate from dominant HOST
HOST class	N/A
BFI / BFIHOST	0
Qmed (l/s)	1.0
Qbar / Qmed Conversion Factor	1.14

Hydrological characteristics

	Default	Edited
SAAR (mm)	736	736
Hydrological region	7	7
Growth curve factor: 1 year	0.85	0.85
Growth curve factor: 30 year	2.3	2.3
Growth curve factor: 100 year	3.19	3.19

Notes:

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

Normally limiting discharge rates which are less than 2.0 l/s/ha are set at 2.0 l/s/ha.

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

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

(3) Is $SPR/SPRHOST \leq 0.3$?

Greenfield runoff rates

	Default	Edited
Qbar (l/s)	NaN	1.14
1 in 1 year (l/s)	NaN	0.97
1 in 30 years (l/s)	NaN	2.61
1 in 100 years (l/s)	NaN	3.62

Appendix C

Ford Airfield Market Overspill Car Park

Drainage Strategy





Soakaway 1
Catchment Area = 4611m²
6.5m x 115m x 0.6m deep
Base of Soakaway = 4.0m AOD

Soakaway 2
Catchment Area = 4575 m²
6.5m x 115m x 0.6m deep
Base of Soakaway = 4.0m AOD

Soakaway 3
Catchment Area = 4717 m²
6.5m x 115m x 0.6m deep
Base of Soakaway = 4.0m AOD

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Legend

Site Boundary

 Car park perimeter track. Compacted Type 1 granular material.

 Car park access route to parking areas. Permeable surface with tanked sub base construction. Surface will either be porous asphalt, permeable concrete block, grasscrete or Golpa / Cellweb Gravel Reinforcement. To be confirmed.

 Soft landscaped/aggregate car parking areas. Laid with a cross fall so that surface water runoff flows into the tanked permeable surfaced access route with a tanked sub base.



Soakaway cellular storage system constructed in the gravelly SAND (Trial Hole S5 2.65m begl) / sandy CLAY (Borehole B5 1.5 to 2.6m begl).



Drainage network, manholes and sewers which capture surface water runoff that have passed through the tanked permeable paving system and to discharge it into the cellular soakaway.

A	24.10.19	Market land use plan updated	IS	AM
Rev.	Date	Amendment	By	Ch

Status	Indicative
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Client	Wates Redrow
--------	-----------------

Job	Ford Airfield Market
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Title	Overspill Car Park Drainage Strategy
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Scale 1:500	@ A1	Date April 2019
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Drawn by AM	Checked by	Approved by
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Drawing No.	Rev.
C85228-SK145	A