

## **Flood Risk Assessment and Surface Water Drainage Statement**

Proposed Production Building Extension at

**Sefter Farm South  
Pagham Rd, Bognor Regis, West Sussex**

On behalf of

**Barfoots of Botley**

November 2025

## Document History and Status

Project Number 23995

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|               |         |                           |                             |                             |

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## **1 Non Technical Summary**

- 1.1 This Flood Risk Assessment and Drainage Statement has been undertaken on behalf of Barfoots of Botley in support of a Planning Application for the construction of a 2,195m<sup>2</sup> extension to the south side of the existing Sefter Farm South production building and hard standing together with a watercourse diversion and resulting reduction in plan area of the irrigation reservoir immediately south of the development proposals at Sefter Farm, Pagham Road, Bognor Regis West Sussex.
- 1.2 The existing packhouse was granted planning permission on 9 June 2017 under reference P/76/16/PL.
- 1.3 This Assessment is to be read in conjunction with all planning, architectural and other reports that accompany the Planning Application for the proposed development.
- 1.4 The site is currently located in Flood Zone 1 and is predicted to be within tidal Flood Zones 1 and 2 in the future year 2115.
- 1.5 A suitable surface water and foul water drainage system has been designed to accommodate the anticipated flows from the proposed development.
- 1.6 The proposed sustainable drainage system will recycle surface water collected from the extension roof for irrigation and discharge surface water collected from the hardstanding at a suitably restricted rate to the relocated onsite watercourse which discharges to the Pagham Rife to the west of the site.
- 1.7 Sufficient storage will be provided for all storm return periods up to and including the 1:100 year rainfall event with an allowance for climate change.
- 1.8 This report concludes that in terms of flood risk planning the proposed development is safe, will not increase flood risk elsewhere and is suitable at this location.

## 2 Planning Policy Context

### 2.1 National Planning Policy Framework

2.1.1 The current version of the National Planning Policy Framework is dated December 2024 and was amended on 7 February 2025 to correct cross references from footnotes 7 and 8 and amend the end of the first sentence of paragraph 155 in relation to development in the Green Belt to make its intent clear.

2.1.2 With regard to planning and flood risk the National Planning Policy Framework states that *‘when determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment<sup>63</sup>. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:*

- a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;*
- b) the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;*
- c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;*
- d) any residual risk can be safely managed; and*
- e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.’*

2.1.3 Footnote 63 states that *‘a site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.*

2.1.4 With regard to major developments the NPPF states that *‘sustainable drainage systems provided as part of proposals for major development should:*

- a) take account of advice from the Lead Local Flood Authority;*

- b) *have appropriate proposed minimum operational standards; and*
- c) *have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development.'*

2.1.5 Major development is defined as follows:

*'For housing, development where 10 or more homes will be provided, or the site has an area of 0.5 hectares or more. For non-residential development it means additional floorspace of 1,000m<sup>2</sup> or more, or a site of 1 hectare or more, or as otherwise provided in the Town and Country Planning (Development Management Procedure) (England) Order 2015.'*

## 2.2 National Standards for Sustainable Drainage Systems (SuDS)

2.2.1 The National Standards for Sustainable Drainage Systems were published on 19 June 2025.

2.2.2 The standards are intended to be used in conjunction with the National Planning Policy Framework and remain non statutory guidance.

2.2.3 **Standard 1: runoff destinations** states:

*'1.1 a 'SuDS approach' shall be adopted to address the management of surface water by the development and where it should be discharged. Runoff shall be treated as a resource and managed in a way that avoids negative impacts of the development on flood risk, the morphology and water quality of receiving waters and the associated ecology.*

*1.2 Runoff from the development shall be discharged to the following final destinations, to the maximum extent practicable, in accordance with the below hierarchy:*

*priority 1: collected for non-potable use*

*priority 2: infiltrated to ground*

*priority 3: discharged to an above ground surface water body*

*priority 4: discharged to a surface water sewer, or another piped surface water drainage system*

*priority 5: discharged to a combined sewer*

*Note 1: priority 1 is the highest priority and priority 5 is the lowest.*

*Note 2: for the purposes of this standard, a combined sewer is a sewer intended to receive both foul sewage and surface runoff and does not include a sewer intended to receive only foul sewage, even if*

*it has the capacity to accommodate additional flows or has an element of surface water in it already.*

*1.3 To utilise a lesser priority final destination, appropriate evidence shall be provided that demonstrates all higher priority final destinations have been utilised to the maximum extent practicable. Higher cost alone shall not be a reason to utilise lower priority final destinations.*

*1.4 Where more than one final destination is utilised, each final destination's ability to accept runoff shall be maximised in order of priority.'*

**2.2.4 Standard 2: management of everyday rainfall (interception) states:**

*'2.1 Apply a 'SuDS approach' so that at least the first 5mm of rainfall for the majority of rainfall events does not result in runoff from the site to surface waters or piped drainage systems.*

*2.2 Evidence shall be provided that the approach to managing runoff from 'everyday' rainfall has been developed alongside and in support of the management of runoff quality (standard 4) and the delivery of amenity and biodiversity benefits (standards 5 and 6).'*

**2.2.5 Standard 3: management of extreme rainfall and flooding states:**

*'3.1 A 'SuDS approach' shall be adopted to address the management of development runoff during extreme rainfall, including allowances for climate change and urban creep to:*

- protect people and property on the development from flooding of the surface water drainage system*
- mitigate any increased flood risk to people and property adjacent to or downstream of the development*
- protect the receiving water body from morphological damage or minimise the impact on sewer capacity*

*3.2 When discharging to an infiltration feature, the system shall be appropriately sized to accommodate the design event based on ground conditions and contributing areas.*

*3.3 When discharging to an above ground surface water body, sewer or other piped drainage system, the surface water runoff (rate and volume) for the 1% annual exceedance probability (AEP) event shall be controlled to ensure the runoff from the development does not increase flood risk elsewhere.*

- 3.4 *When discharging to an above ground surface water body, sewer or other piped drainage system, the surface water runoff rate for the 50% AEP event shall be controlled to ensure development runoff from an event of this magnitude has no negative impact.*
- 3.5 *Any flooding from the surface water drainage system for events up to the 1% AEP event shall be managed within the development.*
- 3.6 *Any flooding from off-site sources for the 1% AEP event should be managed on site or safely routed through the site, ensuring any downstream risks are not increased compared to the pre-development scenario.*
- 3.7 *The risks (both on and off the development) associated with flooding from the surface water drainage system for exceedance events greater than the 1% AEP event shall be appropriately managed.*

**2.2.6 Standard 4: water quality** states:

- ‘4.1 *Apply a ‘SuDS approach’ that protects surface waters, groundwater and coastal waters by managing the quality of the surface water runoff to adequately address water quality risks from the development.*
- 4.2 *The proposed SuDS management train(s) shall be based on a robust water quality risk assessment, appropriate to the pollution hazard and sensitivity of receiving waters, reflecting industry recognised guidance or other quantitative assessment as agreed with the approving body and permitting requirements.’*

**2.2.7 Standard 5: amenity** states:

- ‘5.1 *A ‘SuDS approach’ shall be adopted that maximises benefits for amenity through the creation of multi-functional places and landscapes.’*

**2.2.8 Standard 6: biodiversity** states:

- ‘6.1 *A ‘SuDS approach’ shall be adopted to ensure the surface water drainage system maximises biodiversity benefits throughout the development lifecycle.*
- 6.2 *The surface water drainage system shall add biodiversity value by:*
- *creating diverse, self-sustaining, resilient local ecosystems which contribute to net gains in biodiversity*
  - *supporting and promoting natural local habitat and species, for example, through local nature recovery strategies (LNRS)*

- *contributing to the delivery of local biodiversity strategies*
- *contributing to habitat connectivity*

**2.2.9 Standard 7: design of drainage for construction, operation, maintenance, decommissioning and structural integrity states:**

*‘7.1 A ‘SuDS approach’ shall be adopted to ensure that surface water drainage systems are designed so they can be easily and safely constructed, operated and maintained taking account of the need to minimise negative impacts on natural resources and the environment.*

*7.2 The designer shall provide a management and maintenance plan [that supports the design objectives detailed in standards 1 to 6 and ensures the performance of the surface water drainage system with regards to runoff destinations, everyday and extreme rainfall, water quality, amenity and biodiversity is maintained throughout the lifetime of the development.*

*7.3 Surface water drainage design shall examine for the likelihood and consequences of potential failure scenarios that may occur during the operation phase and safely manage the associated risks.*

*7.4 The surface water drainage system shall be designed to ensure structural integrity of all components under anticipated loading conditions for the design life of the development so that it does not affect the structural integrity of any existing or proposed components within, or adjacent to, the development.’*

**2.3 Lead Local Flood Authority**

2.3.1 West Sussex County Council became a Lead Local Flood Authority under the Flood and Water Management Act 2010 and was given a series of new responsibilities including the role of statutory consultee for surface water management for Major Planning Applications.

2.3.2 As part of their role West Sussex County Council have produced the following documents:

- Preliminary Flood Risk Assessment dated May 2011
- Policy for the Management of Surface Water dated November 2018
- Local Flood Risk Management Strategy 2025-2030 dated July 2025

2.3.3 Those documents have been reviewed in the preparation of this report.

**2.4 Arun District Council**

2.4.1 Arun District council have produced the following document in regard to flood risk:

- Level 1 Strategic Flood Risk Assessment dated August 2016

2.4.2 Arun District Council have produced a Surface Water Drainage Design Checklist, the current version of Full Surface Water Drainage Design Checklist version 7.0 dated 1 October 2025 has been reviewed in the preparation of this report.

## 2.5 Local Planning Policy

2.5.1 The Arun Local Plan 2011-2031 was adopted by Arun District Council on 18 July 2018.

2.5.2 The following policies are of specific relevance to this Flood Risk Assessment:

2.5.3 **Policy W DM2 Flood Risk** states that *'development in areas at risk from flooding, identified on the latest Environment Agency flood risk maps and the Council's Strategic Flood Risk Assessment (SFRA), will only be permitted where all of the following criteria have been satisfied:*

- a. The sequential test in accordance with the National Planning Policy Guidance has been met.*
- b. A site specific Flood Risk Assessment demonstrates that the development will be safe, including access and egress, without increasing flood risk elsewhere and reduce flood risk overall.*
- c. The sustainability benefits to the wider community are clearly identified.*
- d. The scheme identifies adaptation and mitigation measures.*
- e. Appropriate flood warning and evacuation plans are in place; and*
- f. New site drainage systems are designed to take account of events which exceed the normal design standard i.e. consideration of flood flow routing and utilising temporary storage areas.*

*The reports prepared as part of the criteria above must take into account contingency allowances, taking climate change into account as set out in Flood Risk Assessments: climate change allowances section of the NPPG.*

*In locations where strategic flood defence or resilient and resistant construction measures are necessary within the site itself, proposals will be required to demonstrate how measures have been incorporated as an intrinsic part of the scheme in a manner which is compatible with the latest Strategic Flood Risk Assessment.*

*All development proposals must take account of relevant Surface Water Management Plans, Catchment Flood Management Plans and related Flood*

*Defence Plans and strategies such as the Lower Tidal River Arun Strategy. The council may require financial contributions from development on sites where measures to address flood risk or to improve the environmental quality of watercourses have been identified by these Plans and Strategies.'*

- 2.5.4 Policy W DM3 Sustainable Urban Drainage Systems** states that *'to increase the levels of water capture and storage and improve water quality, all development must identify opportunities to incorporate a range of Sustainable Urban Drainage Systems (SUDS), appropriate to the size of development, at an early stage of the design process.*

*Proposals for both major and minor development proposals must incorporate SUDS within the private areas of the development in order to provide source control features to the overall SUDS design. These features include:*

- Green roofs*
- Permeable driveways and parking*
- Soakaways*
- Water harvesting and storage features including water butts.*

- 2.5.5** *Proposals for major development must also integrate SUDS within public open spaces and roads, reflecting discussion with the appropriate bodies. SUDS must therefore be integrated into the overall design of a development and must:*

- a. Contribute positively to the appearance of the area, integrating access to allow maintenance of existing watercourses and the system.*
- b. Effectively manage water (including its quality)*
- c. Accommodate and enhance biodiversity by making connections to existing Green Infrastructure assets and*
- d. Provide amenity for local residents (ensuring a safe environment)*
- e. Retain the existing drainage network of the site and the wider area,*
- f. Be maintained in perpetuity, supported through a Maintenance and Management Plan/Regime, including its financing, agreed with the Local Planning Authority.*

*In order to ensure that SUDS discharge water from the development at the same or lesser rate, as prior to construction, developers must:*

- f. Follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations and the SUDS manual produced by CIRIA.*

- g. Undertake up to six months groundwater monitoring within the winter period.*
- h. Undertake winter percolation testing in accordance with BRE365.*
- i. The proposed drainage system must be designed to ensure that there is no flooding on a 1 in 30 year storm event.*
- j. The design must also take account of the 1 in 100 year storm event plus 30% allowance for climate change, on stored volumes, to ensure that there is no flooding of properties or the public highway or inundation of the foul sewerage system. Any excess flows must be contained within the site boundary, and within designated storage areas.'*

### 3 Existing Site

#### 3.1 Site Location

- 3.1.1 The development site is located at the south of the Sefter Farm South Packhouse on Sefter Farm, Pagham Road, Bognor Regis, West Sussex, PO21 3PX.



**Image 1: Site Location**

- 3.1.2 The closest watercourse is the Pagham Rife which is located approximately 200m from the western site boundary. The Pagham Rife is classified as Main River.
- 3.1.3 A copy of the site location plan is located in Appendix 1 at the rear of this report.

#### 3.2 Site Description

- 3.2.1 The site is approximately 2.74ha in area and currently comprises the access road from Pagham Road to the northeast of the site, part of the existing hardstanding to the south and west of the existing pack house, the existing irrigation reservoir to the south of the pack house with the remainder of the site being unpaved soft landscaping.
- 3.2.2 Existing ground levels across the part of the site comprising the area where the new hardstanding and the packhouse extension will be located are between the existing packhouse and reservoir are highest at the southeastern at approximately 5.45m AOD and lowest at the southwest at approximately 3.4m AOD.

3.2.3 A copy of the existing site layout plan is located in Appendix 2 at the rear of this report.

### 3.3 Existing Drainage

3.3.1 Surface water collected from the roof of the existing pack house and the area to the west of the packhouse is collected via an existing syphonic drainage network and discharged to the existing irrigation reservoir to the west of the existing packhouse.

3.3.2 There is a drainage ditch to the south of the existing packhouse which conveys greenfield runoff from land to the east of the site and in part from the existing hard standing to the south of the packhouse to a piped surface water network to the west of the packhouse.

3.3.3 That drainage system discharges surface water by gravity via a surface water drain located beneath the workers' accommodation to the west of the Sefter South site to the Pagham Rife.

3.3.4 Pre-developed greenfield runoff rates have been established using the HR Wallingford tool for Greenfield Runoff Estimation based on the FEH Statistical Method for rainfall estimation.

3.3.5 The Hydrology of Soil Type (HOST) has been confirmed by the National Soil Resources Institute at Cranfield University as soil type 9 which is classified as *'Soils seasonally waterlogged by fluctuating groundwater and with relatively slow lateral saturated conductivity'*.

|                |               |
|----------------|---------------|
| Calculated by: | Steve Doughty |
| Site name:     | Sefter Farm   |
| Site location: | Pagham        |

## Site Details

|            |                   |
|------------|-------------------|
| Latitude:  | 50.78889° N       |
| Longitude: | 0.73656° W        |
| Reference: | 823552576         |
| Date:      | Mar 11 2025 15:50 |

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Cina, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

## Runoff estimation approach

FEH Statistical

## Site characteristics

Total site area (ha): 1

## Methodology

$Q_{MED}$  estimation method:

Calculate from BFI and SAAR

BFI and SPR method:

Calculate from dominant HOST

HOST class:

9

BFI / BFIHOST:

0.682

$Q_{MED}$  (l/s):

1.51

$Q_{BAR}$  /  $Q_{MED}$  factor:

1.14

## Hydrological characteristics

|                                | Default | Edited |
|--------------------------------|---------|--------|
| SAAR (mm):                     | 700     | 700    |
| Hydrological region:           | 7       | 7      |
| Growth curve factor 1 year:    | 0.85    | 0.85   |
| Growth curve factor 30 years:  | 2.3     | 2.3    |
| Growth curve factor 100 years: | 3.19    | 3.19   |
| Growth curve factor 200 years: | 3.74    | 3.74   |

## Notes

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

When  $Q_{BAR}$  is  $< 2.0$  l/s/ha then limiting discharge rates 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 consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

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

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

## Greenfield runoff rates

|                       | Default | Edited |
|-----------------------|---------|--------|
| $Q_{BAR}$ (l/s):      | 1.72    | 1.72   |
| 1 in 1 year (l/s):    | 1.46    | 1.46   |
| 1 in 30 years (l/s):  | 3.95    | 3.95   |
| 1 in 100 years (l/s): | 5.48    | 5.48   |
| 1 in 200 years (l/s): | 6.43    | 6.43   |

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at [www.uksuds.com](http://www.uksuds.com). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at [www.uksuds.com/terms-and-conditions.htm](http://www.uksuds.com/terms-and-conditions.htm). The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

**Image 2: Greenfield Runoff Calculation**

3.3.6 The pre-developed greenfield runoff rates are as follows:

- $Q_{bar}$  1.72 l/s/ha
- 1:30 year 3.95 l/s/ha
- 1:100 year 5.48 l/s/ha

### 3.4 Geology and Groundwater

3.4.1 A site investigation was undertaken on the site by Constructive Evaluation in June 2016.

3.4.2 The surficial cover to the development area was predominantly found to be formed by Made Ground to a maximum depth of 0.80m below ground level overlying clay substrata.

3.4.3 Groundwater observations confirmed groundwater is perched within the superficial soils at a depth of 0.70-0.80m below ground level.

3.4.4 Extracts from the site investigation are located in Appendix 3 at the rear of this report.

## **4 Flood Zone and Flood History**

### **4.1 Tidal Flood Zone**

4.1.1 The Environment Agency's flood mapping confirms that the site is currently located within tidal Flood Zone 1.

4.1.2 In the future year 2115 the site will remain almost exclusively within tidal Flood Zone 1 and at its extreme western edge within in defended tidal Flood Zone 2.

### **4.2 Fluvial Flood Zone**

4.2.1 The site is located in fluvial Flood Zone 1.

### **4.3 Flood History**

#### **4.3.1 Environment Agency**

4.3.1.1 The Environment Agency's online map of historic flood incidents does not identify any historic incidents of flooding affecting the site or in its immediate vicinity.

#### **4.3.2 West Sussex County Council**

4.3.2.1 The Preliminary Flood Risk Assessment dated May 2011 does not identify any specific flood incidents affecting the site / in the immediate vicinity of the site.

#### **4.3.3 Arun District Council**

4.3.3.1 The Level 1 Strategic Flood Risk Assessment dated August 2016 identified a historic incidence of surface water flooding to the field to the east of the site. The extent is likely to be as shown on the surface water flood map which forms Appendix E of that assessment.

4.3.4 Copies of the available flood maps and correspondence are located in Appendix 4 at the rear of this report.

## **5 Flooding Potential**

### **5.1 Tidal Flooding**

- 5.1.1 The site is currently located in tidal Flood Zone 1 and is predicted to be within tidal Flood Zones 1 and 2 in the future year 2115.
- 5.1.2 The Product 4 information received from the Environment Agency confirms the defended 2115 flood level at 3.56m AOD and the undefended 2115 level at 4.57m AOD.
- 5.1.3 The lowest level on the proposed external yard will be 3.50m which could result in surface ponding of the southeast corner of the yard to a depth of up to 970mm during a 1:200 year undefended tidal flood in the future year 2115.
- 5.1.4 In the defended scenario surface ponding of the extreme southeast corner of the yard would be at a depth of 60mm during a 1:200 year defended tidal flood event in the future year 2115.
- 5.1.5 Neither event would affect the proposed building nor its access on its eastern elevation with all flood waters remaining external and on the western side of the site.

### **5.2 Fluvial Flooding**

- 5.2.1 The site is located in fluvial Flood Zone 1 and is not at risk of flooding from anything less than a 1:1,000 year fluvial flood event.

### **5.3 Surface Water Flooding**

- 5.3.1 The Environment Agency's maps confirm that the external works around the existing building are at a low to medium risk of surface water flooding of up to 200mm between the future years 2040 and 2060.
- 5.3.2 The building itself will remain unaffected.
- 5.3.3 The flood mapping contained within the various flood documents produced by West Sussex County Council and Arun District Council does not identify any flood risk associated with surface water or overland flow routes.

### **5.4 Groundwater Flooding**

- 5.4.1 As previously noted site investigation has confirmed that groundwater is perched within the superficial soils at a depth of 0.70-0.80m below ground level.
- 5.4.2 The flood mapping contained within Arun District Council's Level 1 Strategic Flood Risk Assessment dated August 2016 includes a map showing areas susceptible to groundwater emergence.

5.4.3 The mapping is divided into 1x1km squares and identifies the proportion of each square where geological and hydrogeological conditions show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring.

5.4.4 The site is located within a 1x1km square of which more than 75% is considered potentially susceptible to groundwater emergence.

5.4.5 There are no records identified within West Sussex County Council's Preliminary Flood Risk Assessment nor in Arun District Council's Strategic Flood Risk Assessment of groundwater flooding affecting the site.

## 5.5 Reservoir Flooding

5.5.1 The Environment Agency's online maps do not identify the site as being at risk of flooding from reservoirs.

## 6 Development Proposals

### 6.1 Description

6.1.1 The development proposals are for the construction of a 2,195m<sup>2</sup> extension to the south side of the existing Sefter Farm South production building and hard standing together with a watercourse diversion and resulting reduction in plan area of the irrigation reservoir immediately south of the development proposals.

6.1.2 The areas of the positively drained elements of the development are summarised as follows:

- Extension Roof Area 2,195m<sup>2</sup>
- External Hard Standing (Including Dock Leveller) 3,490m<sup>2</sup>

6.1.3 The finished floor level of the proposed extension will be at 5.05m AOD and tie into the existing building.

6.1.4 A copy of the proposed site layout plan showing the positively drained areas is located in Appendix 5 at the rear of this report.

### 6.2 Surface Water Drainage Generally

6.2.1 CIRIA report C753 The SuDS Manual-v6 provides guidance on surface water drainage. The aim for surface water runoff is to match greenfield runoff rates and volumes where reasonably achievable.

6.2.2 The National Standards for Sustainable Drainage Systems set out the drainage hierarchy for surface water drainage and notes the following list of drainage options in order of preference:

- Priority 1: collected for non-potable use
- Priority 2: infiltrated to ground
- Priority 3: discharged to an above ground surface water body
- Priority 4: discharged to a surface water sewer, or another piped surface water drainage system
- Priority 5: discharged to a combined sewer

6.2.3 The preferred surface water drainage strategy should where possible be based on infiltration to ground, however, as previously noted during site investigation work the site was predominantly found to be formed by Made Ground to a maximum depth of 0.80m below ground level over clay substrata.

6.2.4 Groundwater observations confirmed that groundwater is perched within the superficial soils at a depth of 0.70-0.80m below ground level and as such infiltration is not a practical method of discharging surface water runoff from this site.

6.2.5 The possibility of providing an infiltration based drainage system was also previously investigated and ruled out during the planning application process for the existing packhouse as detailed in the Flood Risk Assessment for that building which was undertaken in July 2016 by The Civil Engineering Practice Limited. The planning permission reference for that development is P/76/16/PL.

### 6.3 Surface Water Drainage for Extension Roof

6.3.1 Surface water collected from the new roof will be collected in the same manner as the existing roof and discharged via a syphonic drainage system to the existing reservoir to the west of the packhouse for reuse within the wider site's irrigation system.

6.3.2 That reservoir has a surface area at top of bank of approximately 10,855m<sup>2</sup>.

6.3.3 The reservoir has an overflow outfall pipe to the Pagham ride which is set 500mm below the top of bank.

6.3.4 The normal operational water level is maintained 500mm below the overflow.

6.3.5 The upper surface water area is approximately 9,320m<sup>2</sup>.

6.3.6 The total positively drained area of the new extension will be 2,195m<sup>2</sup>.

6.3.7 Runoff collected from the area of the new extension for the 1 in 100 year climate change rainfall event will be stored in the existing irrigation reservoir and reused for irrigation with no discharge from the site during any event.

6.3.8 Calculations have been undertaken to determine the total volume of water collected from the site during a 1:100year +45% rainfall event.

6.3.9 This volume will be approximately 428m<sup>3</sup> and equates to a rise of 46mm across the existing reservoir resulting in a new freeboard of 454mm which is well within the required 300mm minimum.

### 6.4 Surface Water Drainage for New Hardstanding

6.4.1 Surface water collected from the new hardstanding will be discharged at a suitably restricted rate to the relocated watercourse to the south of the proposed extension.

6.4.2 The total positively drained area of the hardstanding and dock leveller will be approximately 3,490m<sup>2</sup> and the equivalent greenfield runoffs are as follows:

- Q<sub>bar</sub> (approximate 1:2 year at 1.72 l/s/ha 0.6 l/s
- 1:30 year at 3.95 l/s/ha 1.38 l/s
- 1:100 year at 5.48 l/s/ha 1.91 l/s

6.4.3 The National Standards for Sustainable Drainage Systems notes that *'the peak allowable discharge rate from the development to surface waters or sewers for the 50% AEP event shall be limited to the equivalent 50% AEP greenfield runoff rate, or 3 l/s/ha, whichever is the greater.'*

*Where the volume of runoff discharged from the development to surface waters or sewers for the 1% AEP, 6-hour rainfall event is greater than the volume of greenfield runoff for the same rainfall event, the peak allowable discharge rate from the development for the 1% AEP event shall be limited to the 50% AEP greenfield runoff rate or 3l/s/ha, whichever is the greater.'*

6.4.4 For previously developed sites a 'relaxation factor' shall be applied to the target 50% and 1% AEP greenfield runoff rates where evidence is provided that demonstrates why greenfield runoff or 3l/s/ha rates cannot be achieved and this is agreed with the approving body. This relaxation factor shall be no greater than 5 times the greenfield runoff rate.'

6.4.5 The noted 3l/s/ha for the 3,490m<sup>2</sup> area equates to a restriction of 1.05l/s

6.4.6 Calculations have therefore been prepared based on a discharge rate no greater than 1l/s during the 1:100 year plus climate change event.

6.4.7 The calculations confirm that a 30% voided subbase beneath a 200mm concrete slab, divided into five separate sections and discharging east to west through a series of flow control devices will provide sufficient storage to accommodate the 1:100 year rainfall event below ground.

6.4.8 A further 22m<sup>3</sup> of storage will be provided above ground at the western extent of the proposed service yard to accommodate the additional storage volume required during the 1:100 year+45% event.

6.4.9 The retention of the first 5mm of rainfall required by Standard 2 of the National standards for sustainable drainage systems has been met with the provision of a voided subbase acting as a filter drain and vegetated drainage channel.

## 6.5 Watercourse Diversion

- 6.5.1 The existing watercourse to the south of the existing packhouse will be relocated to the south of the new proposal such that it continues to accept the existing surface water runoff from the area to the east of the packhouse.
- 6.5.2 The outfall from the existing ditch is a 225mm diameter pipe laid at a gradient of 1:39 which in turn discharges to a further 44m of 225mm diameter pipes laid with a combined hydraulic gradient of 1:366.
- 6.5.3 The capacity of this network has been calculated using the Colebrook White equation for circular pipes under full bore conditions and a pipe roughness of 0.6mm. The existing network has a conveyance capacity of 26.9l/s.
- 6.5.4 In order to provide sufficient depth of subbase beneath the new hardstanding the invert level of the outfall from the realigned ditch will need to be lowered to 2.9m AOD resulting in the existing outfall pipe gradient being slackened to 1:155.
- 6.5.5 Full bore conditions for the resultant out fall pipe as calculated above confirm a conveyance capacity of 41.6l/s and a velocity of 1.05 m/s.
- 6.5.6 The alterations are therefore capable of passing the same flow as the existing downstream network and maintain a self cleansing velocity.
- 6.5.7 The increased depth of realigned ditch will also provide a greater level of storage than the existing ditch which while not required will provide an additional benefit to the site as a whole.

## 6.6 Reduction of Existing Irrigation Reservoir Surface Area

- 6.6.1 The existing reservoir south of the proposed extension has a surface area at top of bank of approximately 11,602m<sup>2</sup> and is maintained with 500mm of freeboard with maximum upper surface water area of approximately 10,962m<sup>2</sup>.
- 6.6.2 This reservoir is an irrigation balancing reservoir which is managed as part of the wider irrigation network across the site.
- 6.6.3 The reduced size reservoir will have a surface area at top of bank of approximately 5,134m<sup>2</sup> and will be maintained with 500mm of freeboard with maximum upper surface water area of approximately 4,713m<sup>2</sup>.
- 6.6.4 There are proposals for a new 125,000m<sup>3</sup> reservoir to the north of the Sefter Farm buildings which has planning permission under reference P/127/24/AG.

6.6.5 Water levels and stored volume will be managed with a reduction of abstraction currently permitted from the Pagham Rife under the existing abstraction licence held by Barfoots of Botley leading to a temporarily reduced capacity within the wider irrigation network until such time as the new reservoir is constructed.

6.6.6 Copies of the surface water drainage proposal drawings and supporting calculations are located in Appendix 6 at the rear of this report.

6.6.7 Copies of the detailed design drawings including construction details are located in Appendix 7 at the rear of this report.

## 6.7 Water Quality

6.7.1 The proposed development is for commercial agricultural use. In accordance with CIRIA SuDS Manual 2015 (Report C753), the pollution hazard level for this type of development is classified as between low and medium depending on the use / area of the site.

6.7.2 The surface water scheme will include mitigation to ensure that surface water is suitably treated and any pollution risk adequately managed prior to irrigation reuse and in the case of the new hardstanding prior to a restricted discharge to the onsite drainage ditch and to the Pagham Rife.

6.7.3 Table 26.2 in Chapter 26 of CIRIA report C753 The SuDS Manual provides Pollution Hazard Indices for varying land types. Those of relevance to the development proposals are as follows:

| Land Use                            | Pollution hazard level | Total suspended solids (TSS) | Metals | Hydrocarbons |
|-------------------------------------|------------------------|------------------------------|--------|--------------|
| Commercial / Industrial roofs       | Low                    | 0.3                          | 0.2    | 0.05         |
| Commercial yards and delivery areas | Medium                 | 0.7                          | 0.6    | 0.7          |

**Table 1: Pollution Hazard Indices**

6.7.4 The surface water drainage design will include the use of permeable subbase acting as a filter strip, on site drainage channel (swale), and ponds / reservoirs.

| SuDS Type        | Total suspended solids (TSS) | Metals | Hydrocarbons |
|------------------|------------------------------|--------|--------------|
| Pond / Reservoir | 0.7                          | 0.7    | 0.5          |
| Filter Strip     | 0.4                          | 0.4    | 0.5          |
| Swale            | 0.5                          | 0.6    | 0.6          |

**Table 2: Pollution Mitigation Indices**

6.7.5 Where multiple drainage components are used in series the individual mitigation index of secondary and tertiary components is lowered by 50% due to reduced performance associated with primary treatment and the proposed infrastructure will meet the target treatment level required as follows:

| <b>Extension Roof</b> | <b>Total suspended solids (TSS)</b> | <b>Metals</b> | <b>Hydrocarbons</b> |
|-----------------------|-------------------------------------|---------------|---------------------|
| Pond / Reservoir      | 0.7                                 | 0.7           | 0.5                 |

| <b>Commercial Hardstanding</b> | <b>Total suspended solids (TSS)</b> | <b>Metals</b> | <b>Hydrocarbons</b> |
|--------------------------------|-------------------------------------|---------------|---------------------|
| Filter Strip                   | 0.4                                 | 0.4           | 0.5                 |
| Swale at 50%                   | 0.25                                | 0.3           | 0.3                 |
| <b>Total Treatment</b>         | <b>0.65</b>                         | <b>0.7</b>    | <b>0.8</b>          |

**Table 3: Pollution Mitigation Provision**

6.7.6 An interim drainage management and maintenance plan is located in Appendix 8 at the rear of this report.

## 7 Safe Development

### 7.1 Flood Zone Compatibility

7.1.1 The site and its wider area are predominantly located in Flood Zone 1 with extreme western area of external works located in future year Flood Zone 2.

7.1.2 With reference to Annex 3 of the National Planning Policy Framework and Table 2 of the Government Guidance on Flood Risk and Coastal Change at <https://www.gov.uk/guidance/flood-risk-and-coastal-change>:

- Annex 3: Flood Risk Vulnerability Classification

Land and buildings used for agriculture are classified as Less Vulnerable.

- Table 2: Flood Risk Vulnerability and Flood Zone Compatibility

Less Vulnerable development is considered appropriate in Flood Zones 1 and 2 and 3a.

7.1.3 The notes to Table 2 state that *'this table does not show the application of the Sequential Test which should be applied first to guide development to the lowest flood risk areas; nor does it reflect the need to avoid flood risk from sources other than rivers and the sea'*.

### 7.2 Finished Floor Level

7.2.1 The finished floor level of the proposed extension will be at 5.05m AOD and tie into the existing building.

7.2.2 This places the building above both the defended 2115 flood level of 3.56m AOD and the undefended 2115 level at 4.57m AOD.

### 7.3 Risk to Others

7.3.1 The proposed surface water drainage system will be designed to current standards incorporating SuDS elements providing attenuation and storage which will minimise runoff leaving the site during times of heavy rain.

7.3.2 Allowance has been made for a 45% increase in rainfall intensities which accords with the latest figures published by the Environment Agency and with the requirements under the National Planning Policy Framework.

7.3.3 The proposed drainage system will incorporate sufficient treatment prior to final discharge thus mitigating the risk of pollution from the site.

## 7.4 Surface Water Exceedance Route

7.4.1 In the event that part of the onsite surface water drainage network was to become blocked, suffer a failure due to lack of maintenance or be inundated with a storm beyond the 1:100 year +45% design storm surface water would migrate overland towards the Pagham Rife.

7.4.2 A surface water exceedance route plan is located in Appendix 9 at the rear of this report.

## 8 Conclusions

- 8.1 The site is currently located in Flood Zone 1 and is predicted to be within tidal Flood Zones 1 and 2 in the future year 2115. The type of development is for agricultural use and is appropriate in Flood Zones 1 and 2 and 3a.
- 8.2 The site is not at risk of flooding from fluvial sources, overland surface water flows, or reservoirs.
- 8.3 The site is located within a 1x1km square of which more than 75% is considered potentially susceptible to groundwater emergence.
- 8.4 Groundwater monitoring has confirmed that groundwater is perched within the superficial soils at a depth of 0.70-0.80m below ground level and there are no records of groundwater emergence.
- 8.5 The geology of the area is predominantly clay and is not suitable to accommodate an infiltration drainage system.
- 8.6 A suitable SuDS drainage system is proposed which accords with the requirements of national and local policy.
- 8.7 A SuDS drainage system is proposed which accords with the requirements of national and local policy and will ensure 100% reused of rainwater captured from the extension roof for irrigation.
- 8.8 Surface water collected from the new hardstanding area will be collected with surface water restricted to 3l/s/ha during the 1:100 year plus climate change rainfall event and discharged to the relocated onsite watercourse which discharges to the Pagham Rife to the west of the site.
- 8.9 Calculations confirm that surface water runoff generated by the proposed development can be attenuated on site for all rainfall events up to the 1:100 year event plus climate change event.
- 8.10 Water quality improvement will be provided to mitigate against any risk to the receiving waterbodies.
- 8.11 A suitable surface water and foul water drainage system has been designed to accommodate the anticipated flows from the proposed development and in terms of drainage the development proposals are suitable at this location.
- 8.12 In terms of flood risk planning the proposed development is safe and will manage surface water from all rainfall events up to the 1:100 year plus climate change event so as not to increase flood risk elsewhere.
- 8.13 The development proposals are suitable at this location.

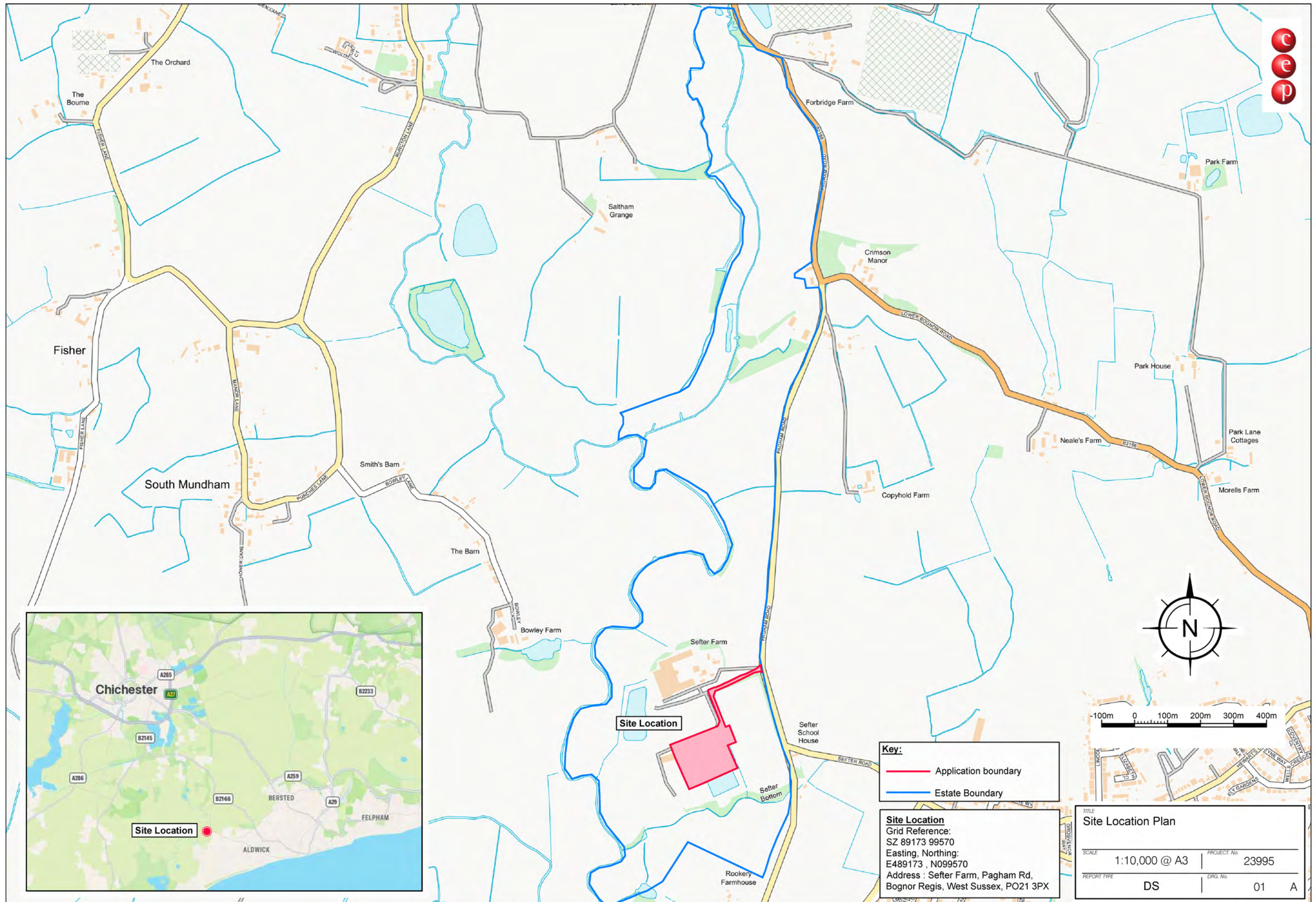
## **9 List of Appendices, Images and Tables**

|            |                                                        |
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| Appendix 2 | Existing Site Layout Plan                              |
| Appendix 3 | Extracts from Site Investigation                       |
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| Appendix 5 | Proposed Site Layout and Positively Drained Areas Plan |
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|         |                                |
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**Appendix 1**  
**Site Location Plan**



**Appendix 2**  
**Existing Site Layout Plan**

Sefter Farm South  
Packhouse

Reservoir

Reservoir

Track

Silos

WB



-10m 0 10m 20m 30m 40m

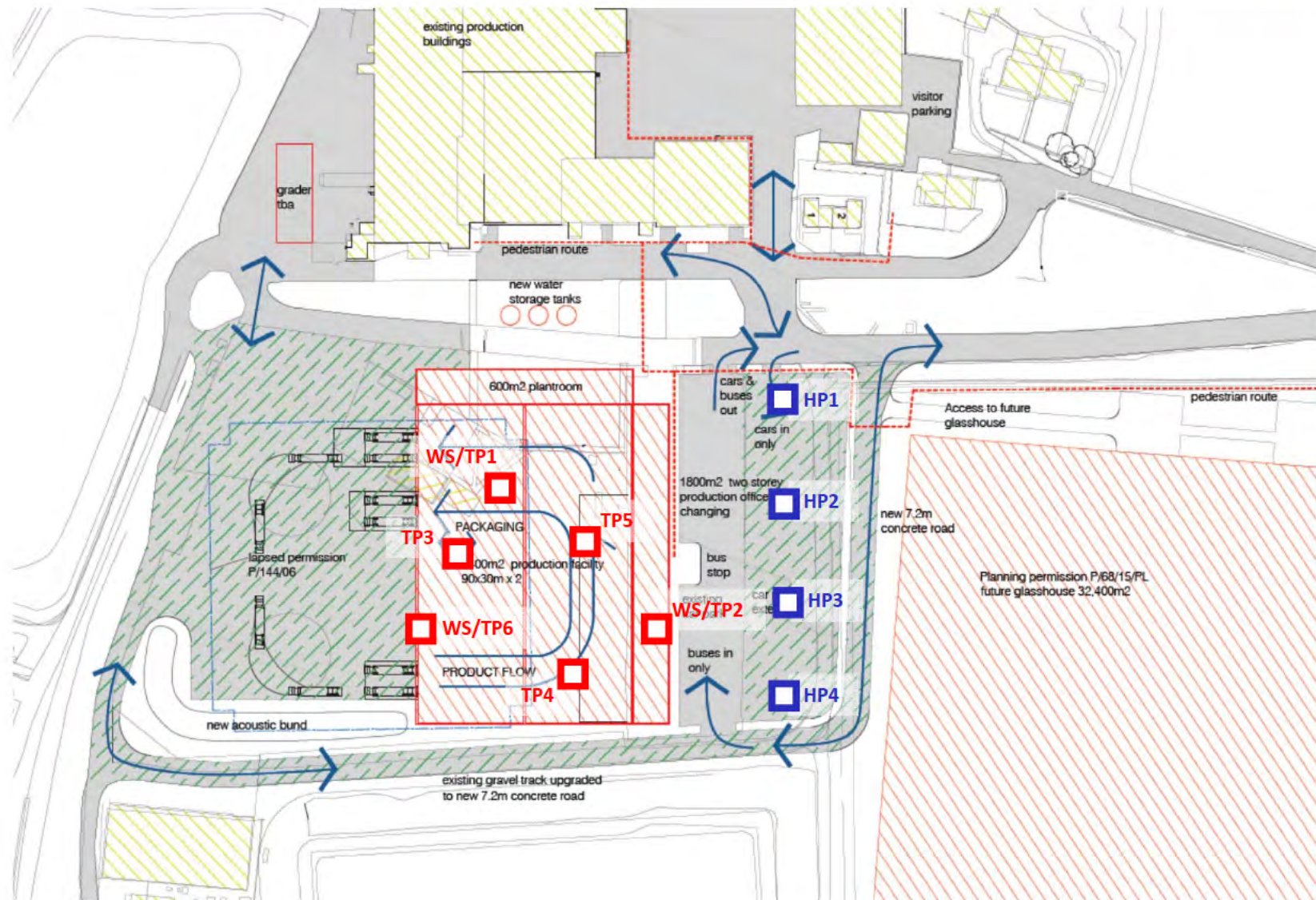
|                                    |             |             |       |
|------------------------------------|-------------|-------------|-------|
| TITLE<br>Existing Site Layout Plan |             |             |       |
| SCALE                              | 1:1000 @ A3 | PROJECT No. | 23995 |
| REPORT TYPE                        | DS          | DRG. No.    | 02 A  |

**Appendix 3**  
**Extracts from Site Investigation**

# Investigation Plan

Project Ref: 16.9088

Site Name: Seftor Farm



Please refer to the stratigraphic logs contained within Appendix B for a more detailed description.

## **5.2 Groundwater**

Shallow groundwater was encountered across the site, occurring as seepages within deep trial pits and window sample boreholes at depths of 0.70m to 2.00mbgl. Resting levels within the window sample boreholes were found to range from 0.70m to 0.80mbgl.

## **5.3 Visual and Olfactory Observations**

The Made Ground across the site was found to contain various detritus, including masonry rubble and discrete horizons of wood chipping, however no evidence of soil contamination was observed within any of the exploratory holes.

## **6.0 GEOTECHNICAL TESTING**

### **6.1 Geotechnical Testing**

#### *6.1.1 Atterberg Limits and Natural Moisture Content*

In total, ten disturbed samples of the underlying soils were submitted for determination of their Natural Moisture Content (NMC) and Plasticity Index (PI). Five of these samples were recovered from the London Clay Formation, and five from the overlying superficial soils.

NMC values in the superficial deposits ranged from 18-30%. The underlying London Clay recorded NMC values of 26-35%.

Liquid limit values in the superficial deposits ranged from 21% to 43% and modified plasticity index values were recorded as 11-22%, once the portion retained on the 425micron sieve had been accounted for (11-25%). On this basis the superficial soils would be classified as clays of low to intermediate plasticity and of low to medium shrinkage potential on the basis of NHBC guidance, chapter 4.2 'Building Near Trees'.

Within the London Clay Formation, liquid limits ranged from 52-71%, and the modified plasticity on the basis of the portion retained on the 425 micron sieve (0-25%) is recorded as 27-47%. These soils would be classified as high to very high plasticity clay and would be of medium to high shrinkage potential on the basis of the NHBC guidance.

#### *6.1.2 Sulphate and pH Analysis*

Twenty samples were submitted for determination of pH and Water Soluble Sulphate concentration.

Water soluble sulphate concentrations were found to range from <10mg/l to 363mg/l, with pH levels ranging from 5.6 to 8.1.

Full laboratory test results can be found in Appendix D.

N-values within the Bognor Sand Member soils recorded values of N=52-101, these values are indicative of very dense granular soils.

### 6.3.2 Dynamic Cone Penetrometer Testing

A total of three locations were tested using Dynamic Cone Penetrometer (DCP) equipment with two test completed at locations DCP2 and DCP3 where one test was positioned on the verge and one in the haul road. The testing was completed to provide insitu CBR values for pavement design.

The table below provides the recorded equivalent CBR values in each test over a range of formations levels.

| Formation Depth (mm) | Equivalent CBR % |      |       |      |       |
|----------------------|------------------|------|-------|------|-------|
|                      | DCP1             | DCP2 | DCP2A | DCP3 | DCP3A |
| 100                  | 17               | 153  | 88    | 3    | 45    |
| 200                  | 28               | 440  | 78    | 6    | 48    |
| 300                  | 21               | -    | -     | 5    | 30    |
| 400                  | 12               | -    | -     | 12   | 16    |
| 500                  | 5                | -    | -     | 7    | 11    |
| 600                  | 7                | -    | -     | 8    | 8     |
| 700                  | 6                | -    | -     | 10   | 7     |

The results of this insitu testing are shown in Appendix B.

## 7.0 DISCUSSION OF GROUND CONDITIONS

### 7.1 Soil Engineering Properties

It is understood that the proposals for the site include the construction of a new portal framed distribution building, which will include an internal finished floor level of approximately 1.00-1.50mbgl above current ground level. Final loadings are not known at the time of writing, however considering the nature of the structure column loads are expected to be moderately high.

In order to produce the raised ground floor slab options including suspended slab and the construction of an earth embankment utilising material sourced from elsewhere on site are considered as construction options.

The surficial cover to the development area was predominantly found to be formed by Made Ground soils to a maximum depth of 0.80mbgl, with local topsoil deposits. This Made Ground shows compositional variation, however is largely formed by a sandy and gravelly Clay, however granular portions are described locally.

Superficial deposits underlying the surface cover have been proved to comprise a composite deposit with stratigraphic records indicating mixed gravelly Clay, gravelly Sand and silty Sand soils to a maximum depth of 2.00mbgl. These deposits are considered to form interdigitating Raised Marine and Head Deposit soils.

Insitu testing has indicated that these superficial soils are of low to medium strength character with SPT N-values indicative of soft to firm or firm consistency clay soils and loose to medium dense granular soils.

The results of laboratory testing indicate that the superficial deposits are of low to intermediate plasticity and of low to medium shrinkage potential in accordance with NHBC guidance.

The underlying London Clay formation is initially encountered as a stiff consistency fissured and thinly laminated silty Clay. This results of insitu testing indicate this material to be firm to stiff consistency, becoming stiff consistency with depth. Laboratory testing indicates that the London Clay is of high to very high plasticity and is of medium to high shrinkage potential. This stratum is encountered to a maximum depth of 5.00mbgl.

Within WS/TP1 and WS/TP2 at depths of 3.90m and 4.40mbgl to the maximum drilled depth of 5.00mbgl, soils considered representative of the Bognor Sand Member were encountered and were described as dense silty Sand. Insitu test results however indicate that this sand is a very dense granular soil.

Groundwater observations indicate that the groundwater is perched within the superficial soils at a depth of 0.70-0.80mbgl.

## **7.2 Shallow Foundations**

It cannot be recommended that major structural foundations are formed with the made Ground revealed by this investigation. Soils of this origin are frequently present in a weak and variable condition such that unacceptable settlement would be expected, even under the action of light loading intensities.

Furthermore the low to medium strength character and highly variable composition of the superficial soils across the site are expected to preclude that use of a spread type foundation as total and differential settlement levels would be expected to exceed tolerable limits.

Additionally the temporary works involved in the formation of a spread foundation would likely prove problematic owing to the presence of water bearing low strength and / or granular soils. Open excavations in these water bearing soils would be prone to collapse.

## **7.3 Deep Foundations**

In order to overcome the issues associated with weak and compositionally inconsistent superficial soils it is recommended that a piled foundation is used for the new building, particularly given the anticipated spans and potentially suspended floor for the new development.

The bedrock geology is also found to be variable in terms of composition, with the Bognor Sand Member encountered in two of the three window sample boreholes. Whilst the London Clay Formation is expected to act as a suitable bearing medium for piled foundations, the thickness / extent of the Bognor Sand would need to be ascertained as well as the geotechnical parameters to at least 5.00m below the depth of piled foundations to allow a suitable economic foundation to be designed.

It would be recommended that additional investigations are undertaken within the footprint of the new development to allow pile design to be completed. This is expected to take the form of at least 2no exploratory cable percussion boreholes to a depth of 15.00-20.00mbgl.

#### **7.4 Floor Slabs and Pavements**

The floor slab design will depend on the final foundation designs and is dependent on the underlying materials, including bearing capacity and the presence of any cohesive or Made Ground Soils.

Given the variable thickness of Made Ground and the locally potentially shrinkable soils encountered, it is considered that a fully suspended floor would be most suitable from the perspective of design confidence.

However the proposed use of the floor itself may make the use of a suspended floor slab uneconomic or impractical in terms of additional column loading. As a result it may be prudent to consider the use of adequate compaction and establishment of a suitable thickness of engineering fill material to act as a base for the new slab. It would also be recommended to consider the use of displacement type ground improvement measures to increase the load bearing potential of the shallow soils to accept loading from a new floor.

CBR testing adjacent to the access roadway has indicated high CBR values, generally in excess of 10%. However the comparatively weak Made Ground and topsoil encountered elsewhere is unlikely to provide such a suitable subgrade material. It would be suggested that design values of 1-3% are assumed in the design of the new loading bay area and floor slab.

#### **7.5 Excavations and Groundwater**

It is likely that excavations of less than 1.20mbgl will require support to their faces due to the variable nature of Made Ground as well as locally weak and saturated shallow soils. Should excavations be taken below this then adequate support should be provided in order to satisfy statutory safety regulations.

Groundwater has been identified up to 0.70mbgl during site works.

Therefore any excavation made below groundwater levels on site is expected to be subject to the inflow of groundwater which is expected to result in the further instability of excavation faces, particularly where granular soils are encountered. It is strongly recommended that provision is made in the specification of ground works for dewatering.

Where groundwater is identified within any of the excavations during the construction phase then it should be dealt with appropriately and removed using good engineering practices.

The design of any temporary retaining structures to support excavation faces should be made assuming the following moderately conservative parameters: