



ATKINS CHECKED

JO

Atkins  
The Hub, 500  
Park Avenue  
Aztec West  
Almondsbury  
Bristol  
Attention: Sarah Generalski-Sparling

Your Ref 40380/NVS  
Our Ref 201500  
Date 02 September 2015  
Contact [REDACTED]

Dear Sirs

### Provision of Sewer Main Record Extracts – VAT Receipt

**Land between Pagham Road, Sefter Road, Hook Lane, Pagham, West Sussex  
PO21 3PD**

Further to your recent enquiry regarding the provision of Southern Water apparatus record extracts for the above location.

Please be aware that there are areas within our region in which there are neither sewers nor water mains. Similarly, whilst the enclosed extract may indicate the approximate location of our apparatus in the area of interest, it should not be relied upon as showing that further infrastructure does not exist and may subsequently be found following site investigation. Therefore actual positions of the disclosed (and any undisclosed) infrastructure should be determined on site, because Southern Water does not accept any responsibility for inaccuracy or omission regarding the enclosed plan and accordingly it should not be considered to be a definitive document.

I confirm payment of the appropriate fee in the sum of £49.92

The breakdown of costs is as follows: -

- |                                |        |
|--------------------------------|--------|
| • Provision of record extracts | £41.60 |
| • VAT @ 20.0%                  | £8.32  |

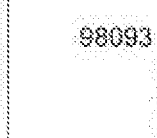
VAT Registration Number 813 0378 56

Should you require any additional information regarding this matter please contact this office at the address given at the foot of this letter.

Yours faithfully

Land Search Department

Letter B



**LINE TYPES / COLORS**

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# Appendix E

## SOAKAWAY REPORT

Our Ref: 70014147-L01

3 December 2015

Ruth McKeown  
Hallam Land Management: South East Region  
108 New Bond Street  
London  
W1S 1EF

WSP UK Limited  
One Queens Drive  
Birmingham  
B5 4PJ

Dear Ruth,

**Subject: Land at Pagham – Soakaway Infiltration Testing Report**

## INTRODUCTION

Hallam Land Management (HLM) commissioned WSP | Parsons Brinkerhoff (WSP) to undertake preliminary soakaway infiltration testing at the Land at Pagham development site in accordance with our proposal reference 70014147-P03.

A Site Location Plan is included as **Figure 1** and a Site Boundary Plan as **Figure 2**, both within **Annex A**.

The limitations to the nature of our assessment are provided within the Notes on Limitations section at the end of this report.

## BACKGROUND AND OBJECTIVES

The exact layout and final design have not yet been confirmed; however the current development plan is for circa 350 residential homes to be constructed across the site.

The soakaway infiltration testing is required to support the design of Sustainable Urban Drainage Systems (SUDs) and to refine the development masterplan.

## SITE LAYOUT AND SETTING

The site is situated approximately 4.5km west of the centre of Bognor Regis and is bounded by Pagham Road in the west, Hook Lane in the south and east, and Sefter Road in the north. The development area is roughly rectangular in shape, approximately 345m wide at its widest point and 740m long. The site is bisected by a 500m long drain running at an east-west orientation across the site.

Published geological mapping indicates that the site is underlain by superficial deposits comprising River Terrace Deposits across the majority of the site, with Raised Beach Deposits along the northwest boundary. The underlying solid geology is shown to be London Clay Formation.

The River Terrace Deposits and Raised Beach Deposits are classified by the Environment Agency as Secondary A aquifers and the London Clay Formation as Unproductive Strata. No groundwater abstractions are present within a 1km radius of the site.

## SITE WORKS METHODOLOGY

### TRIAL PIT EXCAVATION

Site works were undertaken between 12 and 13 November 2015.

A buried services scan was undertaken by Midland Survey Limited at each test location and a total of 11 trial pits were excavated across the site to a maximum depth of 2.4m below ground level (bgl) using a tracked 8 tonne excavator. Groundwater was encountered in five trial pits (SA01A, SA01B, SA02A, SA06A and SA06B) at depths of between 1.2 and 2.2m bgl. Soakaway tests were undertaken in six trial pits; SA01C, SA02B, SA03, SA04, SA05 and SA06C.

The soakaway locations are presented on **Figure 3** and associated exploratory hole logs are presented in **Annex B**.

## SOAKAWAY TESTING

The soakaway infiltration tests were undertaken in general accordance with BRE 365 'Soakaway Design' (2007). Each soakaway pit was filled to an appropriate depth with water from a mobile bowser supplied by Tardis Environmental. The falling water level was then monitored at regular intervals to record the rate of infiltration.

The guidance suggests undertaking three tests per soakaway pit and that each soakaway test should be monitored until at least 75% effective depth has drained. Due to slow infiltration rates across the site, it was not possible to allow the recommended number of tests to be undertaken.

The tests were carried out within the River Terrace Deposits and due to the relatively stable excavation walls, a gravel fill was not required for temporary support during completion of the tests.

Upon completion of the soakaway infiltration tests, each trial pit was emptied of water, and advanced by approximately 0.5m to confirm the underlying geology prior to backfilling. Nominal compaction of the arisings was undertaken using the excavator.

## GROUND CONDITIONS ENCOUNTERED

The ground conditions encountered were generally as anticipated from published geological mapping.

The geological profile encountered comprised the following general stratigraphy:

- ⇒ **Topsoil** – encountered within all trial pits, ranging in thickness from 0.3 to 0.4m and comprising dark brown slightly sandy slightly gravelly clay;
- ⇒ **River Terrace Deposits** – encountered in all trial pits to a maximum depth of between 1.2 and 2.4m bgl comprising light orange brown, occasionally mottled grey brown, clay locally with sandy and/or gravelly lenses. This was underlain by orange brown slightly clayey gravelly sand encountered at depths between 1.2 and 2.2m bgl.

Groundwater was encountered in locations SA01A, SA01B, SA02, SA06A and SA06B between depths of 1.2 bgl and 2.2m bgl at the interface between the overlying clay strata and the gravelly sand band within the River Terrace Deposits.

Representative soil samples of the clay and sand strata were obtained from the trial pits for geotechnical laboratory analysis for soil classification. The results of the Particle Size Distribution (PSD) analysis indicate that the samples of River Terrace Deposits obtained from SA01C, SA04 and SA06C contain between 30% and 93% of 'fine material' (silt and clay). PSD analysis on a sample obtained at 2.2m bgl in SA01A indicated a 96% granular (sand, gravel and cobbles) composition.

## SOAKAWAY INFILTRATION RESULTS AND DISCUSSION

The results of the soakaway infiltration tests are summarised in **Table 1**, with soakaway testing data provided within **Annex C**.

**Table 1: Summary of Soil Infiltration Test Results**

| EXPLORATORY LOCATION | STRATUM DESCRIPTION                             | TOTAL TEST TIME (MINUTES) | TOTAL FALL IN WATER LEVEL (M) |
|----------------------|-------------------------------------------------|---------------------------|-------------------------------|
| SA01C                | Stiff grey brown slightly sandy CLAY.           | 240                       | 0.12                          |
| SA02B                | Stiff light brown CLAY.                         | 180                       | 0.05                          |
| SA03                 | Firm orange brown mottled grey brown CLAY.      | 210                       | 0.00                          |
| SA04                 | Stiff to firm orange brown slightly sandy CLAY. | 180                       | 0.05                          |
| SA05                 | Firm orange brown CLAY.                         | 180                       | 0.00                          |
| SA06C                | Stiff orange brown CLAY.                        | 240                       | 0.02                          |

Infiltration rates could not be calculated in accordance with BRE guidance for any of the test locations due to slow drainage rates and the absence of 75% effective depth soakage within the timeframe of the tests.

## SUMMARY AND CONCLUSIONS

Although not completed in strict accordance with BRE 365 due to the slow drainage rates recorded, the soakaway tests undertaken provide a preliminary understanding of the infiltration capacity of the River Terrace Deposits beneath the site.

BRE 365 states that it should take 24 hours for a soakaway to discharge from full to half-full in readiness for subsequent storm in-flow. Based on the soakaway test results, this may not be achievable.

The River Terrace Deposits are not considered suitable to support soakaway drainage, but is likely to be suitable for construction of flood attenuation ponds or surface water storage ponds given the low infiltration capacity recorded.

Should soakaway drainage be considered further for the proposed development, it is recommended that testing is undertaken over a 24 hour period to confirm specific conditions in the proposed location(s) of the soakaway drainage features. In addition, the thickness and variability of the River Terrace Deposits will require consideration during the design stage, particularly given the variability of the cohesive and granular strata along with the relatively shallow groundwater beneath parts of the site.

## CLOSING

We trust the above meets with your requirements. Should you have any comments or queries please do not hesitate to contact the undersigned.

Yours sincerely,

Vicky Kennaugh  
Environmental Consultant  
vicky.kennaugh@wspgroup.com

John Davies  
Regional Director  
john.davies@wspgroup.com

Encl. *Annex A – Figures*  
*Annex B – Exploratory Hole Logs*  
*Annex C – Soakaway Results*  
*Notes on Limitations*

## Annex A – Figures





Key  
 Site Boundary



Map data ©2015 Google Imagery ©2015 ,  
Bluesky, DigitalGlobe, Getmapping plc,  
Infoterra Ltd & Bluesky

data ©2015 Google Imagery ©2015 , Bluesky, DigitalGlobe, Getmapping plc, Infoterra Ltd & Bluesky



TITLE:  
  
Land at Pagham

FIGURE No:  
  
Figure 2



Key

■

 Soakaway Location

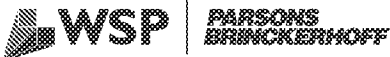
□

 Approximate Site Boundary



Imagery ©2015, Bluesky, DigitalGlobe, Getmapping plc, Infoterra Ltd & Bluesky

Imagery ©2015, Bluesky, DigitalGlobe, Getmapping plc, Infoterra Ltd & Bluesky



TITLE:

Land at Pagham

FIGURE No:

Figure 3

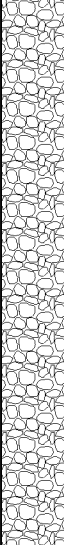
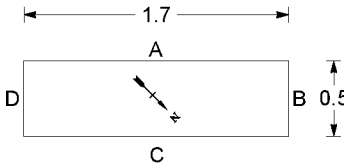
## Annex B – Exploratory Hole Logs

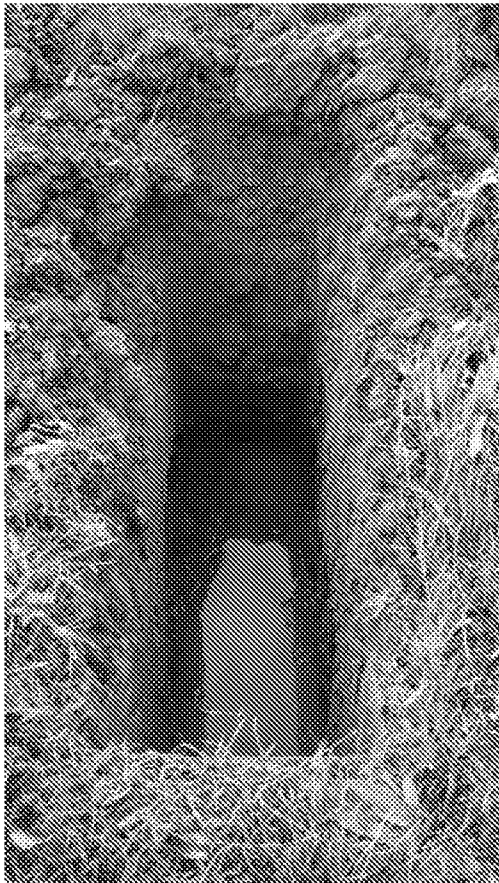


08 WSP TP LOG LS 1 PHOTO 70014147 - LAND AT PAGHAM.GPJ WSPTEMPLATE1.03.GDT 3/12/15

|                                                                                                                                                                                                                                                                                                                                                                                                                           |  |                    |  |                                      |  |                                        |               |                                        |                  |                  |                 |                         |                                                                                                                                                        |  |        |         |                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------------|--|--------------------------------------|--|----------------------------------------|---------------|----------------------------------------|------------------|------------------|-----------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------|---------|--------------------|
| <div>WSP   Parsons Brinckerhoff<br/>One Queens Drive, Birmingham<br/>B5 4PJ<br/>Telephone: 01213524700</div>                                                                                                                                                                                                                                                                                                              |  | TRIAL PIT LOG      |  | Depth                                |  | Type                                   | PID<br>(ppmV) | HSV<br>(kN/m2)                         | P Pen<br>(kN/m2) | Water            | Elev.<br>(mAOD) | Depth<br>(Thick-ness)   | STRATA                                                                                                                                                 |  | Legend | Geology | Install / Backfill |
| Project<br>Land at Pagham                                                                                                                                                                                                                                                                                                                                                                                                 |  | Job No<br>70014147 |  |                                      |  |                                        |               |                                        |                  |                  |                 | (0.20)                  | Firm brown slightly sandy CLAY with abundant fine root material. (TOPSOIL)                                                                             |  |        | TS      |                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                           |  |                    |  |                                      |  |                                        |               |                                        |                  |                  | 5.65            | 0.20                    | Stiff greyish brown slightly sandy CLAY. (RIVER TERRACE DEPOSITS)                                                                                      |  |        | RT      |                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                           |  |                    |  |                                      |  |                                        |               |                                        |                  |                  |                 | (1.40)                  |                                                                                                                                                        |  |        |         |                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                           |  |                    |  |                                      |  |                                        |               |                                        |                  |                  | 4.25            | 1.60                    |                                                                                                                                                        |  |        |         |                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                           |  |                    |  |                                      |  |                                        |               |                                        |                  |                  |                 | (0.20)                  | Soft light brown sandy gravelly CLAY with occasional flint cobbles. Gravel is fine to coarse, subangular to subrounded flint. (RIVER TERRACE DEPOSITS) |  |        | RT      |                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                           |  |                    |  |                                      |  |                                        |               |                                        |                  |                  | 4.05            | 1.80                    | Exploratory hole completed at 1.8m bgl.                                                                                                                |  |        | END     |                    |
| General Remarks<br>Exploratory hole located approximately 5.0m to the east of SA01A.<br>Groundwater encountered at 1.8m bgl rising to 1.7m bgl in 30 minutes.<br>No visual or olfactory evidence of contamination.<br>Shoring/Support: None<br>Stability: Stable<br>Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification. |  |                    |  | Length<br>1.70m                      |  | Logged By<br>VK                        |               | Client<br>Hallam Land Management       |                  | Sheet<br>1 of 1  |                 |                         |                                                                                                                                                        |  |        |         |                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                           |  |                    |  | Width<br>0.50m                       |  | Ground Level (m AOD)<br>5.850          |               | Co-Ordinates (NGR)<br>E 489727 N 99459 |                  | Date<br>12-11-15 |                 | Trial Hole No.<br>SA01B |                                                                                                                                                        |  |        |         |                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                           |  |                    |  | Orientation<br>45 degrees from north |  | Method/Plant Used<br>8 Tonne Excavator |               | Contractor<br>Bastable Plant Hire      |                  | Scale<br>1:20.0  |                 |                         |                                                                                                                                                        |  |        |         |                    |

08 WSP TP LOG LS 1 PHOTO 70014147 - LAND AT PAGHAM.GPJ WSPETEMPLATE1.03.GDT 3/12/15

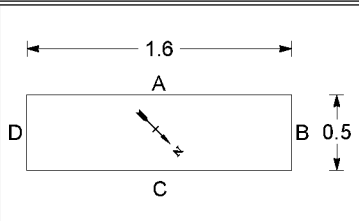
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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------------|--|-------------------------------------------------------------------------------------|---------------|-----------------|------------------|----------------|-----------------|--------------------------------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------------------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------------------------------|--|----------------------------------|--|----------------------------------------|--|------------------|--|-----------------------------------|--|-----------------|--|-----------------|--|-------------------------|--|
| <div><div><div><div><div></div><div>WSP</div></div><div>WSP   Parsons Brinckerhoff<br/>One Queens Drive, Birmingham<br/>B5 4PJ<br/>Telephone: 01213524700</div></div></div><div>TRIAL PIT LOG</div></div>                                                                                                                                                                                                                                                                                     |  | Depth              |  | Type                                                                                | PID<br>(ppmV) | HSV<br>(kN/m2)  | P Pen<br>(kN/m2) | Water          | Elev.<br>(mAOD) | Depth<br>(Thick-<br>-ness)           | STRATA |                                                                                                                                                        |        |                                                                                     |                       |                                                                                     |  |                                  |  |                                        |  |                  |  |                                   |  |                 |  |                 |  |                         |  |
| Project<br>Land at Pagham                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | Job No<br>70014147 |  |                                                                                     |               |                 |                  |                |                 |                                      |        | Description                                                                                                                                            | Legend | Geology                                                                             | Install /<br>Backfill |                                                                                     |  |                                  |  |                                        |  |                  |  |                                   |  |                 |  |                 |  |                         |  |
|                                                                                                                                                                                                                                                                                                                                                                                                             |  |                    |  | 1.50                                                                                |               | B               |                  |                |                 |                                      |        | Firm brown slightly sandy CLAY with abundant fine root material. (TOPSOIL)                                                                             |        |  | TS                    |  |  |                                  |  |                                        |  |                  |  |                                   |  |                 |  |                 |  |                         |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |                    |  |                                                                                     |               |                 |                  |                |                 |                                      |        | Stiff greyish brown slightly sandy CLAY. (RIVER TERRACE DEPOSITS)                                                                                      |        |  | RT                    |  |  |                                  |  |                                        |  |                  |  |                                   |  |                 |  |                 |  |                         |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |                    |  |                                                                                     |               |                 |                  |                |                 |                                      |        | 0.60 m bgl Becoming orangeish brown.                                                                                                                   |        |                                                                                     |                       |                                                                                     |  |                                  |  |                                        |  |                  |  |                                   |  |                 |  |                 |  |                         |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |                    |  |                                                                                     |               |                 |                  |                |                 |                                      |        | Soft light brown sandy gravelly CLAY with occasional flint cobbles. Gravel is fine to coarse, subangular to subrounded flint. (RIVER TERRACE DEPOSITS) |        |  | RT                    |  |  |                                  |  |                                        |  |                  |  |                                   |  |                 |  |                 |  |                         |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |                    |  |                                                                                     |               |                 |                  |                |                 |                                      |        | Exploratory hole completed at 1.8m bgl.                                                                                                                |        |                                                                                     | END                   |                                                                                     |  |                                  |  |                                        |  |                  |  |                                   |  |                 |  |                 |  |                         |  |
| <div><div>General Remarks</div><div>Exploratory hole used as a soakway between 1.7m bgl and 0.7m bgl.<br/>Exploratory hole located approximately 5.0m to the west of SA01A.<br/>No groundwater encountered.<br/>No visual or olfactory evidence of contamination.<br/>Shoring/Support: None<br/>Stability: Stable</div><div>Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.</div></div> |  |                    |  |  |               | Length<br>1.70m |                  | Width<br>0.50m |                 | Orientation<br>45 degrees from north |        | Logged By<br>VK                                                                                                                                        |        | Ground Level (m AOD)<br>5.850                                                       |                       | Method/Plant Used<br>8 Tonne Excavator                                              |  | Client<br>Hallam Land Management |  | Co-Ordinates (NGR)<br>E 489727 N 99459 |  | Date<br>12-11-15 |  | Contractor<br>Bastable Plant Hire |  | Scale<br>1:20.0 |  | Sheet<br>1 of 1 |  | Trial Hole No.<br>SA01C |  |

|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |             |      |                                                                                                                                   |                                                                                     |         |                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------------|--|------|---------------|----------------|------------------|-------|-----------------|-----------------------|-------------|------|-----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------|-------------------------------------------------------------------------------------|
| <div><div><div><div><div></div><div>WSP</div></div><div>WSP   Parsons Brinckerhoff<br/>One Queens Drive, Birmingham<br/>B5 4PJ<br/>Telephone: 01213524700</div></div></div><div>TRIAL PIT LOG</div></div> |  | Depth              |  | Type | PID<br>(ppmV) | HSV<br>(kN/m2) | P.Pen<br>(kN/m2) | Water | Elev.<br>(mAOD) | Depth<br>(Thick-ness) | STRATA      |      |                                                                                                                                   |                                                                                     |         |                                                                                     |
| Project<br>Land at Pagham                                                                                                                                                                                 |  | Job No<br>70014147 |  |      |               |                |                  |       |                 |                       | Description |      |                                                                                                                                   | Legend                                                                              | Geology | Install / Backfill                                                                  |
|                                                                                                                         |  |                    |  |      |               |                |                  |       |                 |                       | 4.48        | 0.30 | Firm brown slightly sandy CLAY with abundant fine root material. (TOPSOIL)                                                        |  | TS      |  |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |             |      | Stiff orangeish brown CLAY. (RIVER TERRACE DEPOSITS)                                                                              |  |         |                                                                                     |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |             |      |                                                                                                                                   |                                                                                     | RT      |  |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |             |      |                                                                                                                                   |                                                                                     |         |                                                                                     |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |             |      |                                                                                                                                   |                                                                                     |         |                                                                                     |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       | 3.58        | 1.20 | Orangeish brown slightly clayey gravelly SAND. Gravel is fine to coarse, subangular to subrounded flint. (RIVER TERRACE DEPOSITS) |  | RT      |  |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |             |      |                                                                                                                                   |                                                                                     |         |                                                                                     |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       | 3.18        | 1.60 | Exploratory hole completed at 1.6m bgl.                                                                                           |  | END     |                                                                                     |

|                                                   |
|---------------------------------------------------|
| General Remarks                                   |
| Groundwater encountered at 1.5m bgl.              |
| No visual or olfactory evidence of contamination. |

Shoring/Support: None  
Stability: Stable

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.



|             |                       |
|-------------|-----------------------|
| Length      | 1.60m                 |
| Width       | 0.50m                 |
| Orientation | 45 degrees from north |

|                      |                   |
|----------------------|-------------------|
| Logged By            | VK                |
| Ground Level (m AOD) | 4.778             |
| Method/Plant Used    | 8 Tonne Excavator |

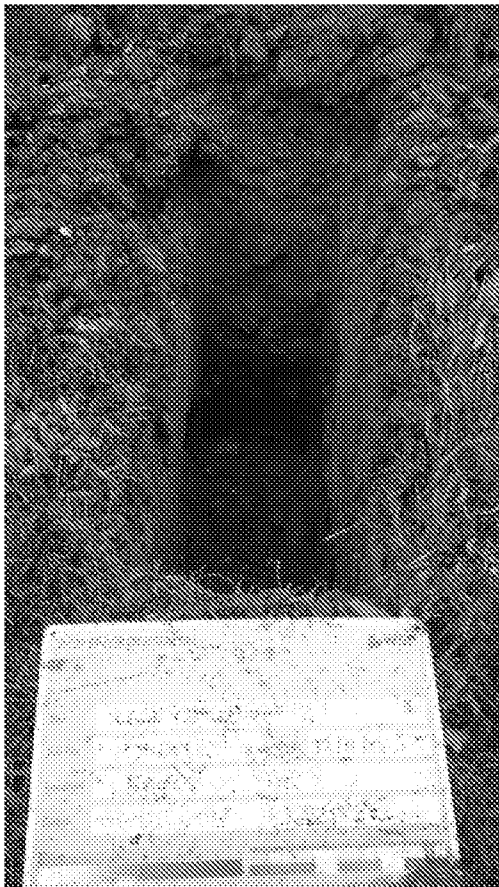
|                                        |                  |
|----------------------------------------|------------------|
| Client                                 |                  |
| Hallam Land Management                 |                  |
| Co-Ordinates (NGR)<br>E 489497 N 99363 | Date<br>12-11-15 |
| Contractor<br>Bastable Plant Hire      | Scale<br>1:20.0  |

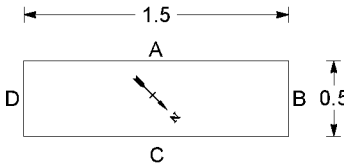
Sheet  
1 of 1

Trial Hole No.

**SA02A**

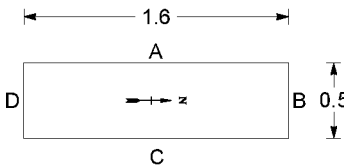
08 WSP TP LOG LS 1 PHOTO 70014147 - LAND AT PAGHAM.GPJ WSPTEMPLATE1.03.GDT 3/12/15

|                                                                                                                                                                                                                                        |  |                    |  |           |               |                |                  |       |                 |                                         |        |             |        |                                                                            |                    |                                                                                     |                                                      |                                                                                     |                                                                                     |    |                                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------------|--|-----------|---------------|----------------|------------------|-------|-----------------|-----------------------------------------|--------|-------------|--------|----------------------------------------------------------------------------|--------------------|-------------------------------------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----|-------------------------------------------------------------------------------------|
| <div><div><div><div><div></div><div>WSP</div></div><div><div>WSP   Parsons Brinckerhoff</div><div>One Queens Drive, Birmingham</div><div>B5 4PJ</div><div>Telephone: 01213524700</div></div></div><div>TRIAL PIT LOG</div></div></div> |  | Depth              |  | Type      | PID<br>(ppmV) | HSV<br>(kN/m2) | P Pen<br>(kN/m2) | Water | Elev.<br>(mAOD) | Depth<br>(Thick-ness)                   | STRATA |             |        |                                                                            |                    |                                                                                     |                                                      |                                                                                     |                                                                                     |    |                                                                                     |
| Project<br>Land at Pagham                                                                                                                                                                                                              |  | Job No<br>70014147 |  |           |               |                |                  |       |                 |                                         |        | Description | Legend | Geology                                                                    | Install / Backfill |                                                                                     |                                                      |                                                                                     |                                                                                     |    |                                                                                     |
|                                                                                                                                                      |  |                    |  | 1.40      |               | B              |                  |       |                 |                                         |        |             |        | Firm brown slightly sandy CLAY with abundant fine root material. (TOPSOIL) |                    |  | TS                                                   |  |                                                                                     |    |                                                                                     |
|                                                                                                                                                                                                                                        |  |                    |  |           |               |                |                  |       |                 |                                         |        |             |        |                                                                            |                    |  |                                                      |                                                                                     |                                                                                     |    |                                                                                     |
|                                                                                                                                                                                                                                        |  |                    |  |           |               |                |                  |       |                 |                                         |        |             |        |                                                                            |                    | 4.48 0.30                                                                           | Stiff orangeish brown CLAY. (RIVER TERRACE DEPOSITS) |                                                                                     |  | RT |  |
|                                                                                                                                                                                                                                        |  |                    |  |           |               |                |                  |       |                 |                                         |        |             |        |                                                                            |                    | (1.40)                                                                              |                                                      |                                                                                     |                                                                                     |    |                                                                                     |
|                                                                                                                                                                                                                                        |  |                    |  | 3.08 1.70 |               |                |                  |       |                 | Exploratory hole completed at 1.7m bgl. |        |             | END    |                                                                            |                    |                                                                                     |                                                      |                                                                                     |                                                                                     |    |                                                                                     |
|                                                                                                                                                                                                                                        |  |                    |  |           |               |                |                  |       |                 |                                         |        |             |        |                                                                            |                    |                                                                                     |                                                      |                                                                                     |                                                                                     |    |                                                                                     |

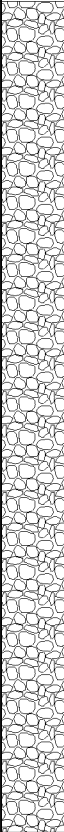
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                     |                                      |  |                                        |  |                                        |  |                  |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------|--|----------------------------------------|--|----------------------------------------|--|------------------|--|
| <div><div>General Remarks</div><div>Exploratory hole used as a soakway between 1.4m bgl and 0.4m bgl.</div><div>Exploratory hole located approximately 5.0m to the south of SA02A.</div><div>No groundwater encountered.</div><div>No visual or olfactory evidence of contamination.</div><div>Shoring/Support: None</div><div>Stability: Stable</div><div>Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.</div></div> |  | Length<br>1.50m                      |  | Logged By<br>VK                        |  | Client<br>Hallam Land Management       |  | Sheet<br>1 of 1  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                     | Width<br>0.50m                       |  | Ground Level (m AOD)<br>4.778          |  | Co-Ordinates (NGR)<br>E 489497 N 99363 |  | Date<br>12-11-15 |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                     | Orientation<br>45 degrees from north |  | Method/Plant Used<br>8 Tonne Excavator |  | Contractor<br>Bastable Plant Hire      |  | Scale<br>1:20.0  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                     |                                      |  |                                        |  |                                        |  |                  |  |

Trial Hole No.  
  
SA02B

08 WSP TP LOG LS 1 PHOTO 70014147 - LAND AT PAGHAM.GPJ WSPTEMPLATE1.03.GDT 3/12/15

|                                                                                                                                                                                                           |  |                                                                                     |  |                                      |               |                                        |                  |                                        |                 |                       |                                                           |                                                                                                                                                   |         |                    |  |  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------------------------------------------------------------------------------------|--|--------------------------------------|---------------|----------------------------------------|------------------|----------------------------------------|-----------------|-----------------------|-----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|---------|--------------------|--|--|--|
| <div><div><div><div><div></div><div>WSP</div></div><div>WSP   Parsons Brinckerhoff<br/>One Queens Drive, Birmingham<br/>B5 4PJ<br/>Telephone: 01213524700</div></div></div><div>TRIAL PIT LOG</div></div> |  | Depth                                                                               |  | Type                                 | PID<br>(ppmV) | HSV<br>(kN/m2)                         | P Pen<br>(kN/m2) | Water                                  | Elev.<br>(mAOD) | Depth<br>(Thick-ness) | STRATA                                                    |                                                                                                                                                   |         |                    |  |  |  |
| Project<br>Land at Pagham                                                                                                                                                                                 |  | Job No<br>70014147                                                                  |  | Description                          |               |                                        |                  |                                        |                 |                       |                                                           | Legend                                                                                                                                            | Geology | Install / Backfill |  |  |  |
|                                                                                                                         |  |                                                                                     |  | 1.70                                 | B             |                                        |                  |                                        |                 |                       | (0.40)                                                    | Firm brown slightly sandy CLAY with rare gravel and abundant fine root material. Gravel is fine to medium, subrounded to rounded flint. (TOPSOIL) |         | TS                 |  |  |  |
|                                                                                                                                                                                                           |  |                                                                                     |  |                                      |               |                                        |                  |                                        |                 |                       | 6.29 0.40                                                 |                                                                                                                                                   |         |                    |  |  |  |
|                                                                                                                                                                                                           |  |                                                                                     |  |                                      |               |                                        |                  |                                        |                 |                       | (1.60)                                                    |                                                                                                                                                   |         |                    |  |  |  |
|                                                                                                                                                                                                           |  |                                                                                     |  |                                      |               |                                        |                  |                                        |                 |                       | 4.69 2.00                                                 | Firm orangeish brown mottled greyish brown CLAY. (RIVER TERRACE DEPOSITS)                                                                         |         |                    |  |  |  |
|                                                                                                                                                                                                           |  |                                                                                     |  |                                      |               |                                        |                  |                                        |                 |                       | (0.40)                                                    |                                                                                                                                                   |         |                    |  |  |  |
|                                                                                                                                                                                                           |  |                                                                                     |  |                                      |               |                                        |                  |                                        |                 | 4.29 2.40             | Firm orangeish brown sandy CLAY. (RIVER TERRACE DEPOSITS) |                                                                                                                                                   | RT      |                    |  |  |  |
|                                                                                                                                                                                                           |  |                                                                                     |  |                                      |               |                                        |                  |                                        |                 |                       | Exploratory hole completed at 2.4m bgl.                   |                                                                                                                                                   | END     |                    |  |  |  |
| General Remarks<br>Exploratory hole used as a soakway between 1.7m bgl and 0.7m bgl.<br>No groundwater encountered.<br>No visual or olfactory evidence of contamination.                                  |  |  |  | Length<br>1.60m                      |               | Logged By<br>VK                        |                  | Client<br>Hallam Land Management       |                 | Sheet<br>1 of 1       |                                                           |                                                                                                                                                   |         |                    |  |  |  |
| Shoring/Support: None<br>Stability: Stable                                                                                                                                                                |  |                                                                                     |  | Width<br>0.50m                       |               | Ground Level (m AOD)<br>6.693          |                  | Co-Ordinates (NGR)<br>E 489782 N 99264 |                 | Date<br>13-11-15      |                                                           | Trial Hole No.<br><br>SA03                                                                                                                        |         |                    |  |  |  |
| Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.                                                     |  |                                                                                     |  | Orientation<br>90 degrees from north |               | Method/Plant Used<br>8 Tonne Excavator |                  | Contractor<br>Bastable Plant Hire      |                 | Scale<br>1:20.0       |                                                           |                                                                                                                                                   |         |                    |  |  |  |

08 WSP TP LOG LS 1 PHOTO 70014147 - LAND AT PAGHAM.GPJ WSPETEMPLATE1.03.GDT 3/12/15

|                                                                                                                                                                                                                                                                                                                                                                                                                |  |                                      |  |                                                                                                    |      |                                        |                |                  |       |                                  |                            |                                                                                                                                 |                                                                                     |        |                                                                                     |                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------------------------------|--|----------------------------------------------------------------------------------------------------|------|----------------------------------------|----------------|------------------|-------|----------------------------------|----------------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------|-------------------------------------------------------------------------------------|-----------------------|
| <div>WSP   Parsons Brinckerhoff<br/>One Queens Drive, Birmingham<br/>B5 4PJ<br/>Telephone: 01213524700</div>                                                                                                                                                                                                                                                                                                   |  | TRIAL PIT LOG                        |  |                                                                                                    |      |                                        |                |                  |       |                                  |                            |                                                                                                                                 |                                                                                     |        |                                                                                     |                       |
| Project<br>Land at Pagham                                                                                                                                                                                                                                                                                                                                                                                      |  | Job No<br>70014147                   |  | Depth                                                                                              | Type | PID<br>(ppmV)                          | HSV<br>(kN/m2) | P Pen<br>(kN/m2) | Water | Elev.<br>(mAOD)                  | Depth<br>(Thick-<br>-ness) | STRATA                                                                                                                          |                                                                                     | Legend | Geology                                                                             | Install /<br>Backfill |
|                                                                                                                                                                                                                                                                                                                              |  |                                      |  | 1.40                                                                                               | B    |                                        |                |                  |       |                                  | (0.20)<br>6.39 0.20        | Firm brown slightly sandy CLAY with abundant fine root material. (TOPSOIL)                                                      |  | TS     |  |                       |
|                                                                                                                                                                                                                                                                                                                                                                                                                |  |                                      |  |                                                                                                    |      |                                        |                |                  |       |                                  | (0.30)<br>6.09 0.50        | Stiff brown slightly sandy CLAY. (RIVER TERRACE DEPOSITS)                                                                       |  | RT     |                                                                                     |                       |
|                                                                                                                                                                                                                                                                                                                                                                                                                |  |                                      |  |                                                                                                    |      |                                        |                |                  |       |                                  | (0.60)<br>5.49 1.10        | Stiff pale orangeish brown slightly sandy CLAY. (RIVER TERRACE DEPOSITS)<br>0.60 m bgl Tree root in southwestern corner of pit. |  | RT     |                                                                                     |                       |
|                                                                                                                                                                                                                                                                                                                                                                                                                |  |                                      |  |                                                                                                    |      |                                        |                |                  |       |                                  | (0.90)<br>4.59 2.00        | Firm pale brown mottled orangeish brown slightly sandy CLAY. (RIVER TERRACE DEPOSITS)                                           |  | RT     |                                                                                     |                       |
|                                                                                                                                                                                                                                                                                                                                                                                                                |  |                                      |  |                                                                                                    |      |                                        |                |                  |       |                                  | (0.20)<br>4.39 2.20        | Firm light grey mottled orangeish brown silty slightly sandy CLAY. (RIVER TERRACE DEPOSITS)                                     |  | RT     |                                                                                     |                       |
|                                                                                                                                                                                                                                                                                                                                                                                                                |  |                                      |  |                                                                                                    |      |                                        |                |                  |       |                                  |                            | Exploratory hole completed at 2.2m bgl.                                                                                         |                                                                                     | END    |                                                                                     |                       |
|                                                                                                                                                                                                                                                                                                                                                                                                                |  |                                      |  |                                                                                                    |      |                                        |                |                  |       |                                  |                            |                                                                                                                                 |                                                                                     |        |                                                                                     |                       |
| <div>General Remarks<br/>Exploratory hole used as a soakway between 1.5m bgl and 0.5m bgl.<br/>No groundwater encountered.<br/>No visual or olfactory evidence of contamination.</div> <div>Shoring/Support: None<br/>Stability: Stable</div> <div>Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.</div> |  |                                      |  | <div><div><div>1.4</div><div>A</div><div>B</div><div>0.5</div><div>C</div></div><div>D</div></div> |      | Length<br>1.40m                        |                | Logged By<br>VK  |       | Client<br>Hallam Land Management |                            | Sheet<br>1 of 1                                                                                                                 |                                                                                     |        |                                                                                     |                       |
|                                                                                                                                                                                                                                                                                                                                                                                                                |  | Width<br>0.50m                       |  | Ground Level (m AOD)<br>6.586                                                                      |      | Co-Ordinates (NGR)<br>E 489729 N 99145 |                | Date<br>13-11-15 |       | Trial Hole No.<br><b>SA04</b>    |                            |                                                                                                                                 |                                                                                     |        |                                                                                     |                       |
|                                                                                                                                                                                                                                                                                                                                                                                                                |  | Orientation<br>90 degrees from north |  | Method/Plant Used<br>8 Tonne Excavator                                                             |      | Contractor<br>Bastable Plant Hire      |                | Scale<br>1:20.0  |       |                                  |                            |                                                                                                                                 |                                                                                     |        |                                                                                     |                       |

08 WSP TP LOG LS 1 PHOTO 70014147 - LAND AT PAGHAM.GPJ WSPTEMPLATE1.03.GDT 3/12/15

|                                                                                                                                                                                                           |  |       |      |               |                |                  |       |                 |                      |                    |                                                                                                                                                      |             |     |        |         |                    |
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| <div><div><div><div><div></div><div>WSP</div></div><div>WSP   Parsons Brinckerhoff<br/>One Queens Drive, Birmingham<br/>B5 4PJ<br/>Telephone: 01213524700</div></div></div><div>TRIAL PIT LOG</div></div> |  | Depth | Type | PID<br>(ppmV) | HSV<br>(kN/m2) | P Pen<br>(kN/m2) | Water | Elev.<br>(mAOD) | Depth<br>(Thickness) | STRATA             |                                                                                                                                                      |             |     |        |         |                    |
| Project<br>Land at Pagham                                                                                                                                                                                 |  |       |      |               |                |                  |       |                 |                      | Job No<br>70014147 |                                                                                                                                                      | Description |     | Legend | Geology | Install / Backfill |
|                                                                                                                                                                                                           |  |       | 1.20 | B             |                |                  |       |                 | 5.65                 | 0.30               | Firm brown slightly sandy CLAY with rare gravel and abundant fine root material. Gravel is fine to medium, subangular to subrounded flint. (TOPSOIL) |             |     | TS     |         |                    |
|                                                                                                                                                                                                           |  |       |      |               |                |                  |       |                 |                      |                    | Firm orangeish brown CLAY. (RIVER TERRACE DEPOSITS)                                                                                                  |             |     |        | RT      |                    |
|                                                                                                                                                                                                           |  |       |      |               |                |                  |       |                 |                      |                    |                                                                                                                                                      |             |     |        |         |                    |
|                                                                                                                                                                                                           |  |       |      |               |                |                  |       |                 |                      |                    | Exploratory hole completed at 1.5m bgl.                                                                                                              |             | END |        |         |                    |
|                                                                                                                                                                                                           |  |       |      |               |                |                  |       |                 |                      |                    |                                                                                                                                                      |             |     |        |         |                    |
|                                                                                                                                                                                                           |  |       |      |               |                |                  |       |                 |                      |                    |                                                                                                                                                      |             |     |        |         |                    |

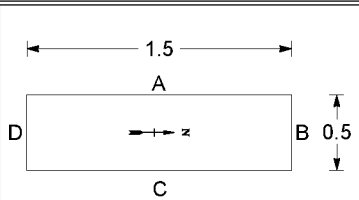
|                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |  |  |                                      |  |                                        |  |                                        |  |                  |                            |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--------------------------------------|--|----------------------------------------|--|----------------------------------------|--|------------------|----------------------------|--|
| <div><div><div>General Remarks</div><div>Exploratory hole used as a soakway between 1.2m bgl and 0.4m bgl.<br/>No groundwater encountered.<br/>No visual or olfactory evidence of contamination.</div><div>Shoring/Support: None<br/>Stability: Stable</div><div>Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.</div></div></div> |  |  |  | Length<br>1.50m                      |  | Logged By<br>VK                        |  | Client<br>Hallam Land Management       |  | Sheet<br>1 of 1  |                            |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |  |  | Width<br>0.45m                       |  | Ground Level (m AOD)<br>5.945          |  | Co-Ordinates (NGR)<br>E 489460 N 99027 |  | Date<br>12-11-15 | Trial Hole No.<br><br>SA05 |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |  |  | Orientation<br>45 degrees from north |  | Method/Plant Used<br>8 Tonne Excavator |  | Contractor<br>Bastable Plant Hire      |  | Scale<br>1:20.0  |                            |  |

| <div>WSP   Parsons Brinckerhoff<br/>One Queens Drive, Birmingham<br/>B5 4PJ<br/>Telephone: 01213524700</div>                                                                     |  | TRIAL PIT LOG      |  | Depth | Type | PID<br>(ppmV) | HSV<br>(kN/m2) | P-Pen<br>(kN/m2) | Water              | Elev.<br>(mAOD) | Depth<br>(Thick-ness) | STRATA                                                  |  | Legend | Geology                                                 | Install / Backfill |  |  |  |  |  |  |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------------|--|-------|------|---------------|----------------|------------------|--------------------|-----------------|-----------------------|---------------------------------------------------------|--|--------|---------------------------------------------------------|--------------------|--|--|--|--|--|--|--|
| Project<br>Land at Pagham                                                                                                                                                        |  | Job No<br>70014147 |  | 1.50  | B    |               |                |                  | <div>1<br/>▼</div> |                 |                       | Description                                             |  |        |                                                         |                    |  |  |  |  |  |  |  |
| Firm brown slightly sandy slightly gravelly CLAY with abundant fine root material. Gravel is fine to medium, subangular to subrounded flint with rare brick fragments. (TOPSOIL) |  |                    |  |       |      |               |                |                  |                    |                 |                       | <div><div></div><div></div><div></div><div></div></div> |  | TS     | <div><div></div><div></div><div></div><div></div></div> |                    |  |  |  |  |  |  |  |
| Stiff orangeish brown CLAY. (RIVER TERRACE DEPOSITS)                                                                                                                             |  |                    |  |       |      |               |                |                  |                    |                 |                       | <div><div></div><div></div><div></div><div></div></div> |  | RT     | <div><div></div><div></div><div></div><div></div></div> |                    |  |  |  |  |  |  |  |
| 0.90 m bgl becoming slightly gravelly. Gravel is fine to coarse, subangular to subrounded flint.                                                                                 |  |                    |  |       |      |               |                |                  |                    |                 |                       |                                                         |  |        |                                                         |                    |  |  |  |  |  |  |  |
| Light orangeish brown slightly clayey gravelly SAND. Gravel is fine to coarse, subangular to rounded flint. (RIVER TERRACE DEPOSITS)                                             |  |                    |  |       |      |               |                |                  |                    |                 |                       | <div><div></div><div></div><div></div><div></div></div> |  | RT     | <div><div></div><div></div><div></div><div></div></div> |                    |  |  |  |  |  |  |  |
| Exploratory hole completed at 1.7m bgl.                                                                                                                                          |  |                    |  |       |      |               |                |                  |                    |                 |                       |                                                         |  | END    |                                                         |                    |  |  |  |  |  |  |  |

|                                                                                                                                |
|--------------------------------------------------------------------------------------------------------------------------------|
| <p><b>General Remarks</b><br/> Groundwater encountered at 1.4m bgl.<br/> No visual or olfactory evidence of contamination.</p> |
|--------------------------------------------------------------------------------------------------------------------------------|

Shoring/Support: None  
Stability: Stable

Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification.



|        |       |
|--------|-------|
| Length | 1.50m |
|--------|-------|

Width 0.50m

|             |                       |
|-------------|-----------------------|
| Orientation | 90 degrees from north |
|-------------|-----------------------|

|           |    |
|-----------|----|
| Logged By | VK |
|-----------|----|

|                      |       |
|----------------------|-------|
| Ground Level (m AOD) | 5.685 |
|----------------------|-------|

|                   |                   |
|-------------------|-------------------|
| Method/Plant Used | 8 Tonne Excavator |
|-------------------|-------------------|

|        |                        |
|--------|------------------------|
| Client | Hallam Land Management |
|--------|------------------------|

Co-Ordinates (NGR)  
E 489338 N 98858

|            |                     |
|------------|---------------------|
| Contractor | Bastable Plant Hire |
|------------|---------------------|

|      |          |
|------|----------|
| Date | 13-11-15 |
|------|----------|

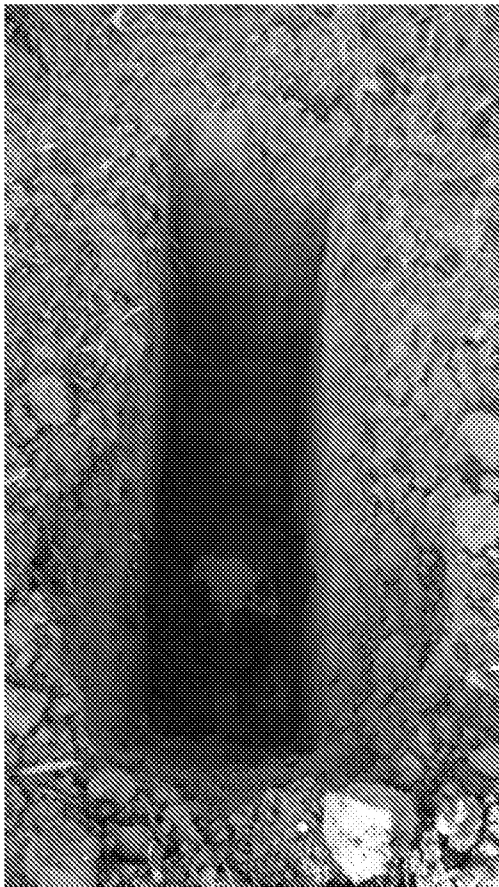
Scale 1:20.0

Sheet  
1 of 1

Trial Hole No.

**SA06A**

08 WSP TP LOG LS 1 PHOTO 70014147 - LAND AT PAGHAM.GPJ WSPETEMPLATE1.03.GDT 3/12/15

|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |        |                                                                                                                                                        |                                                                                     |         |                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------------|--|------|---------------|----------------|------------------|-------|-----------------|-----------------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------|-------------------------------------------------------------------------------------|
| <div><div><div><div><div></div><div>WSP</div></div><div>WSP   Parsons Brinckerhoff<br/>One Queens Drive, Birmingham<br/>B5 4PJ<br/>Telephone: 01213524700</div></div></div><div>TRIAL PIT LOG</div></div> |  | Depth              |  | Type | PID<br>(ppmV) | HSV<br>(kN/m2) | P Pen<br>(kN/m2) | Water | Elev.<br>(mAOD) | Depth<br>(Thick-ness) | STRATA |                                                                                                                                                        |                                                                                     |         |                                                                                     |
| Project<br>Land at Pagham                                                                                                                                                                                 |  | Job No<br>70014147 |  |      |               |                |                  |       |                 |                       |        | Description                                                                                                                                            | Legend                                                                              | Geology | Install / Backfill                                                                  |
|                                                                                                                         |  |                    |  |      |               |                |                  |       |                 |                       |        | Firm brown slightly sandy slightly gravelly CLAY with abundant fine root material. Gravel is fine to medium, subangular to subrounded flint. (TOPSOIL) |  | TS      |  |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |        | (0.40)                                                                                                                                                 |  |         |                                                                                     |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |        | 5.29 0.40                                                                                                                                              |  |         |                                                                                     |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |        | (0.80)                                                                                                                                                 |  | RT      |  |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |        | 4.49 1.20                                                                                                                                              |  |         |                                                                                     |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |        | 4.39 1.30                                                                                                                                              |  | RT      |  |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |        | Light orangeish brown slightly clayey gravelly SAND. Gravel is fine to coarse, subangular to rounded flint. (RIVER TERRACE DEPOSITS)                   |  | END     |                                                                                     |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |        | Exploratory hole completed at 1.3m bgl.                                                                                                                |                                                                                     |         |                                                                                     |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |        |                                                                                                                                                        |                                                                                     |         |                                                                                     |
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|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |        |                                                                                                                                                        |                                                                                     |         |                                                                                     |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |        |                                                                                                                                                        |                                                                                     |         |                                                                                     |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |        |                                                                                                                                                        |                                                                                     |         |                                                                                     |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |        |                                                                                                                                                        |                                                                                     |         |                                                                                     |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |        |                                                                                                                                                        |                                                                                     |         |                                                                                     |
|                                                                                                                                                                                                           |  |                    |  |      |               |                |                  |       |                 |                       |        |                                                                                                                                                        |                                                                                     |         |                                                                                     |



## Annex C – Soakaway Results

Project: Land at Pagham  
 Code: 70014147  
 Client: Hallam Land Management

**TEST DATA**

|                             |            |
|-----------------------------|------------|
| Pit reference               | SA01C      |
| Test reference              | 1.0        |
| Test date                   | 12/11/2015 |
| Test start time             | 10:52:00   |
| Pit depth (m)               | 1.7        |
| Pit width (m)               | 0.5        |
| Pit length (m)              | 1.7        |
| Depth to standing water (m) | 0.7        |

**Test 1**

Subsequent tests not undertaken.

| Time (min) | Depth (m) |
|------------|-----------|
| 0.0        | 0.70      |
| 0.5        | 0.70      |
| 1.0        | 0.70      |
| 2.0        | 0.70      |
| 3.0        | 0.70      |
| 4.0        | 0.70      |
| 5.0        | 0.70      |
| 10.0       | 0.70      |
| 15.0       | 0.70      |
| 30.0       | 0.70      |
| 60.0       | 0.76      |
| 120.0      | 0.80      |
| 150.0      | 0.80      |
| 180.0      | 0.81      |
| 210.0      | 0.82      |
| 240.0      | 0.82      |
|            |           |
|            |           |
|            |           |

Method of calculation      Test did not complete - no soil infiltration rate calculated.

Pit gravel filled?      No

Max. depth (m)      1.70

Effective depth (m)      0.70

Effective drop (m)      1.00

75% effective full depth (m)      0.95

50% effective full depth (m)      1.20

25% effective full depth (m)      1.45

t75 (min)

t50 (min)

t25 (min)

**Trial Pit Log**

| Depth (m bgl) | Geological description                                                                                                        |
|---------------|-------------------------------------------------------------------------------------------------------------------------------|
| 0.0-0.2       | Firm brown slightly sandy CLAY with abundant fine root material. (TOPSOIL)                                                    |
| 0.2-1.6       | Stiff greyish brown slightly sandy CLAY.                                                                                      |
| 1.6-1.8       | Soft light brown sandy gravelly CLAY with occasional flint cobbles. Gravel is fine to coarse, subangular to subrounded flint. |



## TRIAL PIT SOAKAGE TEST

Project: Land at Pagham  
Code: 70014147  
Client: Hallam Land Management

### TEST DATA

|                             |            |
|-----------------------------|------------|
| Pit reference               | SA02B      |
| Test reference              | 1.0        |
| Test date                   | 12/11/2015 |
| Test start time             | 12:15:00   |
| Pit depth (m)               | 1.4        |
| Pit width (m)               | 0.6        |
| Pit length (m)              | 1.6        |
| Depth to standing water (m) | 0.4        |

### Test 1

| Time (min) | Depth (m) |
|------------|-----------|
| 0.0        | 0.40      |
| 0.5        | 0.40      |
| 1.0        | 0.40      |
| 2.0        | 0.40      |
| 3.0        | 0.40      |
| 4.0        | 0.40      |
| 5.0        | 0.40      |
| 10.0       | 0.40      |
| 15.0       | 0.40      |
| 30.0       | 0.42      |
| 60.0       | 0.43      |
| 120.0      | 0.43      |
| 150.0      | 0.44      |
| 180.0      | 0.45      |
|            |           |
|            |           |
|            |           |
|            |           |

Subsequent tests not undertaken.

Method of calculation Test did not complete - no soil infiltration rate calculated.

Pit gravel filled? No

Max. depth (m) 1.40

Effective depth (m) 0.40

Effective drop (m) 1.00

75% effective full depth (m) 0.65

50% effective full depth (m) 0.90

25% effective full depth (m) 1.15

t75 (min)

t50 (min)

t25 (min)

### Trial Pit Log

| Depth (m bgl) | Geological description                                                     |
|---------------|----------------------------------------------------------------------------|
| 0.0-0.3       | Firm brown slightly sandy CLAY with abundant fine root material. (TOPSOIL) |
| 0.3-1.7       | Stiff light brown CLAY.                                                    |

# TRIAL PIT SOAKAGE TEST

Project: Land at Pagham  
Code: 70014147  
Client: Hallam Land Management

## TEST DATA

|                             |            |
|-----------------------------|------------|
| Pit reference               | SA03       |
| Test reference              | 1.0        |
| Test date                   | 13/11/2015 |
| Test start time             | 11:57:00   |
| Pit depth (m)               | 1.6        |
| Pit width (m)               | 0.50       |
| Pit length (m)              | 1.7        |
| Depth to standing water (m) | 0.7        |

## Test 1

Subsequent tests not undertaken.

| Time (min) | Depth (m) |
|------------|-----------|
| 0.0        | 0.70      |
| 0.5        | 0.70      |
| 1.0        | 0.70      |
| 2.0        | 0.70      |
| 3.0        | 0.70      |
| 4.0        | 0.70      |
| 5.0        | 0.70      |
| 10.0       | 0.70      |
| 15.0       | 0.70      |
| 30.0       | 0.70      |
| 60.0       | 0.70      |
| 120.0      | 0.70      |
| 150.0      | 0.70      |
| 180.0      | 0.70      |
|            |           |
|            |           |
|            |           |
|            |           |
|            |           |

Method of calculation Test did not complete - no soil infiltration rate calculated.

Pit gravel filled? No

Max. depth (m) 1.60

Effective depth (m) 0.70

Effective drop (m) 0.90

75% effective full depth (m) 0.93

50% effective full depth (m) 1.15

25% effective full depth (m) 1.38

t75 (min)

t50 (min)

t25 (min)

## Trial Pit Log

| Depth (m bgl) | Geological description                                                                                                                            |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 0.0-0.4       | Firm brown slightly sandy CLAY with rare gravel and abundant fine root material. Gravel is fine to medium, subrounded to rounded flint. (TOPSOIL) |
| 0.4-2.0       | Firm orangeish brown mottled greyish brown CLAY.                                                                                                  |
| 2.0-2.4       | Firm orangeish brown sandy CLAY.                                                                                                                  |

# TRIAL PIT SOAKAGE TEST

Project: Land at Pagham  
Code: 70014147  
Client: Hallam Land Management

## TEST DATA

|                             |            |
|-----------------------------|------------|
| Pit reference               | SA04       |
| Test reference              | 1.0        |
| Test date                   | 13/11/2015 |
| Test start time             | 11:09:00   |
| Pit depth (m)               | 1.5        |
| Pit width (m)               | 0.50       |
| Pit length (m)              | 1.4        |
| Depth to standing water (m) | 0.5        |

### Test 1

Subsequent tests not undertaken.

| Time (min) | Depth (m) |
|------------|-----------|
| 0.0        | 0.50      |
| 0.5        | 0.50      |
| 1.0        | 0.50      |
| 2.0        | 0.50      |
| 3.0        | 0.50      |
| 4.0        | 0.50      |
| 5.0        | 0.50      |
| 10.0       | 0.50      |
| 15.0       | 0.50      |
| 30.0       | 0.50      |
| 60.0       | 0.53      |
| 120.0      | 0.55      |
| 150.0      | 0.55      |
| 180.0      | 0.55      |
| 210.0      | 0.55      |
|            |           |
|            |           |
|            |           |
|            |           |

Method of calculation Test did not complete - no soil infiltration rate calculated.

Pit gravel filled? No

Max. depth (m) 1.50

Effective depth (m) 0.50

Effective drop (m) 1.00

75% effective full depth (m) 0.75

50% effective full depth (m) 1.00

25% effective full depth (m) 1.25

t75 (min)

t50 (min)

t25 (min)

### Trial Pit Log

| Depth (m bgl) | Geological description                                                     |
|---------------|----------------------------------------------------------------------------|
| 0.0-0.2       | Firm brown slightly sandy CLAY with abundant fine root material. (TOPSOIL) |
| 0.2-0.5       | Stiff brown slightly sandy CLAY.                                           |
| 0.5-1.1       | Stiff pale orangeish brown slightly sandy CLAY.                            |
| 1.1-2.0       | Firm pale brown mottled orangeish brown slightly sandy CLAY.               |
| 2.0-2.2       | Firm light grey mottled orangeish brown silty slightly sandy CLAY.         |



## TRIAL PIT SOAKAGE TEST

Project: Land at Pagham  
Code: 70014147  
Client: Hallam Land Management

### TEST DATA

|                             |            |
|-----------------------------|------------|
| Pit reference               | SA05       |
| Test reference              | 1.0        |
| Test date                   | 12/11/2015 |
| Test start time             | 13:05:00   |
| Pit depth (m)               | 1.2        |
| Pit width (m)               | 0.45       |
| Pit length (m)              | 1.5        |
| Depth to standing water (m) | 0.4        |

### Test 1

| Time (min) | Depth (m) |
|------------|-----------|
| 0.0        | 0.40      |
| 0.5        | 0.40      |
| 1.0        | 0.40      |
| 2.0        | 0.40      |
| 3.0        | 0.40      |
| 4.0        | 0.40      |
| 5.0        | 0.40      |
| 10.0       | 0.40      |
| 15.0       | 0.40      |
| 30.0       | 0.40      |
| 60.0       | 0.40      |
| 120.0      | 0.40      |
| 150.0      | 0.40      |
| 180.0      | 0.40      |
|            |           |
|            |           |
|            |           |
|            |           |

Subsequent tests not undertaken.

Method of calculation Test did not complete - no soil infiltration rate calculated.

Pit gravel filled? No

Max. depth (m) 1.20

Effective depth (m) 0.40

Effective drop (m) 0.80

75% effective full depth (m) 0.60

50% effective full depth (m) 0.80

25% effective full depth (m) 1.00

t75 (min)

t50 (min)

t25 (min)

### Trial Pit Log

| Depth (m bgl) | Geological description                                                                                                                               |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0.0-0.3       | Firm brown slightly sandy CLAY with rare gravel and abundant fine root material. Gravel is fine to medium, subangular to subrounded flint. (TOPSOIL) |
| 0.3-1.5       | Firm orangeish brown CLAY.                                                                                                                           |

# TRIAL PIT SOAKAGE TEST

Project: Land at Pagham  
Code: 70014147  
Client: Hallam Land Management

## TEST DATA

|                             |            |
|-----------------------------|------------|
| Pit reference               | SA06C      |
| Test reference              | 1.0        |
| Test date                   | 13/11/2015 |
| Test start time             | 10:31:00   |
| Pit depth (m)               | 1.0        |
| Pit width (m)               | 0.45       |
| Pit length (m)              | 1.4        |
| Depth to standing water (m) | 0.5        |

## Test 1

Subsequent tests not undertaken.

| Time (min) | Depth (m) |
|------------|-----------|
| 0.0        | 0.50      |
| 0.5        | 0.50      |
| 1.0        | 0.50      |
| 2.0        | 0.50      |
| 3.0        | 0.50      |
| 4.0        | 0.50      |
| 5.0        | 0.50      |
| 10.0       | 0.50      |
| 15.0       | 0.50      |
| 30.0       | 0.50      |
| 60.0       | 0.50      |
| 120.0      | 0.50      |
| 150.0      | 0.51      |
| 180.0      | 0.51      |
| 240.0      | 0.52      |
|            |           |
|            |           |
|            |           |
|            |           |

Method of calculation Test did not complete - no soil infiltration rate calculated.

Pit gravel filled? No

Max. depth (m) 1.00

Effective depth (m) 0.50

Effective drop (m) 0.50

75% effective full depth (m) 0.63

50% effective full depth (m) 0.75

25% effective full depth (m) 0.88

t75 (min)

t50 (min)

t25 (min)

## Trial Pit Log

| Depth (m bgl) | Geological description                                                                                                                                                           |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0.0-0.4       | Firm brown slightly sandy slightly gravelly CLAY with abundant fine root material. Gravel is fine to medium, subangular to subrounded flint with rare brick fragments. (TOPSOIL) |
| 0.4-1.2       | Stiff orangeish brown CLAY.                                                                                                                                                      |

## Notes on Limitations

# LIMITATIONS FOR WSP LAND RESTORATION AND GROUND ENGINEERING DIVISION

## General

WSP Environmental Limited has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed and outlined in the body of the report. Unless explicitly agreed otherwise, in writing, this report has been prepared under WSP UK Limited standard Terms and Conditions- as included within our proposal to the Client.

Project specific appointment documents may be agreed on a project by project basis, at our discretion. A charge may be levied for both the time to review and finalise appointments documents and also for associated changes to the appointment terms. WSP Environmental Limited reserve the right to amend the fee should any changes to the appointment terms create an increase risk to WSP

The report needs to be considered in the light of the WSP proposal and associated limitations of scope. The report needs to be read in full and isolated sections cannot be used without full reference to other elements of the report.

## Phase 1 Geo Environmental and Preliminary Risk Assessments

The works undertaken to prepare this report comprised a study of available and easily documented information from a variety of sources (including the Client), together with (where appropriate) a brief walk over inspection of the Site and correspondence with relevant authorities and other interested parties. Due to the short timescales associated with these projects responses may not have been received from all parties. WSP Environmental Limited cannot be held responsible for any disclosures that are provided post production of our report and will not automatically update our report.

The opinions given in this report have been dictated by the finite data on which they are based and are relevant only for the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, WSP Environmental Limited reserves the right to review such information and, if warranted, to modify the opinions accordingly.

It should be noted that any risks identified in this report are perceived risks based on the information reviewed. Actual risks can only be assessed following intrusive investigations of the Site.

WSP does not warrant work / data undertaken / provided by others.

This section covers reports with the following titles or combination of titles: phase 1; Desk top study; geo environmental assessment; development appraisal; preliminary environmental risk assessment; constraints report; due diligence report; geotechnical development review; environmental statement; environmental chapter; geotechnical development risk register or baseline environmental assessment.

## Intrusive Investigation Reports

The investigation has been undertaken to provide information concerning the type and degree of contamination present at the Site in order to allow a generic risk assessment to be undertaken or the soil properties to allow for geotechnical development constraints to be identified.

The objectives of the investigation are limited to establishing the risks associated with potential contamination sources with the potential to cause harm to human health, building materials, the environment (including adjacent land), or controlled waters. For Geotechnical investigations the purpose is to broadly identify the development constraints associated with the physical property of the soils underlying the site.

The amount of exploratory work, soil property and chemical testing undertaken has necessarily been restricted by various factors which may include accessibility, the presence of services; existing buildings; current site usage or short timescales. The exploratory holes completed assess only a small percentage of the area in relation to the overall size of the Site, and as such can only provide a general indication of conditions. The number of sampling points and the methods of sampling and testing do not preclude the possible existence of localised "hotspots" of contamination where concentrations may be significantly higher than those actually encountered or ground conditions that vary from those identified. In addition, there may be exceptional ground conditions elsewhere on the site which have not been disclosed by this investigation and which have therefore not been taken into account in this report. For example these include spatial variations in soil properties; the varying thickness and physical nature of the strata identified and changes in groundwater levels or flow rates.

The inspection; testing and monitoring records relate specifically to the investigation points and the timeframe that the works were undertaken. They will also be limited by the techniques employed. WSP Environmental Limited have interpreted between these points based upon assumptions to develop our interpretation and conclusions. The assumption made in forming our conclusions is that the ground and groundwater conditions (both chemically and physically) are the same as have been encountered during the works undertaken at the specific points of investigation.

On 1st April 2010, BS EN 1997-1:2004 (Eurocode 7: Geotechnical Design – Part 1) became the mandatory baseline standard for geotechnical ground investigations.

In terms of geotechnical design for foundations, slopes, retaining walls and earthworks, EC7 sets guidance on design procedures including specific guidance on the numbers and spacings of boreholes for geotechnical design, there are limits to methods of ground investigation and the quality of data obtained and there are also prescriptive methods of assessing soil strengths and methods of design. Unless otherwise explicitly stated, the work has not been undertaken in accordance with EC7. A standard geotechnical interpretative report will not meet the requirements of the Geotechnical Design Report (GDR) under Eurocode 7. The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. The report is likely to represent a Ground Investigation Report (GIR) under the Eurocode 7 guidance.

During any build programme WSP Environmental Limited should be consulted if alternative ground conditions are encountered. It assumes during any site works that the contractor will use their best endeavours to manage and control groundwater and other unforeseen ground conditions. WSP Environmental Limited will not be liable for actions taken prior to consultation.

The scope of the investigation was selected on the basis of the specific development and land use scenario proposed by the Client and may be inappropriate to another form of development or scheme. If the development layout was not known at the time of the investigation the report findings may need revisiting once the development layout is confirmed.

The risk assessment and opinions provided are based on currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values. Specific assumptions associated with the WSP Environmental Limited risk assessment process have been outlined within the body or associated appendix of the report.

Additional investigations may be required in order to satisfy relevant planning conditions or to resolve any engineering and environmental issues.

If costs have been included in relation to additional site works, and / or site remediation works these must be considered as indicative only and must, be confirmed by a qualified quantity surveyor.

The following report titles (or combination) may cover this category of work: geo environmental site investigation; geotechnical assessment; GIR (Ground Investigation reports); preliminary environmental and geotechnical risk assessment; geotechnical risk register.

## **Detailed Quantitative Risk Assessments and Remedial Strategy Reports**

These reports build upon previous report versions and associated notes. The scope of the investigation; further testing and monitoring and associated risk assessments were selected on the basis of the specific development and land use scenario proposed by the Client and may not be appropriate to another form of development or scheme layout. The risk assessment and opinions provided are based on currently available approaches in the generation of Site Specific Assessment Criteria relating to contamination concentrations and are not considered to represent a risk in a specific land use scenario to a specific receptor. No liability can be accepted for the retrospective effects of any future changes or amendments to these values, associated models or associated guidance.

The outputs of the Detailed Quantitative Risk Assessments are based upon WSP Environmental Limited manipulation of standard risk assessment models. These are our interpretation of the risk assessment criteria. Prior to adoption they will need discussing and agreeing with the Regulatory Authorities prior to adoption on site. The regulatory discussion and engagement process may result in an alternative interpretation being determined and agreed. The process and timescales associated with the Regulatory Authority engagement are not within the control of WSP. All costs and programmes presented as a result of this process should be validated by a quantity surveyor and should be presumed to be indicative.

## **Geotechnical Design Report (GDR)**

The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. All the relevant information needs to be provided to allow for a GDR to be produced.

### **Monitoring (including Remediation Monitoring reports)**

These reports are factual in nature and comprise monitoring, normally groundwater and ground gas and data provided by contractors as part of an earthworks or remedial works.

The data is presented and will be compared with assessment criteria.

### **Asbestos in soils**

Unless explicitly included for in our proposal, our investigation does not include for a formal asbestos assessment. The inspection for asbestos, either as asbestos containing materials (ACMs) lying on the surface or as ACMs and/or as loose asbestos fibres within made ground / stockpiles are excluded.. Our report will include for the factual reporting of any soil screens that are collected. These results should be treated cautiously and should not be relied upon to provide detailed and representative information on the delineation, type and extent of bulk ACMs and/or trace loose asbestos fibres within the soil matrix at the site.

Where we indicate in our proposal that we will consider asbestos we will undertake screening of representative soil samples for the presences / absence of loose asbestos fibres. If these are found a further and more detailed specific investigation into asbestos in soils, where asbestos quantification testing will be undertaken. These investigations are associated with more rigorous monitoring of asbestos and health and safety provisions.

# Appendix F

## SUDS DESIGN STATEMENT

# SUDS DESIGN STATEMENT

## GENERAL PRINCIPLES AND CONSIDERATIONS

The purpose of the proposed drainage strategy is to ensure that the proposed scheme does not exacerbate any existing flood risks upstream or downstream of the site, in accordance with the principles set out within the NPPF.

Sustainable Drainage Systems (SuDS) will be implemented throughout this development scheme. The conceptual SuDS strategy for the proposed development has been devised using the principles outlined within the current published guidance in the form of the NPPF, PPG and CIRIA amongst others.

The impact of climate change is a key factor when determining a drainage strategy. The NPPF and PPG guidance advocate a “development lifespan” approach for dealing with climate change allowances. The PPG specifies a minimum design life for residential development of 100 years.

The Environment Agency published updated allowances for climate change<sup>3</sup> in February 2016. The updated allowances are based on a regional approach to peak river flow and sea level allowances along with updated allowances for peak rainfall intensity. Relevant parts of Tables 1 and 2 are included below.

| <b>SOUTH-EAST<br/>RIVER BASIN<br/>DISTRICT</b> | <b>TOTAL POTENTIAL<br/>CHANGE ANTICIPATED<br/>FOR '2020s' (2015 TO 2039)</b> | <b>TOTAL POTENTIAL<br/>CHANGE ANTICIPATED<br/>FOR '2050s' (2040 TO 2069)</b> | <b>TOTAL POTENTIAL<br/>CHANGE ANTICIPATED<br/>FOR '2080s' (2070 TO 2115)</b> |
|------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Upper End                                      | 25%                                                                          | 50%                                                                          | 105%                                                                         |
| Higher Central                                 | 15%                                                                          | 30%                                                                          | 45%                                                                          |
| Central                                        | 10%                                                                          | 20%                                                                          | 35%                                                                          |

| <b>APPLIES ACROSS<br/>ALL OF ENGLAND</b> | <b>TOTAL POTENTIAL<br/>CHANGE ANTICIPATED<br/>FOR '2020s' (2015 TO 2039)</b> | <b>TOTAL POTENTIAL<br/>CHANGE ANTICIPATED<br/>FOR '2050s' (2040 TO 2069)</b> | <b>TOTAL POTENTIAL<br/>CHANGE ANTICIPATED<br/>FOR '2080s' (2070 TO 2115)</b> |
|------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Upper end                                | 10%                                                                          | 20%                                                                          | 40%                                                                          |
| Central                                  | 5%                                                                           | 10%                                                                          | 20%                                                                          |

In light of the above guidance requirements, an increase of 40% in peak rainfall intensity has been used as the allowance for climate change within the proposed drainage design to determine the performance of the drainage system.

It is intended that all of the proposed SuDS and drainage exceedance devices located within the communal and open space areas will be offered for adoption to the LLFA or LPA. The proposed maintenance regimes for the devices should be in accordance with CIRIA C753 “The SuDS Manual” and other best practice guidelines. Should the LLFA or LPA not be willing to adopt certain aspects of the system, it is the intention that a third party management company be established to maintain the features in perpetuity. An adoption agreement between the developer and Maintenance Company will be based upon the CIRIA ICoP MA2 SuDS Maintenance Framework Agreement.

<sup>3</sup> <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

It is the intention across the site to mimic the existing drainage regime as close as possible and therefore prevent flood risk from being exacerbated on or off site.

The proposed drainage system will comprise of a traditional drainage network that will be supplemented, where appropriate, with various SuDS devices to provide source control, water quality treatment and biodiversity enhancement. The pipe drainage network will be designed to the current edition of Sewers for Adoption and offered to the incumbent operator for adoption under Section 104 of the Water Industry Act.

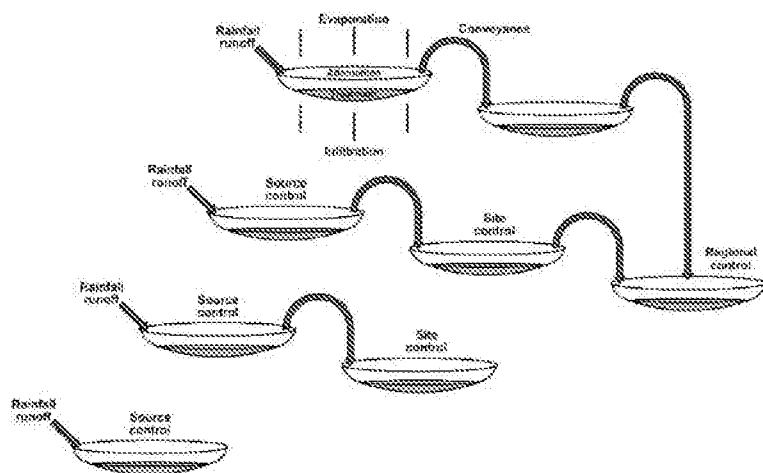
Due to the level of detail within the scheme layout at this stage, it is not possible to determine the final quantum and arrangement of the SuDS features within the site however, the intention of this report is to provide a commitment to the implementation of SuDS and a toolkit of options for future developers.

## THE SUDS MANAGEMENT TRAIN

In order to mimic natural catchment processes as closely as possible, a SuDS Management Train is proposed and uses drainage techniques to incrementally reduce pollution, flow rates and volumes.

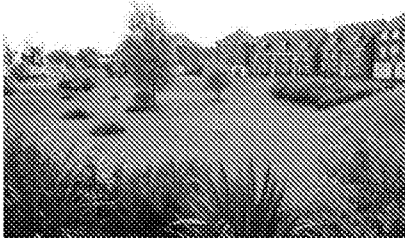
CIRIA C697 States:

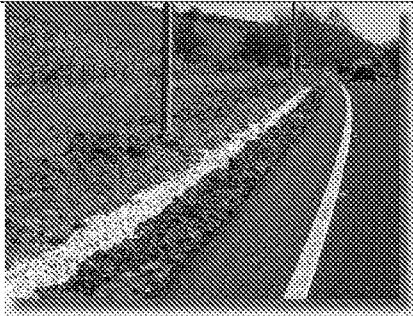
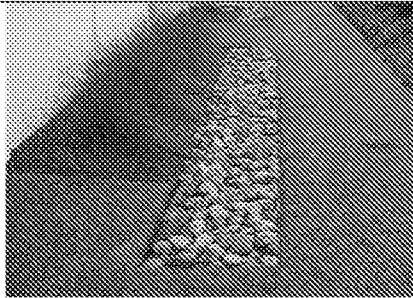
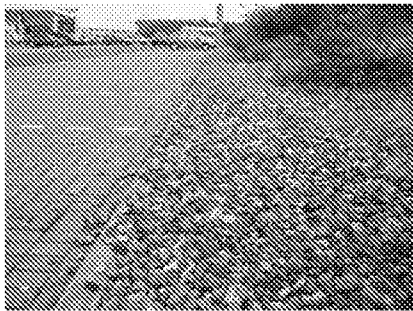
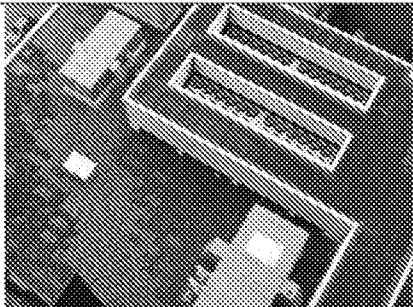
*“The management train is summarised in Figure 1.5. Wherever possible, storm water should be managed in small, cost-effective landscape features located within small sub-catchments rather than being conveyed to and managed in large systems at the bottom of drainage areas (end of pipe solutions). The techniques that are higher in the hierarchy are preferred to those further down so that prevention and control of water at source should always be considered before site or regional controls. However, where upstream control opportunities are restricted, a number of lower hierarchy options should be used in series. Water should be conveyed elsewhere only if it cannot be dealt with on site.”*



A hierarchy has been considered in applying the use of SuDS into the Proposed Development to help provide; prevention in terms of pollution, source control and site controls.

Whilst further details of the concept strategy are contained within **Chapter 5** of the FRA and **Appendices A and B**, the table below identifies a range of SuDS measures and their appropriateness within the site.

| FEATURE                          | DESCRIPTION                                                                                                                                                                                                                            | EXAMPLE                                                                              | APPROPRIATE                                                                                                                                                                                                              |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Filter Strips</b>             | These are wide, gently sloping areas of grass or other dense vegetation that treat runoff from adjacent impermeable areas.                                                                                                             |    | <p>✗</p> <p>A lack of suitable infiltration rates recorded on site limits the use of infiltration based SuDS devices such as filter strips. As such, their use has not been considered.</p>                              |
| <b>Swales</b>                    | Swales are broad, shallow channels covered by grass or other suitable vegetation. They are designed to convey and/or store runoff, and can infiltrate the water into the ground (if ground conditions allow).                          |    | <p>✓</p> <p>A large swale has been considered, collecting and attenuating all runoff from development south of the on-site drain. Further consideration will be given to roadside swales during the detailed design.</p> |
| <b>Infiltration Basins</b>       | Infiltration basins are depressions in the surface that are designed to store runoff and infiltrate the water to the ground. They may also be landscaped to provide aesthetic and amenity value.                                       |  | <p>✗</p> <p>A lack of suitable infiltration rates recorded on site limits the use of infiltration based SuDS devices such as infiltration basins. As such, their use has not been considered.</p>                        |
| <b>Wet Ponds</b>                 | Wet ponds are basins that have a permanent pool of water for water quality treatment. They provide temporary storage for additional storm runoff above the permanent water level. Wet ponds may provide amenity and wildlife benefits. |  | <p>✓</p> <p>It is expected wet ponds will be included below the invert level of the attenuation basins. The exact shape and size will be developed during the later design stage.</p>                                    |
| <b>Extended Detention Basins</b> | Extended detention basins are normally dry, though they may have small permanent pools at the inlet and outlet. They are designed to detain a certain volume of runoff as well as providing water quality treatment.                   |  | <p>✓</p> <p>Three basins are included in the proposed surface water strategy to attenuate runoff.</p>                                                                                                                    |

|                             |                                                                                                                                                                                                                                                                                                     |                                                                                      |                                                                                                                                                                                                                                                                                                         |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Constructed Wetlands</b> | Constructed wetlands are ponds with shallow areas and wetland vegetation to improve pollutant removal and enhance wildlife habitat.                                                                                                                                                                 |    | <p><b>x</b></p> <p>Constructed wetlands may be considered during the later stages of design as opposed to wet ponds.</p>                                                                                                                                                                                |
| <b>Filter Drains</b>        | Filter drains are trenches that are filled with permeable material. Surface water from the edge of paved areas flows into the trenches, is filtered and conveyed to other parts of the site. A slotted or perforated pipe may be built into the base of the trench to collect and convey the water. |    | <p><b>x</b></p> <p>Filter drains may be considered during the later stages of design subject to space and level constraints</p>                                                                                                                                                                         |
| <b>Infiltration Devices</b> | Infiltration devices temporarily store runoff from a development and allow it to percolate into the ground.                                                                                                                                                                                         |   | <p><b>x</b></p> <p>A lack of suitable infiltration rates recorded on site limits the use of infiltration based SuDS devices. As such, their use has not been considered.</p>                                                                                                                            |
| <b>Pervious Surfaces</b>    | Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse, or release to surface water.                                                                                                  |  | <p><b>x</b></p> <p>Pervious pavements may be included in the proposed strategy however due to poor infiltration rates any pervious surfaces may require some form of underdrain. It is expected the quantum and nature of any pervious surfaces will be detailed during the later stages of design.</p> |
| <b>Green Roofs</b>          | Green roofs are systems which cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation.                                                                                                                   |  | <p><b>x</b></p> <p>Due to the residential use of the development, green roofs have not been included in the design.</p>                                                                                                                                                                                 |

## WATER QUALITY

Impermeable surfaces collect pollutants from a wide variety of sources including cleaning activities, wear from car tyres, vehicle oil and exhaust leaks and general atmospheric deposition (source: CIRIA C609). The implementation of SuDS in development drainage provides a significant benefit in removal of pollutant from development run-off.

In most cases, contaminants become attached to sediment particles either before entering the water body or upon entry. CIRIA 609 reports that up to 90% of certain contaminants, usually trace elements, are transported in this way leaving a dissolved concentration of circa 10%.

Many SuDS systems rely on the infiltration of water through the ground layer into permeable sub soils or through sedimentation in low flow storage basins.

This settling and filtering of contaminated run off through a fine grained matrix separates the suspended contaminated sediment from the body of water subsequently causing the water to leave the SuDS device in a more polished form than how it entered; porous paving is a prime example of this.

Furthermore, by implementation of SuDS features it is possible to optimize overall pollutant removal as water will undergo this process of filtering before being discharged to an appropriate receptor. The overall percentage of removal can be calculated individually for each differing SuDS technique, this is shown by the formula below:

**Overall pollutant removal =  $(TPL \times C1) + (RPL \times C2) + (RPL \times C3) + \dots$  for each other control in series**

**Where: TPL – Total Pollutant Load**

**RPL – Remaining Pollutant Load (after previous treatment(s))**

**C(x) – Suds Control removal efficiency**

At present, the site and surrounding area does not benefit from any additional measures of storm water treatment.

Due to the need to provide wider sustainability benefits and view the development at a strategic level, SuDS will be implemented to passively treat run off from the development so as to have a positive impact on the surrounding natural environment.

As the site is not presently served by any means of storm water treatment mechanisms, by providing the afore SuDS within the proposed development it will be possible to maintain present water quality in the area and thus the development can be seen to be having no significant environmental impact in relation to water.

## HEALTH AND SAFETY

The proposed layout of the SuDS features will be designed in accordance with the best practice SuDS guidance documents and national standards, supplemented, where appropriate, with local LLFA / LPA guidance and the requirements of the water company and maintenance company to ensure the features are effective not only in terms of their hydraulic design but also from a safety perspective during construction, operation and maintenance.

Outline health and safety risk assessments should be completed for the individual drainage features proposed as part of the final site design, setting out the risks and incorporating proposals for how these are to be managed.