FOREMAN HOMES

LAND AT KINGSCROFT FARM, MEYRICK ROAD HAVANT, PO9 1NX

FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY

REPORT REF NO.
2200510-R03

JULY 2023

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CONTENTS

Page

1. INTRODUCTION 1
Site Location 1
Development Proposals 2

2. POLICY CONTEXT 3
National Planning Policy Framework 3
Flood and Water Management Act (2010) 3
Sustainable Drainage Systems - Non-statutory technical standards for sustainable drainage systems March 2015 4
Havant Borough Council Core Strategy (2011) 4
Partnership for Urban South Hampshire Strategic Flood Risk Assessment (Updated 2016) 5
Climate Change Allowances 6
Sequential Test Requirements 7
Exception Test Requirements 7

3. BASELINE CONDITIONS 9
Hydrology 9
Topography 9
Ground Conditions 10
Existing Sewer Infrastructure 12

4. SOURCES OF FLOODING 13
Flood Zone Designation 13
Fluvial / Tidal Flooding 14
Pluvial Flooding 16
Groundwater Flooding 16
Sewer Flooding 17
Artificial Sources 17

5. FLOOD RISK MANAGEMENT 19
Finished Floor Levels 19
Floodplain Compensation 19

Maintenance buffer 19
Safe Access and Egress 20
Flood Response Plan 20

6. PROPOSED SURFACE WATER DRAINAGE STRATEGY 21
Existing Surface Water Discharge 21
Proposed Sustainable Drainage Systems (SuDS) 21
Long Term Storage and Urban Creep 25
Overland Flow Routes 25
Water Quality 26
Maintenance and Management of System 26

7. PROPOSED FOUL WATER DRAINAGE STRATEGY 27

8. CONCLUSIONS 28

APPENDICES

Appendix A Proposed Development Layout and Landscaping Plans
Appendix B Culvert Survey
Appendix C Topographical Survey
Appendix D Ground Investigation Reports
Appendix E Southern Water Asset Plans
Appendix F Modelling Report and Environment Agency Correspondence
Appendix G Culvert Maintenance Easements
Appendix H Flood Response Plan
Appendix I Greenfield Run off Rates
Appendix J Ground Investigation Report
Appendix K Indicative Drainage Strategy
Appendix L Proposed Surface Water Drainage Calculations
Appendix M Pollution Hazard Indices Tables
Appendix N SuDS Maintenance Plan
Appendix O Foul Drainage Calculations

DOCUMENT CONTROL SHEET

REV	ISSUE PURPOSE	AUTHOR	CHECKED	APPROVED	DATE
-	DRAFT	TA	CC 	BC 	25/07/23

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1. INTRODUCTION

1.1. Ardent Consulting Engineers (hereafter referred to as "Ardent") has been commissioned by Foreman Homes to undertake a Flood Risk Assessment (FRA) and Drainage Strategy for the proposed residential development at Kingscroft Farm, Portsmouth (hereafter referred to as 'the site').

1.2. The contents of this FRA assess the implications of flood risk on the proposed development. This FRA has been prepared with specific reference to the requirements of National Planning Policy Framework (NPPF) released in July 2021 and the Planning Practice Guidance (PPG), which superseded the Technical Guidance to the NPPF, in March 2014. This report also takes into consideration the requirements within the Non-statutory Technical Standards for Sustainable Drainage Systems (March 2015) and its Best Practice Guidance (July 2015).

1.3. This FRA and Drainage Strategy serves as an update to a previous FRA undertaken by Ardent (Ref. 2200510-01) as part of a prior outline planning application at the site (Ref. APP/22/00669) submitted to Havant Borough Council (HBC).

1.4. This FRA and Drainage Strategy has been prepared to support a new outline planning application to be resubmitted to HBC.

Site Location

1.5. The Site is located off Meyrick Road, Havant, Hampshire. The Site is centred on National Grid Reference 470574mN, 106180mE (TQ 33089 79438). The development Site is approximately 3.4ha in total and comprises arable farmland. Figure 1-1 below shows the site location plan.

1.6. The application site is bound to the north and west by the Hermitage Stream and the A27 to the south. To the east of the site are residential and commercial properties.

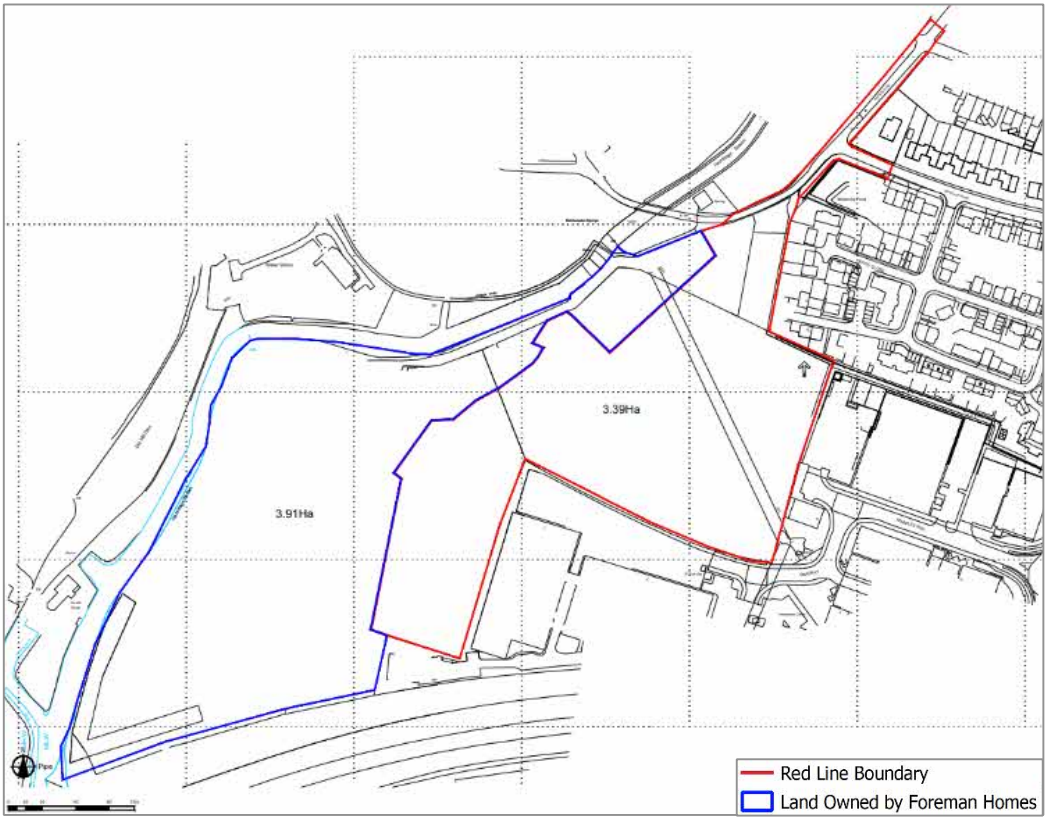


Figure 1-1: Site Location Plan

Development Proposals

1.7. The proposal includes the redevelopment of Site to provide a residential development comprising of up to 120 new dwellings with associated parking, infrastructure, gardens, and soft landscaping.

1.8. Refer to Appendix A for the full development proposals.

2. POLICY CONTEXT

National Planning Policy Framework

2.1. The National Planning Policy Framework (NPPF) was introduced on 27 March 2012. This document was revised in July 2018, February 2019 and most recently July 2021; where paragraphs 159 to 169 inclusive establish the Planning Policy relating to flood risk management. The Technical Guide to the NPPF was superseded by the Planning Practice Guidance (PPG) in March 2014.

2.2. It states all plans should apply a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change –to avoid where possible, flood risk to people and property. They should do this and manage residual risk, by:

a) applying the sequential test, and if necessary, the exception test as set out below;

b) safeguarding land from development that is required for current and future flood management;

c) using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding (making as much use as possible of natural flood management techniques as part of an integrated approach to flood risk management); and

d) where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development including housing, to more sustainable locations.

2.3. The Planning Practice Guidance (PPG) provides the methodology required to undertake the Sequential and Exception Tests.

Flood and Water Management Act (2010)

2.4. The Flood and Water Management Act places a duty on all flood risk management authorities to co-operate with each other. The act also

provides lead local flood authorities and the Environment Agency with a power to request information required in connection with their flood risk management functions.

Sustainable Drainage Systems - Non-statutory technical standards for sustainable drainage systems March 2015

2.5. The Non-statutory technical standards for sustainable drainage systems were published in March 2015. They should be used in conjunction with the Planning Practice Guidance. In addition, the Best Practice Guidance for the Non-statutory technical standards was published in July 2015 by LASOO.

2.6. The Local Planning Authority (LPA) may set local requirements for planning permission that have the effect of more stringent requirements than these non-statutory technical standards.

2.7. In addition, SuDS should be designed in accordance with CIRIA 753 SuDS Manual, which represents current best practice.

Havant Borough Council Core Strategy (2011)

2.8. The Havant Borough Council Core Strategy sets the planning framework for the communities until 2026. In preparing this strategy the council has sought to address local needs, especially for housing and economic development, with an emphasis on high quality design and stewardship of the borough's high quality natural and built environment.

Policy CS15 Flood and Coastal Erosion Risk

2.9. Development in areas at risk of flooding now and in the future as identified on the latest Environment Agency flood risk maps and Strategic Flood Risk Assessment climate change maps will only be permitted where:

a) It meets the sequential and exception test (where required) in relation to PPS25.

b) The site is located in a low hazard area as defined in the Strategic Flood Risk Assessment.

c) A site-specific flood risk assessment demonstrates that the development will be safe, including the access, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

d) The scheme incorporates flood protection, flood resilience and resistance measures appropriate to the character and biodiversity of the area and the specific requirements of the site.

e) Appropriate flood warning and evacuation plans are in place.

f) New site drainage systems are designed taking account of events which exceed the normal design standard.

All development will be required to ensure that there is no net increase in surface water run off. Priority should be given to incorporating Sustainable Drainage Systems (SuDS) to manage surface water drainage, unless it is proven that SuDS are not appropriate. Where SuDs are provided arrangements must be put in place for their whole life management and maintenance.

The council will work with partners to implement the Coastal Policy Zones in the North Solent Shoreline Management Plan to ensure that development avoids areas at risk from coastal erosion and coastal flooding and that areas required to offset coastal squeeze and prevent habitat fragmentation, to allow species to adapt to climate change, are identified and protected from development.

Partnership for Urban South Hampshire Strategic Flood Risk Assessment (Updated 2016)

2.10. The Partnership for Urban South Hampshire Strategic Flood Risk Assessment (PUSH SFRA) was produced by Atkins in 2016 and is an update to the original Strategic Flood Risk Assessment Produced in 2007. PUSH is a partnership of Hampshire County Council, Isle of Wight, Portsmouth and Southampton and the district authorities of Eastleigh, East Hampshire, Fareham, Gosport, Havant, New Forest, Test Valley and Winchester.

2.11. The PUSH SFRA includes mapping of flood risk within the area.

Climate Change Allowances

2.15. The Planning Practice Guidance states that to allow for the predicted impacts of climate change on Peak River Flow Allowances, consideration should be given to the catchment within which the site is located. The site is located within the East Hampshire Management Catchment and as such the following allowances detailed in Table 3-1 are applicable to the site.

Table 2-1: East Hampshire Management Catchment peak river flow allowances

	Central	Higher	Upper
2020s	19%	24%	37%
2050s	22%	30%	51%
2080s	37%	51%	88%

2.16. For 'more and 'less' vulnerable development the Planning Practice Guidance states that the central allowance should be used. Therefore, under the NPPF, an allowance of 37% would achieve the policy requirements in assessing the flood risk associated with the development.

2.17. A model has been run as detailed below, utilising the previous peak river flow allowances of 45%, which would represent a higher flood risk on site and is therefore more conservative.

2.18. The Planning Practice Guidance states that to allow for the predicted impacts of climate change on surface water runoff within the East Hampshire Management Catchment, the following increases detailed in Table 3-2 below to rainfall intensity should be allowed for. For development with a lifetime up to or beyond 2100, the upper end allowances should be used.

Table 2-2: East Hampshire Management Catchment Peak Rainfall Allowances

	Central	Upper
3.3% annual exceedance rainfall event		
2050s	20%	35%
2070s	25%	40%
1% annual exceedance rainfall event		
2050s	20%	40%
2070s	25%	45%

2.19. Therefore, under the NPPF an allowance of 45% for the effects of climate change for the 1% annual exceedance rainfall event would achieve the policy requirements in designing the drainage elements the proposed residential redevelopment.

Sequential Test Requirements

2.20. The aim of the sequential test is to steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.

2.21. As the site is located in Flood Zone 1, located outside of the 1 in 100 Year + 40% CC fluvial flood extent, and is at low risk of flooding from all other sources, the Sequential Test would not be required.

Exception Test Requirements

2.22. Table 2 (Flood risk vulnerability classification) of the Planning Practice Guidance (PPG) classes the residential use as More Vulnerable. According to Table 3 (refer to Figure 2-1 below) of the PPG, the Site,

which is a More Vulnerable development in Flood Zone 1, would not be required to undergo the Exception Test.

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	✗	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	✗	✗	✗	✓*

Key:

✓ Development is appropriate

✗ Development should not be permitted.

Figure 2-1: Extract from the PPG - Table 3: Flood Risk Vulnerability

3. BASELINE CONDITIONS

Hydrology

3.1. Hermitage Stream, a Main River, bounds the site to the north and west. The coastline is located approximately 500m to the south.

3.2. A 1500mm dia bypass culvert, consisting of cast iron and concrete sections also exists within the site boundary running from northeast to southwest as shown on Figure 3-1 below. Correspondence with the EA confirmed that this is also classified as a main river.

3.3. A survey was carried out by OnSite in January 2020. The full survey and condition assessment can be found in Appendix B. The depth to invert level of the culvert was found to be approximately 3m bgl.

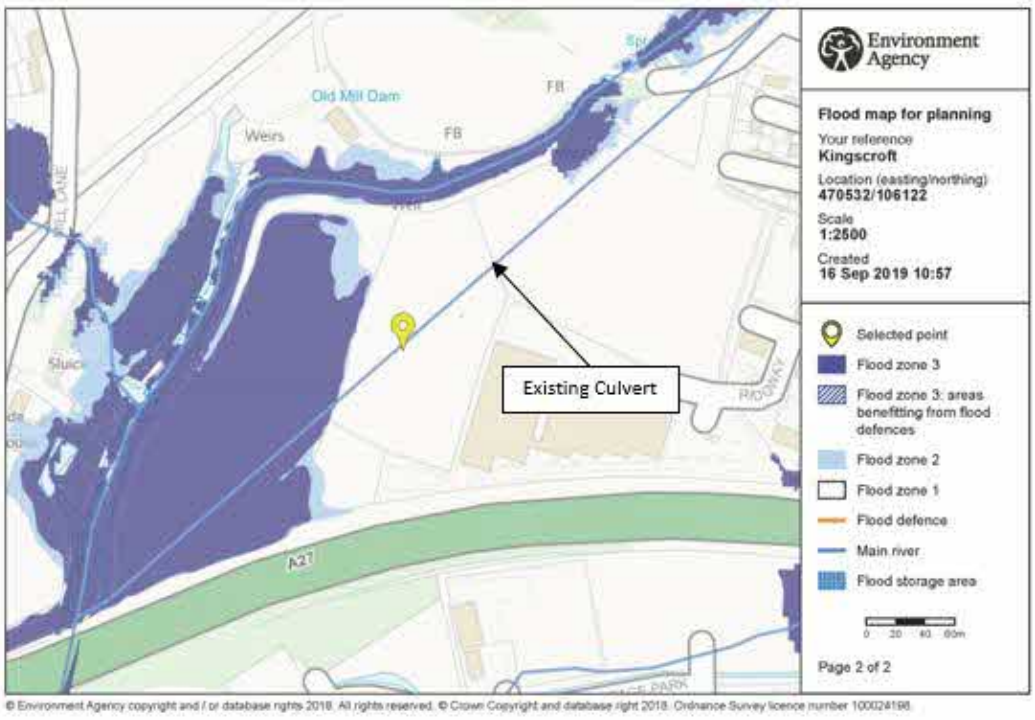


Figure 3-1: Existing Culvert Within Site

Topography

3.4. A topographical survey of the site was carried out in October 2019 and is included in Appendix C. Elevations across the Site are in the order of 5.87 – 4.69 m AOD, with a slope generally falling from north to south with an average gradient of 1 in 170.

Ground Conditions

3.5. A review of British Geological Survey (BGS) mapping indicates that the geology of the site consists of Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation (undifferentiated) with superficial deposits of River Terrace Deposits (undifferentiated) – (Sand, Silt And Clay) and Alluvium (Clay, Silt, Sand and Gravel) recorded across the Site. Refer to Figure 3-2 and Figure 3-3 below for BGS Bedrock and Superficial Deposits details respectively.

3.6. There are three boreholes recorded within the site; SU70NW94, SU70NW95, and SU70NW96. The records at the site indicate the presence of topsoil underlain by firm brown clay with flint, which is in turn underlain by brown sandy clay and flint. Groundwater was encountered at approximately 5m bgl.

3.7. In addition, a ground investigation report was undertaken by Soils Ltd at the site in November 2019 which confirms the above ground conditions. This indicated topsoil/made ground consisting of clay at depths of 0.1-0.4m bgl underlain by clay and sand river terrace deposits to depths of 1.5-5m bgl, which are in turn underlain by the Lewes Nodular Chalk Formation. The Ground Investigation Reports can be found in Appendix D.

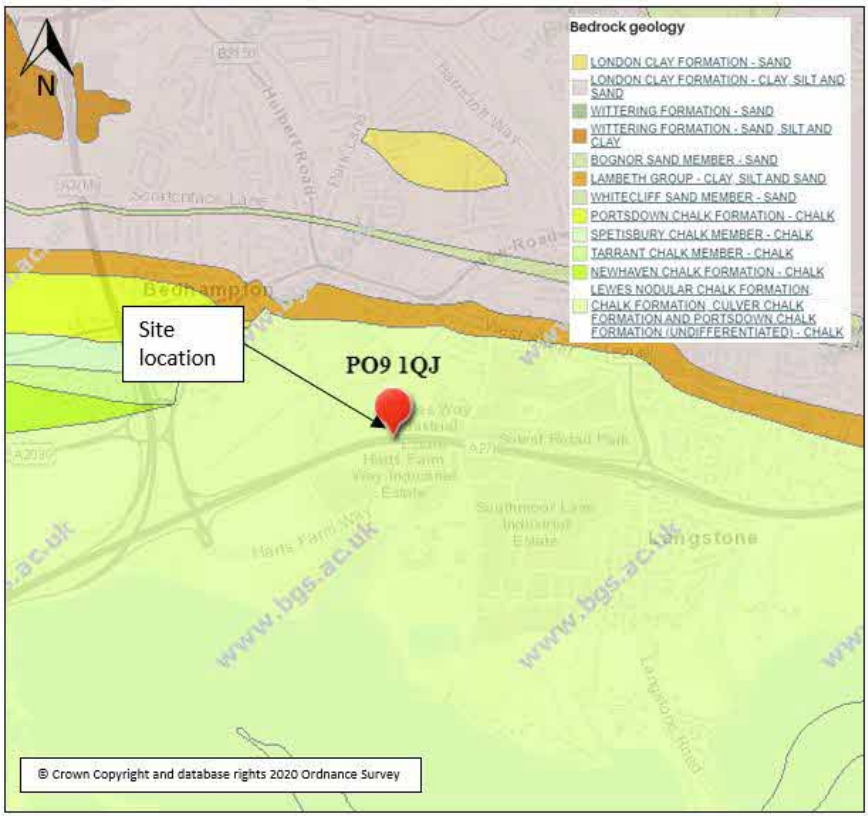


Figure 3-2: BGS Online Geology Mapping - Bedrock

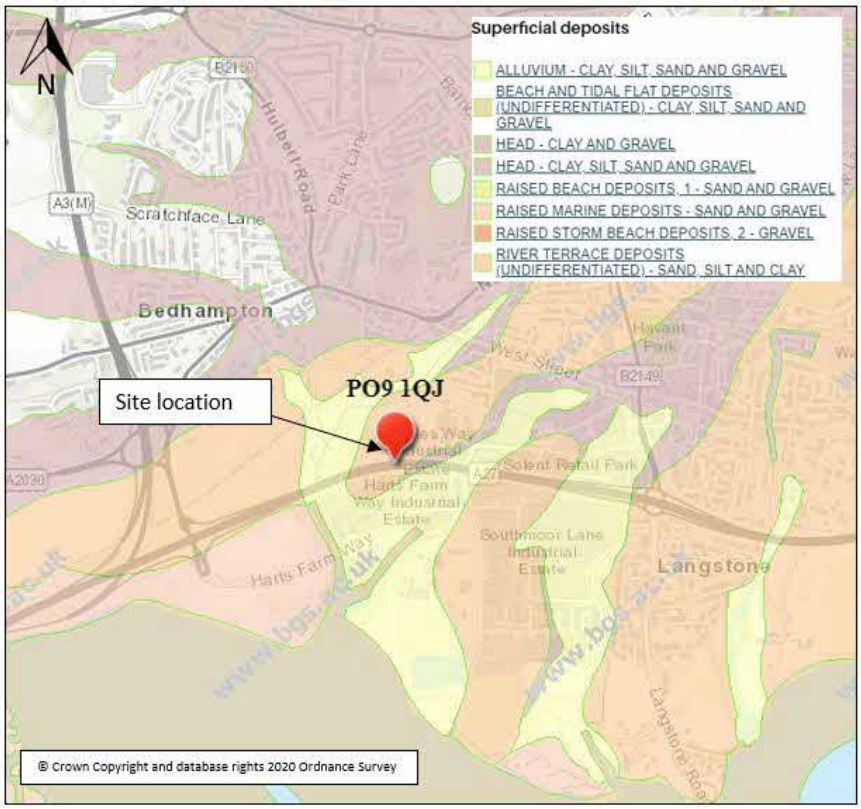


Figure 3-3: BGS Online Geology Mapping – Superficial Deposits

Existing Sewer Infrastructure

3.7. There are no public sewers within the site boundary however a number of foul sewers are present to the east of the site and serving the residential estate and commercial area to the east.

3.8. There is also public surface water sewer present to the southeast of the site.

3.9. Refer to Appendix E for the Southern Water Asset Plans.

4. SOURCES OF FLOODING

4.1. The NPPF requires flood risk from the following sources to be assessed, each of which are assessed separately below:

Fluvial sources (river flooding);

Tidal sources (flooding from the sea);

Sewer Flooding;

Groundwater sources;

Pluvial sources (flooding resulting from overland flows);

Artificial sources, canals, reservoirs etc.; and,

It also requires the risk from increases in surface water discharge to be assessed (surface water management).

Flood Zone Designation

4.2. Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences. The NPPF Planning Practice Guidance defines Flood Zones as follows:

Flood Zone 1: Low Probability. Land having a less than 1 in 1,000 annual probability of river or sea flooding.

Flood Zone 2: Medium Probability. Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.

Flood Zone 3a: High Probability. Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding.

Flood Zone 3b: The Functional Floodplain. This zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise:

land having a 3.3% or greater annual probability offlooding, with any existing flood risk management infrastructure operating effectively; or

land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding).

Fluvial / Tidal Flooding

4.3. According to the Environment Agency's indicative flood map for planning, as illustrated below, the site located in Flood Zone 1, however it is adjacent to an area at high risk of flooding associated with Hermitage Stream. Refer to Figure 4-1 below.

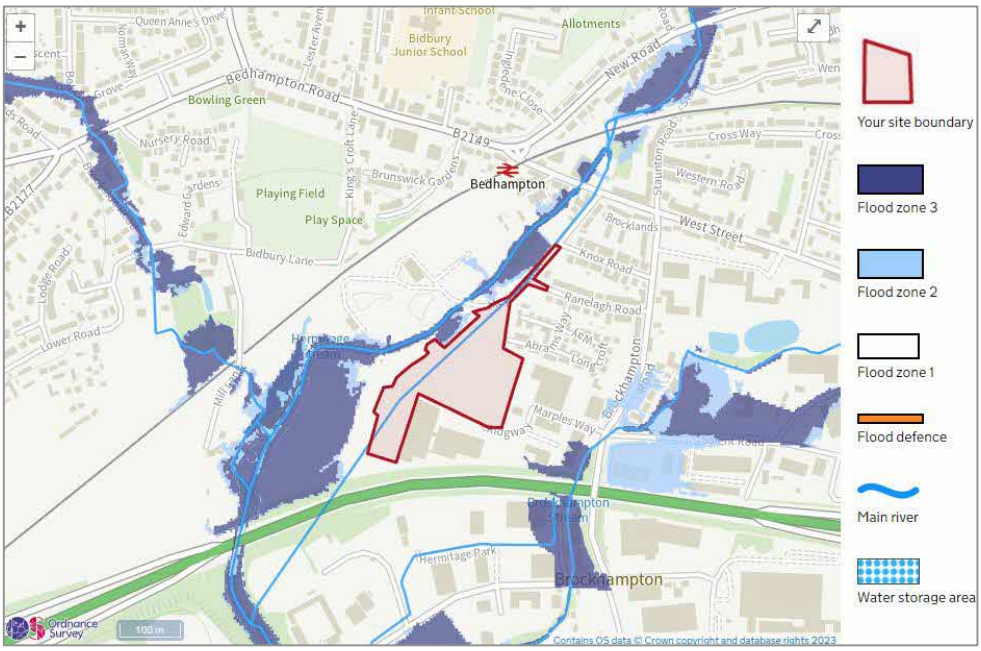


Figure 4-1: Environment Agency Flood Map for Planning

4.4. Site specific Hydraulic Modelling has been carried out for this site. The model was developed by Atkins in 2008 as part of The Havant Flood Mapping Study and was updated by Ardent in 2019. The updated model was accepted by the Environment Agency as detailed in the Hydraulic Modelling Report and Environment Agency letter included in Appendix F

4.5. Following consultation with the Environment Agency (EA), it was requested that the latest 100-year climate change requirements (at the time of the request), which came into force on the 29th February 2016 for South East River Basin, were run. The model was therefore run for the 1 in 100 year plus 45% allowance for climate change.

4.6. The new Environment Agency guidance in July 2021 states that a 37% climate change allowance should be used for this location based on the central peak river flow allowance for the East Hampshire Management Catchment. The hydraulic modelling used 45%, and therefore the flood outlines have been used as a conservative approach. However, further hydraulic modelling could be carried out to ascertain the level required on site.

4.7. The model results indicated that the maximum in channel predicted flood level for the 1 in 100 year + 45% Climate Change is 6.12m AOD within close proximity to the Site. The predicted flood outlines are showed on Figure 4-2 below. As per the Environment Agency Flood Map, the entire site is not at risk of fluvial flooding and falls outside of the modelled climate change extents.

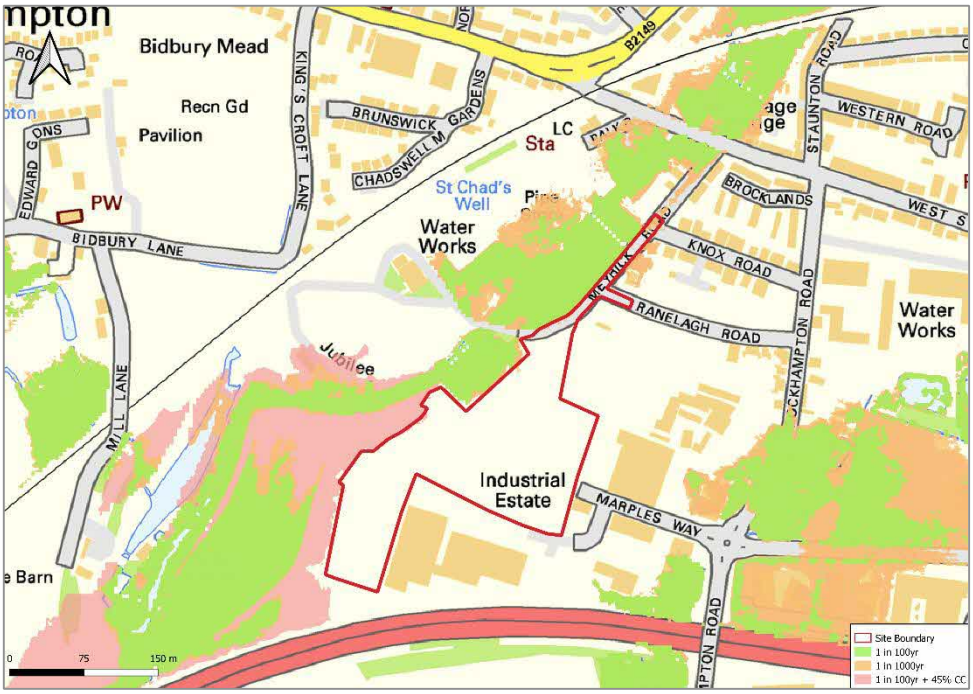


Figure 4-2: Hydraulic Modelling Flood Outlines

Pluvial Flooding

4.8. The Environment Agency surface water flood maps show that the majority of the development site is in an area that has a 'very low' risk of surface water flooding, meaning that there is less than a 0.1% chance of flooding from surface water flooding each year.

4.9. There are areas of 'low' to 'medium' risk of surface water flooding along the northern boundary. Refer to Figure 4-3 below. These areas are consistent with areas shown to be at risk of fluvial flooding and therefore this is considered to be the main risk to the site. Any mitigation for the fluvial flood risk will also manage the surface water flooding.

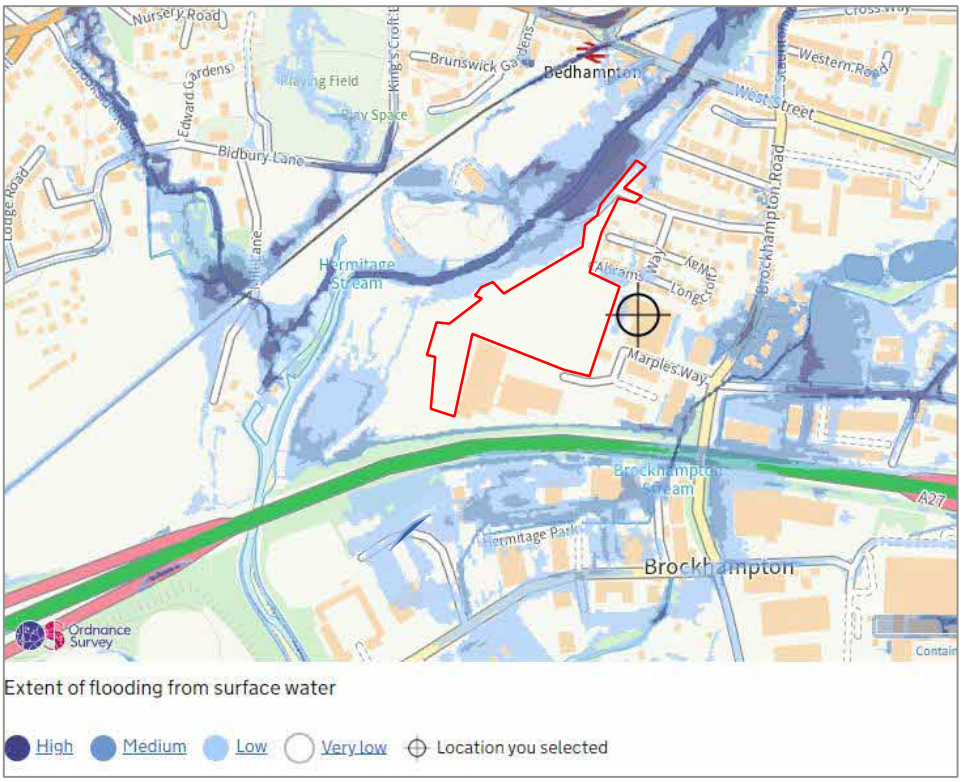


Figure 4-3: Environment Agency Flood Map for Surface Water

Groundwater Flooding

4.10. The PUSH SFRA mapping shows the site has not had any incidents of groundwater flooding however it is located in an area with high bedrock permeability as shown in Figure 4-4 below.

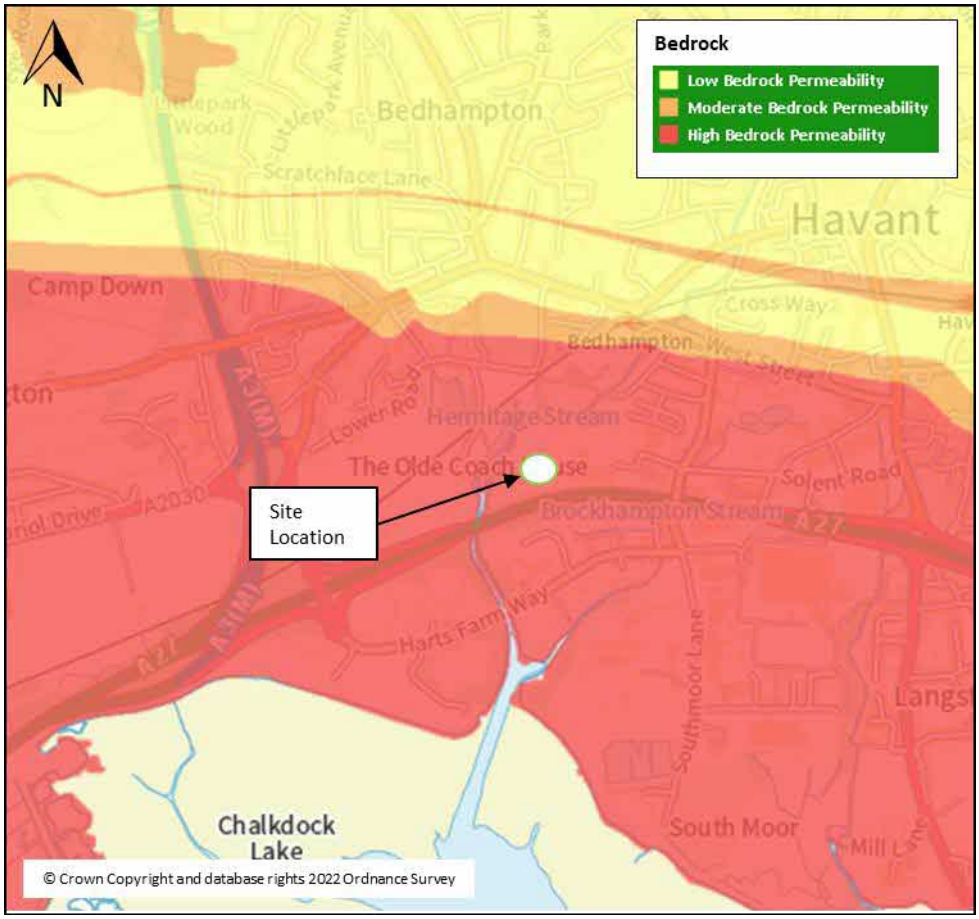


Figure 4-4: SFRA Ground Water Mapping

4.11. Local boreholes located within the site (SU70NW94, SU70NW94, and SU70NW94) show ground water at a depth of approximately 5m below ground. It is considered that groundwater would only pose a risk to sub ground level development. Since the development does not propose any below ground construction, groundwater is not seen as a flood risk to the development.

Sewer Flooding

4.12. According to the PUSH SFRA, there is no record of sewer flooding within the vicinity of the Site.

4.13. The risk of sewer flooding is therefore assessed as very low.

Artificial Sources

4.14. According to the Environment Agency's Flood risk from reservoir map, the Site is not in an area at risk of flooding from artificial sources.

4.15. The site is therefore considered to be at a 'very low' risk of flooding from artificial sources.

5. FLOOD RISK MANAGEMENT

5.1. This site-specific flood risk assessment aims to demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

Finished Floor Levels

5.2. As the site is situated withing Flood Zone 1 and falls outside of the modelled fluvial flood extents accounting for climate change, the raising of the Finished Floor Levels above the design flood (1% AEP + 45% CC event) level will not be required.

Floodplain Compensation

5.3. According to the NPPF, floodplain compensation should be provided on a level for level, volume for volume basis for any development within the floodplain.

5.4. As the site is situated outside of the 100 year + 45% flood extent, floodplain compensation will not be required.

Maintenance buffer

5.5. As mentioned above, a 1500mm dia bypass culvert, consisting of cast iron and concrete sections is running through the site from northeast to southwest. The EA confirmed that this is also classified as a main river.

5.6. A maintenance buffer of 8m is maintained from all proposed buildings either side of the existing culvert as requested by the EA.

5.7. A maintenance buffer of 5m is maintained from the access road which runs parallel to the culvert, along the western, north western part of the culvert. A figure showing the easements and distances is included in Appendix G. However, the 8m buffer zone mentioned above is still available on the other side of the culvert.

5.8. The easements provided will be enough to allow for easy access and maintenance.

5.9. As part of the previous planning application, a meeting with held with the Environment Agency to discuss the proposed in relation to the culverted watercourse. It was agreed that the proposals were acceptable in principle subject to the undertaking of further investigation and design work as part of the ongoing design of the scheme.

Safe Access and Egress

5.10. Safe access and egress are required to enable the evacuation of people from the development and provide the emergency services with access to the development during times of flood.

5.11. In terms of safe access and egress in the event of a flood, the road network which serves the site remains dry during the 100 year +45% flood event. Residents can leave the site via Ranelagh Road and Brockhampton Road to the north of the development.

Flood Response Plan

5.12. In the event of a flood, it is important to ensure that warning systems are in place and responsibility is assigned to be able to quickly deal with a flood event. It is therefore recommended that each residential unit is registered with the Environment Agency's 'Floodline' service (Tel. 0345 988 1188) to potentially receive advanced warning of any extreme event and enable the premises to be evacuated and/or evacuation measures deployed.

5.13. No development is located within the floodplain therefore the residents would be safe should an extreme event occur. Safe egress/access is also afforded via Meryrick Road then heading east Ranelagh Road and north on Brockhampton Road to the north of the development. A Flood Response Plan is provided in Appendix H.

5.14. The advice of the emergency services should however be taken on the day.

6. PROPOSED SURFACE WATER DRAINAGE STRATEGY

Existing Surface Water Discharge

6.1. The planning redline boundary equates to 3.4 ha of predominantly greenfield land. Based on the topography of the Site, greenfield runoff generated onsite will currently flow overland into the existing Hermitage River running along the northern and western boundary. The existing 1500mm diameter bisects the Site in a northeast to southwest direction.

6.2. The existing greenfield runoff rates from the eastern and western parcels have been determined using the ICP SuDS Mean Annual Flow Method. The catchment size has been based upon the proposed developable area of 2.81 ha, thereby excluding any large areas proposed as open green spaces which will continue to drain freely at greenfield rate. As detailed below, the Site has been split into two separate catchments areas (refer to Figure 6.1) to accommodate the 1500mm dia. culvert. Peak Greenfield Runoff rates are presented in Table 6-1 below. Full calculations can be found in Appendix I.

Table 6-1: Greenfield Discharge rates

	Size (Ha)	Existing Greenfield Run-off rate (l/s)			
		Qbar	1 in 1 year	1 in 30 year	1 in 100 year
Developable Area 1*	1.23	6.3	5.4	14.3	20.2
Developable Area 2*	1.58	8.1	6.9	18.4	25.9

*Refer to Figure 6.1 for locations of each catchment

Proposed Sustainable Drainage Systems (SuDS)

6.3. DEFRA's Non-statutory technical guidance for Sustainable Drainage Systems and CIRIA Guidance C753 "The SuDS Manual" have been used to determine the appropriate SuDS Strategy, which considers the spatial and environmental constraints of the Site.

6.4. Under the NPPF and its Planning Practice Guidance an allowance of 45% for the effects of climate change will achieve the policy requirements for the proposed development.

6.5. In accordance with the NPPF Planning Practice Guidance, surface water runoff should be disposed of according to the following hierarchy:

- into the ground (infiltration);
- to a surface water body;
- to a surface water sewer, highway drain, or another drainage system; or
- to a combined sewer.

6.6. As discussed in Section 3, The Site is underlain Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation which may be compatible with the use of infiltration systems.

6.7. However, Soils Limited Ground Investigation Report (Appendix J) findings confirm the site is underlain by chalk with superficial deposits above. Groundwater monitoring was undertaken as part of the onsite ground investigation, and this found groundwater levels to be less than 2.5m below ground level during the winter months. The site also falls into a Zone 1 Source Protection Zone and in located within a Principal Aquifer. Additionally, the Environment Agency Groundwater Vulnerability Map indicates the site is in a Soluble Rock Risk area. This is characteristic of chalk formation.

6.8. In addition, in its existing state, the site drains to the watercourse and therefore it is considered that infiltration will not be possible or appropriate.

6.9. A 1500mm dia. culvert runs through the centre of the site with a 8m easement required each side of the culvert. In order to reduce the impact on the culvert of construction of pipes, the site has been separated into two separate catchments as shown in Figure 6.1 below, however due to the layout of the site, it will be necessary to reduce the easement of the culvert to allow for sewers within the

highway. This has been discussed with, and accepted by, the Environment Agency, shown in Appendix K.

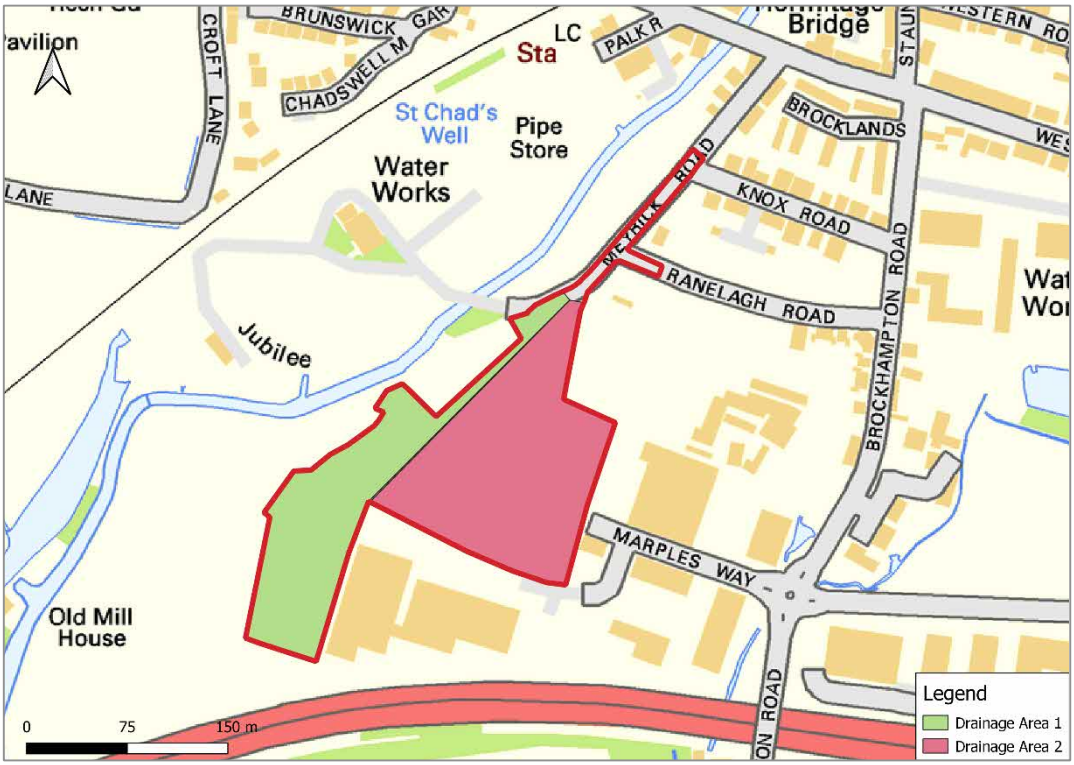


Figure 6-1: Catchment Areas

6.10. It is therefore proposed to discharge surface water runoff from the Developable Area 1 into the existing watercourse running to the west of the site and to discharge surface water from Developable Area 2 into the existing Southern Water surface water sewer immediately to the south of the site via a sewer requisition.

6.11. Surface water will be attenuated within Sustainable Urban Drainage features prior to being discharged to the Hermitage Stream and Southern Water sewers at a controlled rate equivalent to the greenfield runoff rates for the developable area of the Site.

6.12. The constraints and opportunities for the use of SuDS techniques are appraised using the Management Train approach outlined in CIRIA C753 'The SuDS Manual' in Table 6-2 below.

Table 6-2: SuDS Assessment

Type:	Infiltration Devices (Source Control)
Constraints:	Underlying geology may be compatible with infiltration systems. Variable geology.
Opportunities:	Limited due to site layout and space constraints.
Type:	Lined Permeable Paving (Source Control)
Constraints:	None
Opportunities:	Use of lined permeable paving implemented in strategy.
Type:	Rainwater Harvesting (Source Control)
Constraints:	The benefits of rainwater harvesting on a specific design storm event cannot be quantified, due to the seasonal availability of storage within the structure.
Opportunities:	Opportunities in amenity areas to provide harvesting features such as rain gardens, raised planters and water butts exist. However, it is difficult to quantify contribution, and therefore not included within calculations as part of this surface water management strategy
Type:	Swales, etc. (Permeable Conveyance)
Constraints:	In order to provide practicable attenuation benefits 1:3 side-slope swales tend to require a significant land requirement.
Opportunities:	None due to spatial constraints.
Type:	Tree Pits/Rain gardens
Constraints:	Subject to Landscape Architect's design.
Opportunities:	There may be opportunities to use landscaped space to incorporate tree pits.
Type:	Green Roofs
Constraints:	Subject to Architect's design.
Opportunities:	Green roofs are not proposed as part of the development.
Type:	Attenuation Tanks (end of pipe treatment)
Constraints:	None
Opportunities:	Should additional attenuation be required this could be achieved by use of oversized sewers or geo-cellular storage attenuation.

6.13. After consideration of the CIRIA C753 SuDS Management Train approach, the most viable SuDS options for this site is a solution combining lined attenuation basins and geocellular storage. Permavoid paving has also been proposed for additional storage. Refer to Drawing No. 2006910-002C in Appendix K for the proposed surface water drainage strategy.

Proposed surface water runoff rates

6.14. Due to the risk of flooding to the west of the site, flows will be restricted to a maximum discharge rate of 6.3 l/s (equivalent to Qbar for Area 1) for Area 1 and 8.1 l/s (equivalent to Qbar for Area 2), for all rainfall events up to the 1 in 100 year plus a 45% allowance for climate change.

6.15. MicroDrainage modelling results show there is no flooding on the Site during rainfall events up to the 1 in 100 year including 45% climate

change rainfall event. MicroDrainage modelling results are included in Appendix L.

6.16. Southern Water has confirmed that the existing sewerage network has sufficient capacity to accommodate the proposed surface water discharge from the proposed development.

Long Term Storage and Urban Creep

6.17. It is proposed to restrict discharge rates from the development site to a discharge rate equal to Qbar for each catchment. As such, the Long Term Storage would not be required in accordance with the recommendations of The SuDS Manual (C753).

6.18. It is proposed to develop the site for a residential use. As such, 10% urban creep has been included in the calculations. As the application is outline, the impermeable area of the proposed development has been estimated based on the indicative layout. The impermeable area of the site will be confirmed when the layout is fixed and further hydraulic calculations will be undertaken.

Overland Flow Routes

6.19. The surface water drainage strategy has been designed to ensure minimal flooding occurs as a result of the 1 in 100-year rainfall event (including an allowance for climate change). Any minor flooding would be contained within the extent of the highway.

6.20. Site levels will be designed to ensure that exceedance flows are directed towards the proposed drainage network and away from buildings. Exceedance flows will be directed to the proposed surface water basins and the watercourse. The exceedance flow routes are shown in the drainage strategy drawing included in Appendix K.

6.21. Should the capacity of the surface water basins be exceeded during an extreme rainfall event, surface water would flow towards the watercourse in the east of the site.

Water Quality

6.22. Development proposals are for residential use. Based on C753 Simple Index Treatment Method, the development would have an associated pollution hazard level of 'Medium' to 'High'. The recommended stages of treatment will be provided by the permavoid paving, and attenuation basins. Permavoid paving in specific areas will provide an additional level of treatment of surface runoff. Refer to Appendix M for the simple Index Treatment Method calculations.

Maintenance and Management of System

6.23. The maintenance of all SuDS components will be in accord with the best practices and the CIRIA C753 The SuDS Manual. The recommended Operation and Maintenance requirements for the proposed permeable paving, swales and detention basin are outlined in the Management Plan in Appendix N.

6.24. A management company will be appointed to maintain any parts of the network which are not to be offered for adoption to Southern Water.

7. PROPOSED FOUL WATER DRAINAGE STRATEGY

7.1. It is proposed to develop the site to comprise up to 120 new dwellings.

7.2. The peak foul flow rate for the proposed development has therefore been calculated to be 5.5l/s. Refer to Appendix O.

7.3. It is proposed that foul flows from the development will discharge into the existing Southern Water foul sewer that exists to the east of the site. Refer to the preliminary drainage strategy Drawing No. 2006910-002C provided in Appendix K.

7.4. Southern Water has confirmed that the existing sewerage network has sufficient capacity to accommodate the proposed Foul water discharge from the proposed development.

8. CONCLUSIONS

8.1. This FRA has been produced to support the planning application for the proposed residential development at Kingscroft Farm.

8.2. The proposal includes the redevelopment of the existing land to provide a residential led, development comprising of up to 120 new dwellings with associated parking and landscaping, and all necessary ancillary and enabling works.

8.3. The Site is located in Flood Zone 1. Hydraulic modelling undertaken by Ardent has shown the site is modelled to remain flood free under the 100 year plus 45% allowance for climate change flood event.

8.4. In terms of safe access and egress in the event of a flood, the road network which serves the site remains dry during the 100 year +45% flood event. Occupants can leave the site via A27 heading east and subsequently north or west and subsequently north.

8.5. The Environment Agency's surface water flood maps show that the development site is in an area that has a 'Low' risk of surface water flooding and no other means of flooding identified as posing a risk to the site.

6.25. The drainage strategy set out in this report has been undertaken to accommodate the existing 1500mm culvert bisecting the development. It is proposed that the western and eastern area's of the development discharge into the Hermitage Stream and southern water sewers at Qbar rates respectively. Southern Water has confirmed that the existing sewerage network has sufficient capacity to accommodate the proposed surface & foul water discharge from the proposed development.

8.6. A maintenance buffer of 8m is maintained from all proposed buildings either side of the existing 1500mm culvert as requested by the EA.

8.7. A maintenance buffer of 5m is maintained from the access road which runs parallel to the culvert, along the western, north western part of the culvert. However, the 8m buffer zone mentioned above is still available on the other side of the culvert. The easements provided will

be enough to allow for easy access and maintenance. This approach was agreed in principle with the Environment Agency as part of the consultation period for the previous application.

8.8. The drainage strategy is suitable to protect the site and surrounding areas from surface water flooding for all events up to and including the 1 in 100-year storm event including a 45% allowance for climate change.

8.9. The peak foul flow rate for the proposed development is calculated to be 5.5 l/s. It is proposed that foul flows from the development will discharge into the Southern Water foul sewer to the east of the site.

8.10. In conclusion, this FRA demonstrates that the proposals are consistent with the aims of NPPF, PPG and Development Plan. The site would not be at risk of flooding or increase the flood risk to others.

Appendix A



Please Note:

This drawing must not be scaled, dimensions to be checked on site and any discrepancies are to be highlighted to the Architect prior to construction.

Prior to the commencement of any works, the Contractor is to check and / or determine all construction details including checking existing site levels and dimensions.

This drawing is to be read in conjunction with all other project drawings, construction notes and / or project specifications including those by other project consultants and specialists. All discrepancies should be reported immediately.

Design subject to detail development / approval.
Measurements and accommodation schedules subject to amendments following coordinated input by others.
Costings cannot be finalised until approval /confirmation by relevant authorities and Client.

Further design information:

Rev.	Description	DATE	DB / CB
J	ProW increased to 3m, connection to Marples Way shown	09.05.23	VP/HJE
H	Bat corridors not shown	07.03.23	VP/HJE
G	Amended to new layout	01.03.23	VP/HJE
F	Bat Corridors shown	21.10.22	VP/HJE
E	Amended to client's comments	21.06.22	VP/HJE
D	Access amended to highways' design	17.05.22	VP/HJE
C	Amended to client's comments	13.05.22	VP/HJE
B	Red line removed	26.04.22	VP/HJE
A	Amended to client comments	11.04.22	DV/HJE

Date	Apr '22
Drawn By/Checked By	VP / HJE
Scale	1:1000 @ A2
Revision	J
Project	Land at Kingscroft Farm Meyrick Road, Havant
Title	Illustrative Site Plan
Dwg#	18.099.02
Status	Sketch

hgp

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Fareham, Hampshire
PO16 7JH

01329 283 225
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www.hgp-architects.co.uk

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0330 333 7365
info@foremanhomes.co.uk

Water Works
Weir
CS
Und
NTL
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Jubilee Path
Hermitage Stream
Spring
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Bedhampton Springs
Valve
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Balancing Pond
METRICK ROAD
RANELAGH ROAD
KINGSCROFT CORNER
DOYLE CLOSE
BEDHAMPTON ROAD
Manor Court
Pond
MARPLES WAY
RIDGWAY
El Sub Sta
ESS
Inspection Cover

N

Accommodation Schedule

15 No.1 Bed Apartments - 12%of total
44 No.2 Bed Apartments - 37%of total

26 No.2 Bed Houses - 21%of total
35 No.3 Bed Houses - 30%of total

Grand Total - 120 Dwellings

Land at Kingscroft Farm, Havant
120 Unit Site Plan 1:1000 at A2

Appendix B

Culvert Inspection Services Framework Scheme 2019 - SSD

Survey and Condition Assessment Report

Watercourse: Hermitage Stream
Site Address: Meyrick Road, Brockhampton
Asset Number: 127046
Client Contact: David Searle
OnSite Ref: OSWW1902279
Survey Completion: 100.00%
Date of Survey: 06/01/2020

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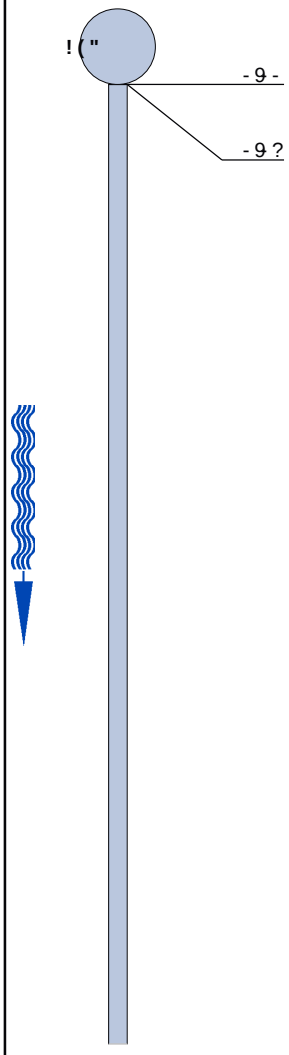
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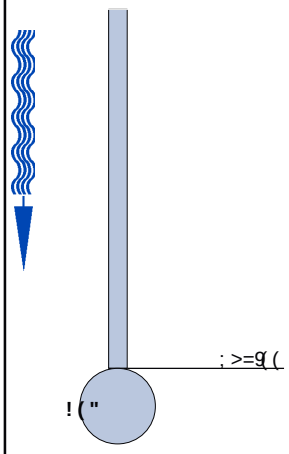


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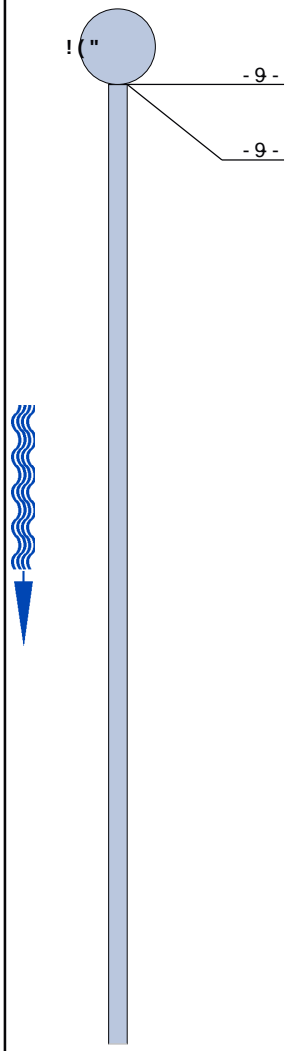
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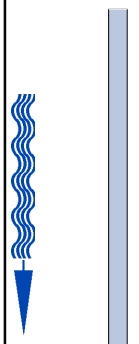
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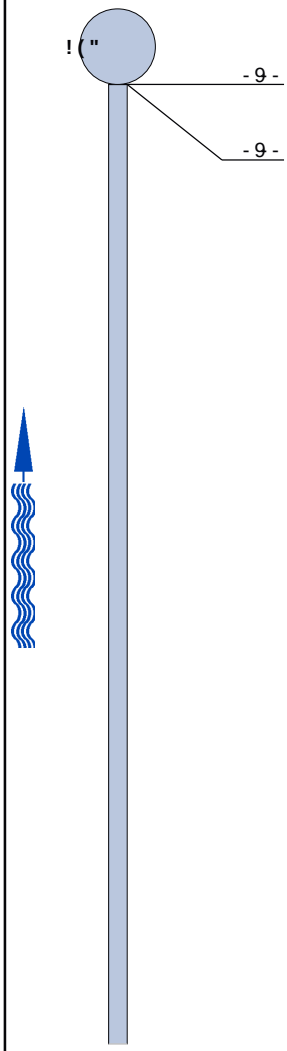
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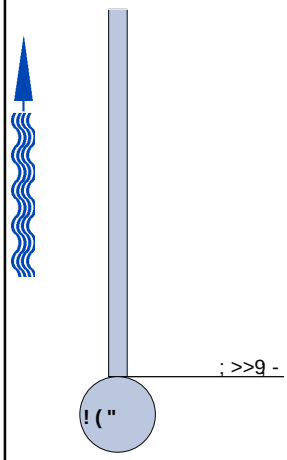
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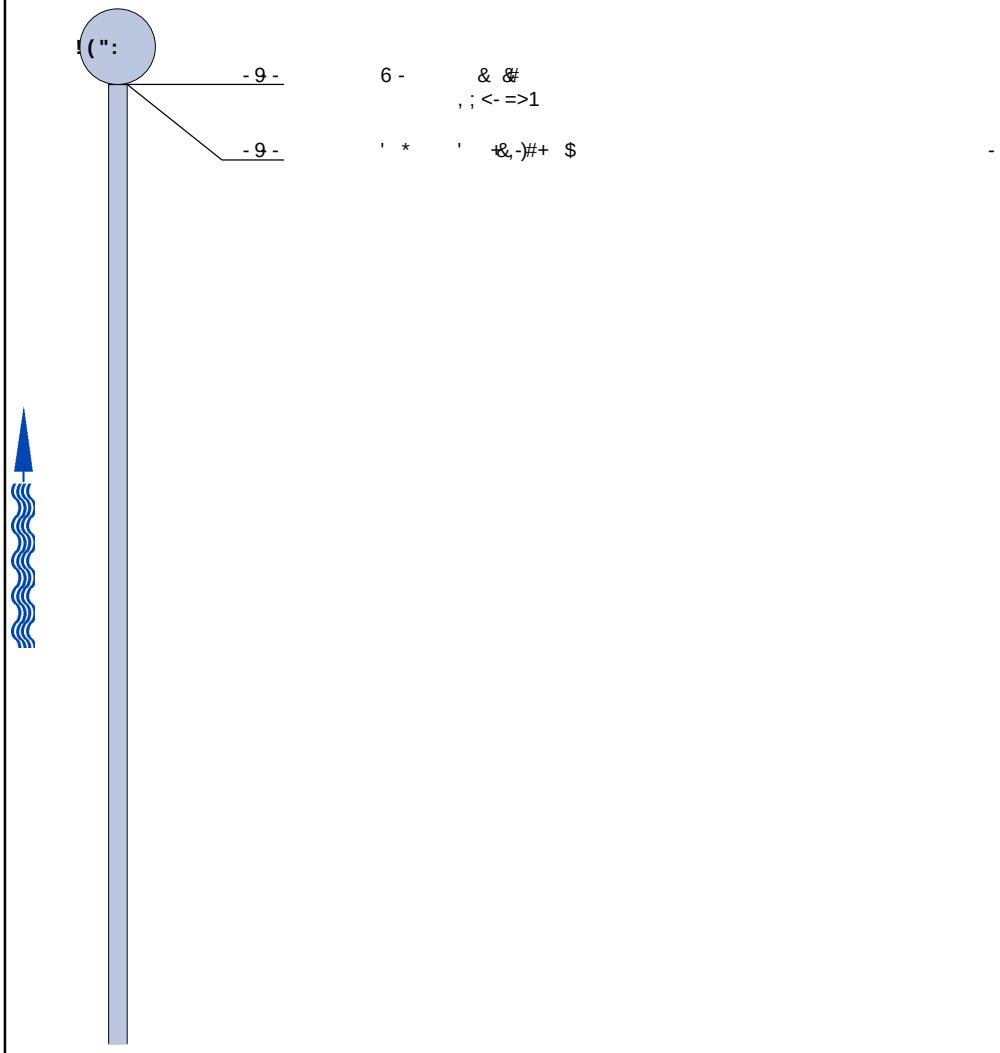
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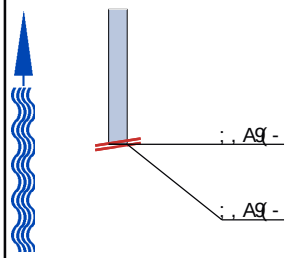
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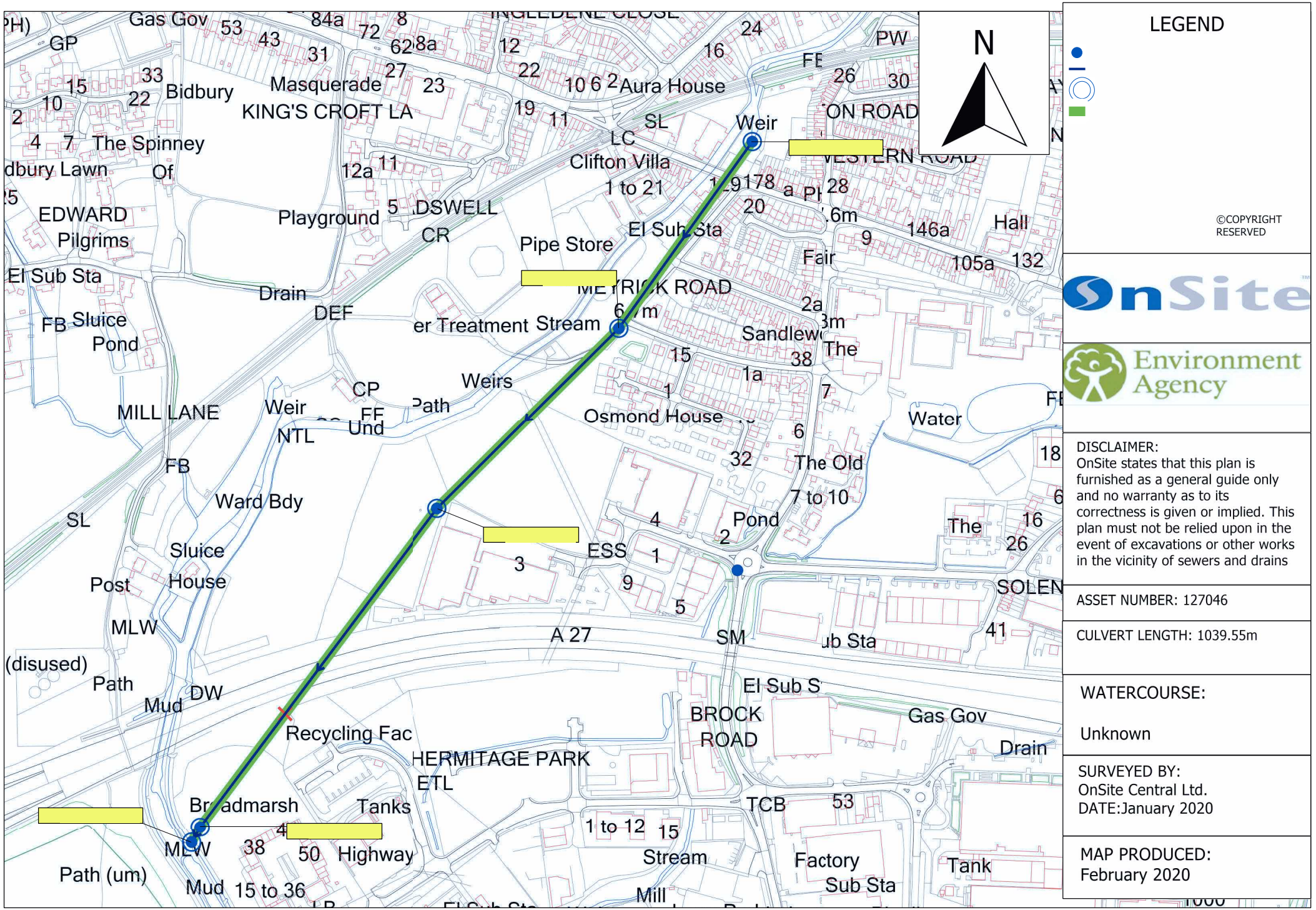
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ASSET NUMBER: 127046

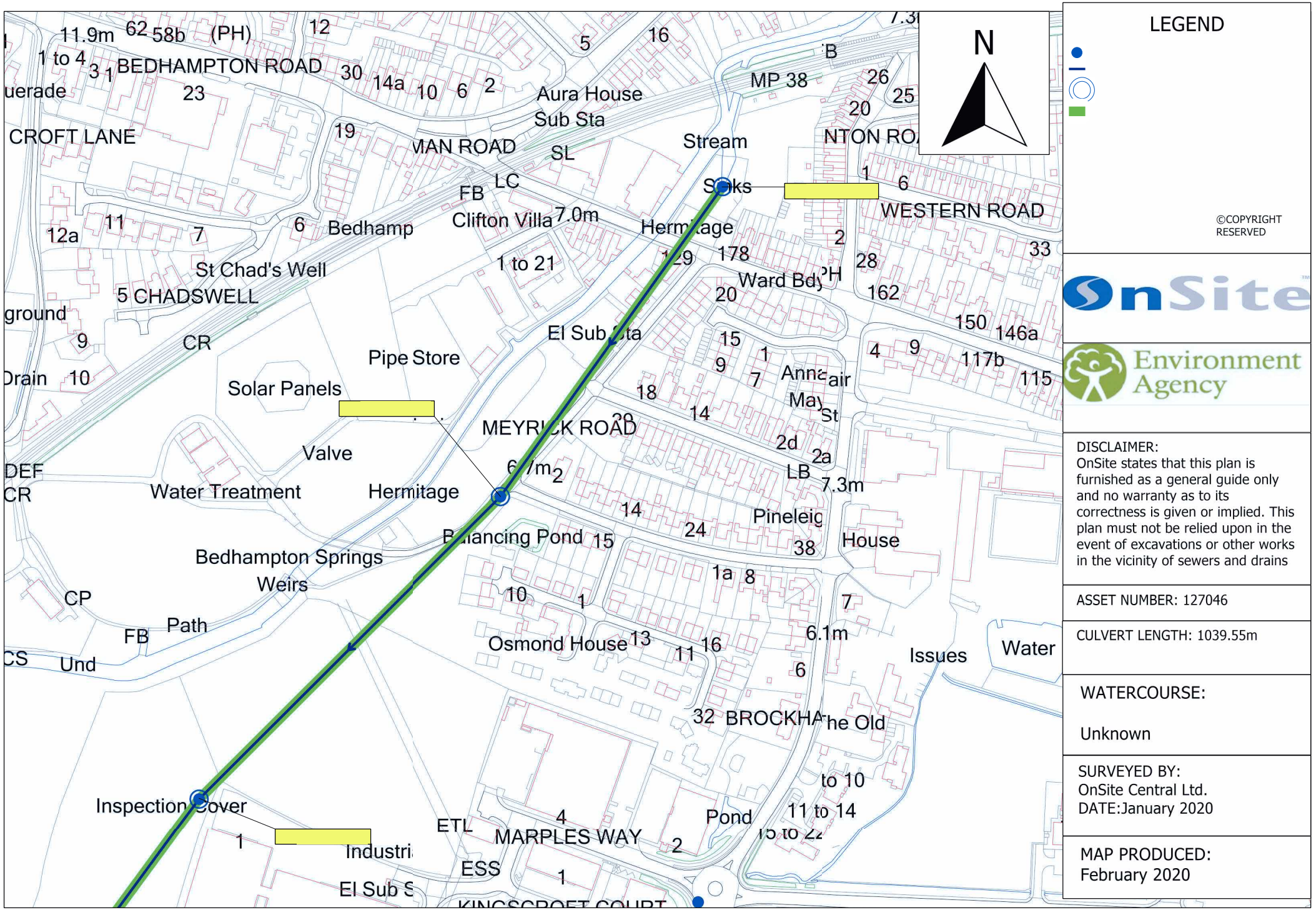
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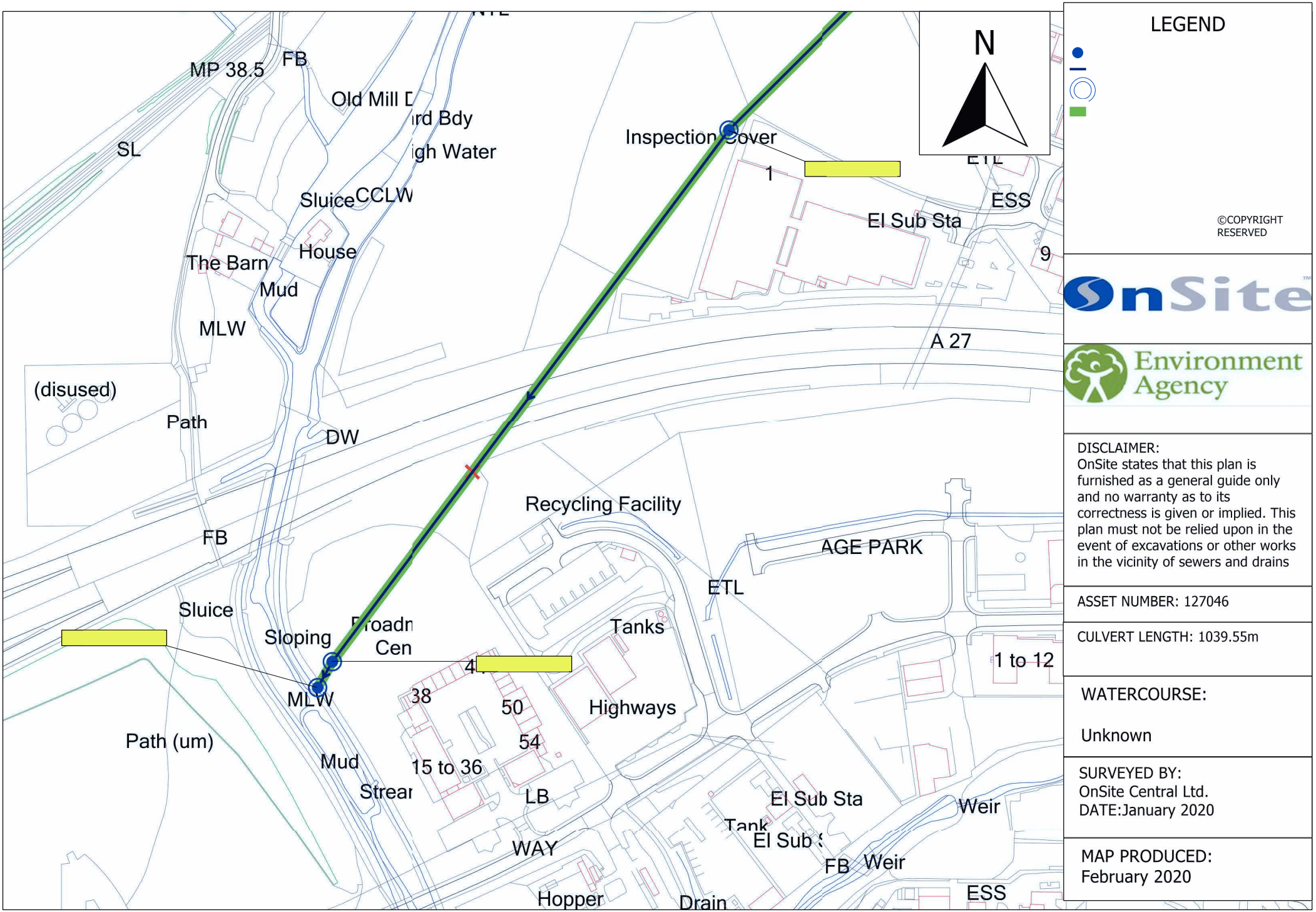
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DATE:January 2020

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February 2020
BEDHAMPTON ROAD
CROFT LANE
WESTERN ROAD
MEYRICK ROAD
MARPLES WAY
Aura House Sub Sta
Stream
Clifton Villa
St Chad's Well
5 CHADSWELL
Pipe Store
Solar Panels
Valve
Water Treatment
Hermitage
Balancing Pond
Bedhampton Springs Weirs
Osmond House
Inspection Cover
Pond
KINGSCROFT COURT
7.0m
6.1m
7.3m



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CULVERT LENGTH: 1039.55m

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DATE:January 2020

MAP PRODUCED:
February 2020

MANHOLE RECORD CARD

LOCATION	SUZUKI GARAGE, WEST STREET

NODE REFERENCE	127046INLET
COORDINATES (m)	470921.56,106536.33
DRAINAGE AREA CODE	-
SURVEY DATE	09 Jan 2020

YEAR LAID	-		STATUS	WC	FUNCTION	S	NODE TYPE	I F	COND ITION	SIZE (mm)			TOXIC ATMOSPHERE	N
COVER	SHAPE	-	HINGED	N	LOCK	N	DUTY	-	-	-	X	-	GAS TYPE	-
SHAFT	SIDE ENTRY	N	REGULAT COURSES	-	DEPTH (mm)	-			-	-	X	-	EVIDENCE OF VERMIN	N
CHAMBER	SOFFIT	-	STEPS	-	LADDERS	-	LNDGS	-	-	-	X	-	CONSTRUCTI ON CODE	-

STRUCTURAL CONDITION	-	MAINTENANCE CONDITION	-	DEPTH OF FLOW (mm)	-	DEPTH OF SILT (mm)	-	HEIGHT SURCH (mm)	-	COVER LEVEL (m AD)	-

INCOMING PIPES

	UPSTREAM REFERENCE	PIPE SHAPE		PIPE SIZE (mm)		BACKDROP DIAM (mm)	PIPE MATERIAL	LINING	DEPTH FROM COVER (m)	INVERT LEVEL (m AD)
A				X						
B				X						
C				X						
D				X						
E				X						
F				X						

OUTGOING PIPES

	DOWNSTREAM REFERENCE					COND	CRITY			
X	127046MH01	C	-	X	1500	-	-	CI	-	2.950
Y				X						

CONDITION (Y if action required)	COVER	N	IRONS / LADDERS	N	SHAFT	N	CHAMBER	N	BENCHING	N	OTHER	N

REMARKS

-
TRASH SCREEN IN PLACE



LOCATION SKETCH -



PLAN SKETCH -



LOCATION IMAGE -



INTERNAL IMAGE -

MANHOLE RECORD CARD

LOCATION	MEYRICK ROAD

NODE REFERENCE	127046MH01
COORDINATES (m)	470781.01,106339.09
DRAINAGE AREA CODE	-
SURVEY DATE	10 Jan 2020

YEAR LAID	-		STATUS	WC	FUNCTION	S	NODE TYPE	MH	CONDITION	SIZE (mm)			TOXIC ATMOSPHERE	N
COVER	SHAPE	C	HINGED	N	LOCK	N	DUTY	H	-	1180	X	-	GAS TYPE	-
SHAFT	SIDE ENTRY	N	REGULAT COURSES	-	DEPTH (mm)	2460			-	900	X	-	EVIDENCE OF VERMIN	N
CHAMBER	SOFFIT	-	STEPS	-	LADDERS	-	LNDGS	-	-	-	X	-	CONSTRUCTION CODE	-

STRUCTURAL CONDITION	-	MAINTENANCE CONDITION	-	DEPTH OF FLOW (mm)	100	DEPTH OF SILT (mm)	-	HEIGHT SURCH (mm)	-	COVER LEVEL (m AD)	-

		UPSTREAM REFERENCE	PIPE SHAPE	PIPE SIZE (mm)			BACKDROP DIAM (mm)	PIPE MATERIAL	LINING	DEPTH FROM COVER (m)	INVERT LEVEL (m AD)
INCOMING PIPES	A	127046INLET	C	- X	1500		-	CO	-	4.120	
	B	GULLY	C	- X	150		-	VC	-	1.590	
	C			X							
	D			X							
	E			X							
	F			X							

		DOWNSTREAM REFERENCE					COND	CRITY			
OUTGOING PIPES	X	127046MH02	C	- X	1500		-	-	CO	-	4.100
	Y			X							

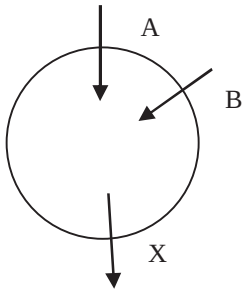
CONDITION (Y if action required)	COVER	N	IRONS / LADDERS	N	SHAFT	N	CHAMBER	N	BENCHING	N	OTHER	N

REMARKS

-
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LOCATION SKETCH -



PLAN SKETCH -



LOCATION IMAGE -



INTERNAL IMAGE -

MANHOLE RECORD CARD

LOCATION	HORSE FIELDS, MAYRICK ROAD

NODE REFERENCE	127046MH02
COORDINATES (m)	470589.01,106147.37
DRAINAGE AREA CODE	-
SURVEY DATE	10 Jan 2020

YEAR LAID	-		STATUS	WC	FUNCTION	S	NODE TYPE	MH	CONDITION	SIZE (mm)			TOXIC ATMOSPHERE	N
COVER	SHAPE	D	HINGED	N	LOCK	N	DUTY	H	-	630	X	1260	GAS TYPE	-
SHAFT	SIDE ENTRY	N	REGULAT COURSES	3	DEPTH (mm)	600			-	680	X	1200	EVIDENCE OF VERMIN	N
CHAMBER	SOFFIT	S	STEPS	3	LADDERS	-	LNDGS	-	-	2536	X	1530	CONSTRUCTION CODE	B

STRUCTURAL CONDITION	-	MAINTENANCE CONDITION	-	DEPTH OF FLOW (mm)	100	DEPTH OF SILT (mm)	0	HEIGHT SURCH (mm)	-	COVER LEVEL (m AD)	-

INCOMING PIPES

	UPSTREAM REFERENCE	PIPE SHAPE	PIPE SIZE (mm)			BACKDROP DIAM (mm)	PIPE MATERIAL	LINING	DEPTH FROM COVER (m)	INVERT LEVEL (m AD)
A	127046MH01	C	- X	1500		-	CO	-	3.510	
B	UNKNOWN	C	- X	600		-	CO	-	3.200	
C			X							
D			X							
E			X							
F			X							

OUTGOING PIPES

	DOWNSTREAM REFERENCE					COND	CRITY			
X	127046MH03	C	- X	1500		-	-	CO	-	3.410
Y			X							

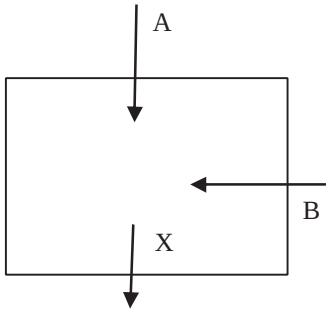
CONDITION (Y if action required)											
COVER	N	IRONS / LADDERS	N	SHAFT	N	CHAMBER	N	BENCHING	N	OTHER	N

REMARKS

-
-



LOCATION SKETCH -



PLAN SKETCH -



LOCATION IMAGE -



INTERNAL IMAGE -

MANHOLE RECORD CARD

LOCATION	HANTS FARM ROAD

NODE REFERENCE	127046MH03
COORDINATES (m)	470337.35,105810.30
DRAINAGE AREA CODE	-
SURVEY DATE	10 Jan 2020

YEAR LAID	-		STATUS	WC	FUNCTION	S	NODE TYPE	MH	CONDITION	SIZE (mm)			TOXIC ATMOSPHERE	N
COVER	SHAPE	-	HINGED	N	LOCK	N	DUTY	-	-	-	X	-	GAS TYPE	-
SHAFT	SIDE ENTRY	N	REGULAT COURSES	-	DEPTH (mm)	-			-	-	X	-	EVIDENCE OF VERMIN	N
CHAMBER	SOFFIT	-	STEPS	-	LADDERS	-	LNDGS	-	-	-	X	-	CONSTRUCTION CODE	-

STRUCTURAL CONDITION	-	MAINTENANCE CONDITION	-	DEPTH OF FLOW (mm)	-	DEPTH OF SILT (mm)	-	HEIGHT SURCH (mm)	-	COVER LEVEL (m AD)	-

		UPSTREAM REFERENCE	PIPE SHAPE		PIPE SIZE (mm)		BACKDROP DIAM (mm)	PIPE MATERIAL	LINING	DEPTH FROM COVER (m)	INVERT LEVEL (m AD)
INCOMING PIPES	A	127046MH02	C	-	X	1500	-	CO	-	-	
	B				X						
	C				X						
	D				X						
	E				X						
	F				X						

		DOWNSTREAM REFERENCE					COND	CRITY			
OUTGOING PIPES	X	127046OUTLET	C	-	X	1500	-	-	CO	-	-
	Y				X						

CONDITION (Y if action required)											
COVER	N	IRONS / LADDERS	N	SHAFT	N	CHAMBER	N	BENCHING	N	OTHER	N

REMARKS

-

UTL CHAMBER



LOCATION SKETCH -

UTL

PLAN SKETCH -



LOCATION IMAGE -

UTL

INTERNAL IMAGE -

MANHOLE RECORD CARD

LOCATION	HANTS FARM ROAD

NODE REFERENCE	127046OUTLET
COORDINATES (m)	470328.00,105794.00
DRAINAGE AREA CODE	-
SURVEY DATE	10 Jan 2020

YEAR LAID	-		STATUS	WC	FUNCTION	S	NODE TYPE	O F	COND ITION	SIZE (mm)			TOXIC ATMOSPHERE	N
COVER	SHAPE	-	HINGED	N	LOCK	N	DUTY	-	-	-	X	-	GAS TYPE	-
SHAFT	SIDE ENTRY	N	REGULAT COURSES	-	DEPTH (mm)	-			-	-	X	-	EVIDENCE OF VERMIN	N
CHAMBER	SOFFIT	-	STEPS	-	LADDERS	-	LNDGS	-	-	-	X	-	CONSTRUCTI ON CODE	-

STRUCTURAL CONDITION	-	MAINTENANCE CONDITION	-	DEPTH OF FLOW (mm)	-	DEPTH OF SILT (mm)	-	HEIGHT SURCH (mm)	-	COVER LEVEL (m AD)	-

		UPSTREAM REFERENCE	PIPE SHAPE	PIPE SIZE (mm)			BACKDROP DIAM (mm)	PIPE MATERIA L	LINING	DEPTH FROM COVER (m)	INVERT LEVEL (m AD)
INCOMING PIPES	A	127046MH03	C	-	X	1500	-	CI	-	2.950	
	B				X						
	C				X						
	D				X						
	E				X						
	F				X						

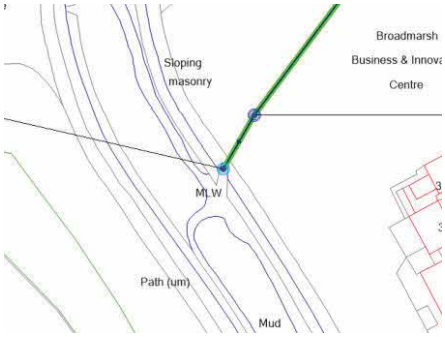
		DOWNSTREAM REFERENCE		COND	CRITY
OUTGOING PIPES	X		X		
	Y		X		

CONDITION (Y if action required)	COVER	N	IRONS / LADDERS	N	SHAFT	N	CHAMBER	N	BENCHING	N	OTHER	N

REMARKS

-

HEADWALL CRACKED ABOVE CROWN OF PIPE. CRACKS AT BOTH WING WALL AT POINT WHERE THEY MEET HEADWALL



LOCATION SKETCH -

PLAN SKETCH -



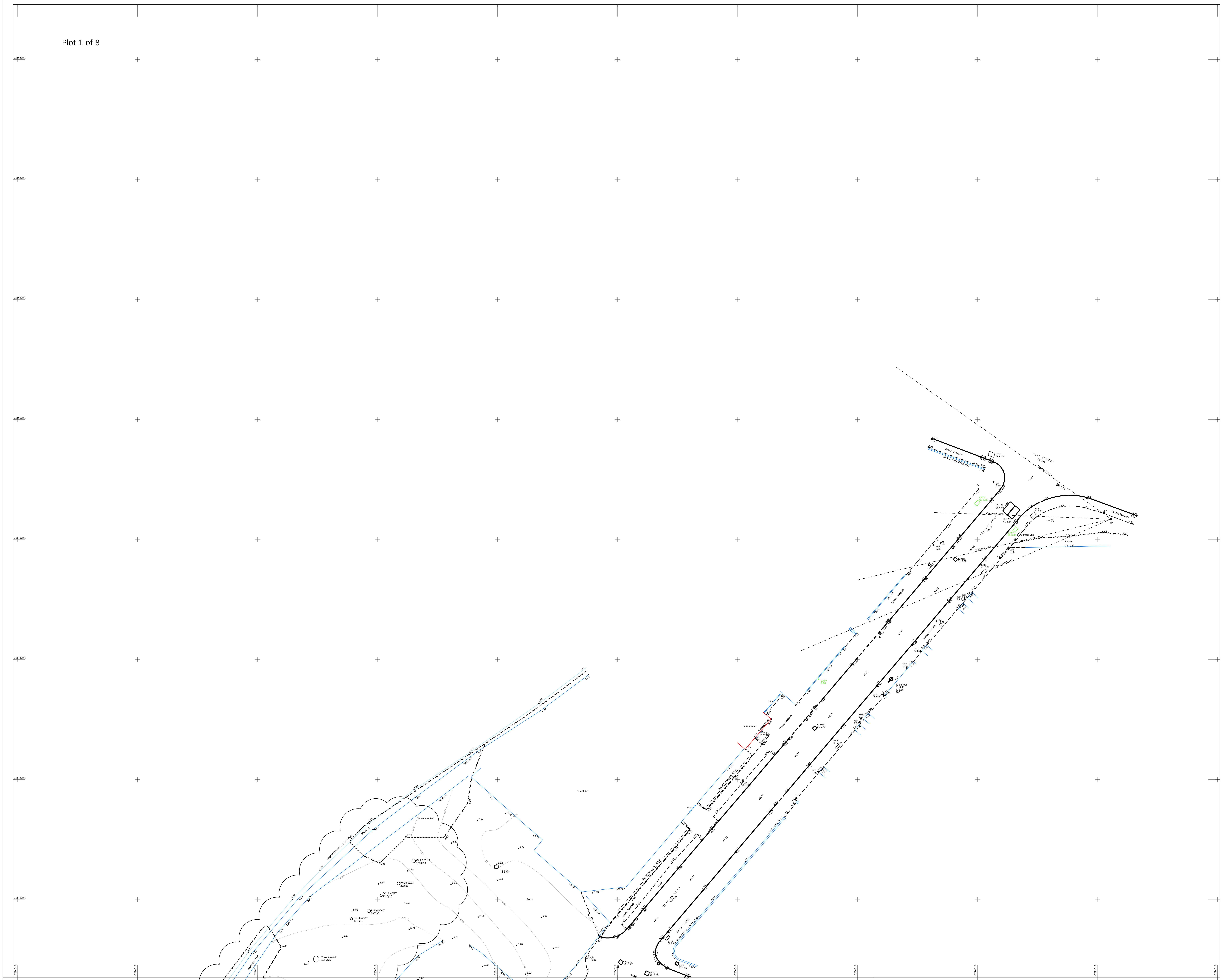
LOCATION IMAGE -



INTERNAL IMAGE -

Appendix C

Plot 1 of 8



NOTES:

Drainage:
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LEGEND

TREE SPECIES INFORMATION

ALDER	ALD	LOCUST	LOC
ASH	ASH	LONDON PLANE	LPN
ASPEN	ASP	MAGNOLIA	MAG
BEECH	BCH	MAPLE	MPL
CEDAR	CED	OAK	OAK
CHERRY	CHY	PINE	PNE
CYPRESS	CYP	POPLAR	POP
ELM	ELM	PRUNUS	PNS
FIR	FIR	RHODODENDRONS	RDN
FRUIT	FRT	ROWAN	RWN
HAWTHORN	HAW	SILVER BIRCH	SIB
HAZEL	HAZ	SORBUS	SOR
HOLLY	HLY	SWEET CHESTNUT	SCH
HORSE CHESTNUT	HCH	SYCAMORE	SYC
HORNBEAM	HRM	WALNUT	WNT
LABURNUM	LRM	WILLOW	WLW
LARCH	LAR	YEW	YEW
LIME	LIM	SPECIES UNKNOWN	SPU
		COPPICED	COP

TREE ANNOTATIONS: Tree Species / Tree Boll Size / No of Bolls
Tree Height / Tree Canopy Spread

FENCE INFORMATION

BARBED WIRE FENCE	BWF
CORRUGATED IRON FENCE	CIF
CLOSE BOARD FENCE	CBF
CHAIN LINK FENCE	CLF
CHESTNUT PALING	CPF
CRASH BARRIER	CBR
HANDRAIL	HDL
IRON RAILINGS	IRF
LARCH LAP FENCE	LLF
MISCELLANEOUS FENCE	MSF
PALISADE FENCE	PSF
PICKET FENCE	PKF
POST AND CHAIN FENCE	PCF
POST AND RAIL FENCE	PRF
POST AND WIRE FENCE	PWF
STOCK WIRE FENCE	SWF
TRELLIS FENCING	TLF

LEVEL INFORMATION

BASEMENT LEVEL	BTL
BED LEVEL	BL
COVER LEVEL	CL
DAMP PROOF COURSE	DPC
FLOOR LEVEL	FL
INVERT LEVEL	IL
OUTFALL LEVEL	OL
THRESHOLD LEVEL	THL
FOUL WATER	FW
SURFACE WATER	SW
UNABLE TO LIFT	UTL
WATER LEVEL	WL

SURFACE INFORMATION

CONCRETE	Conc
BRICK PAVERS	BP
FLOWERBED	FB
PAVING SLABS	PS
RETAINING WALL	RWall
TACTILE PAVING	Tac

FEATURE INFORMATION

BOLLARD	BO	NOTICE BOARD	NB
BRITISH TELECOM BOX	BTB	POST	P
BRITISH TELECOM IC	BTIC	RAIN WATER PIPE	RWP
BUS STOP	BS	RAISED FLOWERBED	RFB
CABLE TELEVISION BOX	CATB	ROAD SIGN	RS
CABLE TELEVISION IC	CATV	RODDING EYE	RE
EARTHING ROD	ER	SERVICE MARKER POST	SMP
ELECTRICITY CABLE PIT	ELCP	SOIL VENT PIPE	SVP
ELECTRICITY CONTROL BOX	ECB	STOP COCK	SC
ELECTRICITY POLE	EP	STOP VALVE	SV
FIRE HYDRANT	FH	TELEGRAPH POLE	TP
INSPECTION COVER	IC	TELEPHONE CALL BOX	TCB
LAMP POST	LP	TRAFFIC SIGNAL	TS
LETTER BOX	LB	TRAFFIC SIGNALS IC	TSIC
LITTER BIN	BIN	WATER METER	WM
KERB OUTLET	KO	WATER TAP	Tap
NAME PLATE	NP		

Level Datum:
Levels are related to OSGB15 derived from the GPS network

Grid:
Grid is related to OSGB15 derived from the GPS network

Northpoint:

ENCOMPASS SURVEYS

Encompass Surveys Ltd
Unit 2
Talisman Business Centre
Duncan Road
Park Gate, Southampton
Hampshire SO31 7GA

Tel: 023 80692002 Email: info@encompass-surveys.co.uk
Fax: 023 80697125 Website: encompass-surveys.co.uk

Client:	Foreman Homes		
Survey Location:	Kingscroft Farm Havant PO9 1NR		
Survey type:	Topographical	Scale:	1:200@A0
Drawing ref:	ENC/0HH7/071019/Top	Date:	October 2019
Drawn/QA:	CH/DH	Revision:	Plot 1 of 8

Plot 2 of 8

NOTES:

Drainage:
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ELM	ELM	PRUNUS	PNS
FIR	FIR	RHODODENDRONS	RDN
FRUIT	FRT	ROWAN	RWN
HAWTHORN	HAW	SILVER BIRCH	SLB
HAZEL	HAZ	SORBUS	SOR
HOLLY	HLY	SWEET CHESTNUT	SCH
HORSE CHESTNUT	HCH	SYCAMORE	SYC
HORNBEAM	HRM	WALNUT	WNT
LABURNUM	LRM	WILLOW	WLW
LARCH	LAR	YEW	YEW
LIME	LIM	SPECIES UNKNOWN	SPU
		COPPICED	COP

TREE ANNOTATIONS: Tree Species / Tree Bolt Size / No of Bolts
Tree Height / Tree Canopy Spread

FENCE INFORMATION

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LEVEL INFORMATION

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FLOOR LEVEL	FL
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OUTFALL LEVEL	OL
THRESHOLD LEVEL	THL
FOUL WATER	FW
SURFACE WATER	SW
UNABLE TO LIFT	UTL
WATER LEVEL	WL

SURFACE INFORMATION

CONCRETE	Conc
BRICK PAVERS	BP
FLOWERBED	FB
PAVING SLABS	PS
RETAINING WALL	Retwall
TACTILE PAVING	Tac

FEATURE INFORMATION

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LITTER BIN	BIN	WATER METER	WM
KERB OUTLET	KO	WATER TAP	TAP
NAME PLATE	NP		

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Survey Location:	Kingscroft Farm Havant PO9 1NR		
Survey type:	Topographical	Scale:	1:200@A0
Drawing ref:	ENC/0H/H7/07101/9/Top	Date:	October 2019
Drawn/QA:	CH/DH	Revision:	Plot 2 of 8

Plot 3 of 8

106340mN
106320mN
106300mN
106280mN
106260mN
470540mE
470560mE
470580mE
470600mE
470620mE
470640mE
470660mE
470680mE

Unable to survey due to no access.

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HORSE CHESTNUT	HCH	SYCAMORE	SYC
HORNBEAM	HRM	WALNUT	WNT
LABURNUM	LRM	WILLOW	WLW
LARCH	LAR	YEW	YEW
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		COPPICED	COP

TREE ANNOTATIONS: Tree Species / Tree Boll Size / No of Bolls
Tree Height / Tree Canopy Spread

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Drawing ref:	ENC/0HH7/071019/Top	Date:	October 2019
Drawn/QA:	CH/DH	Revision:	Plot 3 of 8

Plot 4 of 8

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FRUIT	FRT	ROWAN	RWN
HAWTHORN	HAW	SILVER BIRCH	SIB
HAZEL	HAZ	SORBUS	SOR
HOLLY	HLY	SWEET CHESTNUT	SCH
HORSE CHESTNUT	HCH	SYCAMORE	SYC
HORNBEAM	HRM	WALNUT	WNT
LABURNUM	LRM	WILLOW	WLW
LARCH	LAR	YEW	YEW
LIME	LIM	SPECIES ICIES UNKNOWN	SPU
		COPPICED	COP

TREE ANNOTATIONS: Tree Species / Tree Bolt Size / No of Bolts
Tree Height / Tree Canopy Spread

FENCE INFORMATION

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CORRUGATED IRON FENCE	CIF
CLOSE BOARD FENCE	CBF
CHAIN LINK FENCE	CLF
CHESTNUT PALING	CPF
CRASH BARRIER	CBR
HANDRAIL	HDL
IRON RAILINGS	IRF
LARCH LAP FENCE	LLF
MISCELLANEOUS FENCE	MSF
PALISADE FENCE	PSF
PICKET FENCE	PKF
POST AND CHAIN FENCE	PCF
POST AND RAIL FENCE	PRF
POST AND WIRE FENCE	PWF
STOCK WIRE FENCE	SWF
TRELLIS FENCING	TLF

LEVEL INFORMATION

BASEMENT LEVEL	BTL
BED LEVEL	BL
COVER LEVEL	CL
DAMP PROOF COURSE	DPC
FLOOR LEVEL	FL
INVERT LEVEL	IL
OUTFALL LEVEL	OL
THRESHOLD LEVEL	THL
POUL WATER	PW
SURFACE WATER	SW
UNABLE TO LIFT	UTL
WATER LEVEL	WL

SURFACE INFORMATION

CONCRETE	Conc
BRICK PAVERS	BP
FLOWERBED	FB
PAVING SLABS	PS
RETAINING WALL	Retwall
TACTILE PAVING	Tac

FEATURE INFORMATION

BOLLARD	BO	NOTICE BOARD	NB
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BRITISH TELECOM IC	BTIC	RAIN WATER PIPE	RWP
BUS STOP	BS	RAISED FLOWERBED	RFB
CABLE TELEVISION BOX	CATB	ROAD SIGN	RS
CABLE TELEVISION IC	CATV	RODDING EYE	RE
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ELECTRICITY CONTROL BOX	ECB	STOP COCK	SC
ELECTRICITY POLE	EP	STOP VALVE	SV
FIRE HYDRANT	FH	TELEGRAPH POLE	TP
INSPECTION COVER	IC	TELEPHONE CALL BOX	TCB
LAMP POST	LP	TRAFFIC SIGNAL	TS
LETTER BOX	LB	TRAFFIC SIGNALS IC	TSIC
LITTER BIN	BIN	WATER METER	WM
KERB OUTLET	KO	WATER TAP	TAP
NAME PLATE	NP		

Level Datum:
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Grid:
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Northpoint:

ENCOMPASS SURVEYS

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Park Gate, Southampton
Hampshire SO31 7GA

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Fax: 023 80697125 Website: encompass-surveys.co.uk

Client:	Foreman Homes		
Survey LOCation:	Kingscroft Farm Havant PO9 1NR		
Survey type:	Topographical	Scale:	1:200@A0
Drawing ref:	ENC/0HH7/071019/Top	Date:	October 2019
Drawn/QA:	CH/DH	Revision:	Plot 4 of 8

Plot 5 of 8

NOTES:

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LEGEND

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BEECH	BCH	MAPLE	MPL
CEDAR	CED	OAK	OAK
CHERRY	CHY	PINE	PNE
CYPRESS	CYP	POPLAR	POP
ELM	ELM	PRUNUS	PNS
FIR	FIR	RHODODENDRONS	RDN
FRUIT	FRT	ROWAN	RWN
HAWTHORN	HAW	SILVER BIRCH	SLB
HAZEL	HAZ	SORBUS	SOR
HOLLY	HLY	SWEET CHESTNUT	SCH
HORSE CHESTNUT	HCH	SYCAMORE	SYC
HORNBEAM	HRM	WALNUT	WNT
LABURNUM	LRM	WILLOW	WLW
LARCH	LAR	YEW	YEW
LIME	LIM	SPECIES UNKNOWN	SPU
		COPPICED	COP

TREE ANNOTATIONS: Tree Species / Tree Bolt Size / No of Bolts
Tree Height / Tree Canopy Spread

FENCE INFORMATION

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CLOSE BOARD FENCE	CBF	COVER LEVEL	CL
CHAIN LINK FENCE	CLF	DAMP PROOF COURSE	DPC
CHESTNUT PALING	CPF	FLOOR LEVEL	FL
CRASH BARRIER	CBR	INVERT LEVEL	IL
HANDRAIL	HDL	OUTFALL LEVEL	OL
IRON RAILINGS	IRF	THRESHOLD LEVEL	THL
LARCH LAP FENCE	LLF	FOUL WATER	FW
MISCELLANEOUS FENCE	MSF	SURFACE WATER	SW
PALISADE FENCE	PSF	UNABLE TO LIFT	UTL
PICKET FENCE	PKF	WATER LEVEL	WL
POST AND CHAIN FENCE	PCF		
POST AND RAIL FENCE	PRF		
POST AND WIRE FENCE	PWF		
STOCK WIRE FENCE	SWF		
TRELLIS FENCING	TLF		

SURFACE INFORMATION

CONCRETE	Conc
BRICK PAVERS	BP
FLOWERBED	FB
PAVING SLABS	PS
RETAINING WALL	Retwall
TACTILE PAVING	Tac

FEATURE INFORMATION

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BUS STOP	BS	RAISED FLOWERBED	RFB
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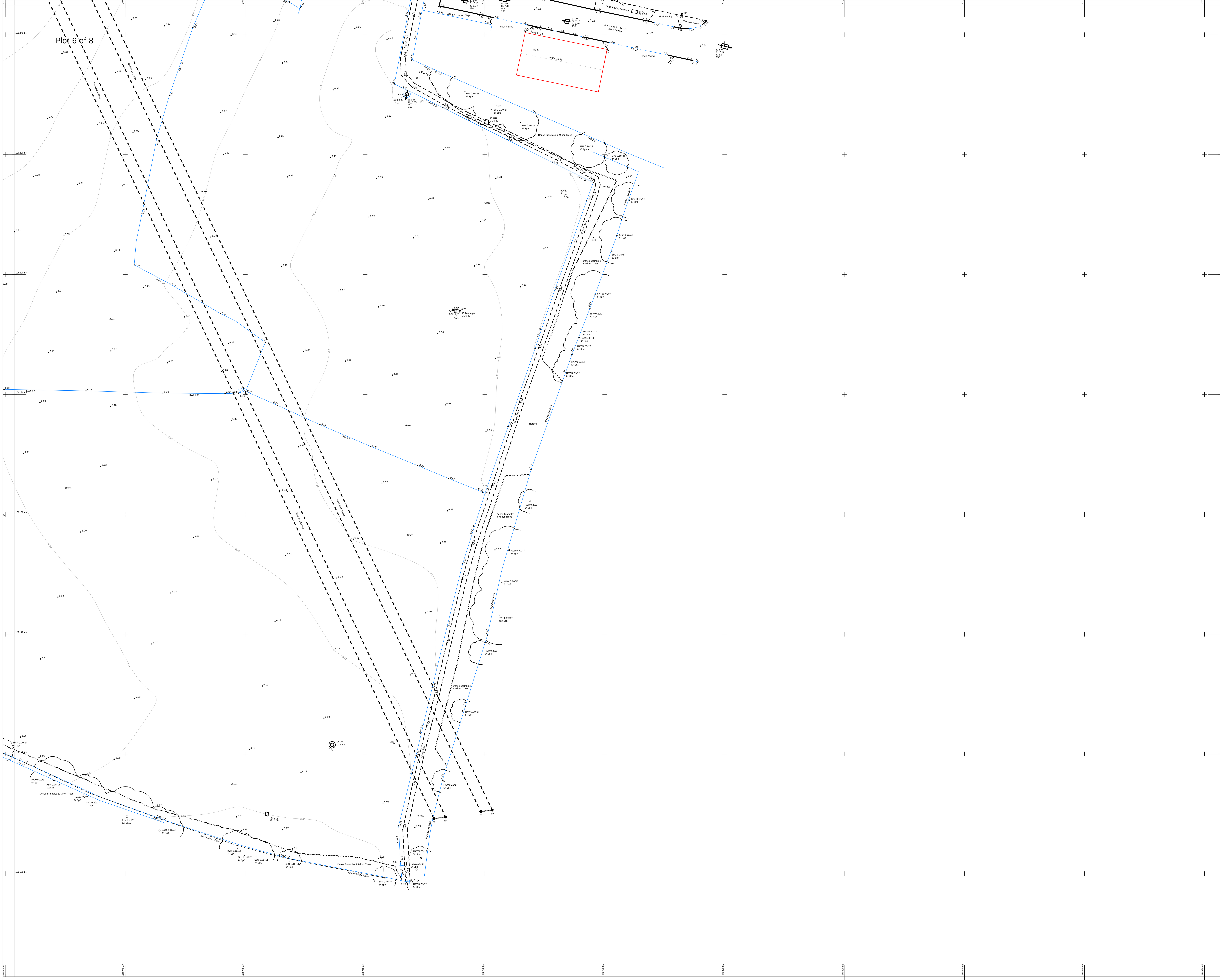
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CYPRESS	CYP	POPLAR	POP
ELM	ELM	PRUNUS	PNS
FIR	FIR	RHODODENDRONS	RDN
FRUIT	FRT	ROWAN	RWN
HAWTHORN	HAW	SILVER BIRCH	SIB
HAZEL	HAZ	SORBUS	SOR
HOLLY	HLY	SWEET CHESTNUT	SCH
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LABURNUM	LRM	WILLOW	WLW
LARCH	LAR	YEW	YEW
LIME	LIM	SPECIES UNKNOWN	SPU
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TREE ANNOTATIONS: Tree Species / Tree Boll Size / No of Bolls
Tree Height / Tree Canopy Spread

FENCE INFORMATION

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POST AND RAIL FENCE	PRF
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STOCK WIRE FENCE	SWF
TRELLIS FENCING	TLF

LEVEL INFORMATION

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BED LEVEL	BL
COVER LEVEL	CL
DAMP PROOF COURSE	DPC
FLOOR LEVEL	FL
INVERT LEVEL	IL
OUTFALL LEVEL	OL
THRESHOLD LEVEL	THL
FOUL WATER	FW
SURFACE WATER	SW
UNABLE TO LIFT	UTL
WATER LEVEL	WL

SURFACE INFORMATION

CONCRETE	Conc
BRICK PAVERS	BP
FLOWERBED	FB
PAVING SLABS	PS
RETAINING WALL	RWall
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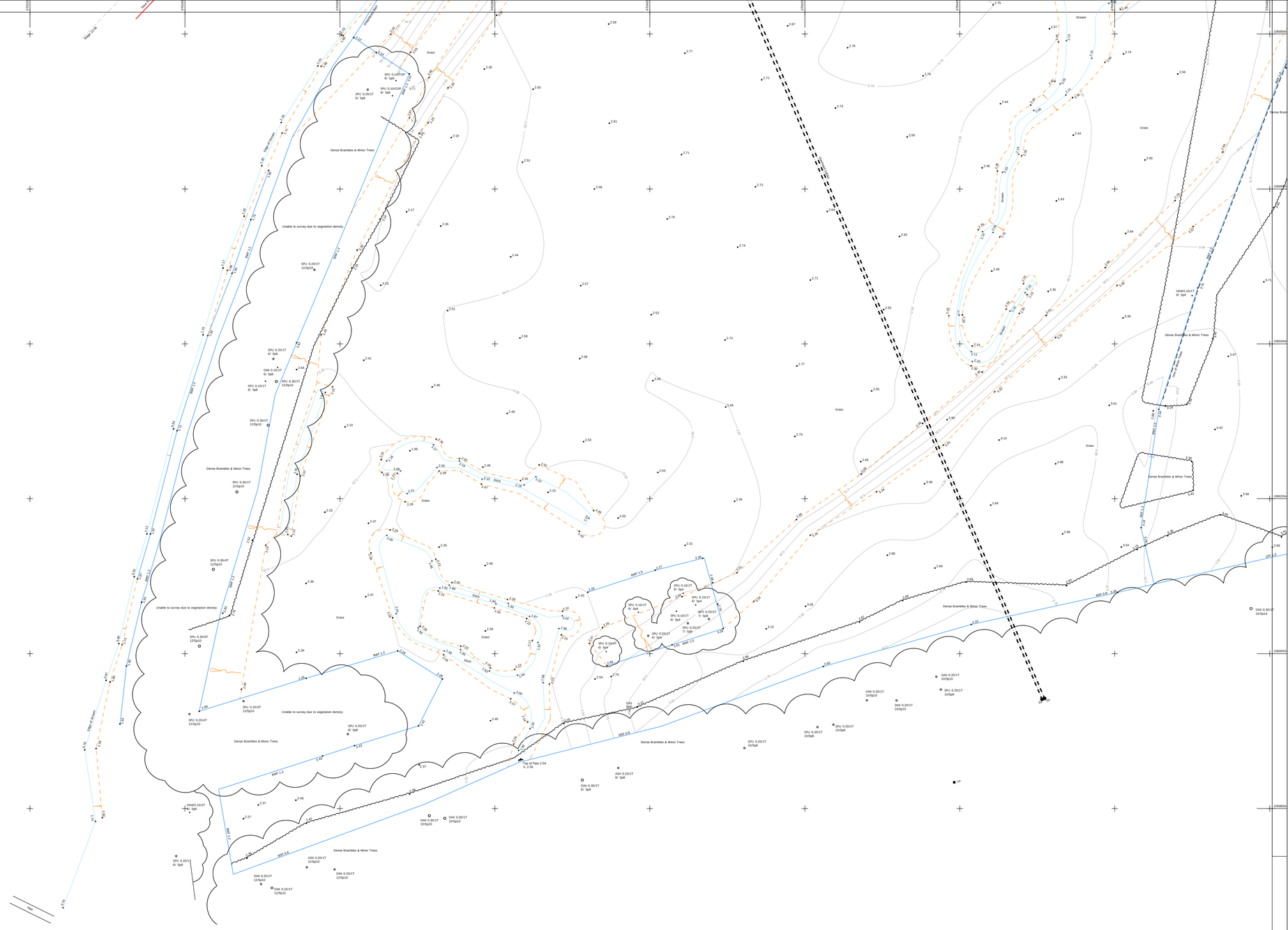
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Drawing ref:	ENC/0HH7/071019/Top	Date:	October 2019
Drawn/QA:	CH/DH	Revision:	Plot 6 of 8

Plot 7 of 8



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LEVEL INFORMATION

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FLOOR LEVEL	FL
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FOUL WATER	FW
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UNABLE TO LIFT	UTL
WATER LEVEL	WL

SURFACE INFORMATION

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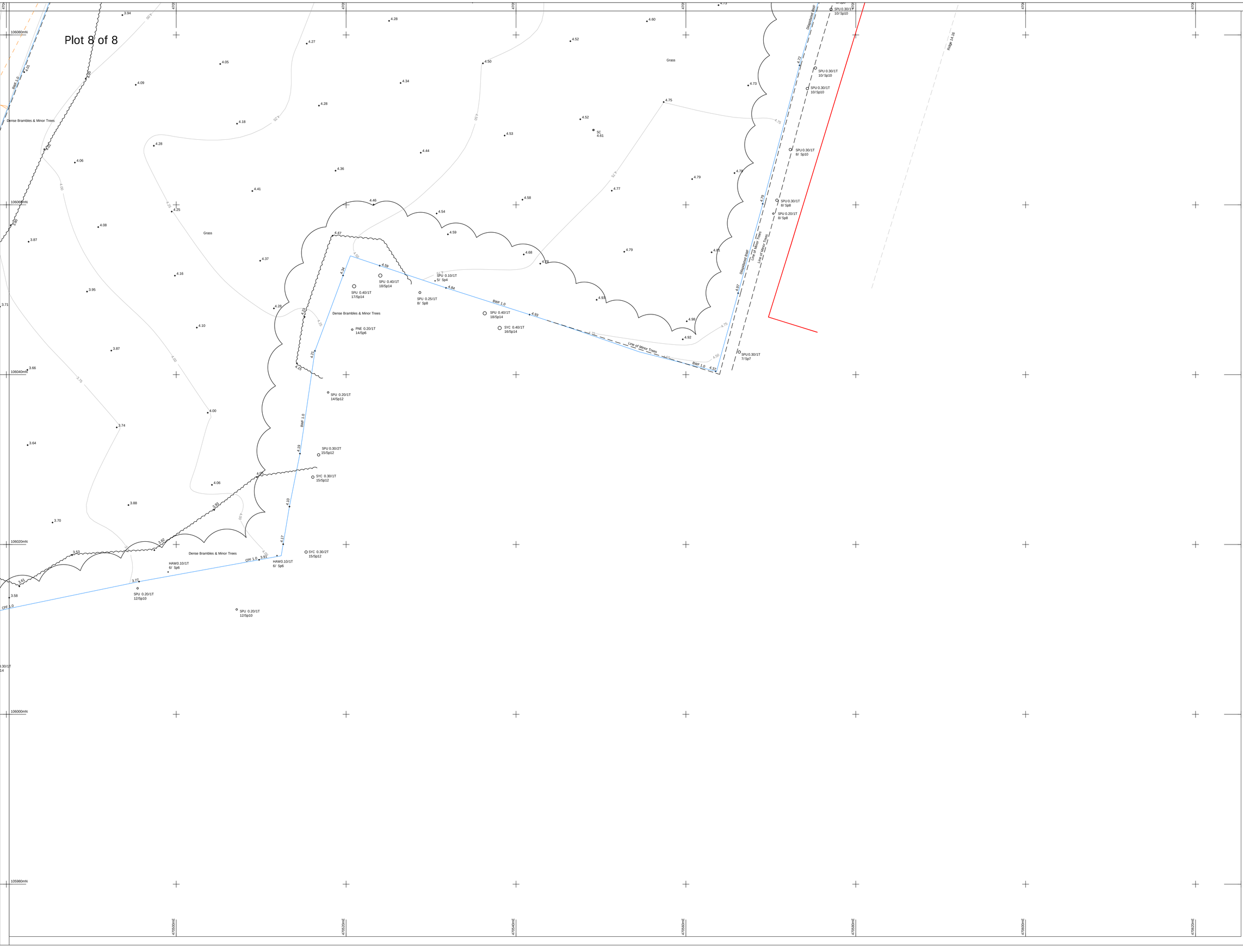
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Plot 8 of 8



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Drawn/QA:	CH/DH	Revision:	Plot 8 of 8

Appendix D

Thomas Telford House, Sun Valley Business Park
Winnall Close
Winchester
S023 OLB

01962 673 330
soilslimited.co.uk

Foreman Homes Ltd.
Brockhampton Holdings Ltd.
Portsmouth Water Ltd.
Brockhampton Property Investments Ltd.

Via email only: Neil.Calderwood@foremanhomes.co.uk

January 2020

Our Ref.: 17877/SGLR

Dear Neil

Re: Kingscroft Farm, Ranelagh Road, Havant, Hampshire PO9 1FJ

Foreman Homes Ltd., Brockhampton Holdings Ltd., Portsmouth Water Ltd. and Brockhampton Property Investments Ltd. commissioned Soils Limited to undertake a Soil-Gas Risk Assessment at the site referred to as Kingscroft Farm, Ranelagh Road, Havant, Hampshire PO9 1FJ.

This letter report must be read in conjunction with the following documents:

Preliminary Investigation Report (Soils Limited report ref.: 17877/PIR_R26, dated November 2019)
Main Investigation Report (Soils Limited report ref.: 17877/MIR_R27, dated November 2019)

Background

The Preliminary Investigation Report (PIR) undertaken on the site identified a low to moderate risk of soil gas onsite associated with offsite sources.

The site was situated within an area where protection or risk assessment against the ingress of radon was required. The site location within an area of 1km grid square were in bands of elevated radon potential. Maximum radon potential was 3-5%.

Radon protection measures are typically only required when the radon potential is 5-10% and therefore it is possible that radon protection measures will not be required as part of the proposed development, however, consultation with the local Building Control department at the Local Authority is recommended as they will be able to advise on whether or not radon protection measures are required in new developments within the

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Registered Office: Newton House, Cross Road, Tadworth, Surrey KT20 5SR

site's vicinity. It is not possible in the course of a survey or inspection to determine whether radon gas is present as the gas is colourless and odourless. Tests can be undertaken to assess the concentration of radon in existing structures.

To quantify the risk posed to the site from the identified sources, a soil gas risk assessment was recommended. This comprised six soil gas monitoring visits undertaken over a period of approximately three months.

Gas Monitoring Records

Soil gas monitoring standpipes were installed in WS1, WS2 and WS4 each to a depth of 4.00m bgl. The locations were selected to provide a general coverage of the site as appropriate to the identified offsite sources.

Monitoring of the standpipes were undertaken on six occasions between 22nd October 2019 and 31st December 2019, targeting periods of low and falling atmospheric pressure where possible.

The concentration of methane (both total and LEL), hydrogen sulphide, carbon monoxide, carbon dioxide and oxygen were measured using a portable infrared monitor. Readings of flowrate were taken with a differential manometer calibrated to give flow rate. A Photo Ionisation Detector (PID) was used to detect for Volatile Organic Compounds (VOCs). The results of the monitoring are provided in Table 1.

Table 1. Soil Gas Monitoring Results

Date (Baro Trend)	Trial Hole	CH_4 (%)	CO_2 (%)	O_2 (%)	H_2S (ppm)	CO (ppm)	LEL (%)	aP (mb)	Flow (l/h)	VOC (ppm)	H_2O (m bgl)	Base of hole
22/10/2019	ATM	0.0	0.0	21.0	0.0	0.0	0.0	1022	0.0	0.0	-	-
(Steady)	WS1	0.0	1.3	19.4	0.0	0.0	0.0	1022	0.0	0.0	DRY	3.80
	WS2	0.0	2.7	14.8	0.0	0.0	0.0	1022	0.0	0.0	DRY	3.61
	WS4	0.0	1.0	20.0	0.0	0.0	0.0	1022	0.0	0.0	DRY	3.86
07/11/2019	ATM	0.0	0.0	21.3	0.0	0.0	0.0	995	0.0	0.0	-	-
(Steady)	WS1	0.0	2.5	16.8	0.0	0.0	0.0	995	0.0	0.0	2.36	3.78
	WS2	0.0	2.6	16.6	0.0	0.0	0.0	995	0.0	0.0	2.56	3.59
	WS4	0.0	0.0	20.7	0.0	0.0	0.0	995	0.0	0.0	3.72	3.85
19/11/2019	ATM	0.0	0.0	21.3	0.0	0.0	0.0	1016	0.0	0.0	-	-
(Steady)	WS1	0.0	2.2	19.1	0.0	0.0	0.0	1016	0.0	0.0	2.36	3.77
	WS2	0.0	3.3	14.3	0.0	0.0	0.0	1016	0.0	0.0	2.68	3.54
	WS4	0.0	**3.8**	9.5	0.0	0.0	0.0	1016	0.0	0.0	DRY	3.82
05/12/2019	ATM	0.0	0.0	19.9	0.0	0.0	0.0	1020	0.0	0.0	-	-
(Falling)	WS1	0.0	1.5	18.0	0.0	0.0	0.0	1020	0.0	0.0	DRY	3.80
	WS2	0.0	0.0	19.9	0.0	0.0	0.0	1020	0.0	0.0	2.67	3.56
	WS4	0.0	2.5	**8.1**	0.0	0.0	0.0	1019	0.0	0.0	3.81	3.83
16/12/2019	ATM	0.0	0.0	19.9	0.0	0.0	0.0	999	0.0	0.0	-	-
(Rising)	WS1	0.0	0.7	18.9	0.0	0.0	0.0	999	**0.1**	0.0	1.99	3.75
	WS2	0.0	2.5	11.6	0.0	0.0	0.0	999	0.0	0.0	2.37	3.53
	WS4	0.0	2.1	10.6	0.0	0.0	0.0	999	0.0	0.0	3.50	3.84
31/12/2019	ATM	0.0	0.0	19.8	0.0	0.0	0.0	1030	0.0	0.0	-	-
(Steady)	WS1	0.0	2.0	12.5	0.0	0.0	0.0	1030	0.0	0.0	2.17	3.78
	WS2	0.0	2.9	10.5	0.0	0.0	0.0	1030	0.0	0.0	2.51	3.52
	WS4	0.0	2.2	8.9	0.0	0.0	0.0	1030	0.0	0.0	3.64	3.84

Notes: Zero reading = below the equipment detection limit. Published barometric pressure trend data obtained for each monitoring visit from Southampton Airport Weather Station.

The monitoring undertaken detected the presence of carbon dioxide at concentrations of between <0.1% and 3.8% v/v and oxygen at concentrations between 8.1% and 20.7% v/v within the monitoring wells.

No concentrations of methane (total or LEL), hydrogen sulphide, carbon monoxide or VOCs were recorded above instrument detection levels, atmospheric pressure was recorded between 995 and 1030mb and no positive gas flow rates were recorded during the monitoring period.

Data Quality

A review was made of the quality of the available data for the site, which can be viewed in Table 2. CIRIA 665 (2007) and BS 8485:2015 stress the need for risk assessments to be based on good quality data and give guidance as to best practice in this respect.

Table 2 – Review of Data Quality

Data Type	Current Situation	UK Practice
Geological and hydro-geological conditions	With regard to soil gas risk assessment the data collected from the intrusive investigation was considered to be good.	CIRA 665, Wilson and Card (1999) and BS 8485:2015 recommend that geology and hydrogeology be fully understood.
Monitoring period	Monitoring has been undertaken on a total of six occasions over an approximate period of approximately three months. Monitoring has been undertaken over a range of seasons and weather conditions including falling-rising and low and high atmospheric pressures.	CIRIA 665 recommends approximately 9 to 12 monitoring visits over approximately 6 moths residential development with development with low to moderate soil gas generation potential of identified sources. Wilson and Card (1999) recommend that for less than 12 months monitoring the protective measures should be made more conservative.
Gas data sets	Borehole flow velocity has been measured on each monitoring occasion.	Borehole flow velocity and borehole gas volume required to define characteristic gas saturation. Modified Wilson and Card, Table 8.5 of CIRIA 665 (2006)/Table 2 of BS 8485:2015.

Data quality was considered good, covering a range of atmospheric pressure trends including readings taken during falling pressure and a low-pressure event (<1000mb), known as worst case conditions. Geological and hydrogeological conditions have been investigated as indicated in previous reports relating to this site. The dataset gained is considered sufficient to characterise the sites gassing regime and no further soil gas monitoring is deemed necessary.

Risk Assessment

Based on the documentation presented in the "BS 8485:2015, Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings" the hazardous gas flow rate (Qhg) was calculated using Equation 1:

$$Q_{hg} = (C_{hg}/100) * q \qquad \textit{Equation 1}$$

Where:

C_{hg} is the measured hazardous gas concentration in percentage volume-by-volume.

q is the flow rate in litres per hour of combined gases found by direct measurement.

If soil gas borehole flow was not detectable, it should be assumed to be at the detection limit of the equipment used, which was 0.1l/hr.

Consequently, the Q_{hg} for carbon dioxide was calculated using Equation 2.

Q_{hg} (l/hr) = gas concentration * borehole flow rate (l/hr) *Equation 2*

= 3.8/100 * 0.1 = 0.0038 l/h

The maximum carbon dioxide concentration was taken as the gas concentration as a percentage and the instrument detection limit was taken as the maximum for the borehole flow rate (0.1l/h) as no positive flow was recorded, thus increasing the degree of conservatism adopted.

Based on the Site Characteristic hazardous gas flow rate of 0.0038l/h, the site falls into Characteristic Gas Situation 1 (CS1), which does not require gas protection measures to be emplaced in accordance with BS 8485:2015.

Groundwater Monitoring

At the time of the intrusive investigation (October 2019), groundwater was recorded during the excavation of one trial hole (TP2) struck at a depth of 3.50m bgl within the River Terrace Deposits.

Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. The investigation was conducted in October (2019), when groundwater levels should be rising from their annual minimum (lowest) elevation, which typically occurs around September to the annual maximum (highest) which typically occurs around March.

Post-works groundwater monitoring was undertaken simultaneously with the soil gas readings comprising six readings from the standpipes installed onsite (WS1, WS2 and WS4) between 22nd October 2019 and 31st December 2019, and results tabulated in Table 1.

The post-works groundwater monitoring recorded water levels within the standpipes at a highest elevation of 1.99m bgl.

Conclusion

A review of the soil gas monitoring undertaken on the site indicated the sites gassing regime to be representative of CS1 under BS 8485:2015 based on the hazardous gas concentration of carbon dioxide screening values, indicating that gas protection measures are not required for the site.

Should you have any queries regarding the above, please do not hesitate to contact the undersigned.

Yours sincerely



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For and on behalf of Soils Limited.

soils LIMITED

Main Investigation Report

at
Kingscroft Farm, Ranelagh Road, Havant, Hampshire PO9 1FJ

for
Foreman Homes Ltd.
Brockhampton Holdings Ltd.
Portsmouth Water Ltd
Brockhampton Property Investments Ltd.

Reference: 17877/MIR_R27
November 2019

Control Document

Project
Kingscroft Farm, Ranelagh Road, Havant, Hampshire PO9 1FJ

Document Type
Main Investigation Report (MIR)

Document Reference
17877/MIR_R27

Document Status
Final

Date
November 2019

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This is not a valid document for use in the design of the project unless it is titled Final in the document status box.

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

AGS Association of Geotechnical & Geoenvironmental Specialists
BGA CORPORATE MEMBER 2019 www.britishgeotech.org.uk
Quality Systems Certifications Ltd ISO 18001 : 2007 REGISTERED FIRM
Quality Systems Certifications Ltd ISO 9001 : 2015 REGISTERED FIRM

Commission

Foreman Homes Ltd., Brockhampton Holdings Ltd, Portsmouth Water Ltd. and Brockhampton Property Investments Ltd. commissioned Soils Limited to undertake an intrusive ground investigation and prepare a Main Investigation Report on land at Kingscroft Farm, Ranelagh Road, Havant, Hampshire PO9 1FJ. The scope of the investigation was outlined in the Soils Limited quotation reference Q21687/rev102, dated 20th September 2019.

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

This Main Investigation Report must be read in conjunction with the Preliminary Investigation (Desk Study) Report undertaken on the above site by Soils Limited, Report ref: 17877/PIR, dated November 2019.

Standards

The site works, soil descriptions and geotechnical testing was undertaken in accordance with the following standards:

BS 5930:2015 and BS EN ISO 22476-2 2005+A1:2011

BS EN 1997-1:2004+A1:2013 Eurocode 7

BS EN ISO 14688-1:2002+A1:2013

BS EN ISO 14688-2:2004+A1:2013

BS 10175:2011+A1:2013

NHBC Standards 2019

The geotechnical laboratory testing was performed by GEO Site & Testing Services Ltd (GSTL) in accordance with the methods given in BS 1377:1990 Parts 1 to 8 and their UKAS accredited test methods.

For the preparation of this report, the relevant BS code of practice was adopted for the geotechnical laboratory testing technical specifications, in the absence of the relevant Eurocode specifications (ref: ISO TS 17892).

The chemical analyses were undertaken by I2 Analytical Services(I2) in accordance with their UKAS and MCERTS accredited test methods or their documented in-house testing procedures. This investigation did not comprise an environmental audit of the site or its environs.

Trial hole is a generic term used to describe a method of direct investigation. The term trial pit, borehole or window sample borehole implies the specific technique used to

produce a trial hole.

Contents

Section 1 Introduction 1
1.1 Objective of Investigation 1
1.2 Location 1
1.3 Site Description 1
1.4 Proposed Development 2
1.5 Anticipated Geology 2
1.5.1 Alluvium 2
1.5.2 River Terrace Deposits 2
1.5.3 Lewes Nodular Chalk Formation 3
1.6 Limitations and Disclaimers 3
Section 2 Site Works 5
2.1 Proposed Project Works 5
2.1.1 Actual Project Works 5
2.2 Ground Conditions 6
2.3 Ground Conditions Encountered in Trial Holes 8
2.3.1 Made Ground and Topsoil 8
2.3.2 River Terrace Deposits 9
2.3.3 Lewes Nodular Chalk Formation 10
2.4 Roots 10
2.5 Groundwater 11
Section 3 Discussion of Geotechnical In-Situ and Laboratory Testing 12
3.1 Dynamic Probe Tests 12
3.2 Infiltration Tests 12
3.3 Atterberg Limit Tests 13
3.4 Particle Size Distribution Tests 13
3.5 Saturation Moisture Content Tests 14
3.6 Sulphate and pH Tests 14
Section 4 Foundation Design 15
4.1 General 15
4.1.1 Made Ground and Topsoil 15
4.1.2 River Terrace Deposits 16
4.1.3 Lewes Nodular Chalk Formation 17

4.1.4 Roots 18
4.1.5 Groundwater 18
4.2 Foundation Scheme General 18
4.2.1 Guidance on Shrinkable Soils 19
4.3 Foundation Scheme 20
4.3.1 Possible Solution Feature 20
4.3.2 Piled Foundations 21
4.3.3 Ground Floor Slab 22
4.4 Subsurface Concrete 22
4.5 Excavations 22
Section 5 Determination of Chemical Analysis 25
5.1 Site Characterisation and Revised Conceptual Site Model 25
5.2 Soil Sampling 25
5.3 Determination of Chemical Analysis 25
Section 6 Qualitative Risk Assessment 27
6.1 Assessment Criteria 27
6.2 Representative Contamination Criteria - Soil 27
6.2.1 Asbestos 28
6.3 Groundwater 28
6.4 Tier 1 Quantitative Risk Assessment 28
6.4.1 Soils 28
6.4.2 Groundwater 28
6.4.3 Soil Gas 29
6.5 Duty of Care 30
6.6 Excavated Material 30
6.7 Re-use of Excavated Material On-site 31
6.8 Imported Material 31
6.9 Discovery Strategy 32

List of Figures

Figure 1 – Site Location Map 34
Figure 2 – Aerial Photograph 35
Figure 3 – Trial Hole Plan 36

List of Tables

Table 2.1 Final Depth of Trial Holes 6
Table 2.2 Ground Conditions 8
Table 2.3 Final Depth of Made Ground/Topsoil 9
Table 2.4 Final Depth of River Terrace Deposits 9
Table 2.5 Final Depth of Lewes Nodular Chalk Formation 10
Table 2.6 Depth of Root Penetration 10
Table 2.7 Groundwater Monitoring 11
Table 3.1 Infiltration Rates 13
Table 5.1 Sampling Strategy 25
Table 5.2 Chemical Analysis Specification 26
Table 6.1 Summary of Chemical Analysis of Soils Sample Exceedance 27

Table B.1.1 SPT "N" Blow Count Cohesive Classification
Table B.1.2 SPT "N" Blow Count Granular Classification
Table B.1.3 Interpretation of SPT “N” Blow Counts in Chalk
Table B.2.1 Interpretation of DPSH Blow Counts
Table B.2.2 Interpretation of Atterberg Limit Tests
Table B.2.3 Interpretation of PSD Tests
Table B.2.4 Interpretation of SMC Tests
Table C.1.1 CSM Revised Post Testing

List of Appendices

Appendix A Field Work

Appendix A.1 Engineers Logs

Appendix B Geotechnical In-Situ and Laboratory Testing

Appendix B.1 Classification

Appendix B.2 Interpretation

Appendix B.3 Geotechnical In-Situ and Laboratory Results

Appendix C Chemical Laboratory Testing

Appendix C.1 Conceptual Site Model

Appendix C.2 Chemical Laboratory Results

Appendix C.3 General Assessment Criteria

Appendix A Information Provided by the Client

Section 1 Introduction

1.1 Objective of Investigation

Foreman Homes Ltd., Brockhampton Holdings Ltd, Portsmouth Water Ltd. and Brockhampton Property Investments Ltd. commissioned Soils Limited to undertake an intrusive ground investigation and to prepare a Main Investigation Report (MIR) to supply the client and their designers with information regarding ground conditions, to assist in preparing a foundation scheme for development that was appropriate to the settings present on the site.

The investigation was to be undertaken to provide comment on appropriate foundation options for the proposed residential development. The investigation was to be made by means of in-situ testing and geotechnical laboratory testing undertaken on soil samples taken from the trial holes.

Soil samples were taken for chemical laboratory testing to enable recommendations for the safe redevelopment of the site and the protection of site workers, end-users and the public from any contamination identified as dictated by the Conceptual Site Model (CSM) in the Preliminary Investigation Report (Desk Study) undertaken for the site by Soils Limited (ref: 17877/PIR, November 2019) and/or the Revised Conceptual Site Model presented in Appendix C.1.

1.2 Location

The site was located at Kingscroft Farm, Ranelagh Road, Havant, Hampshire PO9 1FJ and had an approximate O.S Land Ranger Grid Reference of SU 707 061.

The site location plan is given in Figure 1.

1.3 Site Description

At the time of the investigation the site of the proposed development comprised a field used for horse grazing. The site was adjacent to residential properties to the north-east and a commercial area/business park to the south and south-west. “Hermitage” stream was bounding the site to the north and to the west and Havant Bypass (A27) delineated the site to the south. Fields and residential properties were noted further to the north and a business centre further to the south across the A27.

Vegetation was noted the site boundaries comprising mature trees and shrubs. The site was generally flat lying with a gentle slope to the southwest and was predominantly covered in grass.

The main access was provided by Meyrick Road to the northeast.

An aerial photograph has been included in Figure 2.

1.4 Proposed Development

At the time of reporting (November 2019), the proposal comprised the construction of numerous low-rise residential dwellings and apartment blocks with garages and carports.

The proposed development comprised areas of hard landscaping including access roads, driveways and pavements and areas of soft landscaping including public open space and private gardens.

In compiling this report reliance was placed on drawing number 18.099.02, dated September 2018 and was prepared by HGP Architects. Any change or deviation from the scheme outlined in the drawing could invalidate the foundation design and remediation recommendations presented within this report. Soils Limited must be notified about any such changes.

Development plans provided by the client are presented in Appendix D.

1.5 Anticipated Geology

The 1:50,000 BGS map showed the site to be underlain by the bedrock Lewes Nodular Chalk Formation with overlying superficial River Terrace Deposits to the east and superficial deposits of Alluvium to the west.

1.5.1 Alluvium

Alluvium is the most recent river or estuarine deposit and generally comprises silty clays usually with an appreciable organic content. Lenses of sand and gravel are also commonly found, as are pockets of peat.

The BSI Code of Practice for Foundations, BS8004: 1986, Clause 2.2.2.3.4 Peat and organic soils, includes the caveat that 'all these soils are highly compressible, and even lightly loaded foundations will be subject to considerable settlements over a long period if placed on them. For this reason, these soils are not suitable for carrying the loads for important ‘structures’.

1.5.2 River Terrace Deposits

The rivers Test and Itchen have deposited extensive spreads of River Terrace Deposits in the Hampshire area, representative of ancient floodplains. In total, eleven terraces have been recorded. The River Terrace Deposits consist predominantly of gravels made up of sub angular to sub rounded flints with a significant sand component locally with lenses of silt, clay or peat.

The five highest terraces have appreciable clay content. Poorly sorted, clayey and sandy silts and silty clays overlie the 1st, 3rd, 5th and 6th terraces and locally at above terrace gravels.

1.5.3 Lewes Nodular Chalk Formation

Composed of hard to very hard nodular chalks and hardgrounds (which resist scratching by fingernail) with interbedded soft to medium hard chalks (some grainy) and marls; some griotte chalks. The softer chalks become more abundant towards the top. Nodular chalks are typically lumpy and iron-stained (usually marking sponges). Brash is rough and flaggy or rubbly and tends to be dirty. First regular seams of nodular flint, some large, commence near the base and continue throughout.

Chalk is a weak rock and as such it should be noted that the drilling, excavating and sampling process is detrimental to its fabric and structure. Chalk samples that have been machine sampled will therefore appear to be of a lower descriptive grade, as given in CIRIA C574, than the in-situ chalk. Soil sampling and visual observations from open excavations i.e. trial pits would allow chalk description and classification in accordance with CIRIA 574 including commenting for any aperture and discontinuities in the chalk structure.

Erosional features, such as pipes, swallow holes and solution cavities, usually in-filled with drift deposits, are occasionally found in the chalk, sometimes manifesting themselves at the surface as shallow circular depressions. Solution features may be reactivated by the concentrated ingress of water from leaking drains or soakaways. Reactivation may lead to surface collapse.

1.6 Limitations and Disclaimers

This Main Investigation Report relates to the site located at Kingscroft Farm, Ranelagh Road, Havant, Hampshire PO9 1FJ and was prepared for the sole benefit of Foreman Homes Ltd., Brockhampton Holdings Ltd, Portsmouth Water Ltd. and Brockhampton Property Investments Ltd. (The “Client”). The report was prepared solely for the brief described in Section 1.1 of this report.

Soils Limited disclaims any responsibility to the Client and others in respect of any matters outside the scope of the above.

This report has been prepared by Soils Limited, with all reasonable skill, care and diligence within the terms of the Contract with the Client, incorporation of our General Conditions of Contract of Business and taking into account the resources devoted to us by agreement with the Client.

The report is personal and confidential to the Client and Soils Limited accept no responsibility of whatever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report wholly at its own risk.

The Client may not assign the benefit of the report or any part to any third party without the written consent of Soils Limited.

The ground is a product of continuing natural and artificial processes. As a result, the ground will exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the client in accordance with their brief. As such these do not necessarily address all aspects of ground behaviour at the site.

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

The depth to roots and/or of desiccation may vary from that found during the investigation. The client is responsible for establishing the depth to roots and/or of desiccation on a plot by plot basis prior to the construction of foundations. Supplied site surveys may not include substantial shrubs or bushes and is also unlikely to have data or any trees, bushes or shrubs removed prior to or following the site survey.

Where trees are mentioned in the text this means existing trees, substantial bushes or shrubs, recently removed trees (approximately 20 years to full recovery on cohesive soils) and those planned as part of the site landscaping).

Ownership of land brings with it onerous legal liabilities in respect of harm to the environment. “Contaminated Land” is defined in Section 57 of the Environment Act 1995 as:

“Land which is in such a condition by reason of substances in, on or under the land that significant harm is being caused or that there is a significant possibility of such harm being caused or that pollution of controlled waters is being, or is likely to be caused”.

The investigation, analysis or recommendations in respect of contamination are made solely in respect of the prevention of harm to vulnerable receptors, using where possible best practice at the date of preparation of the report. The investigation and report do not address, define or make recommendations in respect of environmental liabilities. A separate environmental audit and liaison with statutory authorities is required to address these issues.

Ownership of copyright of all printed material including reports, laboratory test results, trial pit and borehole log sheets, including drillers log sheets remains with Soils Limited. License is for the sole use of the client and may not be assigned, transferred or given to a third party.

Section 2 Site Works

2.1 Proposed Project Works

The proposed intrusive investigation was designed to provide information on the ground conditions and to aid the design of foundations for the proposed residential development. The intended investigation, as outlined within the Soils Limited quotation (Q21687, dated 20th September 2019), was to comprise the following items:

4No up to a depth of 4.00m bgl windowless sampler boreholes

4No up to a depth of 6.00m bgl dynamic probes

Machine excavated trial pits with infiltration testing to BRE365

3No. well installations for groundwater level and soil gas monitoring

6 rounds of soil gas monitoring, to include gas flow, methane, carbon dioxide, oxygen, CO, H2S, VOC + groundwater dip

Geotechnical laboratory testing

Contamination laboratory testing

2.1.1 Actual Project Works

The actual project works were undertaken on 1st October 2019 and comprised:

5No. Machine excavated trial pits

Infiltration testing (BRE DG365) within trial pits TP1, TP3 and TP4

5No. window sampler boreholes to 4.00m bgl

Installation of 1No. gas and groundwater monitoring well to 4.00m within WS1,

Installation of 1No. gas and groundwater monitoring well to 4.00m within WS2,

Installation of 1No. gas and groundwater monitoring well to 4.00m within WS4

5No. dynamic probes DPSH – SPT equivalent to 5.00m bgl

Geotechnical laboratory testing

Contamination laboratory testing

Dual-purpose groundwater/gas monitoring wells were installed within three of the windowless sampling boreholes (WS1, WS2 and WS4), to a depth of 4.00m bgl. All wells were fitted with a gas tap. The response zone of the wells was constructed using slotted HDPE plastic pipe from approximately 1.00m bgl depth. Plain plastic HDPE pipe was used from the end of the response zone to the ground level. The response zone was backfilled with gravel, while bentonite was used to the surface. A flush fitting stopcock cover was concreted at ground level to finish the installation at surface. In the absence of well installations, two boreholes (WS3 and WS5) were backfilled with pea shingle upon completion.

Five super heavy dynamic probes, (DP1, DP2, DP3, DP4 and DP5) were driven

prior and adjacent to their corresponding windowless sampling borehole to a depth of 5.00m bgl.

Five trial pits were excavated with a mechanical excavator to depths between 1.95m bgl (TP1) and 3.50m bgl (TP2). The machine excavated trial pits (TP1 – TP5) were backfilled with arisings upon the completion of infiltration testing, where performed, and mounded over to allow for future settlement.

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

All trial hole locations have been presented in Figure 3.

2.2 Ground Conditions

On 1st October 2019, five windowless sampler boreholes (WS1 - WS5) were drilled, using a Premier windowless sampling drilling rig, each to a depth of 4.00m below ground level (bgl) at locations selected by Soils Limited and approved by the client.

Standpipes were installed within the windowless sampling boreholes (WS1 – WS2 & WS4) to allow for continued monitoring of both groundwater and soil gas, where present.

Five dynamic probes, super heavy, (DP1 – DP5) were driven prior and adjacent to their corresponding windowless sampling borehole each to a depth of 5.00m bgl.

Five trial pits were machine excavated to depths ranging between 1.95m (TP1) and 3.50m bgl (TP2) at locations across the site selected by Soils Limited and approved by the client. Following the construction of the trial holes, infiltration tests were carried within three (TP1, TP3, and TP4) out of the five trial holes. Infiltration tests were undertaken in accordance with the principles of BRE DG365:2016. The results of the infiltration testing are outlined in Section 3.2.

The maximum depths of trial holes have been included in Table 2.1.

Table 2.1 Final Depth of Trial Holes

Trial Hole	Depth (m bgl)	Trial Hole	Depth (m bgl)	Probe Hole	Depth (m bgl)
TP1	1.95	WS1	4.00[w]	DP1	5.00
TP2	3.50	WS2	4.00[w]	DP2	5.00
TP3	2.60	WS3	4.00	DP3	5.00
TP4	2.30	WS4	4.00[w]	DP4	5.00
TP5	2.70	WS5	4.00	DP5	5.00

Note: w – well installation

The approximate trial hole locations are shown on Figure 3.

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

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

The soils encountered from immediately below ground surface have been described in the following manner. Where the soil incorporated an organic content such as either decomposing leaf litter or roots or has been identified as part of the in-situ weathering profile, it has been described as Topsoil both on the logs and within this report. Where man has clearly either placed the soil, or the composition altered, with say greater than an estimated 5% of a non-natural constituent, it has been referred to as Made Ground both on the log and within this report.

Chalk is a weak rock and as such it should be noted that the drilling, excavating and sampling process is detrimental to its fabric and structure. Chalk samples that have been machine sampled will therefore appear to be of a lower descriptive grade, as given in CIRIA C574, than the in-situ chalk. Soil sampling and visual observations from open excavations i.e. trial pits would allow chalk description and classification in accordance with CIRIA 574 including commenting for any aperture and discontinuities in the chalk structure.

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

Made Ground/Topsoil (MG/TS)
Alluvium (ALV) [not encountered]
River Terrace Deposits (RTD)
Lewes Nodular Chalk Formation (LPCK)

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

It must be noted, whilst anticipated on the western site area, soils of the Alluvium were not encountered within any of the trial holes during the intrusive investigation.

Table 2.2 Ground Conditions

Strata	Period/Age	Depth Encountered (m bgl)		Typical Thickness (m)	Typical Description
		Top	Bottom		
TS/MG	Anthropocene	G.L.	0.10-0.40	0.25	**MG:** Soft, brown, slightly gravelly, silty, friable CLAY. Occasional fine brick fragments at 0.30m bgl (WS2). Occasional carbonised plant material observed. Frequent fine roots and rootlets noted. **TS:** Firm, brown, slightly gravelly, silty CLAY to clayey SILT. Abundance of fine roots and rootlets encountered.
RTD	Quaternary	0.10-0.40	1.50-5.00[1]	3.00	Orangish brown to greyish brown, gravelly, sandy CLAY becoming light brown mottled white, slightly clayey, gravelly, fine to coarse SAND to slightly sandy, gravelly SILT, becoming whitish brown, slightly clayey, sandy fine to coarse angular flint GRAVEL with occasional flint cobbles in a calcareous silt matrix with depth. Gravel was subangular to subrounded clasts of flint, rinded flint and occasional chalk.
LPCK	Turonian	1.50-5.00[1]	4.00[1]-5.00[1,3]	Not proven[2]	The Lewes Nodular Chalk Formation comprised off-white weathered structureless CHALK composed of sandy GRAVEL within light brown comminuted calcareous matrix. Gravel was subangular to subrounded clasts of intact chalk and rinded flint.

Note: [1] Final depth of trial hole. [2] Base of strata not encountered. [3] Inferred from dynamic probes

2.3 Ground Conditions Encountered in Trial Holes

The ground conditions encountered in trial holes have been described below in descending order. The engineering logs are presented in Appendix A.1.

2.3.1 Made Ground and Topsoil

Soils described as Made Ground were encountered in one out of the ten trial holes from ground level and persisted to a depth of 0.30m bgl (WS2).

The Made Ground comprised soft, brown, slightly gravelly, silty, friable CLAY with frequent roots and rootlets. Gravel was fine to coarse sub angular flint. Occasional fine brick fragments at 0.30m bgl (WS2). Occasional carbonised plant material observed.

Soils described as Topsoil were encountered in the remaining nine trial holes from ground level and persisted to a maximum depth of 0.40m bgl (WS5/DP5).

The Topsoil comprised firm, brown, slightly gravelly, silty CLAY to clayey SILT.

Gravel was fine to medium, angular flint. Abundance of fine roots and rootlets encountered.

The depths of Topsoil and Made Ground have been included in Table 2.3.

Table 2.3 Final Depth of Made Ground/Topsoil

Trial Hole	Depth (m bgl)	Strata	Probe Hole	Strata	Depth (m bgl)
WS 1	0.25	TS	DP1	TS	0.25[1]
WS 2	0.30	MG	DP2	MG	0.30[1]
WS 3	0.30	TS	DP3	TS	0.30[1]
WS4	0.30	TS	DP4	TS	0.30[1]
WS5	0.40	TS	DP5	TS	0.40[1]
TP 1	0.10	TS			
TP2	0.30	TS			
TP3	0.20	TS			
TP4	0.20	TS			
TP5	0.25	TS			

Note: [1]Conditions inferred from dynamic probes

2.3.2 River Terrace Deposits

Soils described as River Terrace Deposits were encountered or inferred in all ten trial holes underlying the Topsoil/Made Ground and persisted to depths ranging between 1.50m bgl (WS5/DP5) and 4.40m bgl (DP1).

The soils of the River Terrace Deposits orangish brown to greyish brown, gravelly, sandy CLAY becoming light brown mottled white, slightly clayey, gravelly, fine to coarse SAND to slightly sandy, gravelly SILT, becoming whitish brown, slightly clayey, sandy fine to coarse angular flint GRAVEL with occasional flint cobbles in a calcareous silt matrix with depth. Gravel was subangular to subrounded clasts of flint, rinded flint and occasional chalk.

The final depths of River Terrace Deposits have been included in Table 2.4.

Table 2.4 Final Depth of River Terrace Deposits

Trial Hole	Depth (m bgl)	Probe Hole	Depth (m bgl)	Trial Hole	Depth (m bgl)
WS 1	4.00 [1]	DP1	4.40 [1,2]	TP1	1.95
WS 2	4.00 [1]	DP2	4.20 [1,2]	TP2	3.50
WS 3	2.70	DP3	2.70 [1,2]	TP3	2.60
WS4	3.30	DP4	3.30 [1,2]	TP4	2.30
WS5	1.50	DP5	1.50 [1,2]	TP5	1.90

Note: [1] Final depth of the trial hole [2] Conditions inferred from dynamic probes

2.3.3 Lewes Nodular Chalk Formation

Soils described as Lewes Nodular Chalk Formation were encountered or inferred in four out of the ten trial holes underlying the River Terrace Deposits and persisted to the full investigatory depth of 5.00m bgl.

Chalk descriptions from samples obtained from windowless sampler drilling techniques are not in accordance with CIRIA C574 and not representative of the in-situ fabric of the chalk. The description of the chalk has therefore been made and reported from direct observation where encountered within machine excavated trial pit TP5.

Where observed in-situ, the Lewes Nodular Chalk Formation comprised off-white weathered structureless CHALK composed of sandy GRAVEL within light brown comminuted calcareous matrix. Gravel was subangular to subrounded clasts of intact chalk and rinded flint.

The final depths of Lewes Nodular Chalk Formation have been included in Table 2.5.

Table 2.5 Final Depth of Lewes Nodular Chalk Formation

Trial Hole	Depth (m bgl)	Probe Hole	Depth (m bgl)	Trial Hole	Depth (m bgl)
WS1	N/E	DP1	5.00 [1,2]	TP1	N/E
WS2	N/E	DP2	5.00 [1,2]	TP2	N/E
WS3	4.00 [1]	DP3	5.00 [1,2]	TP3	N/E
WS4	4.00 [1]	DP4	5.00 [1,2]	TP4	N/E
WS5	4.00 [1]	DP5	5.00 [1,2]	TP5	2.70[1]

Note: [1] Final depth of the trial hole [2] Conditions inferred from dynamic probes N/E = Not Encountered

2.4 Roots

Roots/rootlets were observed in nine out of the ten trial holes persisting to depths ranging between 0.20m (TP3) and 1.60m bgl (WS3).

The maximum observed depths of root penetration have been included in Table 2.6.

Table 2.6 Depth of Root Penetration

Trial Hole	Depth (m bgl)	Trial Hole	Depth (m bgl)
WS1	0.25	TP1	1.30
WS2	0.30	TP2	N/E
WS3	1.60	TP3	0.20
WS4	1.10	TP4	1.10
WS5	1.00	TP5	1.00

Roots may be found to greater depth at other locations on the site particularly close to trees and/or trees that have been removed both within the site and its close environs.

Vegetation was noted at the site boundaries comprising mature trees and shrubs.

It must be emphasised that the probability of determining the maximum depth of roots from a narrow diameter borehole is low. A direct observation such as from within a trial pit is necessary to gain a better indication of the maximum root depth.

2.5 Groundwater

Groundwater was encountered within one trial hole (TP2) and was struck at a depth of 3.50m bgl within the River Terrace Deposits.

Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. The investigation was conducted in October (2019), when groundwater levels should be rising from their annual minimum (lowest) elevation, which typically occurs around September to the annual maximum (highest) which typically occurs around March.

Post-works groundwater monitoring was requested by the client. At the time of reporting, three monitoring rounds and been undertaken, with a further three rounds scheduled. The results obtained to date are presented in Table 2.7.

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Table 2.7 Groundwater Monitoring

Trial Hole	Depth to Water (m bgl)			Depth of Well (m bgl)
	22/10/19	07/11/2019	19/11/2019	
W S1	DRY	2.36	2.36	4.00
WS2	DRY	2.56	2.68	4.00
WS4	DRY	3.72	DRY	4.00

The report will be updated to include the full results on completion of the monitoring regime.

Section 3 Discussion of Geotechnical In-Situ and Laboratory Testing

3.1 Dynamic Probe Tests

Dynamic probing (DPSH) was undertaken at five locations (DP1 to DP5) adjacent and prior to their corresponding windowless sampling borehole to a depth of 5.00m bgl. The results were converted to equivalent SPT “N60” values based on dynamic energy using commercial computer software (Geostru). The results were then interpreted based on the classifications outlined in Appendix B.1.

The SPT “N60” values presented have been corrected in accordance with BS EN 22476 Part 3, to account for the rig efficiency, borehole depth, overburden factors etc. Further correction of the ‘N’ values should therefore not be necessary. The energy ratio of the drilling rig was 84.53%. The energy ratio for each location is presented on the individual logs within Appendix A.1.

The River Terrace Deposits recorded equivalent SPT “N60” values between 0 and 47 within cohesive beds and 0 to 40 in granular beds. The cohesive beds were classified as **extremely low to very high strength,** varying with depth, with an inferred undrained cohesive strength of <10 to 235kPa. The granular beds were classified as of **very loose to dense** relative density, varying with depth.

The Lewes Nodular Chalk Formation recorded equivalent SPT “N60” values between <8 and >35, classifying the beds as CIRIA grade **structureless (Dm) to structured chalk (C5- A1)**, varying with depth.

A full interpretation of the DPSH tests are outlined in Appendix B.2, Table B.2.1.

3.2 Infiltration Tests

Infiltration tests were performed within trial pits TP1, TP3 and TP4, in order to provide guidance on the suitability of the ground for the adoption of a surface water drainage system. The tests were undertaken in TP1, TP3 and TP4 within the cohesive soils of the River Terrace Deposits following the principles of BRE Digest 365 Soakaway design: 2016. BRE 365 states that for an accurate infiltration rate to be obtained a soakage pit needs to be filled three times in quick succession. Each test can only be ended once 75% of the water present has drained away. The tests comprised piping clean water via a water tanker into the open trial hole, the drop-in water level over time was then recorded to give an indication of soakage potential.

Three complete infiltration tests were performed in TP4 ending once 75% of the water had drained away. One test was performed in TP1 and two tests in TP2 given daylight restrictions. The test performed in TP1 did not complete within the observation period and the data was extrapolated to calculate an indicative infiltration rate.

In-house software was used to calculate infiltration rates in TP1, TP3 and TP4 and the results outlined in Table 3.1.

Table 3.1 Infiltration Rates

Trial Hole	Test Stratum	Test No.	Infiltration Rate (m/s)	Notes
TP1	RTD	1	7.06×10^{-6}	Data extrapolated after 106mins for a rate to be calculated.
TP3	RTD	1	2.61×10^{-5}	
		2	1.76×10^{-5}	
TP4	RTD	1	3.43×10^{-4}	
		2	2.95×10^{-4}	
		3	2.88×10^{-4}	

Notes: RTD = River Terrace Deposits.

Rates of between 3.43×10^{-4}m/sec and 7.06×10^{-6} m/sec were calculated. The variable infiltration rates observed are indicative of the viable fines content of the River Terrace Deposits underlying the site.

3.3 Atterberg Limit Tests

Atterberg Limit tests were performed on two samples (WS1:1.20m and WS4:1.20m bgl), both obtained from the cohesive beds of River Terrace Deposits. The results were classified in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2.

The cohesive soils of River Terrace Deposits were classified as **medium** volume change potential in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2.

A full interpretation of the Atterberg Limit tests is outlined in Table B.2.2, Appendix B.2 and the laboratory report in Appendix B.3.

3.4 Particle Size Distribution Tests

Particle Size Distribution (PSD) tests were performed on three samples (WS1:3.20m, WS4:2.20m and TP1:1.70m bgl) from the granular soils of River Terrace Deposits.

The PSD tests classified the granular beds of the River Terrace Deposits as **not having a volume change potential** in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2. Note that a cohesive soil is only classified as having a volume change potential if it is also plastic and an Atterberg Limit test can be conducted on the strata.

A full interpretation of the PSD tests is outlined in Table B.2.3, Appendix B.2 and the laboratory report in Appendix B.3.

3.5 Saturation Moisture Content Tests

A Saturation Moisture Content (SMC) test was performed on a sample recovered from the soils of Lewes Nodular Chalk Formation (TP5:2.40m bgl). The results were classified based on Table 3.2, CIRIA Publication, Engineering in Chalk, C574, 2002.

The SMC test classified the Lewes Nodular Chalk Formation as high density, with a dry density of **1.72Mg/m^3**.

A full interpretation of the SMC test is outlined in Table B.2.4, Appendix B.2 and the laboratory report in Appendix B.3.

3.6 Sulphate and pH Tests

One sample was taken from the cohesive beds of River Terrace Deposits (WS2:1.20m bgl) and one from the granular beds of the River Terrace Deposits (WS2:2.50m bgl) for water soluble sulphate (2:1) and pH testing in accordance with Building Research Establishment Special Digest 1, 2005, 'Concrete in Aggressive Ground'.

The tests recorded water soluble sulphate between 10.8mg/l and 34.4mg/l with pH values of 8.4 to 8.7.

The significance of the sulphate and pH test results are discussed in Section 4.4 and the laboratory report in Appendix B.3.

Section 4 Foundation Design

4.1 General

An engineering appraisal of the soil types encountered during the site investigation and likely to be encountered during the redevelopment of this site is presented. Soil descriptions are based on analysis of disturbed samples taken from the trial holes.

4.1.1 Made Ground and Topsoil

The terms *Fill* and *Made Ground (non-engineered fill)* are used to describe material, which has been placed by man either for a particular purpose e.g. to form an embankment, or to dispose of unwanted material. For the former use, the Fill and/or Made Ground may well have been selected for the purpose and placed and compacted in a controlled manner. With the latter, great variations in material type, thickness and degree of compaction invariably occur and there can be deleterious or harmful matter, as well as potentially methanogenic organic material.

The BSI Code of Practice for Foundations, BS 8004:2015, Clause 4.1.2.2 states, *'Spread foundations should not be placed on non-engineered fill unless such use can be justified on the basis of a thorough ground investigation and detailed design.'*

Soils described as Made Ground were encountered in one out of the ten trial holes from ground level and persisted to a depth of 0.30m bgl (WS2). The Made Ground comprised soft, brown, slightly gravelly, silty, friable CLAY with frequent roots and rootlets. Gravel was fine to coarse sub angular flint. Occasional fine brick fragments at 0.30m bgl (WS2). Occasional carbonised plant material observed.

Soils described as Topsoil were encountered in the remaining nine trial holes from ground level and persisted to a maximum depth of 0.40m bgl (WS5/DP5). The Topsoil comprised firm, brown, slightly gravelly, silty CLAY to clayey SILT. Gravel was fine to medium, angular flint. Abundance of fine roots and rootlets encountered.

The depths of Topsoil and Made Ground have been included in Table 2.3.

A result of the inherent variability, particularly of uncontrolled Topsoil, Fill and/or Made Ground is that it is usually unpredictable in terms of bearing capacity and settlement characteristics. Foundations should, therefore, be taken through any Topsoil and/or Made Ground and either into, or onto a suitable underlying natural stratum of adequate bearing characteristics.

4.1.2 River Terrace Deposits

Soils described as River Terrace Deposits were encountered or inferred in all ten trial holes underlying the Topsoil/Made Ground and persisted to depths ranging between 1.50m bgl (WS5/DP5) and 4.40m bgl (DP1).

The soils of the River Terrace Deposits orangish brown to greyish brown, gravelly, sandy CLAY becoming light brown mottled white, slightly clayey, gravelly, fine to coarse SAND to slightly sandy, gravelly SILT, becoming whitish brown, slightly clayey, sandy fine to coarse angular flint GRAVEL with occasional flint cobbles in a calcareous silt matrix with depth. Gravel was subangular to subrounded clasts of flint, rinded flint and occasional chalk.

The final depths of River Terrace Deposits have been included in Table 2.4.

The River Terrace Deposits recorded equivalent SPT “N60” values between 0 and 47 within cohesive beds and 0 to 40 in granular beds. The cohesive beds were classified as **extremely low to very high strength,** varying with depth, with an inferred undrained cohesive strength of <10 to 235kPa. The granular beds were classified as of **very loose to dense** relative density, varying with depth.

The results from Atterberg Limits tests showed that the cohesive soils of the River Terrace Deposits had **medium volume change potential** in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2.

The PSD tests classified the granular beds of the River Terrace Deposits as **not having a volume change potential** in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2.

Soils of the River Terrace Deposits encountered on site were predominantly cohesive reaching up to depths ranging from 1.50m bgl (DP5) to 3.30m bgl (DP4), becoming granular with depth. As such are expected to display low to moderate bearing capacities with moderate to high settlement characteristics. The cohesive soils of the River Terrace Deposits were not considered as a suitable bearing stratum for the proposed development due to likely variations both in composition and deposition thickness. The granular soils of River Terrace Deposits could be considered a suitable bearing stratum for the proposed development providing sufficient bearing capacities could be achieved. However, in the areas of DP1 and DP4, the granular beds were encountered at depths exceeding the depth of traditional shallow foundations. Furthermore, no granular soils were encountered in the area of DP3 and DP5 indicating the unit is not laterally continuous across the site.

Additionally, at the locations of DP1 and DP2 soils of the River Terrace Deposits were encountered to depths of up to 4.30m bgl which could represent an infilled solution feature. Further investigation may be considered in this area to delineate this feature.

In consideration of the above, soils of the River Terrace Deposits may be considered a suitable bearing stratum for shallow foundations on a plot by plot basis depending upon location in the development area, subject to further intrusive investigation.

4.1.3 Lewes Nodular Chalk Formation

Soils described as Lewes Nodular Chalk Formation were encountered or inferred in four out of the ten trial holes underlying the the River Terrace Deposits and persisted to the full investigatory depth of 5.00m bgl.

Chalk descriptions from samples obtained from windowless sampler drilling techniques are not in accordance with CIRIA C574 and not representative of the in-situ fabric of the chalk. The description of the chalk has therefore been made and reported from direct observation where encountered within machine excavated trial pit TP5.

The Lewes Nodular Chalk Formation comprised off-white weathered structureless CHALK composed of sandy GRAVEL within light brown comminuted calcareous matrix. Gravel was subangular to subrounded clasts of intact chalk and rinded flint. The final depths of Lewes Nodular Chalk Formation have been included in Table 2.5.

The Lewes Nodular Chalk Formation recorded equivalent SPT “N60” values between <8 and >35, classifying the beds as **structureless (Dm) to structured chalk (C5- A1)**, varying with depth.

Saturated moisture content testing indicated the chalk was of **high density,** with a dry density of **1.72Mg/m^3**.

The bedrock of Lewes Nodular Chalk Formation was not encountered within most of the locations during the investigation (TP1 to TP4, WS1 and WS4).

Chalk descriptions from windowless sampler boreholes are not in accordance with CIRIA C574 and are not representative of in-situ chalk. Chalk descriptions from trial holes are in accordance with CIRIA C574 and are expected to be representative of in-situ chalk. Generally, soils of the Lewes Nodular Chalk Formation are structureless to weak rock and would possess low to moderate bearing and settlement characteristics. The Lewes Nodular Chalk Formation could be suitable as a bearing stratum, however, the depth that the stratum was encountered may be prohibitive for the adoption of strip footings on the areas of DP1, DP2, DP3, DP4, and TP1 to TP5.

It must be noted that the depth to chalk was not constant across the site. The available information presented within Preliminary Investigation Report (Report ref: 17877/PIR, dated November 2019) indicated that there was an inland river crossing

the site moving from the north-east to the south-west.

In the area of DP5, the bedrock of Lewes Nodular Chalk Formation was encountered at a depth suitable for the adoption of shallow foundations, however founding within Grade Dm chalk, encountered within DP3, DP4 and DP5, would significantly lower allowable bearing values. Foundations must bear within a single soil stratum to avoid large differential settlements. Traditional strip foundations onto suitable strength soils of the Lewes Nodular Chalk Formation may be considered on local basis depending upon the location within the development site and subject to additional intrusive investigation.

4.1.4 Roots

Roots/rootlets were observed in nine out of the ten trial holes to depths ranging between 0.20m (TP3) and 1.60m bgl (WS3).

Roots may be found to greater depth at other locations on the site particularly close to trees and/or trees that have been removed both within the site and its close environs. Vegetation was noted at the site boundaries comprising mature trees and shrubs.

It must be emphasised that the probability of determining the maximum depth of roots from a narrow diameter borehole is low. A direct observation such as from within a trial pit is necessary to gain a better indication of the maximum root depth.

4.1.5 Groundwater

Groundwater “strike” was encountered within one trial hole (TP2) and was struck at a depth of 3.50m bgl.

Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. The investigation was conducted in October (2019), when groundwater levels should be rising from their annual minimum (lowest) elevation, which typically occurs around September to the annual maximum (highest) which typically occurs around March.

Further groundwater monitoring was conducted within the standpipes installed on site following completion of site works and has been presented in Table 2.7. At the time of reporting, three rounds had been undertaken and an additional three rounds were scheduled. The report will be updated with the full results on completion of the monitoring regime circa January 2020.

4.2 Foundation Scheme General

At the time of reporting (November 2019), the proposal comprised the construction of a number of residential units with garages and carports.

The proposed development would include hard landscaping such as access roads,

driveways and pavements and soft landscaping such as public open space and private gardens.

In compiling this report reliance was placed on drawing number 18.099.02, dated September 2018 and was prepared by HGP Architects. Any change or deviation from the scheme outlined in the drawing could invalidate the foundation design and remediation recommendations presented within this report. Soils Limited must be notified about any such changes.

Development plans provided by the client are presented in Appendix D.

4.2.1 Guidance on Shrinkable Soils

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

The results from Atterberg Limits Tests showed that the cohesive soils of River Terrace Deposits had **medium volume change potential** in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2.

Medium volume change potential must therefore be adopted where foundations pass through the cohesive soils of River Terrace Deposits. The predominantly cohesive soils of the River Terrace Deposits were encountered at variable depths across the site.

The BRE Digest 241 states: "An increasingly common, potentially damaging situation is where trees or hedges have been cut down prior to building. The subsequent long-term swelling of the zone of clay desiccated by the roots, as moisture slowly returns to the ground, can be substantial. The rate at which the ground recovers is very difficult to predict and if there is any doubt that recovery is complete then bored pile foundations with suspended beams and floors should be used".

The stated intention of the NHBC is to ensure that shrinkage and swelling of plastic soils does not adversely affect the structural integrity of foundations to such a degree that remedial works would be required to restore the serviceability of the building. It must be borne in mind that adherence to the NHBC tables and design recommendations may not, in all cases, totally prevent foundation movement and cracking of brickwork might occur.

The BRE Digest 240 suggests: *"Two courses of action are open:*

Estimate the potential for swelling or shrinkage and try to avoid large changes in the water content, for example by not planting trees near the foundations.

Accept that swelling or shrinkage will occur and take account of it. The foundations

can be designed to resist resulting ground movements or the superstructure can be designed to accommodate movement without damage."

The design of foundations suitable to withstand movements is presented in BRE Digest 241 "Low-rise buildings on shrinkable clay soils: Part 2"

4.3 Foundation Scheme

Foundations **must not** be constructed within any Made Ground/Topsoil and River Terrace Deposits due to the likely variability and potential for large load induced settlements both total and differential.

Roots/rootlets were encountered in nine out of the ten trial holes to depths ranging between 0.20m (TP3) and 1.60m bgl (WS3). If roots are encountered during the construction phase foundations **must not be placed within any live root penetrated** or desiccated **cohesive soils or those with a volume change potential**. Should the foundation excavations reveal such materials, the excavations **must** be extended to greater depth in order to bypass these unsuitable soils. Excavations must be checked by a suitable person prior to concrete being poured.

The depth to chalk varied significantly (1.50 to 4.30m bgl) across the site, not being compatible with the construction of shallow foundations in most site areas. In addition, low blow counts (0 and 1 blows) were recorded to depths of 2.30m to 3.10m bgl in DP2, 4.40m to 5.00m bgl in DP3 and up to 3.00m bgl in DP4, suggesting potential solution features on these areas, due to the presence of potential underground issues.

In consideration of the findings of the intrusive investigation, adoption of shallow foundations is not considered suitable as a site-wide founding solution. However, should a mixed foundation solution be considered economically viable, further consideration to shallow foundations may still be given to some areas of the site subject to additional investigation on a plot by plot basis. Notwithstanding this, adoption of dual foundation solutions within the same block would likely make the process both uneconomical and difficult to manage. Therefore, a piled solution is considered as the most viable approach to the development scheme as a whole.

4.3.1 Possible Solution Feature

The available information presented within Preliminary Investigation Report (Report ref: 17877/PIR, dated November 2019) indicated a moderate risk regarding Ground Dissolution features on site.

The investigation identified the presence of a possible solution feature in the areas of DP/WS1 and DP/WS2 where marked increases in thickness of the River Terrace Deposits were noted. Additionally, the investigation identified the presence of possible solution features in the form of a "soft spot", where low blow counts (0-1) were recorded, corresponding to the soils having "extremely low" cohesive strengths. The possible features were encountered within three locations (DP2,

DP3 and DP4).

Erosional features, such as pipes, swallow holes and solution cavities, usually infilled with drift deposits, are occasionally found in the chalk, sometimes manifesting themselves at the surface as shallow circular depressions, however given the development undertaken in the area it would not be possible to visually identify any such features. Subsequent collapse of erosional features is usually as a result of localised intense inflow of water into the feature.

Considering the information presented above it was concluded that such geohazards are caused by localised erosion of the upper surface of the chalk. This could potentially lead to unacceptable settlements if conventional foundations are adopted. The possible features were encountered within four locations (DP1, DP2, DP3 and DP4), where part of the proposed development was to take place. Similar features may be present in other areas on site. If the configuration of the proposed development changes, Soils Limited must be informed as this may invalidate the foundation recommendations given within this report.

Where shallow foundations are being considered, further investigation should be conducted in the areas of WS/DP1 to WS/D4 where the possible solution features were encountered in order to delineate the size of the features and to establish the most appropriate foundation solution for that area. Ideally, additional probing of the foundation trench lines would be needed to ensure that other areas of deep River Terrace Deposits / possible solution features in the form of a “soft spot” are not present.

Solution features may be reactivated by the concentrated ingress of water from leaking drains or soakaways. Reactivation may lead to surface collapse. Therefore, attention must be drawn in order to ensure that no soakaways are constructed near that area.

4.3.2 Piled Foundations

If adopted the piled foundations must be taken through any Topsoil/Made Ground and River Terrace Deposits into suitable strength soils of the Lewes Nodular Chalk Formation.

The construction of a piled foundation is a specialist job with the actual pile working load depending on the particular type pile and installation method. Prior to finalising the foundation design the advice from a reputable contractor who is familiar with the ground and groundwater conditions present at the site should be sought.

Further intrusive investigation via cable percussive boreholes or CPTu probes would be required to obtain soil parameters at greater depth to inform the design of a piled solution.

4.3.3 Ground Floor Slab

NHBC Standards 2018, Chapter 5.2, Suspended Ground Floors, states:

> *"Ground floors should be constructed as suspended floors where the depth of fill exceeds 600mm".*
> *"Suspended slabs should be adopted where the foundation depth dictated by the NHBC Standards 2018, Chapter 4.2, Appendix 4.2-C would exceed 1.5m bgl."*

The NHBC states that where their Practice notes dictate a foundation depth of 1.5m bgl or greater, then suspended slabs must be adopted for the proposed development.

4.4 Subsurface Concrete

Sulphate concentration measured in 2:1 water/soil extracts fell into Class **DS-1** of the BRE Special Digest 1 2005, *'Concrete in Aggressive Ground'.* Table C2 of the Digest indicated ACEC (Aggressive Chemical Environment for Concrete) site classifications of **AC-1**. The pH of the soils tested ranged between 8.4 and 8.7. The classification given was determined using the mobile groundwater case, in the view of groundwater being encountered. The laboratory results are presented in Appendix B.3.

Concrete to be placed in contact with soil or groundwater must be designed in accordance with the recommendations of Building Research Establishment Special Digest 1 2005, *'Concrete in Aggressive Ground'* taking into account any possible exposure of potentially pyrite bearing natural ground and the pH of the soils.

4.5 Excavations

Shallow excavations in the Made Ground/Topsoil and River Terrace Deposits are likely to be marginally stable in the short term at best.

Deeper excavations taken into the Lewes Nodular Chalk Formation are likely to be stable in the short term, depending on the thickness of overlying River Terrace Deposits. Unsupported earth faces formed during excavation may be liable to collapse without warning and suitable safety precautions should therefore be taken to ensure that such earth faces are adequately supported or battered back to a safe angle of repose before excavations are entered by personnel.

Excavations beneath the groundwater table are likely to be unstable and dewatering of foundation trenches may be necessary. Groundwater monitoring was ongoing at the time of reporting.

4.6 Surface Water Disposal

Infiltration testing was undertaken in TP1, TP3 and TP4 within the cohesive soils of the River Terrace Deposits following the principles of BRE Digest 365 Soakaway design: 2016. The tests comprised piping water via a water tanker into the open trial hole, the drop-in water level over time was then recorded to give an indication of soakage potential.

Infiltration rates of between 7.06 x 10^{-6} m/sec and 3.43 x 10^{-4}m/sec were calculated from the test locations. The estimated rate of **7.06 x 10^{-6}**m/sec (TP1) should be used for the construction of conventional soakaways.

The available information presented within Preliminary Investigation Report (Report ref: 17877/PIR, dated November 2019) indicated a moderate risk regarding Ground Dissolution features on site. The investigation identified the presence of a possible solution feature in the areas of DP/WS1 and DP/WS2 where marked increases in thickness of the River Terrace Deposits were noted. Additionally, the investigation identified the presence of possible solution features in the form of a “soft spot”, where low blow counts (0-1) were recorded, corresponding to the soils having “extremely low” cohesive strengths. The possible features were encountered within three locations (DP2, DP3 and DP4).

Occasional erosional features, such as pipes, swallow holes and solution cavities, usually in-filled with drift deposits, are found in the chalk within this area. These features sometimes manifesting themselves’ at the surface, as shallow circular depressions.

Dissolution features can form due to manmade features such as deneholes. These features can then be reactivated or caused to collapse by the concentrated ingress of water from leaking drains or soakaways.

In line with current guidance (BRE Digest 365, NHBC and CIRIA C574) soakaways should be located remote from the proposed foundations, ideally greater than 20m away from the face of any existing or proposed footing.

In respect to the control of drainage CIRIA C574, Engineering in Chalk; 2002 states;

> “Concentrated ingress of water into the chalk can initiate new dissolution features, particularly in low-density chalk, and destabilise the loose backfill of existing ones. For this reason, any soakaways should be sited well away from foundations for structures, roads or railways, as indicated below:
>
> In areas where dissolution features are known to be prevalent, soakaways should be avoided if at all possible but, if unavoidable, should be sited at least 20m away from any foundations;
>
> Where the chalk is of low density, or its density is not known, soakaways should be sited at least 10m away from any foundations;

Where the chalk is of medium density (or higher), the closest part of the soakaway should be at least 5m away from any foundations.

For drainage systems, flexible jointed pipes should be used wherever possible; particular care should be taken for the avoidance of leaks in both water supply and drainage pipework.

As the Chalk is a vitally important aquifer, the Environment Agency and local authority must be consulted when planning soakaway installations where chalk lies below the site even where it is mantled with superficial deposits.

Consultation with the Environment Agency must be sought regarding any use which may have an impact on groundwater resources.

Section 5 Determination of Chemical Analysis

5.1 Site Characterisation and Revised Conceptual Site Model

The Preliminary Investigation Report undertaken by Soils Limited (report ref: 17877/PIR dated November 2019) identified a very low to moderate risk of ground contamination and from previous usage of the site and offsite sources.

The Main Investigation Report identified Made Ground up to a depth of 0.30m bgl (WS2/DP2). The Made Ground comprised soft, brown, slightly gravelly, silty, friable CLAY. Gravel was fine to coarse sub angular flint. Occasional fine brick fragments noted at 0.30m bgl (WS2). Occasional carbonised plant material observed. Frequent fine roots and rootlets were noted.

Superficial soils of the River Terrace Deposits were encountered underlying the Made Ground. Shallow groundwater was not encountered within the Made Ground during the investigation.

5.2 Soil Sampling

A non-targeted sampling strategy is appropriate when there is:

No adequate information available regarding the likely locations of contamination;
No sensitive areas where there is a need for a high degree of confidence.

A targeted sampling strategy is appropriate when there is:

Adequate information available regarding the likely locations of contamination
Sensitive areas where there is a need for a high degree of confidence.

The CSM identified potential sources and a both targeted and non-targeted sampling pattern was adopted as appropriate to these sources. Table 5.1 outlines the sampling undertaken.

Table 5.1 Sampling Strategy

Sample	Strategy	Proposed Use
WS1:0.20	Topsoil – Cohesive soils	Beneath proposed hardstanding car park area
WS2:0.20	Made Ground – Cohesive soils	Beneath proposed garden area
WS3:0.50	Superficial cohesive soils	Beneath proposed garden area
WS4:0.50	Superficial cohesive soils	Beneath proposed garden area
WS5:0.20	Topsoil – Cohesive soils	Beneath proposed garden area
TP1:0.20	Superficial cohesive soils	Beneath proposed garden area

5.3 Determination of Chemical Analysis

The driver for determination of the analysis suite was the information obtained from the

Preliminary Investigation Report and Main Investigation Report intrusive investigation. Table 5.2 outlines the specification for each sample tested.

Table 5.2 Chemical Analysis Specification

Substance	Locations: Depths (m bgl)						
	WS1:0.20[S]	WS2:0.20[S]	WS3:0.50[S]	WS4:0.50[S]	WS5:0.20[S]	WS5:0.50[S]	TP1:0.20[S]
Asbestos Screen							
Total Phenols							
Organic Matter							
pH							
Metals							
Metalloids							
Organics							
BTEX							
WAC							

Notes: **Metals**: Cd, Cr, Pb, Hg, Ni, Se, CN, S, Cu, Zn, Bo, V. **metalloids**: As. **organics**: USEPA 16 speciated PAH, TPH Texas **Asbestos screening** was undertaken in accordance with HSG 248. [S]= Soil sample.

Section 6 Qualitative Risk Assessment

6.1 Assessment Criteria

The assessment criteria used to determine risks to human health are derived and explained within Appendix C.3.

6.2 Representative Contamination Criteria - Soil

At the time of reporting (November 2019), the proposal comprised the construction of several residential units with garages and carports.

The proposed development would include hard landscaping such as access roads, driveways and pavements and soft landscaping such as public open space and private gardens.

In compiling this report reliance was placed on drawing number 18.099.02, dated September 2018 and was prepared by HGP Architects. Any change or deviation from the scheme outlined in the drawing could invalidate the foundation design and remediation recommendations presented within this report. Soils Limited must be notified about any such changes.

The chemical laboratory results were compared against the representative contaminants concentration for human health receptor to Soil Guideline Values (SGV), Category 4 Screening Levels (C4SL's) or Suitable 4 Use Level (S4UL) for the proposed "Residential with plant uptake" land-use scenario, which was considered the most appropriate given the type of proposed redevelopment.

Table 6.1 outlines the samples that have exceeded their relevant assessment criteria. The full laboratory report is presented in Appendix C.2.

Table 6.1 Summary of Chemical Analysis of Soils Sample Exceedance

Substance	Sam ple locations where SGV, C4SL or S4UL adopted were exceeded for the 'Residential with plant uptake' land-use scenario
None	None

To assess the potential toxicity to the human health receptor from the concentrations of organic compounds tested for, Soil Organic Matter (SOM) tests were undertaken on the samples submitted for chemical testing, which revealed SOM values of between **0.1% and 3.3%**. For each soil sample tested, the Soil Organic Matter recorded was used to derive the appropriate guideline value for organic determinants.

In summary, none of the samples tested showed concentrations in excess of the relevant C4SL and S4UL for a 'Residential with plant uptake' land-use scenario.

6.2.1 Asbestos

Asbestos Containing Material (ACM) was not detected within any of the samples tested. Whilst asbestos containing material was not identified in any of the samples tested it is possible that asbestos is present in other areas of the site. If encountered, care must be taken to ensure any such material is separated and disposed of in an appropriate manner to a licensed waste facility.

6.3 Groundwater

Groundwater was not recovered from the standpipes installed within WS1, WS2 and WS4 since groundwater sampling and testing was not within the client's brief.

Groundwater was only encountered within one trial hole (TP2) and was struck at a depth of 3.50m bgl. Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. The investigation was conducted in October (2019), when groundwater levels should be rising from their annual minimum (lowest) elevation, which typically occurs around September to the annual maximum (highest) which typically occurs around March.

Further groundwater monitoring was conducted within the standpipes installed on site following completion of site works and has been presented in Table 2.7. At the time of reporting, three rounds had been undertaken and an additional three rounds were scheduled. The report will be updated with the full results on completion of the monitoring regime circa January 2020.

6.4 Tier 1 Quantitative Risk Assessment

Quantitative risk assessments are undertaken for the soil, groundwater and soil gas. The CSM has been updated to take account of the assessments below and presented in Appendix C.1. The full laboratory chemical report is presented in Appendix C.2.

6.4.1 Soils

None of the samples tested showed concentrations in excess of the relevant C4SL and S4UL for a "Residential with plant uptake" land-use scenario.

The Tier 1 Quantitative risk assessment therefore established that there was no risk to the human health receptors, to construction workers or future end users.

6.4.2 Groundwater

From information provided by the Preliminary Investigation Report (ref: 17877/PIR), the Environment Agency Hydrogeological Maps stated that the superficial River Terrace Deposits where a Principal Aquifer and could support shallow groundwater. The bedrock Lewes Nodular Chalk Formation was identified as a Principal Aquifer. The overall groundwater vulnerability was based on Secondary Aquifer soils of High Vulnerability, soils which are highly permeable and may be

highly productive and able to support large abstractions for public supply and other purposes.

Groundwater sampling and testing was outside the scope of this investigation. However, as there were no concentrations of determinants in excess of their relevant Environmental Quality Standards (EQS) of the relevant soil screening values for the most onerous land use scenario, “residential with plant uptake”, it is considered that there is a negligible risk to groundwater receptor.

6.4.3 Soil Gas

The Preliminary Investigation Report (ref: 17877/PIR), undertaken on the site identified a low to moderate risk of soil gas onsite associated with offsite sources.

The site was situated within an area where protection or risk assessment against the ingress of radon was required. The site location within an area of 1km grid square were in bands of elevated radon potential. Maximum radon potential was 3-5%.

Radon protection measures are typically only required when the radon potential is 5-10% and therefore it is possible that radon protection measures will not be required as part of the proposed development, however, consultation with the local Building Control department at the Local Authority is recommended as they will be able to advise on whether or not radon protection measures are required in new developments within the site’s vicinity. It is not possible in the course of a survey or inspection to determine whether radon gas is present as the gas is colourless and odourless. Tests can be undertaken to assess the concentration of radon in existing structures.

To quantify the risk posed to the site from the identified sources, a soil gas risk assessment was recommended. This comprised six soil gas monitoring visits undertaken over a period of approximately three months.

Readings of the concentrations of oxygen, methane, carbon dioxide, carbon monoxide, hydrogen sulphide, flow rates, atmospheric pressure and groundwater levels were taken (where possible) after installation of the wells. In addition, monitoring with a Photo-Ionisation Detector (PID) was undertaken in each well to check for the presence of volatile organic compounds (VOCs).

At the time of reporting, monitoring of the wells installed within WS1, WS2 and WS4 had been undertaken on three occasions, with three more visits scheduled. The results of the monitoring will be provided as an addendum Soils Gas Risk Assessment on completion of the monitoring regime, scheduled to complete January 2020.

6.5 Duty of Care

Groundworkers must maintain a good standard of personal hygiene including the wearing of overalls, boots, gloves and eye protectors and the use of dust masks during periods of dry weather.

To prevent exposure to airborne dust by both the general public and construction personnel the site should be kept damp during dry weather and at other times when dust is generated as a result of construction activities. The site should be securely fenced at all times to prevent unauthorised access.

Washing facilities should be provided and eating restricted to mess huts.

6.6 Excavated Material

Excavated material as waste must be defined or classified prior to any disposal, transport, recycling or re-use at or by an appropriately licensed or exempt carrier and/or off-site disposal facility. The requirements inherent in both Duty of Care and Health and Safety must also be complied with. In order to determine what is to happen, what is suitable, appropriate and most effective in the disposal of wastes, especially those subject to CDM waste management plan requirements, several factors must be considered and competent advice should always be sought.

The amount, type and nature of the material to be removed will in part determine the amount and type of analysis that may be required to comply with current waste guidance, and thereby allow a competent person to suitably classify the material. Often this data is uncertain or unavailable, especially in the early stages of a project, and therefore further investigation, testing and analysis may be required as additional information regarding the development becomes available.

Wastes must be classified and defined by their solid characteristics to comply with current waste guidance. Existing information and analysis derived for environmental purposes may therefore be suitable for use in this context. Waste Acceptance Criteria (WAC) report the leachability of materials and therefore cannot be used to classify, characterise or define wastes. The only purpose of a WAC analysis is to determine the suitability of a given material for acceptance at one of the three different types of available licenced landfills (inert, stable non-reactive hazardous or hazardous).

Other options are available that may lead to significant savings against disposal to landfill and expert advice should always be sought from a competent person to advise on their relative costs or benefits and advise on any additional analysis, sampling or investigation that may be required to reduce remaining uncertainties and comply with current guidance. Further consideration of results using HazWasteOnlineTM can be undertaken on request to give an indication of potentially hazardous properties in the materials analysed.

WAC testing was undertaken on two samples (WS2:0.20m and WS3:0.50m bgl) and the

laboratory results are presented in Appendix C.2.

6.7 Re-use of Excavated Material On-site

The re-use of on-site soils may be undertaken either under the Environmental Permitting Regulations 2007 (EPR), in which case soils other than uncontaminated soils are classed as waste, or under the CL:AIRE Voluntary Code of Practice (CoP) which was published in September 2008 and is accepted as an alternative regime to the EPR.

Under the EPR, material that is contaminated but otherwise suitable for re-use is also classified as waste and its re-use should be in accordance with the Environmental Permitting Regulations 2007 (EPR). Environmental Permit Exemptions (EPE) are for the re-use of non-hazardous or inert waste only; hazardous waste cannot be re-used under a permit exemption. EPE apply only to imported inert waste materials; inert material arising on site and recovered on site is not classified as waste and does not require an exemption. It is possible that materials arising on-site will be classified as inert and would not need an exemption.

Environmental Permit Exemptions are only allowed for certain activities, placing controls on the quantities that can be stored and re-used. The re-use of waste shall be within areas and levels defined in planning applications and permissions for the development. An EPE requires a site-specific risk assessment for the receptor site to demonstrate that the materials are suitable for use, i.e. that they will not give rise to harm to human health or pollution of the environment.

Under the CL:AIRE voluntary code of practice (CoP) materials excavated on-site are not deemed contaminated if suitable for re-use at specified locations or generally within the site.

Material that may have been classified as hazardous waste under the EPR may be re-used. The CoP regime requires that a ‘Qualified Person’ as defined under the CoP reviews the development of the Materials Management Plan, including review of Risk Assessments and Remediation Strategy/Design Statement together with documentation relating to Planning and Regulatory issues, and signs a Declaration which is forwarded to the Environment Agency and which confirms compliance with the CoP.

Should it be necessary to import materials from another site where materials are excavated and which is not material from a quarry or produced under a WRAP protocol, then an EPE would be necessary for the imported material whether the work was managed under the CoP or the EPR.

6.8 Imported Material

Any soil, which is to be imported onto the site, must undergo chemical analysis to permit classification prior to its importation and placement in order to ascertain its status with specific regard to contamination, i.e. to prove that it is suitable for the purpose for which it

is intended.

6.9 Discovery Strategy

There may be areas of contamination not identified during the course of the investigation. Such occurrences may also be discovered during the demolition and construction phases for the redevelopment of the site.

Care should be taken during excavation works especially to investigate any soils, which appear by eye (e.g. such as fibrous materials, large amounts of ash and unusual discolouration), odour (e.g. fuel, oil and chemical type odours or unusual odours such as sweet odours or fishy odours) or wellbeing (e.g. light headedness and/or nausea, burning of nasal passages and blistering or reddening of skin due to contact with soil) to be contaminated or of unusual and/or different character to standard soils or those analysed.

In the event of any discovery of potentially contaminated soils or materials, this discovery should be quarantined and reported to the most senior member of site staff or the designated responsible person at the site for action. The location, type and quantity must be recorded and the Local Authority, and a competent and appropriate third-party Engineer/Environmental consultant notified immediately. An approval from the Local authority must be sought prior to implementing any proposed mitigation action.

The discovery strategy must remain on site at all times and must demonstrate a clear allocation of responsibility for reporting and dealing with contamination. A copy of the strategy must be placed on the health and safety notice board and /or displayed in a prominent area where all site staff are able to take note of and consult the document at any time. Any member of the workforce entering the site to undertake any excavation must be made aware of the potential to discover contamination and the discovery strategy.

List of Figures

Figure 1 – Site Location Map 34
Figure 2 – Aerial Photograph 35
Figure 3 – Trial Hole Plan 36

List of Appendices

Appendix A Field Work
Appendix A.1 Engineers Logs
Appendix B Geotechnical In-Situ and Laboratory Testing
Appendix B.1 Classification
Appendix B.2 Interpretation
Appendix B.3 Geotechnical In-Situ and Laboratory Results
Appendix C Chemical Laboratory Testing
Appendix C.1 Conceptual Site Model
Appendix C.2 Chemical Laboratory Results
Appendix C.3 General Assessment Criteria
Appendix A Information Provided by the Client

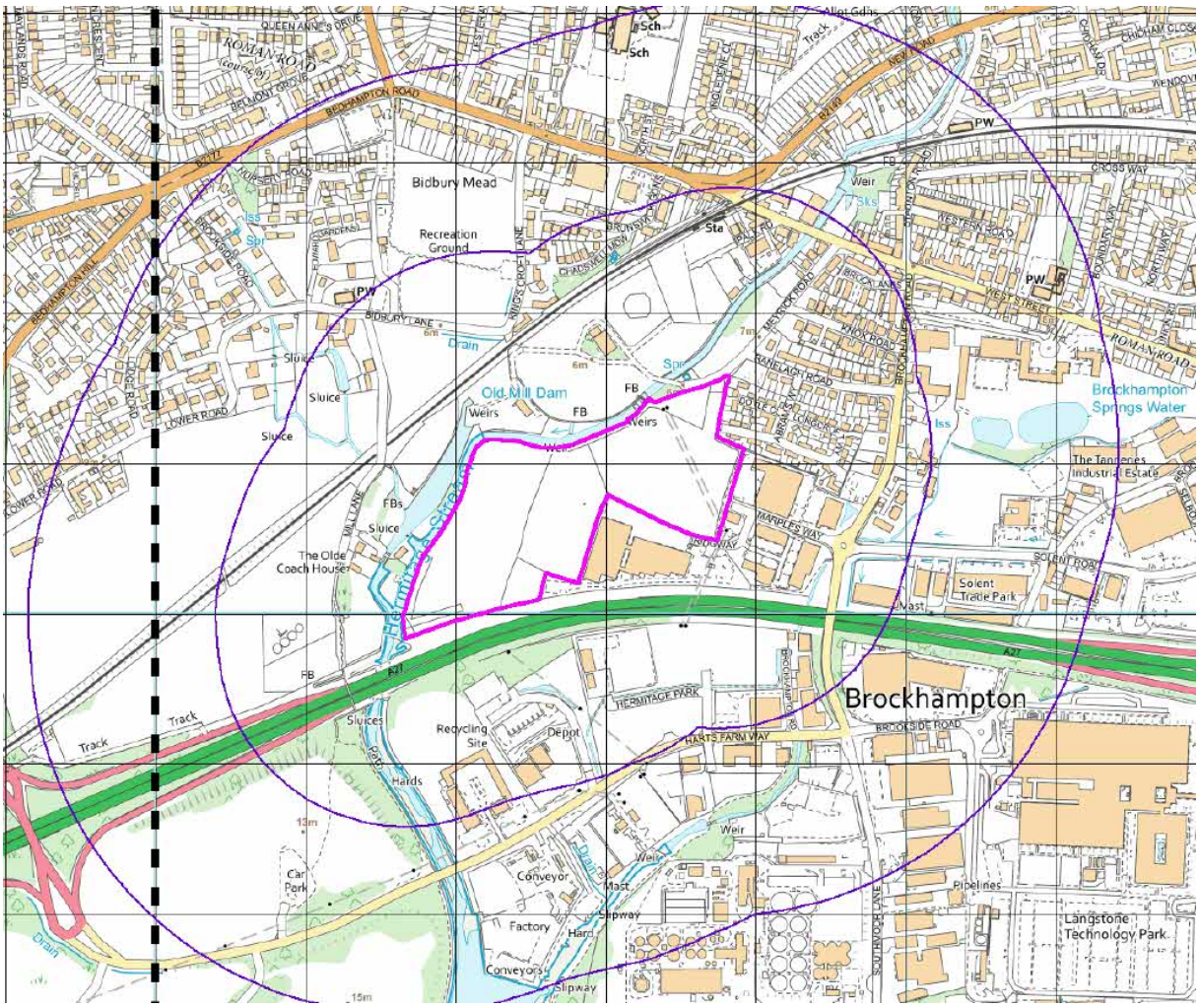


Figure 1 – Site Location Map

Job Number 17877	**Project** Kingscroft Farm, Ranelagh Road, Havant, Hampshire PO9 1FJ
Client Foreman Homes Ltd. Brockhampton Holdings Ltd Portsmouth Water Ltd Brockhampton Property Investments Ltd.	**Date** November 2019



Figure 2 – Aerial Photograph

Project
Kingscroft Farm, Ranelagh Road, Havant, Hampshire PO9 1FJ

Client
Foreman Homes Ltd.
Brockhampton Holdings Ltd.
Portsmouth Water Ltd.
Brockhampton Property Investments Ltd.

Date
November 2019

Job Number
17877



Figure 3 – Trial Hole Plan

Project
Kingscroft Farm, Ranelagh Road, Havant, Hampshire PO9 1FJ

Client
Foreman Homes Ltd.
Brockhampton Holdings Ltd.
Portsmouth Water Ltd.
Brockhampton Property Investments Ltd.

Date
November 2019

Job Number
17877

Appendix A Field Work

Appendix A.1 Engineers Logs

Samples & In Situ Testing			Strata Details		
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend
				0.25	
				(1.00)	
				1.25	
				(1.05)	
				2.30	
				2.50	
				(0.30)	
				2.80	
				3.00	
				(1.00)	
				4.00	

Samples & In Situ Testing			Strata Details		
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend
				(0.30)	
				0.30	
				(0.80)	
				1.10	
				(0.50)	
				1.60	
				(2.40)	
				4.00	

Samples & In Situ Testing			Strata Details		
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend
				(0.30)	
				0.30	
				(0.70)	
				1.00	
				(0.60)	
				1.60	
				(0.55)	
				2.15	
				(0.55)	
				2.70	
				(1.30)	
				4.00	

Samples & In Situ Testing			Strata Details		
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend
				(0.30)	
				0.30	
				(0.60)	
				0.90	
				(1.00)	
				1.90	
				2.00	
				(0.70)	
				2.70	
				(0.60)	
				3.30	
				(0.70)	
				4.00	

Samples & In Situ Testing			Strata Details		
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend
				(0.40)	
				0.40	
				(0.60)	
				1.00	
				(0.50)	
				1.50	
				(2.50)	
				4.00	

Water Strike	Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend
	Depth	Type	Results			
				0.10		
				0.80		
				0.90		
				1.30		
				1.90		
				1.95		

Water Strike	Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend
	Depth	Type	Results			
				0.30		
				1.70		
				3.50		

Water Strike	Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend
	Depth	Type	Results			
				0.20		
				0.50		
				1.00		
				2.60		

Water Strike	Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend
	Depth	Type	Results			
				0.20		
				1.10		
				2.25		
				2.30		

Water Strike	Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend
	Depth	Type	Results			
				0.25		
				1.00		
				1.90		
				2.70		

Appendix B Geotechnical In-Situ and Laboratory Testing

Appendix B.1 Classification

Classification based on SPT "N" values:

The inferred undrained strength of the cohesive soils was based on the SPT "N" blow counts, derived from the relationship suggested by Stroud (1974) and classified using Table B.1.1. (Ref: Stroud, M. A. 1974, "The Standard Penetration Test – its application and interpretation", Proc. ICE Conf. on Penetration Testing in the UK, Birmingham. Thomas Telford, London.).

Table B.1.1 SPT "N" Blow Count Cohesive Classification

Classification	Undrained Cohesive Strength C_u (kPa)
Extremely low	<10
Very low	10 – 20
Low	20 – 40
Medium	40 – 75
High	75 – 150
Very high	150 – 300
Extremely high	> 300

Note: (Ref: BS EN ISO 14688-2:2004+A1:2013 Clause 5.3.)

The relative density of granular soils was classified based of the relationship given in Table B.1.2.

The *UK National Annex to Eurocode 7: Geotechnical design – Part 2: Ground investigation and testing, NA 3.7 SPT test, BS EN 1997-2:2007, Annex F* states "Relative density descriptions on borehole records should also be based on uncorrected SPT N values, unless significantly disturbed, using the density classification in BS 5930:2015, Table 7.

Table B.1.2 SPT "N" Blow Count Granular Classification

Classification	SPT "N" blow count (blows/300mm)
Very loose	0 to 4
Loose	4 to 10
Medium dense	10 to 30
Dense	30 to 50
Very dense	Greater than 50

Note: (Ref: The Standard Penetration Test (SPT): Methods and Use, CIRIA Report 143, 1995)

Chalk samples recovered are disturbed by the sampling process. Therefore, it is difficult to assess an accurate chalk grade for in accordance with CIRIA C574 'Engineering in

Chalk'. In the absence of a standardised correlation between SPT "N" values and chalk grade for the most recent chalk classification (CIRIA C574) a broad indication of the in-situ chalk grade can be assessed using a paper by T.R.M. Wakeling from a site in Mundford, Norfolk, which compares SPT "N" values to the old Spink & Norbury chalk classification. From the Spink & Norbury classification it is possible to infer a basic CIRIA Grade (structureless or structured), as outlined in Table B.1.3.

Table B.1.3 Interpretation of SPT "N" Blow Counts in Chalk

SPT "N" Value Range	Spink & Norbury Grade	Inferred CIRIA Grade
<8	VI	Structureless (Dm)
8 – 15	V	Structureless (Dc)
15 – 20	IV	Structured chalk (C5 – A1)
20 - 25	III	Structured chalk (C5 – A1)
25 - 35	II	Structured chalk (C5 – A1)
>35	I	Structured chalk (C5 – A1)

Note:

Appendix B.2 Interpretation

Table B.2.1 Interpretation of DPSH Blow Counts

DP	Strata	Equivalent SPT N60 Blow Counts	Inferred Cohesive Strength/Granular Density/Approximate CIRIA Chalk Grade
DP1	RTD (cohesive) 0.25 – 2.10 Gravelly CLAY	4 - 24	Very low to high (C_u = 20 – 120kPa)
	RTD (granular)[1] 2.10 – 4.40 Gravelly SAND/Sandy GRAVEL	4 - 32	Very loose to dense
	LPCK[1] 4.40 – 5.00 Chalk	12 - 15	Structureless (Dc) to Structured chalk (C5 – A1)
DP2	RTD (cohesive) 0.30 – 1.60 Gravelly CLAY	4 – 32	Very low to very high (C_u = 20 – 160kPa)
	RTD (granular)[1] 1.60 – 4.20 Gravelly SAND/Sandy GRAVEL	0 - 40	Very loose to dense
	LPCK[1] 4.20 – 5.00 Chalk	15 - 19	Structureless (Dc) to Structured chalk (C5 – A1)
DP3	RTD (cohesive) 0.30 – 2.70 Gravelly CLAY/SILT	4 - 47	Very low to very high (C_u = 20 – 235kPa)
	LPCK[1] 2.70 – 5.00 Chalk	<8 - >35	Structureless (Dm) to Structured chalk (C5 – A1)
DP4	RTD (cohesive) 0.30 – 2.00 & 2.70 – 3.30 Gravelly CLAY	0 - 16	Extremely low to high (C_u = <10 – 80kPa)
	RTD (granular)[1] 2.00 – 2.70 Gravelly SAND	4 - 20	Very loose to medium dense
	LPCK[1] 3.30 – 5.00 Chalk	12 - 27	Structureless (Dc) to Structured chalk (C5 – A1)
DP5	RTD (cohesive) 0.40 – 1.50 Gravelly CLAY/SILT	8 - 28	Low to high (C_u = 40 – 140kPa)
	LPCK[1] 1.50 – 5.00 Chalk	<8 - 27	Structureless (Dm) to Structured chalk (C5 – A1)

Note: [1] Ground conditions inferred past the base of windowless sampler boreholes.

Table B.2.2 Interpretation of Atterberg Limit Tests

Stratum	Moisture Content (%)	Plasticity Index (%)	Passing 425µm Sieve (%)	Modified Plasticity Index (%)	Soil Classification	Volume Change Potential	
						BRE	NHBC
RTD	19 - 23	25 - 31	100	25 - 31	CI	Medium	Medium

Note: BRE Volume Change Potential refers to BRE Digest 240 (based on Atterberg results)
NHBC Volume Change Potential refers to NHBC Standards Chapter 4.2
Soils Classification based on British Soil Classification System
The most common use of the term clay is to describe a soil that contains enough clay-sized material or clay minerals to exhibit cohesive properties. The fraction of clay-sized material required varies, but can be as low as 15%. Unless stated otherwise, this is the sense used in Digest 240. The term can be used to denote the clay minerals. These are specific, naturally occurring chemical compounds, predominately silicates. The term is often used as a particle size descriptor. Soil particles that have a nominal diameter of less than 2 µm are normally considered to be of clay size, but they are not necessarily clay minerals. Some clay minerals are larger than 2 µm and some particles, 'rock flour' for example, can be finer than 2 µm but are not clay minerals.
(The Atterberg Limit Tests were undertaken in accordance with BS 1377:Part 2:1990 Clauses 3.2, 4.3 and 5)

Table B.2.3 Interpretation of PSD Tests

Location	Depth (m bgl)	Soil Description	Volume Change Potential		Passing 63µm Sieve (%)
			BRE	NHBC	
WS1	3.20	Brown sandy silty clayey GRAVEL	No	No	14
WS4	2.20	Brown sandy silty clayey GRAVEL	No	No	14
TP1	1.70	Brown sandy silty clayey GRAVEL with cobbles.	No	No	10

Note: BRE 240 states that a soil has a volume change potential when the clay fraction **exceeds 15%**. Only the silt and clay combined fraction are determined by sieving therefore the volume change potential is estimated from the percentage passing the 63µm sieve. NHBC Standards Chapter 4.2 states that a soil is shrinkable if the percentage of silt and clay passing the 63µm sieve is greater than 35% and the Plasticity Index is greater than 10%.
(The Particle Size Distribution Tests were undertaken in accordance with BS 1377: Part 2: 1990 Clause 9)

Table B.2.4 Interpretation of SMC Tests

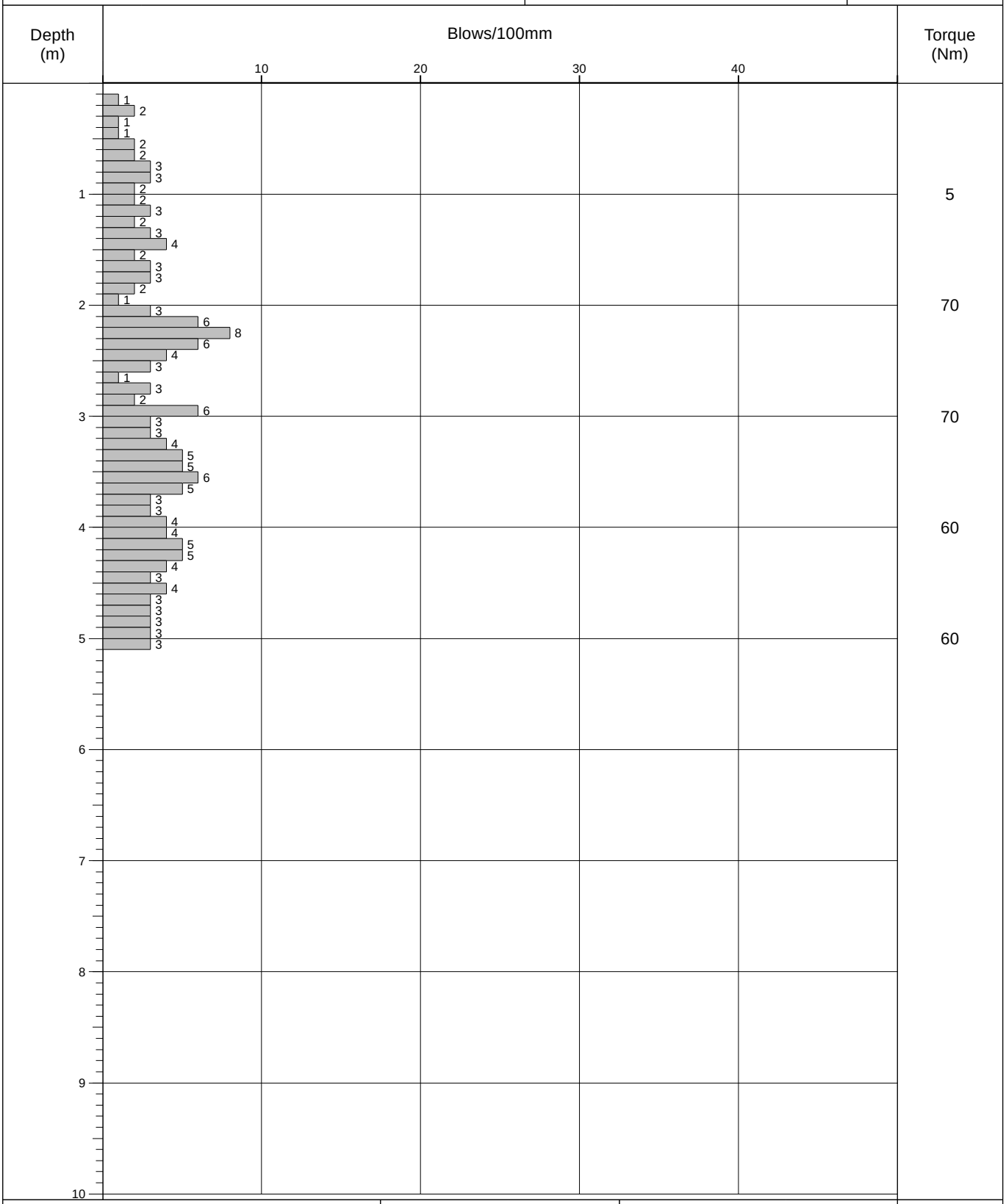
Location	Depth (m bgl)	Bulk Density (Mg/m^3)	Dry Density (Mg/m^3)	Moisture Content (%)	Saturation Moisture Content (%)	Density Classification (CIRIA)
TP1	2.40	2.11	1.72	23	21	High

Note: (The Determination of Saturation Moisture Content of Chalk Tests were made in accordance with BS 1377: Part 2: 1990 Clauses 3.3)

Appendix B.3 Geotechnical In-Situ and Laboratory Results

Soils Limited Newton House, Cross Road, Tadworth KT20 5SR Tel: 01737 814221 Email: admin@soilslimited.co.uk	**Probe Log**	Probe No. **DP1** Sheet 1 of 1

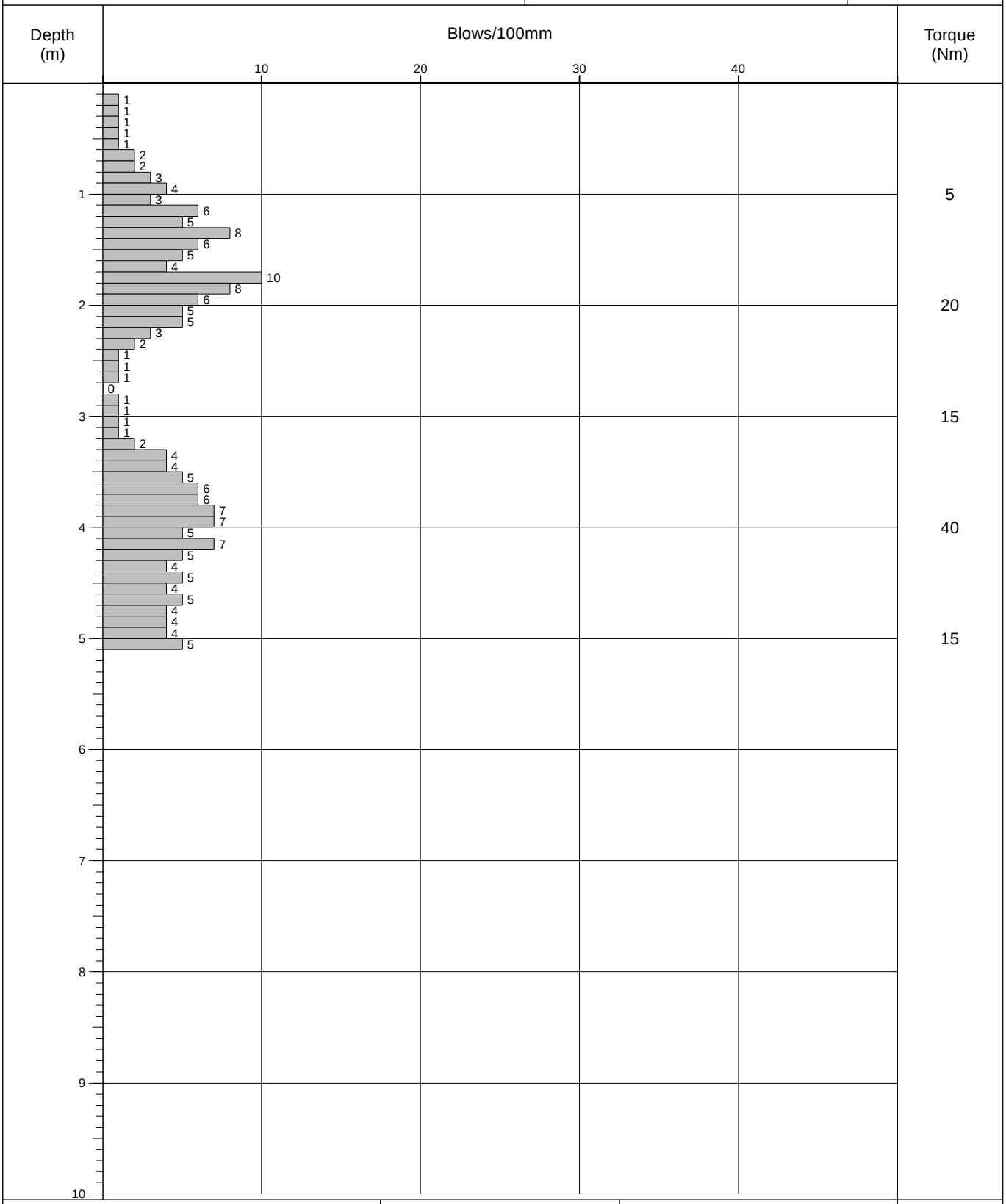
Project Name:	Kingscroft Farm	Project No. 17877	Co-ords:	Hole Type DP
Location:	Kingscroft Farm, Ranelagh Road, Havant, Hampshire, PO9 1FJ		Level: m AOD	Scale 1:50
Client:	Foreman Homes		Dates: 01/10/2019	Logged By



Remarks		Fall Height	750mm	Cone Base Diameter	50.5mm
		Hammer Weight	63.5kg	Final Depth	5m
		Probe Type	DPSH-B	Energy Ratio (Er)	84.53%

Soils Limited Newton House, Cross Road, Tadworth KT20 5SR Tel: 01737 814221 Email: admin@soilslimited.co.uk	**Probe Log**	Probe No. **DP2** Sheet 1 of 1

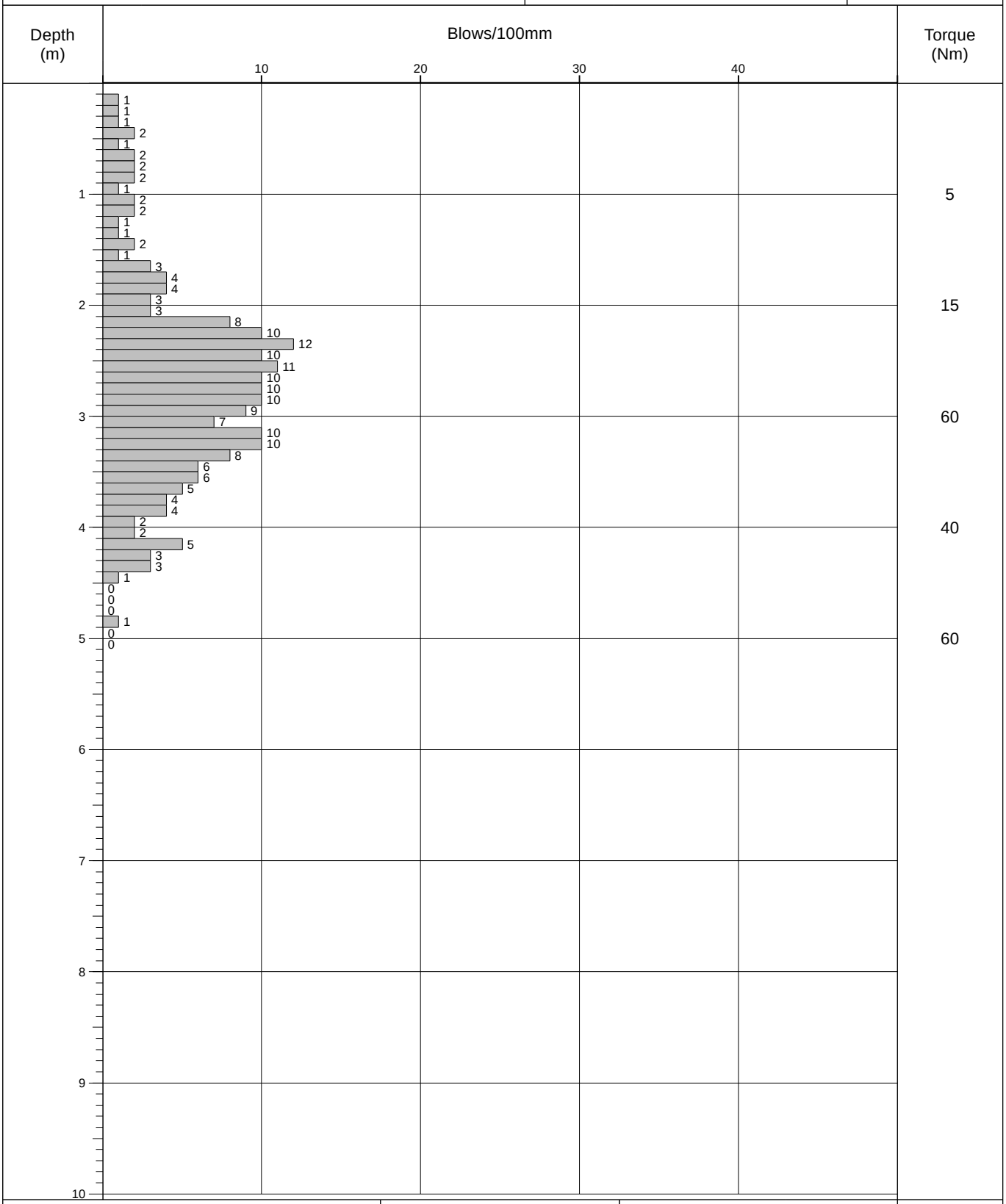
Project Name:	Kingscroft Farm	Project No. 17877	Co-ords:	Hole Type DP
Location:	Kingscroft Farm, Ranelagh Road, Havant, Hampshire, PO9 1FJ		Level: m AOD	Scale 1:50
Client:	Foreman Homes		Dates: 01/10/2019	Logged By



Remarks	Fall Height	750mm	Cone Base Diameter	50.5mm	AGS
	Hammer Weight	63.5kg	Final Depth	5m	
	Probe Type	DPSH-B	Energy Ratio (Er)	84.53%	

Soils Limited Newton House, Cross Road, Tadworth KT20 5SR Tel: 01737 814221 Email: admin@soilslimited.co.uk	**Probe Log**	Probe No. **DP3** Sheet 1 of 1

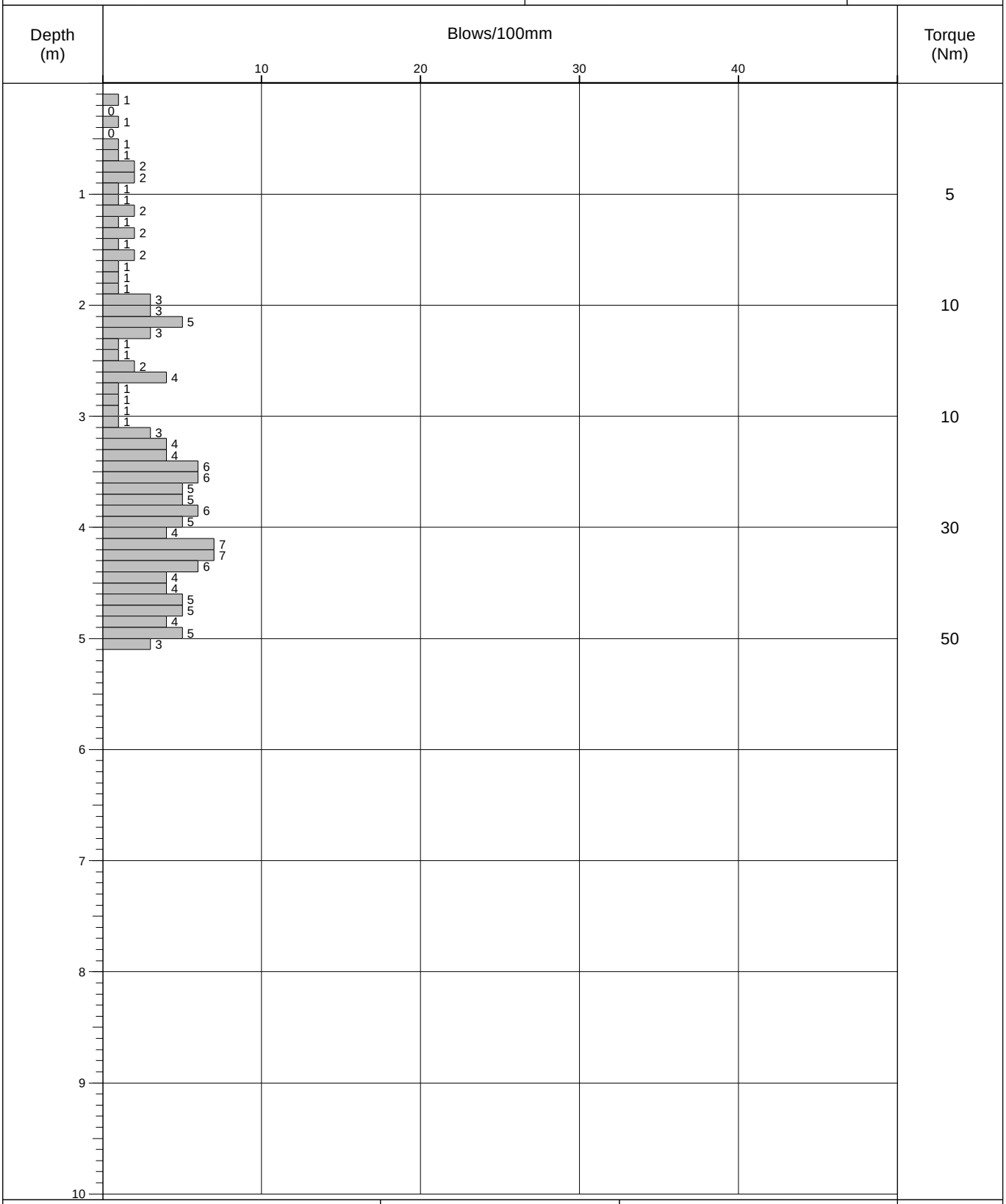
Project Name:	Kingscroft Farm	Project No. 17877	Co-ords:	Hole Type DP
Location:	Kingscroft Farm, Ranelagh Road, Havant, Hampshire, PO9 1FJ		Level: m AOD	Scale 1:50
Client:	Foreman Homes		Dates: 01/10/2019	Logged By



Remarks	Fall Height	750mm	Cone Base Diameter	50.5mm	AGS
	Hammer Weight	63.5kg	Final Depth	5m	
	Probe Type	DPSH-B	Energy Ratio (Er)	84.53%	

Soils Limited Newton House, Cross Road, Tadworth KT20 5SR Tel: 01737 814221 Email: admin@soilslimited.co.uk	**Probe Log**	Probe No. **DP4** Sheet 1 of 1

Project Name:	Kingscroft Farm	Project No. 17877	Co-ords:	Hole Type DP
Location:	Kingscroft Farm, Ranelagh Road, Havant, Hampshire, PO9 1FJ		Level: m AOD	Scale 1:50
Client:	Foreman Homes		Dates: 01/10/2019	Logged By

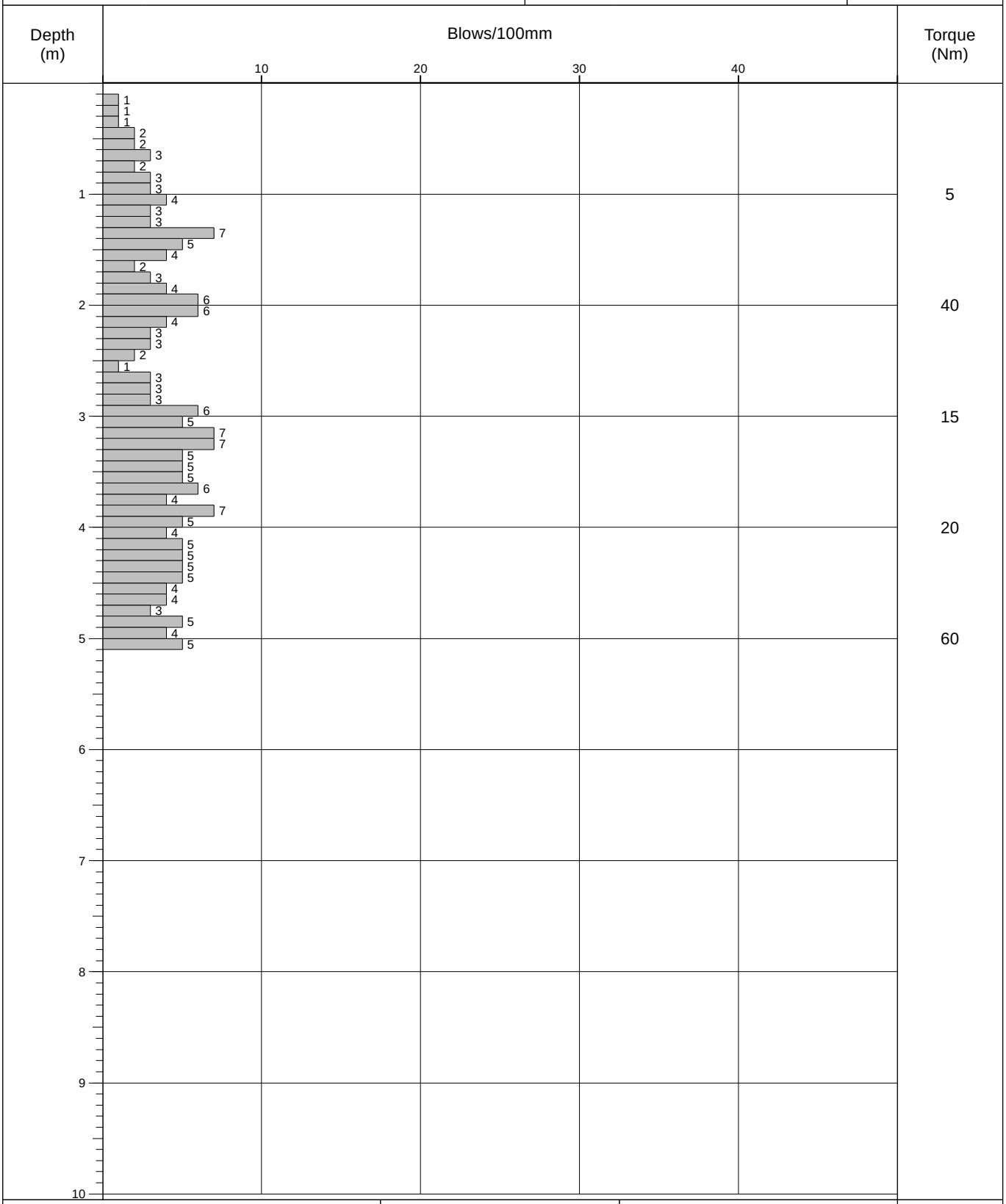


Remarks		Fall Height	750mm	Cone Base Diameter	50.5mm
		Hammer Weight	63.5kg	Final Depth	5m
		Probe Type	DPSH-B	Energy Ratio (Er)	84.53%

AGS

Soils Limited Newton House, Cross Road, Tadworth KT20 5SR Tel: 01737 814221 Email: admin@soilslimited.co.uk	**Probe Log**	Probe No. **DP5** Sheet 1 of 1

Project Name:	Kingscroft Farm	Project No. 17877	Co-ords:	Hole Type DP
Location:	Kingscroft Farm, Ranelagh Road, Havant, Hampshire, PO9 1FJ		Level: m AOD	Scale 1:50
Client:	Foreman Homes		Dates: 01/10/2019	Logged By



Remarks		Fall Height	750mm	Cone Base Diameter	50.5mm
		Hammer Weight	63.5kg	Final Depth	5m
		Probe Type	DPSH-B	Energy Ratio (Er)	84.53%

Laboratory Report

GEO Site & Testing Services Ltd

Contract Number: 46249

Client Ref: **17877**
Client PO: **17877**

Report Date: **31-10-2019**

Client **Soils Limited**
Newton House
Cross Road
Tadworth
Surrey
KT20 5SR

Contract Title: **Kingscroft Farm**
For the attention of: **Tim Rudkin**

Date Received: **22-10-2019**
Date Completed: **31-10-2019**

Test Description	Qty
Moisture Content BS 1377:1990 - Part 2 : 3.2 - * UKAS	2
1 Point Liquid & Plastic Limit BS 1377:1990 - Part 2 : 4.4 & 5.3 - * UKAS	2
PSD Wet Sieve method BS 1377:1990 - Part 2 : 9.2 - * UKAS	3
Saturated Moisture Content of chalk (SMC) BS 1377:1990 - Part 2 : 3.3 - * UKAS	1
Disposal of samples for job	1

Notes: **Observations and Interpretations are outside the UKAS Accreditation**
*** - denotes test included in laboratory scope of accreditation**
- denotes test carried out by approved contractor
@ - denotes non accredited tests

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved Signatories:
Emma Sharp (Office Manager) - Paul Evans (Quality/Technical Manager) - Richard John (Advanced Testing Manager)
Sean Penn (Administrative/Accounts Assistant) - Shaun Jones (Laboratory manager) - Wayne Honey (Administrative/Quality Assistant)

GEO Site & Testing Services Ltd
Unit 3-4, Heol Aur, Dafen Ind Estate, Dafen, Llanelli, Carmarthenshire SA14 8QN
Tel: 01554 784040 Fax: 01554 784041 info@gstl.co.uk gstl.co.uk

GSTL	NATURAL MOISTURE, LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX (BS 1377 : Part 2 : 1990 Method 5)	
Contract Number	46249	
Site Name	Kingscroft Farm.	
Date Tested	26/10/2019	
	DESCRIPTIONS	

Sample/Hole Reference	Sample Number	Sample Type	Depth (m)			Descriptions
WS1		D	1.20	-		Brown silty CLAY.
WS4		D	1.20	-		Brown silty CLAY.
				-		
				-		
				-		
				-		
				-		
				-		
				-		
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Operators	Checked	31/10/2019	Wayne Honey (Administrative/Quality Assistant)
Ieuan Williams	Approved	31/10/2019	Paul Evans (Quality/Technical Manager)

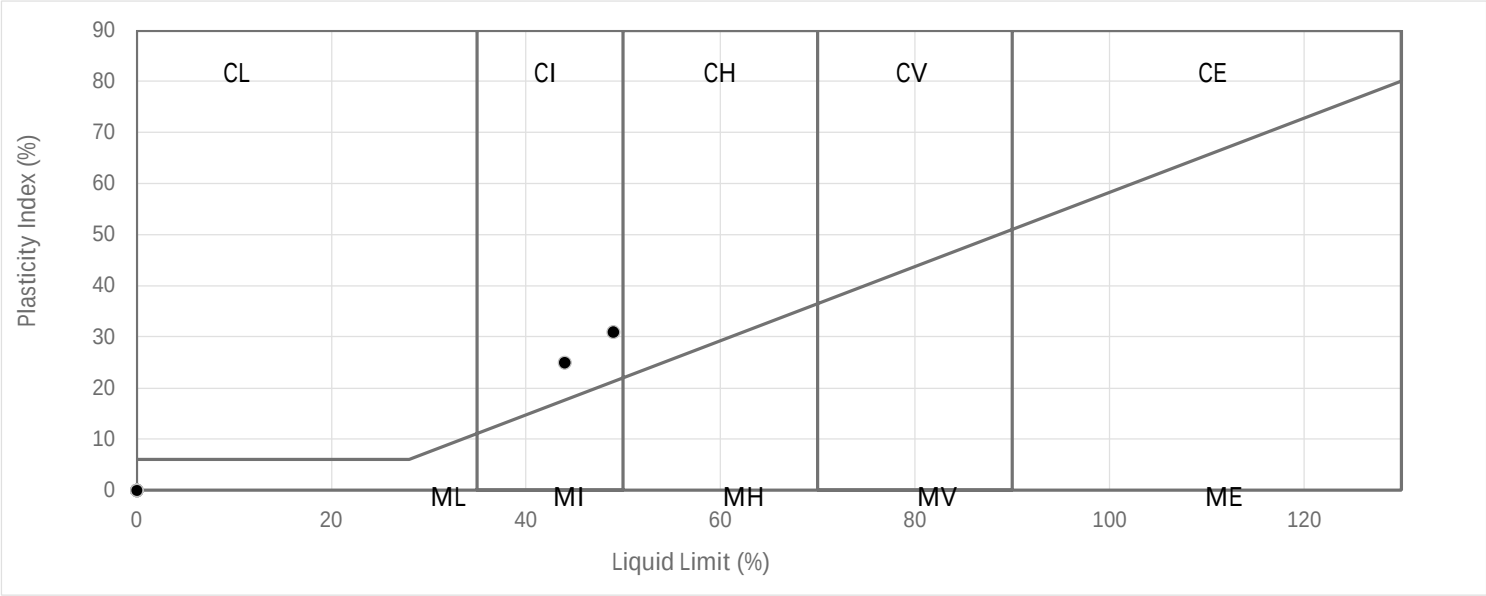
UKAS TESTING
2788

GSTL	NATURAL MOISTURE, LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX (BS 1377 : Part 2 : 1990 Method 5)	
Contract Number	46249	
Project Location	Kingscroft Farm.	
Date Tested	**26/10/2019**	

Sample/Hole Reference	Sample Number	Sample Type	Depth (m)			Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity index %	Passing 0.425mm %	Remarks
WS1		D	1.20	-		19	44	19	25	100	CI Intermediate Plasticity
WS4		D	1.20	-		23	49	18	31	100	CI Intermediate Plasticity
				-							
				-							
				-							
				-							
				-							
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				-							

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION
BS 5930:1999+A2:2010



Operators	Checked	31/10/2019	Wayne Honey (Administrative/Quality Assistant)
Ieuan Williams	Approved	31/10/2019	Paul Evans (Quality/Technical Manager)

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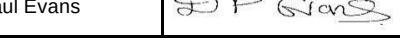
GSTL	Saturation Moisture Content of Chalk BS 1377 : Part 2 : 1990 Section 3.3	
Contract Number	46249	
Site Name	Kingscroft Farm.	
Date Tested	**22/10/2019**	

Hole Reference	Sample Number	Sample Type	Depth (m)			Moisture Content	Bulk Density	Dry Density	Saturated Moisture Content	Remarks
TP5		D	2.40	-		23	2.11	1.72	21	NON-STANDARD
				-						
				-						
				-						
				-						
				-						
				-						
				-						
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Key **Reported As** **Clause**

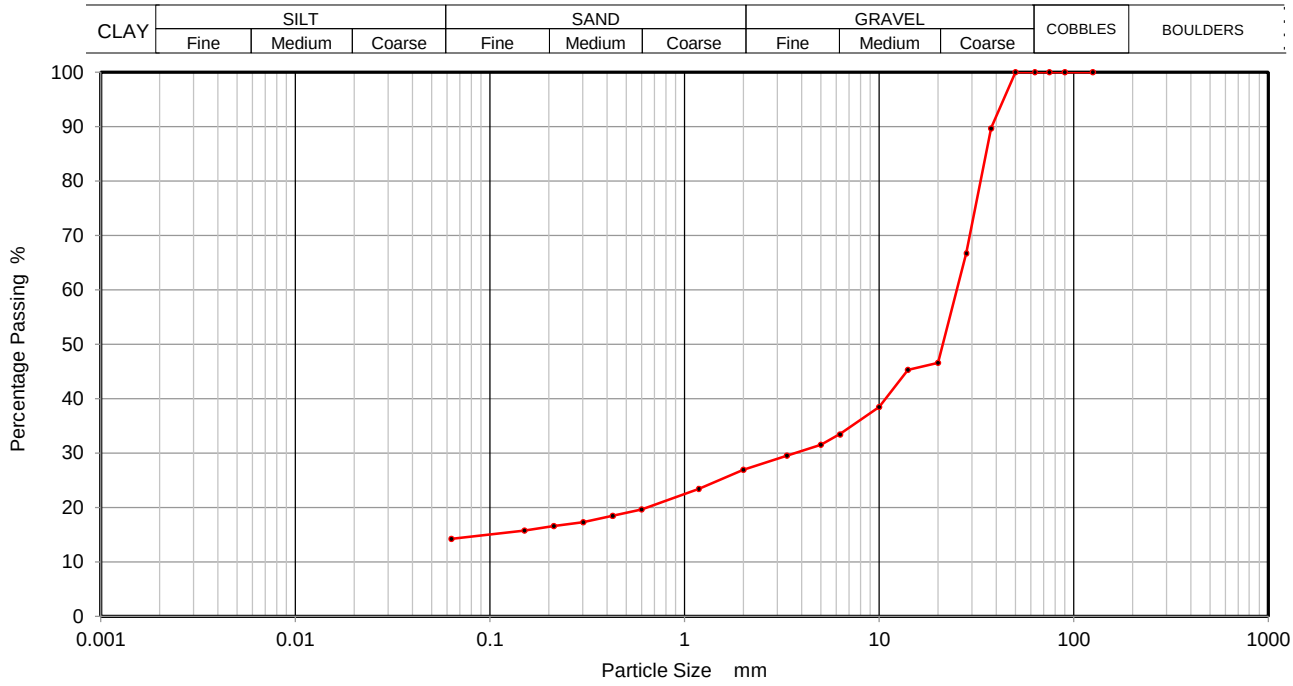
Moisture Content	%	3.2
Bulk Density	Mg/m^3	7.2
Dry Density	Mg/m^3	7.2
SMC	%	3.3.6

If there is a NON-STANDARD in the remarks next to the reported SMC result this means there was no lump of chalk of sufficient volume (300mL-500mL) present in the samples received to meet the testing requirements of the stated standard.

Operators	Checked	30/10/2019	Emma Sharp	
CJ	Approved	31/10/2019	Paul Evans	

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GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	46249
		Borehole/Pit No.	WS1
Site Name	Kingscroft Farm.	Sample No.	
Soil Description	Brown sandy silty clayey GRAVEL.	Depth Top	3.20
		Depth Base	
Date Tested	24/10/2019	Sample Type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	90		
28	67		
20	47		
14	45		
10	38		
6.3	33		
5	32		
3.35	30		
2	27		
1.18	23		
0.6	20		
0.425	18		
0.3	17		
0.212	17		
0.15	16		
0.063	14		

Sample Proportions	% dry mass
Cobbles	0
Gravel	73
Sand	13
Silt and Clay	14

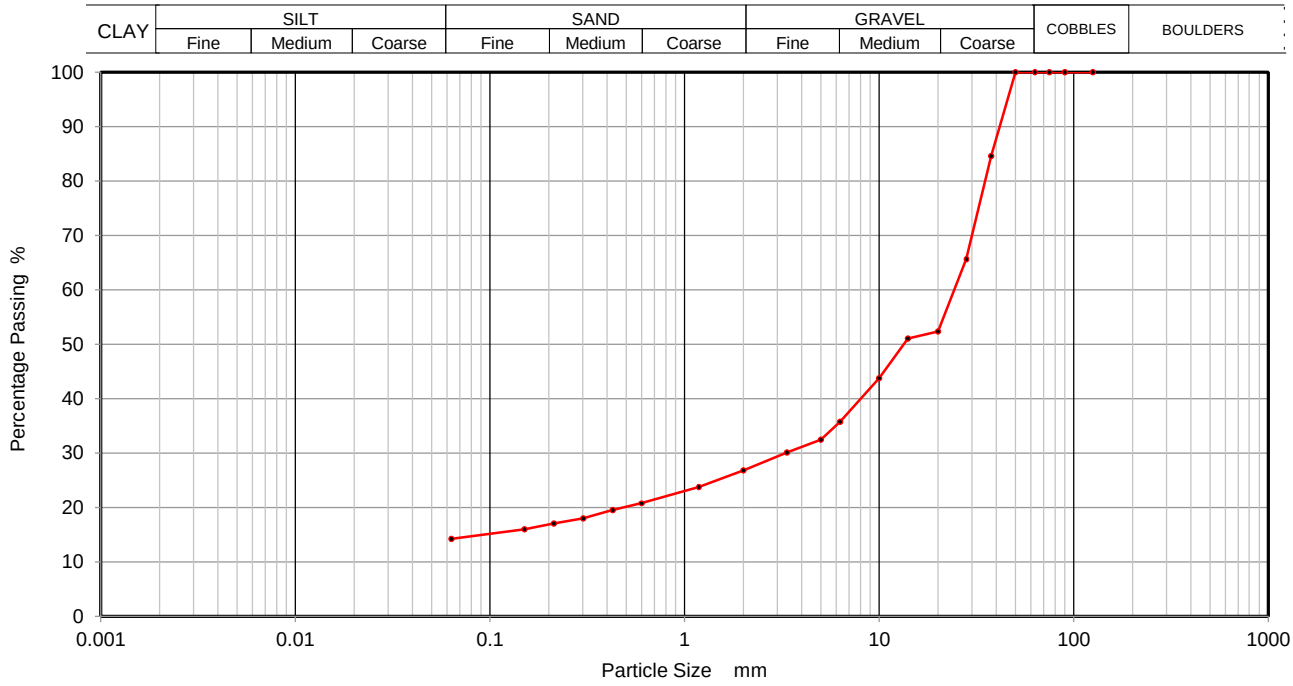
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	30/10/2019	Wayne Honey	W. Honey
RO/MH	Approved	31/10/2019	Paul Evans	P Evans

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GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	46249
		Borehole/Pit No.	WS4
Site Name	Kingscroft Farm.	Sample No.	
Soil Description	Brown sandy silty clayey GRAVEL	Depth Top	2.20
		Depth Base	
Date Tested	24/10/2019	Sample Type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	85		
28	66		
20	52		
14	51		
10	44		
6.3	36		
5	32		
3.35	30		
2	27		
1.18	24		
0.6	21		
0.425	19		
0.3	18		
0.212	17		
0.15	16		
0.063	14		

Sample Proportions	% dry mass
Cobbles	0
Gravel	73
Sand	13
Silt and Clay	14

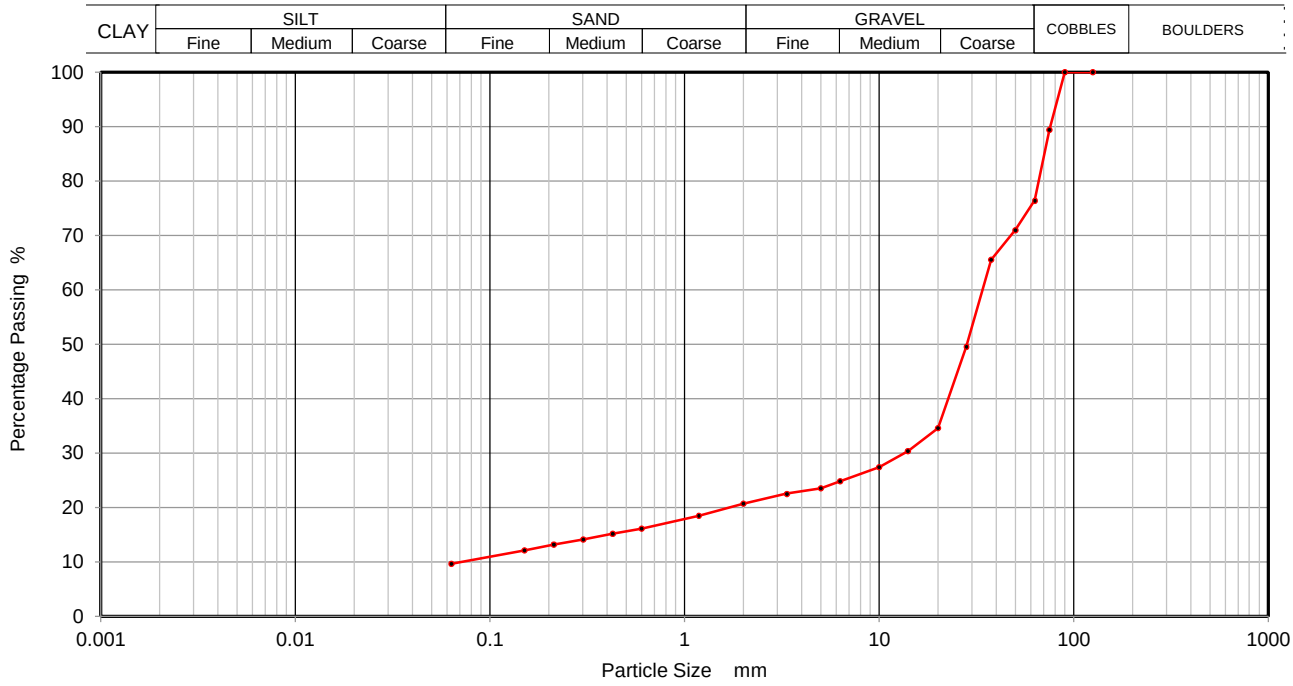
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	30/10/2019	Wayne Honey	W. Honey
RO/MH	Approved	31/10/2019	Paul Evans	P Evans

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GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	46249
		Borehole/Pit No.	TP1
Site Name	Kingscroft Farm.	Sample No.	
Soil Description	Brown sandy silty clayey GRAVEL. With cobbles	Depth Top	1.70
		Depth Base	
Date Tested	24/10/2019	Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	89		
63	76		
50	71		
37.5	66		
28	50		
20	35		
14	30		
10	27		
6.3	25		
5	24		
3.35	22		
2	21		
1.18	18		
0.6	16		
0.425	15		
0.3	14		
0.212	13		
0.15	12		
0.063	10		

Sample Proportions	% dry mass
Cobbles	24
Gravel	55
Sand	11
Silt and Clay	10

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	30/10/2019	Wayne Honey	W. Honey
RO/MH	Approved	31/10/2019	Paul Evans	P Evans

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2788

Tim Rudkin
Soils Ltd
Unit 11
Sun Valley Business Park
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Hampshire
SO23 0LB

e: tr@soilslimited.co.uk

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 19-66697

Project / Site name:	Kingscroft Farm	**Samples received on:**	17/10/2019
Your job number:	17877	**Samples instructed on:**	17/10/2019
Your order number:		**Analysis completed by:**	24/10/2019
Report Issue Number:	1	**Report issued on:**	24/10/2019
Samples Analysed:	2 soil samples		

Signed: [redacted]

Zina Abdul Razzak
Senior Quality Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 19-66697

Project / Site name: Kingscroft Farm

Lab Sample Number				1334872	1334873			
Sample Reference				WS2	WS2			
Sample Number				None Supplied	None Supplied			
Depth (m)				1.20	2.50			
Date Sampled				Deviating	Deviating			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)								
Stone Content	%	0.1	NONE	12	< 0.1			
Moisture Content	%	N/A	NONE	6.7	9.7			
Total mass of sample received	kg	0.001	NONE	0.57	0.72			

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.4	8.7			
Total Sulphate as SO_4	%	0.005	MCERTS	0.028	0.057			
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.034	0.011			
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	34.4	10.8			
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	1.0	2.5			
Total Sulphur	%	0.005	MCERTS	0.009	0.020			
Ammonium as NH_4	mg/kg	0.5	MCERTS	< 0.5	1.3			
Ammonium as NH4 (10:1 leachate equivalent)	mg/l	0.05	MCERTS	< 0.05	0.13			
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	< 2.0	< 2.0			

Heavy Metals / Metalloids

Magnesium (water soluble)	mg/kg	5	NONE	5.1	< 5.0			
Magnesium (leachate equivalent)	mg/l	2.5	NONE	2.5	< 2.5			

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number : 19-66697

Project / Site name: Kingscroft Farm

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1334872	WS2	None Supplied	1.20	Brown clay and sand with stones and gravel
1334873	WS2	None Supplied	2.50	Light brown clay and sand with chalk and gravel.

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number : 19-66697

Project / Site name: Kingscroft Farm

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammonium as NH4 in soil	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method, 10:1 water extraction.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	MCERTS
Chloride, water soluble, in soil	Determination of Chloride colorimetrically by discrete analyser.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests. 2:1 extraction.	L082-PL	D	MCERTS
Magnesium, water soluble, in soil	Determination of water soluble magnesium by extraction with water followed by ICP-OES.	In-house method based on TRL 447	L038-PL	D	NONE
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In-house method based on BS1377 Part 2, 1990, Classification tests	L019-UK/PL	W	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L038-PL	D	MCERTS
Total Sulphur in soil as %	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, and MEWAM 2006 Methods for the Determination of Metals in Soil	L038-PL	D	MCERTS
Water Soluble Nitrate (2:1) as N in soil	Determination of nitrate by reaction with sodium salicylate and colorimetry.	In-house method based on Examination of Water and Wastewatern & Polish Standard Method PN-82/C-04579.08, 2:1 extraction.	L078-PL	W	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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The results included within the report are representative of the samples submitted for analysis.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
WS2		S	19-66697	1334872	a			
WS2		S	19-66697	1334873	a			

Key: a - No sampling date b - Incorrect container
c - Holding time d - Headspace e - Temperature

Appendix C Chemical Laboratory Testing

Appendix C.1 Conceptual Site Model

Table C.1 .1 CSM Revised Post Testing

Source	Potential Contaminant	Exposure Pathway	Receptor	Initial Assessment from Preliminary Investigation Report Information			Comments	Proposed Investigation
				Severity	Probability	Risk		
Local Authority Recorded Landfill Sites, Potentially Infilled Land (Water), Registered Landfill Sites Off-site sources from which potential contamination would have migrated onto the site.	Soil-gas	Inhalation of Vapour/gases (including Radon)	Site Workers/Site Maintenance	Mild	Likely	Moderate/Low	Potentially infilled land (water) and recorded landfilled sites within 0 – 250m to the site. Potential disposal of hazardous waste in unlined pits or ponds poses a threat to human health via migration of contaminants. Risk for release of soil-gas as putrescible materials contained in the landfill may gradually decay. Potential migration of contaminants in solution via groundwater, given that the site was underlain by permeable geology. Potential risk to end-users, off-site users and site workers via inhalation of dust and direct contact, due to residential gardens within the proposed development.	Ground workers should follow regulations on health and safety during development (HSE, 1991). Soil gas monitoring ongoing at the time of reporting.
			End Users	Medium	Likely	Moderate		
			Off-site Users	Mild	Low	Low		
	Soil-gas	Migration of gases via permeable soils (including radon)	Site Workers/Site Maintenance	Mild	Likely	Moderate/Low		
			End Users	Medium	Likely	Moderate		
			Off-site Users	Mild	Low	Low		
			Building and confined spaces	Medium	Likely	Moderate		

Appendix C.2 Chemical Laboratory Results

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Analytical Report Number : 19-66694

Project / Site name:	Kingscroft Farm	Samples received on:	17/10/2019
Your job number:	17877	Samples instructed on:	17/10/2019
Your order number:		Analysis completed by:	24/10/2019
Report Issue Number:	1	Report issued on:	24/10/2019
Samples Analysed:	7 soil samples		

Signed:

Zina Abdul Razzak
Senior Quality Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 19-66694

Project / Site name: Kingscroft Farm

Lab Sample Number				1334851	1334852	1334853	1334854	1334855
Sample Reference				WS1	WS2	WS3	WS4	WS5
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	0.20	0.50	0.50	0.20
Date Sampled				Deviating	Deviating	Deviating	Deviating	Deviating
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)								
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	17	18	9.9	12	17
Total mass of sample received	kg	0.001	NONE	0.86	0.87	0.86	0.94	0.95
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	6.6	6.7	7.3	7.7	7.1
Organic Matter	%	0.1	MCERTS	2.5	3.3	0.3	< 0.1	3.3
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.33
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.29
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.28
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.30
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.43
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.14
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.32
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80	< 0.80	< 0.80	2.09
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	11	11	17	17	13
Boron (water soluble)	mg/kg	0.2	MCERTS	0.8	1.1	1.0	1.2	1.4
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.3	0.4	< 0.2	< 0.2	0.3
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	26	30	30	33	26
Copper (aqua regia extractable)	mg/kg	1	MCERTS	39	34	18	17	36
Lead (aqua regia extractable)	mg/kg	1	MCERTS	100	93	12	13	86
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	0.6	< 0.3	< 0.3	0.8
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	15	19	23	25	17
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	3.2
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	46	44	47	55	44
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	63	65	43	47	77
Petroleum Hydrocarbons								
TPH Texas (C6 - C8)	mg/kg	0.1	ISO 17025	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH Texas (C8 - C10)	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	< 10
TPH Texas (C10 - C12)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH Texas (C12 - C16)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
TPH Texas (C16 - C21)	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	< 10
TPH Texas (C21 - C40)	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	12
TPH Texas (C6 - C40)	mg/kg	10	NONE	< 10	< 10	< 10	< 10	12

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Analytical Report Number: 19-66694

Project / Site name: Kingscroft Farm

Lab Sample Number				1334856	1334857			
Sample Reference				WS5	TP1			
Sample Number				None Supplied	None Supplied			
Depth (m)				0.50	0.20			
Date Sampled				Deviating	Deviating			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)								
Stone Content	%	0.1	NONE	< 0.1	< 0.1			
Moisture Content	%	N/A	NONE	8.6	17			
Total mass of sample received	kg	0.001	NONE	0.94	1.0			
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected			
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.4	7.0			
Organic Matter	%	0.1	MCERTS	1.0	2.8			
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0			
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80			
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	7.6	12			
Boron (water soluble)	mg/kg	0.2	MCERTS	1.6	1.4			
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	0.4			
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0			
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	28	26			
Copper (aqua regia extractable)	mg/kg	1	MCERTS	19	33			
Lead (aqua regia extractable)	mg/kg	1	MCERTS	25	97			
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3			
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	22	16			
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0			
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	40	41			
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	52	61			
Petroleum Hydrocarbons								
TPH Texas (C6 - C8)	mg/kg	0.1	ISO 17025	< 0.1	< 0.1			
TPH Texas (C8 - C10)	mg/kg	10	MCERTS	< 10	< 10			
TPH Texas (C10 - C12)	mg/kg	1	MCERTS	< 1.0	< 1.0			
TPH Texas (C12 - C16)	mg/kg	4	MCERTS	< 4.0	< 4.0			
TPH Texas (C16 - C21)	mg/kg	10	MCERTS	< 10	< 10			
TPH Texas (C21 - C40)	mg/kg	10	MCERTS	< 10	< 10			
TPH Texas (C6 - C40)	mg/kg	10	NONE	< 10	< 10			

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number : 19-66694

Project / Site name: Kingscroft Farm

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1334851	WS1	None Supplied	0.20	Brown loam and clay with gravel and vegetation.
1334852	WS2	None Supplied	0.20	Brown loam and clay with gravel and vegetation.
1334853	WS3	None Supplied	0.50	Light brown clay and sand with vegetation.
1334854	WS4	None Supplied	0.50	Light brown clay and sand with vegetation.
1334855	WS5	None Supplied	0.20	Brown loam and clay with gravel and clinker
1334856	WS5	None Supplied	0.50	Brown loam and clay.
1334857	TP1	None Supplied	0.20	Brown loam and clay with gravel and vegetation.

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Analytical Report Number : 19-66694

Project / Site name: Kingscroft Farm

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In-house method based on BS1377 Part 2, 1990, Classification tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L009-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
TPH Texas (Soil)	Determination of dichloromethane/hexane extractable hydrocarbons in soil by GC-MS.	In-house method	L064-PL	D	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
TP1		S	19-66694	1334857	a			
WS1		S	19-66694	1334851	a			
WS2		S	19-66694	1334852	a			
WS3		S	19-66694	1334853	a			
WS4		S	19-66694	1334854	a			
WS5		S	19-66694	1334855	a			
WS5		S	19-66694	1334856	a			

Key: a - No sampling date b - Incorrect container
c - Holding time d - Headspace e - Temperature

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Analytical Report Number : 19-66695

Project / Site name:	Kingscroft Farm	Samples received on:	17/10/2019
Your job number:	17877	Samples instructed on:	17/10/2019
Your order number:		Analysis completed by:	24/10/2019
Report Issue Number:	1	Report issued on:	24/10/2019
Samples Analysed:	2 10:1 WAC samples		

Signed:

Zina Abdul Razzak
Senior Quality Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Waste Acceptance Criteria Analytical Results

Report No:	19-66695						
					Client: SOILSLTD		
Location	Kingscroft Farm						
Lab Reference (Sample Number)	1334868 / 1334869				Landfill Waste Acceptance Criteria Limits		
Sampling Date					Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID	WS2						
Depth (m)	0.20						
Solid Waste Analysis							
TOC (%)**	1.8				3%	5%	6%
Loss on Ignition (%) **	5.7				--	--	10%
BTEX (µg/kg) **	< 10				6000	--	--
Sum of PCBs (mg/kg) **	< 0.007				1	--	--
Mineral Oil (mg/kg)	< 10				500	--	--
Total PAH (WAC-17) (mg/kg)	2.0				100	--	--
pH (units)**	7.0				--	>6	--
Acid Neutralisation Capacity (mol / kg)	0.0000				--	To be evaluated	To be evaluated
Eluate Analysis	10:1			10:1	Limit values for compliance leaching test		
(BS EN 12457 - 2 preparation utilising end over end leaching procedure)	mg/l			mg/kg	using BS EN 12457-2 at L/S 10 l/kg (mg/kg)		
Arsenic *	0.0038			0.0314	0.5	2	25
Barium *	0.0142			0.118	20	100	300
Cadmium *	< 0.0001			< 0.0008	0.04	1	5
Chromium *	0.0019			0.016	0.5	10	70
Copper *	0.014			0.11	2	50	100
Mercury *	< 0.0005			< 0.0050	0.01	0.2	2
Molybdenum *	0.0014			0.0120	0.5	10	30
Nickel *	0.0035			0.029	0.4	10	40
Lead *	0.0056			0.047	0.5	10	50
Antimony *	< 0.0017			< 0.017	0.06	0.7	5
Selenium *	< 0.0040			< 0.040	0.1	0.5	7
Zinc *	0.0097			0.080	4	50	200
Chloride *	1.9			16	800	4000	25000
Fluoride	0.44			3.6	10	150	500
Sulphate *	1.7			14	1000	20000	50000
TDS*	35			290	4000	60000	100000
Phenol Index (Monohydric Phenols) *	< 0.010			< 0.10	1	-	-
DOC	8.29			68.8	500	800	1000
Leach Test Information							
Stone Content (%)	< 0.1						
Sample Mass (kg)	0.87						
Dry Matter (%)	82						
Moisture (%)	18						

Results are expressed on a dry weight basis, after correction for moisture content where applicable.

*= UKAS accredited (liquid eluate analysis only)

Stated limits are for guidance only and i2 cannot be held responsible for any discrepancies with current legislation

** = MCERTS accredited

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes as defined by the Waste (England and Wales) Regulations 2011 (as amended) and EA Guidance WM3.
This analysis is only applicable for landfill acceptance criteria (The Environmental Permitting (England and Wales) Regulations) and does not give any indication as to whether a waste may be hazardous or non-hazardous.

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Waste Acceptance Criteria Analytical Results

Report No:	19-66695						
					Client: SOILSLTD		
Location	Kingscroft Farm						
Lab Reference (Sample Number)	1334870 / 1334871				Landfill Waste Acceptance Criteria Limits		
Sampling Date					Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID	WS3						
Depth (m)	0.50						
Solid Waste Analysis							
TOC (%)**	0.5				3%	5%	6%
Loss on Ignition (%) **	2.7				--	--	10%
BTEX (µg/kg) **	< 10				6000	--	--
Sum of PCBs (mg/kg) **	< 0.007				1	--	--
Mineral Oil (mg/kg)	< 10				500	--	--
Total PAH (WAC-17) (mg/kg)	< 0.9				100	--	--
pH (units)**	7.7				--	>6	--
Acid Neutralisation Capacity (mol / kg)	1.8				--	To be evaluated	To be evaluated
Eluate Analysis	10:1			10:1	Limit values for compliance leaching test		
(BS EN 12457 - 2 preparation utilising end over end leaching procedure)	mg/l			mg/kg	using BS EN 12457-2 at L/S 10 l/kg (mg/kg)		
Arsenic *	< 0.0011			< 0.0110	0.5	2	25
Barium *	0.0020			0.0184	20	100	300
Cadmium *	< 0.0001			< 0.0008	0.04	1	5
Chromium *	< 0.0004			< 0.0040	0.5	10	70
Copper *	0.0031			0.028	2	50	100
Mercury *	< 0.0005			< 0.0050	0.01	0.2	2
Molybdenum *	0.0004			< 0.0040	0.5	10	30
Nickel *	< 0.0003			< 0.0030	0.4	10	40
Lead *	0.0011			0.010	0.5	10	50
Antimony *	< 0.0017			< 0.017	0.06	0.7	5
Selenium *	< 0.0040			< 0.040	0.1	0.5	7
Zinc *	0.0016			0.015	4	50	200
Chloride *	1.1			10	800	4000	25000
Fluoride	0.16			1.5	10	150	500
Sulphate *	1.6			14	1000	20000	50000
TDS*	12			110	4000	60000	100000
Phenol Index (Monhydric Phenols) *	< 0.010			< 0.10	1	-	-
DOC	5.04			46.5	500	800	1000
Leach Test Information							
Stone Content (%)	< 0.1						
Sample Mass (kg)	0.86						
Dry Matter (%)	90						
Moisture (%)	9.9						

Results are expressed on a dry weight basis, after correction for moisture content where applicable.

*= UKAS accredited (liquid eluate analysis only)

Stated limits are for guidance only and i2 cannot be held responsible for any discrepencies with current legislation

** = MCERTS accrediited

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes as defined by the Waste (England and Wales) Regulations 2011 (as amended) and EA Guidance WM3.
This analysis is only applicable for landfill acceptance criteria (The Environmental Permitting (England and Wales) Regulations) and does not give any indication as to whether a waste may be hazardous or non-hazardous.

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number : 19-66695

Project / Site name: Kingscroft Farm

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1334868	WS2	None Supplied	0.20	Brown loam and clay with gravel and vegetation.
1334870	WS3	None Supplied	0.50	Light brown clay and sand with vegetation.

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number : 19-66695

Project / Site name: Kingscroft Farm

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status

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The results included within the report are representative of the samples submitted for analysis.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
WS2		L	19-66695	1334869	a			
WS2		S	19-66695	1334868	a			
WS3		L	19-66695	1334871	a			
WS3		S	19-66695	1334870	a			

Key: a - No sampling date b - Incorrect container
c - Holding time d - Headspace e - Temperature

Appendix C.3 General Assessment Criteria

HUMAN HEALTH RISK ASSESSMENT

1.1 Introduction

Human Health Generic Quantitative Risk Assessment (GQRA) involves the comparison of contaminant concentrations measured in soil at the site with Generic Assessment Criteria (GAC).

GAC are conservative values adopted to ensure that they are applicable to the majority of possible contaminated site. These values may be published Contaminated Land Exposure Assessment Model (CLEA) derived GAC derived by a third party or the Environment Agency/ DEFRA. It is imperative to the risk assessor to understand the uncertainties and limitations associated with these GAC to ensure that they are used appropriately. Where the adoption of a GAC is not appropriate, for instance when the intended land-use is at variance the CLEA standard land-uses, then a Detailed Quantitative Risk Assessment (DQRA) may be undertaken to develop site specific values for relevant soil contaminants based on the site specific conditions.

1.2 General Assessment Criteria

The Contaminated Land Regime reflects the UK Government's stated objectives of achieving sustainable development through the 'suitable for use approach'.

1.2.1 Contaminated Land Exposure Assessment Model (CLEA)

Current United Kingdom risk assessment practice is based on the Contaminated Land Exposure Assessment Model (CLEA).

The CLEA Guidance comprises the following documents:
EA Science Report SC050021/SR2: Human health toxicological assessment of c in soil.
EA Science Report SC050021/SR3: Updated technical background to the CLEA model.
EA CLEA Bulletin (2009).
CLEA software version 1.04 (2009)
Toxicological reports and SGV technical notes.

The CLEA guidance and tools:
1. do not cover other types of risk to humans, such as fire, suffocation or explosion, or short-term and acute exposures.
2. do not cover risks to the environment, such as groundwater, ecosystems or buildings.
3. do not provide a definitive test for telling when human health risks are significant.
4. are not a legal requirement in assessing land contamination risks. They are not part of the legal regime for Part 2A of the Environmental Protection Act 1990.

1.3 Soil Guideline Values (2009)

The EA are publishing a series of SGV reports for a selection of common contaminants relevant to the assessment of land contamination.
SGV's are generic assessment criteria based on CLEA standard land-uses and can be used to simplify the assessment of human health risks from long-term exposure to

chemical contamination in soil. They do not cover short-term exposure (i.e. construction and maintenance workers), acute exposure or other risks such as fire, suffocation or explosion, as might arise from an accumulation of gases such as methane and carbon dioxide, or either odour or aesthetic issues.

SGV's represent 'trigger values', indicators that soil concentrations above the SGV level may pose a possibility of *significant harm* to human health. The converse, where soil concentrations are less that the SGV, is that the long-term human health risks are considered to be tolerable or minimal.

The CLEA guidance derives soil concentrations of contaminants above which (in the opinion of the EA) there may be a concern that warrants further investigation. It does not provide a definitive test for establishing that the risk is significant.

1.4 Ongoing development of CLEA based guidance

The EA is involved in a programme of publishing SGV's and related toxicity data (the TOX reports). As at July 2009 ten SGV's and matching TOX reports had been published. Soil Assessment Criteria (SAC's) may be derived using toxicity data from the updated TOX reports, where these are published, or from the original TOX reports. SGV reports also take account of recent updates for plant uptake and other factors.

GAC's developed by CLEA guidance and given in this report will need to be assessed against updated TOX reports and SGV's when these are published.
SGV reports may give values that differ from the GAC's used in this report.
These variations may materially alter the remediation requirement for the site, requiring either an increase or decrease in the extent, type and cost of remediation.

1.5 Phytotoxicity

CLEA guidance only addresses human health toxicity; assessment of plant toxicity (phytotoxicity) is based on threshold trigger values obtained from the following source:

ICRCL 70/90: *Notes on the restoration and aftercare of metalliferous mining sites for pasture and grazing*.

1.6 Other Generic Assessment Criteria

If an SGV is not available for a substance identified in the soil then the range of Generic Assessment Criteria published from a collaborative research by Land Quality Management Limited (LQM) and the Chartered Institute of Environmental Health (CIEH) are used for example. In the case of Lead, Category 4 screening levels (C4SLs) have replaced the AtRisk Soil SSV.

1.6.1 EIC/AGS/CL: AIRE

The report represents the collaborative effort of risk assessors from 26 EIC and AGS member companies to produce generic assessment criteria (GAC) for soils for human health risk assessment. The project involved the collation and review of physico-chemical data, toxicological data and information on background

exposure for 44 contaminants sometimes encountered on land affected by contamination in the UK and the derivation of GAC for 351 of these using the CLEA model (v1.06). The GAC are intended to complement soil guideline values (SGV) produced by the Environment Agency of England and Wales and the 2nd edition GAC produced by LQM and CIEH (Nathanail et al, 2009). All three sets of assessment criteria have been derived in general accordance with the Environment Agency of England and Wales Contaminated Land Exposure Assessment (CLEA) guidance and thus the combined efforts of these three groups have resulted in a useful set of screening criteria for the assessment of risks to human health from soil contamination for more than 120 potentially contaminative substances.

1.6.2 Category 4 screening levels (C4SLs) (2014)

A new statutory DEFRA guidance recently (i.e. August 2014) published some GACs with a more pragmatic (but still strongly precautionary) approach in their derivation called the Category 4 screening levels (C4SLs). These values provide a higher simple test for deciding that land is suitable for use and definitely not contaminated land. They are intended as generic screening values, (ii) they describe a level of risk that whilst above 'minimal' is still 'low' and (iii) they provide a 'higher simple test' for deciding that land is suitable for use and definitely not contaminated. These values were derived for four generic land uses: residential, commercial, allotments, and public open space.

1.6.3 LQM/CIEH Suitable 4 Use Level (S4UL) (2015)

The new S4UL's ((Nathanail *et al*, 2015), was developed for around 85 substances and are intended to enable a screening assessment of the risks posed by soil quality on development sites. The updated LQM/CIEH GAC publication was developed to accommodate recent developments in the understanding of chemical, toxicological and routine exposure to soil-based contaminants. The S4ULs were:

- based on Health Criteria Values, updated to reflect changes since 2009
- derived for the standard CLEA land uses and the two public open space scenarios developed by Defra SP1010
- developed for ca 85 substances (those previously covered by the LQM/CIEH GAC and the SGV substances);
- Compliant with SR2 and the long standing principle of 'suitable for use' and reflecting changes to exposure parameters produced by Defra SP1010.

For derivation of these Generic Assessment Criteria reference must be made to: Nathanial, P., McCaffrey, C., Ashmore, M., Cheng, Y., Gillet, A., Ogden, R., Scott, D. *The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (3nd edition)*. **Land Quality Press**. 2015.

1.7 Standard Land-use Scenarios

The standard land-use scenarios used to develop conceptual exposure models are presented in the following sections:

1.7.1 Residential

Generic scenario assumes a typical two-storey house built on a ground bearing slab with a private garden having a lawn, flowerbeds and a small fruit and vegetable patch.

Critical receptor is a young female child (zero to six years old)
Exposure duration is six years.
Exposure pathways include direct soil and indoor dust ingestion, consumption of home-grown produce and any adhering soil, skin contact with soils and indoor dust and inhalation of indoor and outdoor dust and vapours.
Building type is a two-storey small terraced house.

A sub-set of this land-use is residential apartments with communal landscaped gardens where the consumption of home grown vegetables will not occur.

1.7.2 Allotments

Provision of open space (about 250sq.m) commonly made available to tenants by the local authority to grow fruit and vegetable for their own consumption. Typically, there are a number of plots to a site which may have a total area of up to 1 hectare. The tenants are assumed to be adults and that young children make occasional accompanied visits.

Although some allotment holders may choose to keep animals including rabbits, hens, and ducks, potential exposure to contaminated meat and eggs is not considered.

Critical receptor is a young female child (zero to six years old)
Exposure duration is six years.
Exposure pathways include direct soil ingestion, consumption of homegrown produce and any adhering soil, skin contact with soils and inhalation of outdoor dust and vapours.
There is no building.

1.7.3 Commercial/Industrial

The generic scenario assumes a typical commercial or light industrial property comprising a three-storey building at which employees spend most time indoors and are involved in office-based or relatively light physical work.

Critical receptor is a working female adult (aged 16 to 65 years old).
Exposure duration is a working lifetime of 49 years.
Exposure pathways include direct soil and indoor dust ingestion, skin contact with soils and dusts and inhalation of dust and vapours.
Building type is a three-storey office (pre 1970).

1.7.4 Public Open Space within Residential Area

The generic scenario refers to any grassed area 0.05 ha and that is close to Housing.

Grassed area of up to 0.05 ha and a considerable proportion of this (up to 50%) may be bare soil
Predominantly used by children for playing and may be used for activities such as a football kick about
Sufficiently close proximity to home for tracking back of soil to occur, thus indoor exposure pathways apply
older children as the critical receptor on basis that they will use site most frequently (Age class 4-9)
ingestion rate 75 $mg.day^{-1}$

1.7.5 *Public Open Space Park*

This generic scenario refers to any public park that is more than 0.5ha in area:

Public park (>0.5 ha), predominantly grassed and may also contain children's play equipment and border areas of soil containing flowers or shrubs (75% cover)
Female child age classes 1-6
Soil ingestion rate of 50 $mg.day^{-1}$
Occupancy period outdoors = 2 $hours.day^{-1}$
Exposure frequency of 170 days.year-1 for age classes 2-18 and 85 $days.year^{-1}$ for age class 1
Outdoor exposure pathways only (no tracking back).

1.8 Detailed Quantitative Risk Assessments (DQRA)

Where the adoption of an SGV/GAC is not appropriate, for instance when the intended land-use is at variance the CLEA standard land-uses, then a DQRA may be undertaking to develop site specific values for relevant soil contaminants.

Establishing the plausibility that generic exposure pathways exist in practice by measurement and observation.
Developing more accurate parameters using site data.

1.9 Current Criteria

Table 1 presents the current Generic Assessment Criteria and reference should be made to the original publications if needed.

1.10 Statistical Tests

DEFRA R&D Publication CLR 7 (DOE 1994) and Category 4 screening levels (C4SLs) (2014) addressed the statistical treatment of test results and their comparison to Soil Guideline Values.

Consideration must be given to the appropriate area of land to be considered termed the critical averaging area.

For a communal open space or commercial land-use, the critical averaging area will depend on the proposed layout. For a residential use with private gardens the averaging area is the individual plot.

It may be appropriate to compare the upper 95th percentile concentration with the Soil Guideline Value, subject to applying a statistical test to establish that the range of concentrations are reasonably consistent and belonging to the same underlying distribution of data.

The DEFRA discussion paper Assessing risks from land contamination – a proportionate approach ('the way forward') (CLAN06/2006) aimed to increase understanding of the role that statistics can play in quantifying the uncertainty attached to the estimates of the mean concentration of contaminants in soil. In direct response CL:AIRE/CIEH published a joint report, *Guidance in comparing soil contamination data with a critical concentration* (CL:AIRE/CIEH 2008). A software implementation of the statistical techniques given in the report was published by ESI International (2008).

Treatment of Hot-Spots
A statistical test is applied to establish whether the data is a part of a single set, or whether data outliers are present.
Provided that the data is based on random sampling and no distinct contamination source was present at the sampling location, the hot-spot(s) may be excluded and the mean of the remaining data assessed.

Land Use				Residential With or Without Plant Uptake												Public Open Space (POS)								
				With home-grown produce			Without home-grown produce			Allotments			Commercial			Residential			Park					
			SOM	1.0	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	Name	Authority	Date
Type	Contaminants	Species	Year																					
	Antimony		2010						550						7500							EIC/AGS/ CL:AIRE	EIC/AGS/ CL:AIRE	2010
Metals	Arsenic		2014			37			40			49			640			79			168	C4SL	DEFRA	2014
			2015			37			40			40			640			79			170	S4U L	LQM/CIE H	2015
	Beryllium		2015			1.7			1.7			35			12			2.2			63	S4U L	LQM/CIE H	2015
	Boron		2015			290			11000			45			240000			21000			46000	S4UL	LQM/CIEH	2015
	Cadmium		2015			11			85			1.9			190			120			532	S4U L	LQM/CIE H	2015
			2014			26			149			4.9			410			220			880	C4SL	DEFRA	2014
	Chromium	*III*	2015			910			910			18000			8600			1500			33000	S4UL	LQM/CIEH	2015
		VI	2014			21			21			170			49			23			250	C4SL	DEFRA	2014
		VI	2015			6			6			1.8			33			7.7			220	S4U L	LQM/CIE H	2015
	Copper		2015			2400			7100			520			68000			12000			44000	S4UL	LQM/CIEH	2015
	Lead					200			310			80			2330			630			1300	C4SL	DEFRA	2014
	Mercury	Elemental	2012			1.0			1.0			26			26							SGV	DEFRA	2012
			2015			1.2			1.2			21			*58*			16			*30*	S4U L	LQM/CIE H	2015
		Inorganic	2012			170			170			80			36000							SGV	DEFRA	2012
			2015			40			56			19			1100			120			240	S4UL	LQM/CIEH	2015
		Methyl	2012			11			11			8			410							SGV	DEFRA	2012
			2015			11			15			6			320			40			68	S4U L	LQM/CIE H	2015
	Nickel		2012			130			130			230			1800							SGV	DEFRA	2012
			2015			130			180			53			980			230			800	S4U L	LQM/CIE H	2015
	Selenium		2012			350			350			120			13000							SGV	DEFRA	2012
			2015			250			430			88			12000			1100			1800	S4UL	LQM/CIEH	2015
	Vanadium		2015			410			1200			91			9000			2000			5000	S4UL	LQM/CIEH	2015
	Zinc		2015			3700			40000			620			730000			81000			170000	S4UL	LQM/CIEH	2015
BTEX & MTBE	Benzene		2012			0.33			0.33			0.07			95							SGV	DEFRA	2012
			2014			0.87			3.3			0.18			98			140			230	C4SL	DEFRA	2014
			2015	0.087	0.17	0.37	0.38	0.7	1.4	0.017	0.034	0.075	27	47	90	72	72	73	90	100	110	S4UL	LQM/CIEH	2015
	Toluene		2012			610			610			120			4400							SGV	DEFRA	2012
			2015	130	290	660	*880*	1900	3900	22	51	120	*65000*	*110000*	*180000*	56000	56000	56000	*87000*	*95000*	*100000*	S4U L	LQM/CIE H	2015
	Ethylbenzene		2012			350			350			90			2800							SGV	DEFRA	2012
			2015	47	110	260	83	190	440	16	39	91	*4700*	*13000*	*27000*	24000	24000	25000	*17000*	*22000*	*27000*	S4U L	LQM/CIE H	2015
	Xylenes	o-xylene	2012			250			250			160			2600							SGV	DEFRA	2012
			2015	60	140	330	88	210	480	28	67	160	*6600*	*15000*	*33000*	41000	42000	43000	*17000*	*24000*	*33000*	S4U L	LQM/CIE H	2015
		m-xylene	2012			240			240			180			3500							SGV	DEFRA	2012
			2015	59	140	320	82	190	450	31	74	170	*6200*	*14000*	*31000*	41000	42000	43000	*17000*	*24000*	*32000*	S4U L	LQM/CIE H	2015
		p-xylene	2012			230			230			160			3200							SGV	DEFRA	2012
			2015	56	130	310	79	180	310	29	69	160	*5900*	*14000*	*30000*	41000	42000	43000	*17000*	*23000*	*31000*	S4U L	LQM/CIE H	2015
Petroleum Hydrocarbons Fractions	Aliphatic >C5 - C6		2015	42	78	160	42	78	160	730	1700	3900	*3200*	*5900*	*12000*	*570000*	590000	600000	*95000*	*130000*	*180000*	S4UL	LQM/CIEH	2015
	Aliphatic >C6 - C8		2015	100	230	530	100	230	530	2300	5600	13000	*7800*	*17000*	*40000*	600000	610000	620000	*150000*	*220000*	*320000*	S4UL	LQM/CIEH	2015
	Aliphatic >C8 - C10		2015	27	65	150	27	65	150	320	770	1700	*2000*	*4800*	*11000*	13000	13000	13000	*14000*	*18000*	*21000*	S4UL	LQM/CIEH	2015
	Aliphatic >C10 - C12		2015	*130*	*330*	*760*	*130*	*330*	*770*	2200	4400	7300	*9700*	*23000*	*47000*	13000	13000	13000	*21000*	*23000*	*24000*	S4UL	LQM/CIEH	2015
	Aliphatic >C12 - C16		2015	*1100*	*2400*	*4300*	*1100*	*2400*	*4400*	11000	13000	13000	*59000*	*82000*	*90000*	13000	13000	13000	*25000*	*25000*	*26000*	S4UL	LQM/CIEH	2015
	Aliphatic >C16 - C35		2015	*65000*	*92000*	*110000*	*65000*	*92000*	110000	260000	270000	270000	1600000	1700000	1800000	250000	250000	250000	450000	480000	490000	S4UL	LQM/CIEH	2015
	Aliphatic >C35 - C44		2015	*65000*	*92000*	*140000*	*65000*	*92000*	110000	260000	270000	270000	1600000	1700000	1800000	250000	250000	250000	450000	480000	490000	S4UL	LQM/CIEH	2015
	Aromatic >C5 - C7		2015	70	140	300	370	690	1400	13	27	57	*26000*	*46000*	*86000*	56000	56000	56000	*76000*	*84000*	*92000*	S4UL	LQM/CIEH	2015
	Aromatic >C7 - C8		2015	130	290	660	860	1800	3900	22	51	120	*56000*	*110000*	*180000*	56000	56000	56000	*87000*	*95000*	*100000*	S4UL	LQM/CIEH	2015
	Aromatic >C8 - C10		2015	34	83	190	47	110	270	8.6	21	51	*3500*	*8100*	*17000*	5000	5000	5000	*7200*	*8500*	*9300*	S4UL	LQM/CIEH	2015
	Aromatic >C10 - C12		2015	74	180	380	250	590	1200	13	31	74	*16000*	*28000*	*34000*	5000	5000	5000	*9200*	*9700*	*10000*	S4UL	LQM/CIEH	2015
	Aromatic >C12 - C16		2015	140	330	660	1800	2300	2500	23	57	130	*36000*	*37000*	*38000*	5100	5100	5000	10000	10000	10000	S4UL	LQM/CIEH	2015
	Aromatic >C16 - C21		2015	260	540	930	1900	1900	1900	46	110	260	28000	28000	28000	3800	3800	3800	7600	7700	7800	S4UL	LQM/CIEH	2015

Land Use			Residential With or Without Plant Uptake												Public Open Space (POS)								
			With home-grown produce			Without home-grown produce			Allotments			Commercial			Residential			Park					
		SOM	1.0	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	Name	Authority	Date
Type	Contaminants Species	Year																					
	Aromatic >C21 - C35	2015	1100	1500	1700	1900	1900	1900	370	820	1600	28000	28000	28000	3800	3800	3800	7800	7800	7900	S4UL	LQM/CIEH	2015
	Aromatic >C34 - C44	2015	1100	1500	1700	1900	1900	1900	370	820	1600	28000	28000	28000	3800	3800	3800	7800	7800	7900	S4UL	LQM/CIEH	2015
	Aliphatic + Aromatic >C44 - C70		1600	1800	1900	1900	1900	1900	1200	2100	3000	28000	28000	28000	3800	3800	3800	7800	7800	7900	S4UL	LQM/CIEH	2015
Polycyclic Aromatic Hydrocarbons (PAH's) (mg/kg)	Acenaphthene	2015	210	510	1100	*3000*	*4700*	*6000*	34	85	200	*84000*	*97000*	100000	15000	15000	15000	29000	30000	30000	S4UL	LQM/CIEH	2015
	Acenaphthylene	2015	170	420	920	*2900*	*4600*	*6000*	28	69	160	*83000*	*97000*	100000	15000	15000	15000	29000	30000	30000	S4UL	LQM/CIEH	2015
	Anthracene	2015	2400	5400	11000	*31000*	*35000*	*37000*	380	950	2200	520000	54000	540000	74000	74000	74000	150000	150000	150000	S4UL	LQM/CIEH	2015
	Benzo(a)anthracene	2015	7.2	11	13	11	14	15	2.9	6.5	13	170	170	180	29	29	29	49	56	62	S4UL	LQM/CIEH	2015
	Benzo(a)pyrene	2014			5			5.3			5.7			76			10			21	C4SL	DEFRA	2014
		2015	2.2	2.7	3	3.2	3.2	3.2	0.97	2	3.5	35	35	36	5.7	5.7	5.7	11	12	13	S4UL	LQM/CIEH	2015
	Benzo(b)fluoranthene	2015	2.6	3.3	3.7	3.9	4.0	4.0	0.99	2.1	3.9	44	44	45	7.1	7.2	7.2	13	15	16	S4UL	LQM/CIEH	2015
	Benzo(ghi)perylene	2015	320	340	250	360	360	360	290	470	640	3900	4000	4000	640	640	640	1400	1500	1600	S4UL	LQM/CIEH	2015
	Benzo(k)fluoranthene	2015	77	93	100	110	110	110	37	75	130	1200	1200	1200	190	190	190	370	410	440	S4UL	LQM/CIEH	2015
	Chrysene	2015	15	22	27	30	31	32	4.1	9.4	19	350	350	350	57	57	57	93	110	120	S4UL	LQM/CIEH	2015
	Dibenz(a,h)anthracene	2015	0.24	0.28	0.3	0.31	0.32	0.32	0.14	0.27	0.43	3.5	3.6	3.6	0.57	0.57	0.58	1.1	1.3	1.4	S4UL	LQM/CIEH	2015
	Fluoranthene	2015	280	560	890	1500	1600	1600	52	130	290	23000	23000	23000	3100	3100	3100	6300	6300	6400	S4UL	LQM/CIEH	2015
	Fluorene	2015	170	400	860	*2800*	*3800*	*4500*	27	67	160	63000	68000	71000	9900	9900	9900	20000	20000	20000	S4UL	LQM/CIEH	2015
	Indeno(1,2,3-cd)pyrene	2015	27	36	41	45	46	46	9.5	21	39	500	510	510	82	82	82	150	170	180	S4UL	LQM/CIEH	2015
	Naphthalene	2015	2.3	5.6	13	2.3	5.6	13	4.1	10	24	*190*	*460*	*1100*	4900	4900	4900	*1200*	*1900*	*3000*	S4UL	LQM/CIEH	2015
	Phenanthrene	2015	95	220	440	*1300*	*1500*	*1500*	15	38	90	22000	22000	23000	3100	3100	3100	6200	6200	6300	S4UL	LQM/CIEH	2015
	Pyrene	2015	620	1200	2000	3700	3800	3800	110	270	620	54000	54000	54000	7400	7400	7400	15000	15000	15000	S4UL	LQM/CIEH	2015
	Coal Tar(Bap as surrogate matter)	2015	0.79	0.98	1.1	1.2	1.2	1.2	0.32	0.67	1.2	15	15	15	2.2	2.2	2.2	4.4	4.7	4.8	S4UL	LQM/CIEH	2015
Chloroalkanes & alkenes	1,2 Dichloroethane	2015	0.0071	0.011	0.019	0.0092	0.013	0.023	0.0046	0.0083	0.016	0.67	0.97	1.7	29	29	29	21	24	28	S4UL	LQM/CIEH	2015
	1,1,1 Trichloroethane	2015	8.8	18	39	9	18	40	48	110	240	660	1300	3000	140000	140000	*140000*	*57000*	*76000*	*100000*	S4UL	LQM/CIEH	2015
	1,1,2,2 Tetrachloroethane	2015	1.6	3.4	7.5	3.9	8	17	0.41	0.89	2	270	550	1100	1400	1400	1400	1800	2100	2300	S4UL	LQM/CIEH	2015
	1,1,1,2 Tetrachloroethane	2015	1.2	2.8	6.4	1.5	3.5	8.2	0.79	1.9	4.4	110	250	560	1400	1400	1400	1500	1800	2100	S4UL	LQM/CIEH	2015
	Tetrachloroethene	2015	0.18	0.39	0.9	0.18	0.4	0.92	0.65	1.5	3.6	19	42	95	1400	1400	1400	*810*	*1100*	1500	S4UL	LQM/CIEH	2015
	Tetrachloromethane (Carbon Tetrachloride)	2015	0.026	0.056	0.13	0.026	0.056	0.13	0.45	1	2.4	2.9	6.3	14	890	920	950	190	270	400	S4UL	LQM/CIEH	2015
	Trichloroethene	2015	0.016	0.034	0.075	0.017	0.036	0.08	0.041	0.091	0.21	1.2	2.6	5.7	120	120	120	70	91	120	S4UL	LQM/CIEH	2015
	Trichloromethane	2015	0.91	1.7	3.4	1.2	2.1	4.2	0.42	0.83	1.7	99	170	350	2500	2500	2500	2600	2800	3100	S4UL	LQM/CIEH	2015
	Vinyl Chloride (cloroethene)	2015	0.00064	0.00087	0.0014	0.00077	0.001	0.0015	0.00055	0.001	0.0018	0.059	0.077	0.12	3.5	3.5	3.5	4.8	5	5.4	S4UL	LQM/CIEH	2015
Explosives	2,4,6 Trinitrotoluene	2015	1.6	3.7	8.1	65	66	66	0.24	0.58	1.4	1000	1000	1000	130	130	130	260	270	270	S4UL	LQM/CIEH	2015
	RDX (Hexogen/Cyclonite/1,3,5-trinitro-1,3,5-triazacyclohexane)	2015	120	250	540	13000	13000	13000	17	38	85	210000	210000	210000	26000	26000	27000	49000	51000	53000	S4UL	LQM/CIEH	2015
	HMX (Octogen/1,3,5,7-tetrenitro-1,3,5,7-tetrazacyclo-octane)	2015	5.7	13	26	6700	6700	6700	0.86	1.9	3.9	110000	110000	110000	13000	13000	13000	*23000*	*23000*	*24000*	S4UL	LQM/CIEH	2015
Pesticides	Aldrin	2015	5.7	6.6	7.1	7.3	7.4	7.5	3.2	6.1	9.6	170	170	170	18	18	18	30	31	31	S4UL	LQM/CIEH	2015
	Dieldrin	2015	0.97	2	3.5	7	7.3	7.4	0.17	0.41	0.96	170	170	170	18	18	18	30	30	31	S4UL	LQM/CIEH	2015
	Atrazine	2015	3.3	7.6	17.4	610	620	620	0.5	1.2	2.7	9300	9400	9400	1200	1200	1200	2300	2400	2400	S4UL	LQM/CIEH	2015
	Dichlorvos	2015	0.032	0.066	0.14	6.4	6.5	6.6	0.0049	0.01	0.022	140	140	140	16	16	16	26	26	27	S4UL	LQM/CIEH	2015
	Alpha - Endosulfan	2015	7.4	18	41	*160*	*280*	*410*	1.2	2.9	6.8	*5600*	*7400*	*8400*	1200	1200	1200	2400	2400	2500	S4UL	LQM/CIEH	2015
	Beta - Endosulfan	2015	7	17	39	*190*	*320*	*440*	1.1	2.7	6.4	*6300*	*7800*	*8700*	1200	1200	1200	2400	2400	2500	S4UL	LQM/CIEH	2015
	Alpha -Hexachlorocyclohexanes	2015	0.23	0.55	1.2	6.9	9.2	11	0.035	0.087	0.21	170	180	180	24	24	24	47	48	48	S4UL	LQM/CIEH	2015
	Beta -Hexachlorocyclohexanes	2015	0.085	0.2	0.46	3.7	3.8	3.8	0.013	0.032	0.077	65	65	65	8.1	8.1	8.1	15	15	16	S4UL	LQM/CIEH	2015
	Gamma -Hexachlorocyclohexanes	2015	0.06	0.14	0.33	2.9	3.3	3.5	0.0092	0.023	0.054	67	69	70	8.2	8.2	8.2	14	15	15	S4UL	LQM/CIEH	2015
Chlorobenzenes	Chlorobenzene	2015	0.46	1	2.4	0.46	1	2.4	5.9	14	32	56	130	290	11000	13000	14000	*1300*	*2000*	*2900*	S4UL	LQM/CIEH	2015
	1,2-Dichlorobenzene	2015	23	55	130	24	57	130	94	230	540	*2000*	*4800*	*11000*	90000	95000	98000	*24000*	*36000*	*51000*	S4UL	LQM/CIEH	2015
	1,3-Dichlorobenzene	2015	0.4	1	2.3	0.44	1.1	2.5	0.25	0.6	1.5	30	73	170	300	300	300	390	440	470	S4UL	LQM/CIEH	2015
	1,4-Dichlorobenzene	2015	61	150	350	61	150	350	15	37	88	*4400*	*10000*	*25000*	17000	17000	1700	*36000*	*36000*	*36000*	S4UL	LQM/CIEH	2015
	1,2,3,-Trichlorobenzene	2015	1.5	3.6	8.6	1.5	3.7	8.8	4.7	12	28	102	250	590	1800	1800	1800	*770*	*1100*	*1600*	S4UL	LQM/CIEH	2015
	1,2,4,-Trichlorobenzene	2015	2.6	6.4	15	2.6	6.4	15	55	140	320	220	530	1300	15000	17000	19000	*1700*	*2600*	*4000*	S4UL	LQM/CIEH	2015
	1,3,5,-Trichlorobenzene	2015	0.33	0.81	1.9	0.33	0.81	1.9	4.7	12	28	23	55	130	1700	1700	1800	*380*	*580*	*860*	S4UL	LQM/CIEH	2015

Land Use			Residential With or Without Plant Uptake							Allotments			Commercial			Public Open Space (POS)								
			With home-grown produce			Without home-grown produce										Residential			Park					
		SOM	1.0	2.5	6	1	2.5	6		1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	Name	Authority	Date
Type	Contaminants Species	Year																						
	1,2,3,4,-Tetrachlorobenzene	2015	15	36	78	24	56	120		4.4	11	26	1700	3080	4400	830	830	830	*1500*	*1600*	*1600*	S4UL	LQM/CIEH	2015
	1,2,3,5,- Tetrachlobenzene	2015	0.66	1.6	3.7	0.75	1.9	4.3		0.38	0.9	2.2	*49*	*120*	*240*	78	79	79	*110*	*120*	*130*	S4UL	LQM/CIEH	2015
	1,2,4, 5,- Tetrachlobenzene	2015	0.33	0.77	1.6	0.73	1.7	3.5		0.06	0.16	0.37	*42*	*72*	*96*	13	13	13	25	26	26	S4UL	LQM/CIEH	2015
	Pentachlrobenzene	2015	5.8	12	22	19	30	38		1.2	3.1	7	*640*	*770*	*830*	100	100	100	190	190	190	S4UL	LQM/CIEH	2015
	Hexachlorobenzene	2015	*1.8*	*3.3*	4.9	*4.1*	*5.7*	*6.7*		0.47	1.1	2.5	*110*	120	120	16	16	16	30	30	30	S4UL	LQM/CIEH	2015
Phenols & Chlorophenols																								
	Phenols	2012			420			420				280			*3200*							SGV	DEFRA	2012
		2015	120	200	380	440	690	1200		23	42	83	*440*	*690*	*1300*	*440*	*690*	*1300*	*440*	*690*	*1300*	S4UL	LQM/CIEH	2015
	Chlorophenols (4 Congeners)	2015	0.87	2	4.5	94	150	210		0.13	0.3	0.7	3500	4000	4300	620	620	620	1100	1100	1100	S4UL	LQM/CIEH	2015
	Pentachlorophenols	2015	0.22	0.52	1.2	*27*	29	31		0.03	0.08	0.19	400	400	400	60	60	60	110	120	120	S4UL	LQM/CIEH	2015
Others																								
	Carbon Disulphide	2015	0.14	0.29	0.62	0.14	0.29	0.62		4.8	10	23	11	22	47	11000	11000	12000	1300	1900	2700	S4UL	LQM/CIEH	2015
	Hexachloro-1,3-Butadiene	2015	0.29	0.7	1.6	0.32	0.78	1.8		0.25	0.61	1.4	31	66	120	25	25	25	48	50	51	S4UL	LQM/CIEH	2015
	Sum of PCDDs, PCDFs and dioxin-like PCB's.	2012			8			8				8			240							SGV	DEFRA	2012

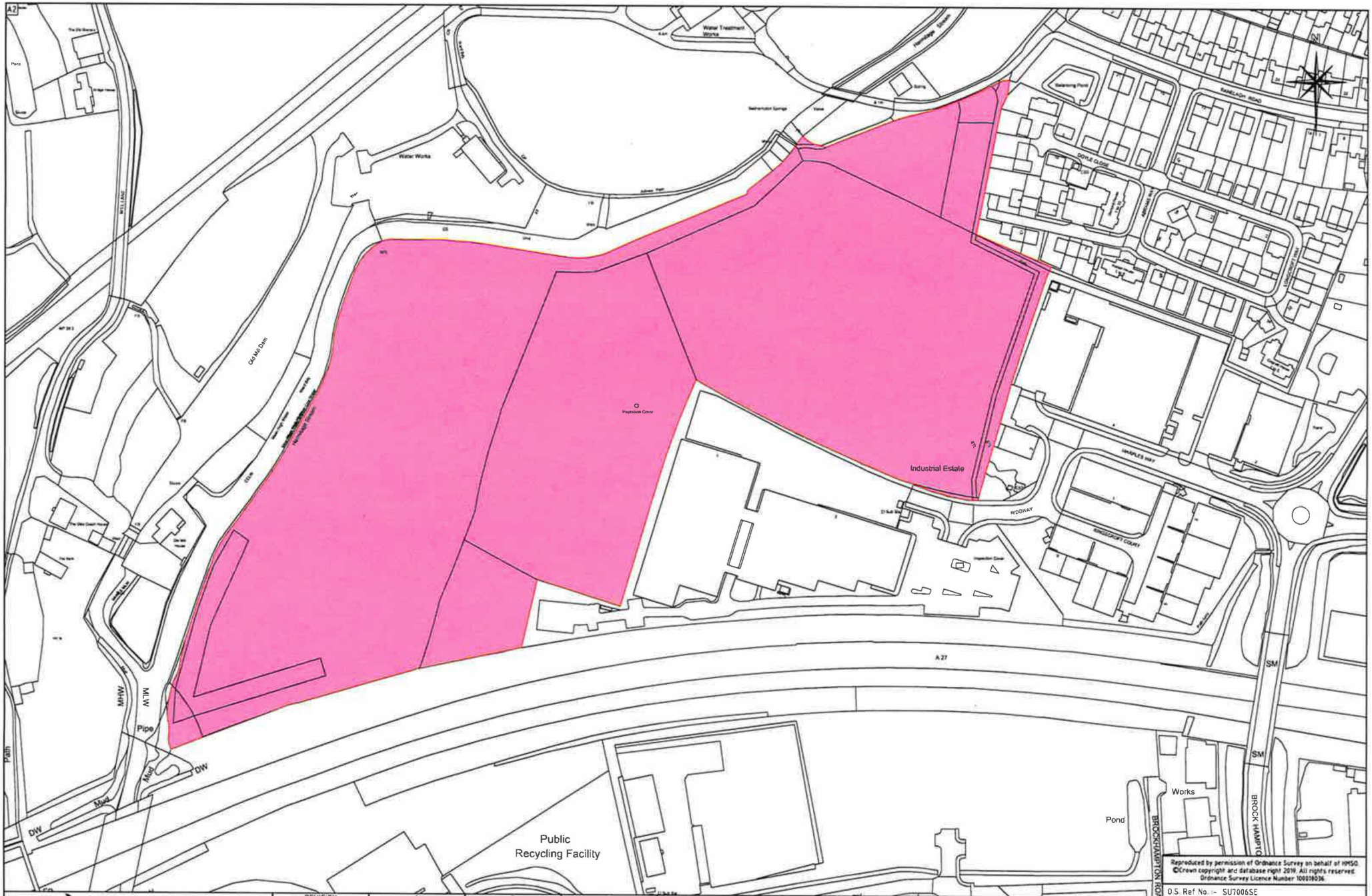
NOTE

Priority	Guideline (mg kg^{-1})
1	Site Specific Assessment Criteria (SSAC) (Soils Limited)
2	2014: Category 4 Screening Level (C4SL) (Contaminated Land: Application in Real Environment (CL:ARE), 2014)
3	2012: Soil Guideline Value (SGV) (Environment Agency, 2009)
4	2015: Suitable 4 Use Level (S4UL) (Nathanail *et al*, 2015)

For Generic Risk Assessment, the values in Bold have priority

Table reviewed February 2018

Appendix A Information Provided by the Client



Portsmouth Water
Telephone: Havant (023) 9249 9888
Fax: Havant (023) 9245 3632 Website:
www.portsmouthwater.co.uk
Registered Office: PO Box 8 West Street
Havant Hampshire PO9 1LG
REGISTERED IN ENGLAND No. 2536455

REVISION	A	B	C
DESCRIPTION			
DATE			

LAND TO BE SOLD
KINGSCROFT FARM
HAVANT

O.S. Ref No. :- SU7006SE

Drawing No.	Job No.	Date	Scale
57/273		02-04-19	1:1250
Drawn By	Traced By	Checked By	
	DCR	SPB	



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This drawing is to be read in conjunction with all other HGP Planning drawings and all supporting documents.

This drawing may incorporate information from other professionals and as such HGP Architects cannot accept responsibility for the integrity and accuracy of such information.

SAFETY, HEALTH & ENVIRONMENTAL INFORMATION

In addition to the hazards/ risks normally associated with the type of work detailed on this drawing, please note the following:

It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved method statement.

0 5 10 15 20 25 30 40m

REVISIONS	DATE	DRN	CKD	REV
Amended to new layout	02.05.19	HE	HE	C
Added landscaping	30.04.19	HE	HE	B
Amended as client's comments	15.10.18	HE	HE	A

CLIENT

FOREMAN HOMES

PROJECT

Kings Croft Farm

TITLE

Illustrative Site Plan

STATUS

Sketch

Drawn	Checked	Scale	Date
JJR	HJE	1:500 @ A1	Sep '18

Drawing No. 18.099.02

Revision C

HGP ARCHITECTS

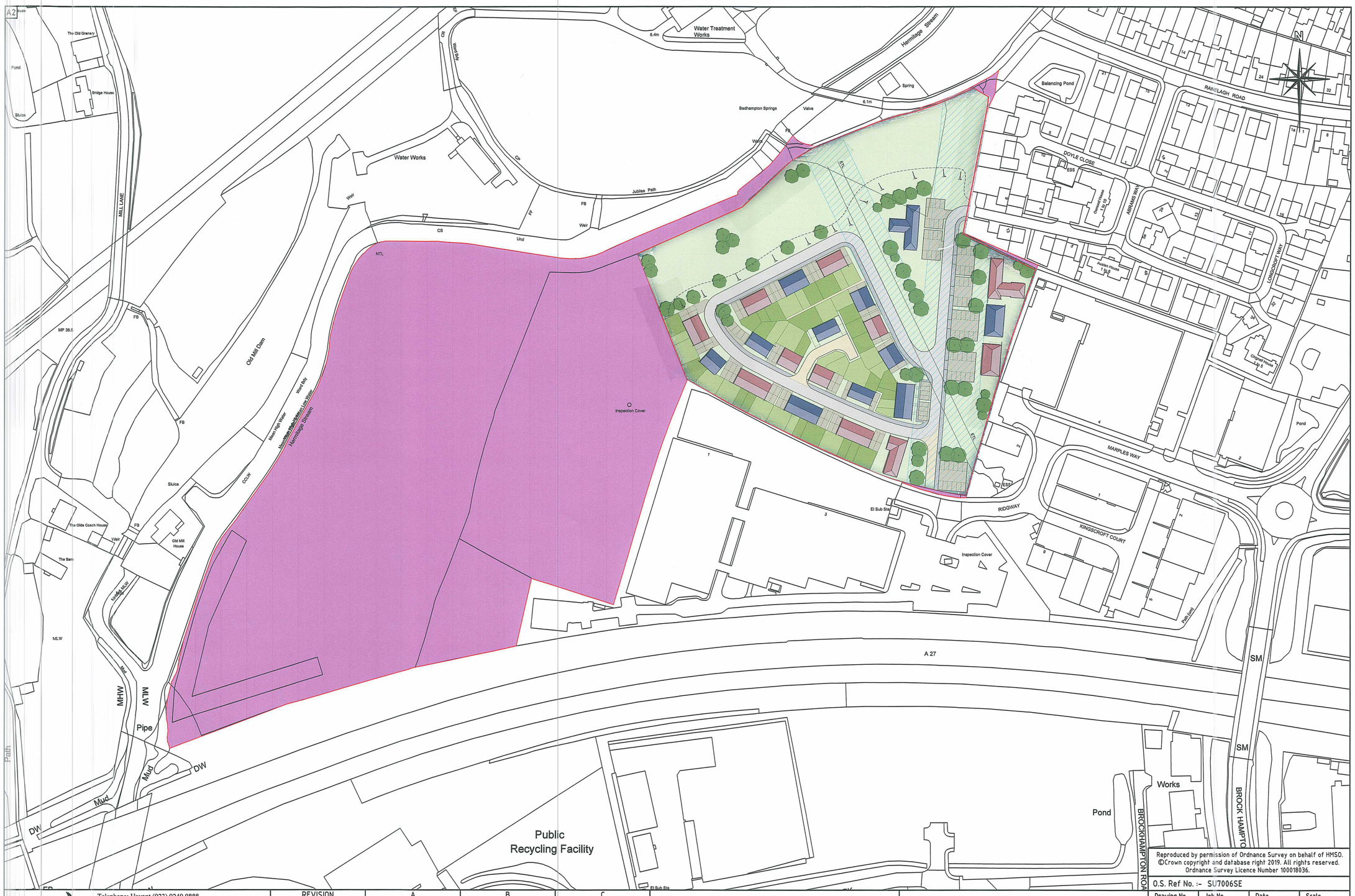
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Havant Hampshire PO9 1LG
REGISTERED IN ENGLAND No. 2536455

REVISION	A	B	C
DESCRIPTION			
DATE			

LAND TO BE SOLD
KINGS CROFT FARM
HAVANT

Drawing No.	Job No.	Date	Scale
57/273		02-04-19	1:1250
Drawn By	Traced By	Checked By	
	DCR	SPB	

Soils Limited
Geotechnical & Environmental Consultants

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T 01737 814221
W soilslimited.co.uk

Appendix E

(c) Crown copyright and database rights 2021 Ordnance Survey 100031673 | Date: 23/09/21 | Scale: 1:1250 | Map Centre: 470680,106187 | Data updated: 20/09/21 | Our Ref: 656381 - 1 | Wastewater Plan A1

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2021 Ordnance Survey 100031673 .This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.

Foul Gravity Sewer | Combined Gravity Sewer | Culverted Water Course or Treated Effluent | Surface Water Gravity Sewer | Rising Main, Vacuum or Syphon | Combined Pumping Station | Surface Water Pumping Station | Foul Pumping Station | Water Treatment Works | Section 104 Area | Building Over Agreement Area | Foul Manhole | Combined Manhole | Surface Water Manhole | Side Entry Manhole, Desanisation Chamber, Dummy Manhole or Surface Water Soakaway | Combined Outfall | Foul Outfall | Surface Water Outfall | Surface Water Inlet

fhammer@ardent-ce.co.uk

Kingscroft Farm

WATER for LIFE from Southern Water.

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
0100	F	4.92	3.98	
0101	F	0.00	0.00	
0102	F	0.00	0.00	
0400	F	9.28	8.34	
0401	F	7.60	5.38	
0402	F	7.93	4.98	
0403	F	7.76	4.84	
1002	F	5.59	0.00	
1003	F	5.79	3.24	
1004	F	5.05	3.60	
1301	F	6.66	0.00	
1400	F	8.02	6.50	
1401	F	8.34	7.28	
1402	F	9.25	7.87	
1403	F	9.32	8.06	
1404	F	9.24	8.11	
1501	F	9.22	7.37	
1504	F	0.00	0.00	
1802	F	5.30	1.70	
1803	F	4.96	2.10	
1804	F	5.39	1.79	
1900	F	5.35	2.31	
1901	F	5.89	2.64	
1902	F	0.00	0.00	
2001	F	4.70	2.63	
2201	F	4.28	0.00	
2301	F	8.16	6.37	
2302	F	7.06	6.54	
2401	F	8.40	6.15	
2402	F	9.23	6.20	
2508	F	0.00	0.00	
2901	F	3.65	2.48	
3401	F	9.10	7.50	
3402	F	7.85	0.00	
3901	F	3.25	0.00	
4901	F	2.84	0.00	
5401	F	0.00	0.00	
5402	F	0.00	0.00	
5801	F	3.01	0.11	
6401	F	7.84	0.00	
6402	F	0.00	0.00	
6502	F	10.04	5.32	
6503	F	9.82	5.28	
6901	F	4.15	2.89	
6902	F	4.15	2.97	
7001	F	5.80	0.00	
7002	F	6.05	3.89	
7003	F	5.67	3.44	
7004	F	4.74	2.13	
7101	F	6.42	2.42	
7102	F	6.33	4.16	
7103	F	5.98	1.01	
7201	F	6.33	1.37	
7202	F	6.96	2.70	
7203	F	6.42	0.00	
7204	F	7.15	3.43	
7205	F	7.40	6.05	
7206	F	7.15	2.97	
7301	F	6.75	5.56	
7302	F	6.05	0.00	
7303	F	6.79	3.52	
7304	F	5.92	3.14	
7305	F	6.62	0.00	
7306	F	6.15	0.00	
7307	F	6.65	0.00	
7308	F	6.72	0.00	
7309	F	6.67	3.05	
7310	F	0.00	0.00	
7401	F	6.93	3.48	
7402	F	6.78	0.00	
7802	F	4.09	0.55	
7901	F	0.00	0.00	
7902	F	3.63	1.85	
7903	F	4.00	2.53	
7904	F	4.15	2.66	
8101	F	6.34	4.46	
8102	F	6.51	4.57	
8201	F	7.15	3.99	
8202	F	7.15	4.17	
8203	F	7.15	4.75	
8204	F	7.15	5.75	
8205	F	7.15	5.17	
8206	F	7.15	4.74	
8207	F	7.38	6.03	
8401	F	0.00	0.00	
8402	F	6.53	3.26	
8403	F	6.94	3.19	
8404	F	6.70	3.17	
8405	F	6.93	5.45	
8406	F	6.82	5.26	
8407	F	0.00	0.00	
8505	F	6.85	4.64	
9101	F	5.32	0.00	
9102	F	0.00	0.00	
9105	F	0.00	0.00	
9201	F	6.89	4.64	
9202	F	6.15	4.29	
9203	F	6.07	4.12	
9204	F	7.15	5.47	
9205	F	7.15	5.62	
9206	F	7.15	5.99	
9207	F	7.30	6.25	
9301	F	7.20	4.69	
9302	F	7.67	4.93	
9303	F	7.19	4.66	
9304	F	7.76	4.85	
9305	F	0.00	0.00	
9306	F	0.00	0.00	
9307	F	0.00	0.00	
9400	F	0.00	0.00	
9402	F	6.62	0.00	
9509	F	7.30	5.80	
0450	S	7.77	0.00	
0452	S	8.30	0.00	
1450	S	8.40	7.90	
1451	S	9.27	8.30	
1452	S	9.28	8.41	
1453	S	8.22	7.70	
1454	S	8.19	7.63	
1455	S	9.32	8.38	
1550	S	9.27	8.54	
1850	S	0.00	0.00	
2450	S	10.27	8.77	
3450	S	8.09	6.69	
3451	S	9.76	7.83	
3452	S	9.12	8.08	
4350	S	5.82	4.23	
4450	S	7.90	6.33	
4451	S	7.13	5.78	
4452	S	6.30	5.34	
4453	S	5.68	0.00	
4454	S	6.33	0.00	
5450	S	7.85	6.68	
5451	S	7.43	6.31	
5452	S	7.52	0.00	
5453	S	7.25	5.28	
5454	S	7.39	5.48	
5550	S	10.23	8.12	
6150	S	5.45	3.48	
6151	S	5.29	3.29	
6152	S	5.20	3.20	
6450	S	7.85	0.00	
6560	S	9.83	7.93	
7050	S	6.02	4.55	
7051	S	5.74	3.95	
7150	S	6.42	4.76	
7151	S	6.36	4.75	
7152	S	6.20	4.66	
7153	S	5.54	3.69	
8150	S	7.04	5.28	
8151	S	6.42	4.93	
8450	S	6.58	5.82	
8451	S	6.71	5.51	
8452	S	6.74	4.64	
9150	S	4.98	0.00	
9151	S	4.92	0.00	
9250	S	7.04	5.06	
9251	S	5.80	4.36	
9350	S	7.22	5.44	
9450	S	7.09	6.09	
9451	S	7.56	6.92	
9452	S	7.81	7.02	
9453	S	7.99	6.86	
9454	S	8.13	6.78	
9455	S	8.08	6.76	
9456	S	7.62	6.76	
9457	S	6.90	5.46	
9458	S	7.54	6.68	
9459	S	6.68	4.86	

Appendix F

Date : 9 September 2019

Project : Kingscroft Farm, Portsmouth – Hydraulic Modelling Note

Project Ref : 191930

Report Ref : 191930-01

Report Title : Hydraulic Modelling Note

DOCUMENT CONTROL

REV	ISSUE PURPOSE	AUTHOR	CHECKED	APPROVED	DATE
-	Draft for EA	GA	BC	DRAFT	09-09-19

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1.0 INTRODUCTION

Ardent Consulting Engineers (hereafter referred to as Ardent) has been commissioned by Portsmouth Water to undertake a hydraulic modelling exercise for a Site Kingscroft Farm, Portsmouth at NGR 470616, 106208. The nearest postcode to the Site is PO9 1QJ (refer to Figure 1).

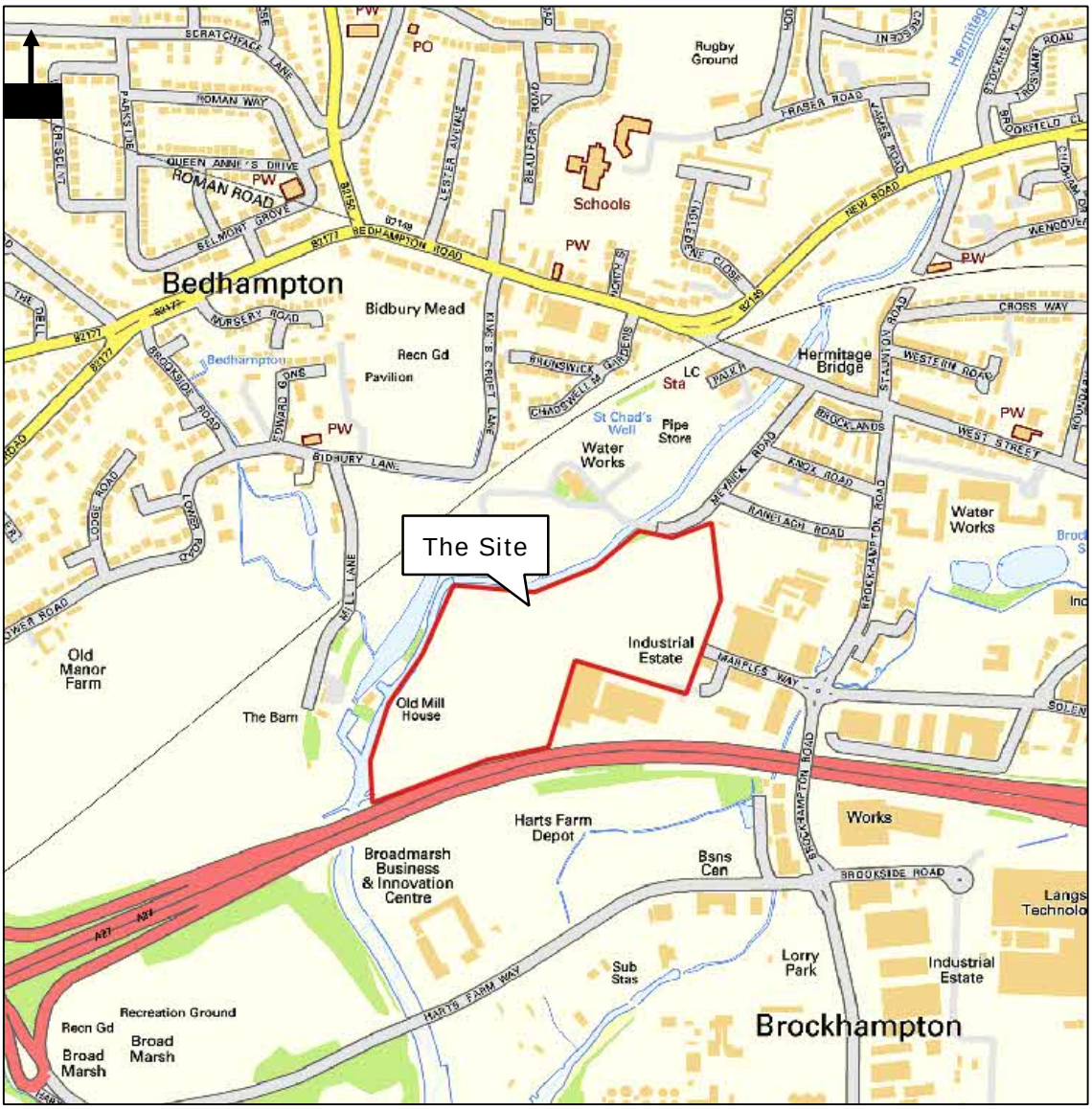


Figure 1: Site Location

The Environment Agency's online flood mapping indicate that the Site is located within Flood Zone 3. As the Site is considered sensitive to flood risk, it is required that the revised climate change allowances should be used to determine minimum Finished Floor Levels and safe access and egress routes. Following consultation with the Environment Agency (EA), it was requested that the latest 100 year climate change requirements, which came into force on the 29th February 2016 for South East River Basin, were run.

This Technical Note outlines the methodology adopted to assess the latest Climate Change requirements and provides details of hydraulic model updates and results.

2.0 HYDRAULIC MODELLING

2.1 Background

The hydraulic model used to provide additional flood outlines was the existing InfoWorks RS Model of the streams which flow through the town of Havant in Hampshire. The model was developed by Atkins in 2008 as part of The Havant Flood Mapping Study.

2.2 Model Changes

As mentioned above the original model was built using the legacy InfoWorks RS software which is no longer supported. Therefore, is was necessary that the RS model was migrated into InfoWorks ICM.

No major changes were made to the model apart from those necessary to completely rebuilt connectivity among the separate river reaches and storage areas. These were all manually checked against the original RS model to ensure that everything connects back up.

It was also be necessary to recreate all boundary inputs. The way these are applied to a model is very different in ICM compared to RS. Therefore, the boundary conditions were also manually imported and checked against the original RS model to ensure that inflows and outflows were correctly applied to the model.

2.3 Hydrology

Fluvial Inflows

Suitable allowance for increased river flow due to climate change were considered based on the EA's February 2016 guidance.

For more vulnerable residential developments in Flood Zone 3 the 'higher central' allowance is used and for less vulnerable commercial developments the 'central' climate change allowance is required and this should be consider for the lifetime of the development.

The Site of interest is located in the South East Region, therefore the following climate change allowances were assessed:

1 in 100yr plus 45% event which should be used as the design event
1 in 100yr plus 105% event which should be used for sensitivity testing

All QT boundaries were revised to account for the new climate change allowances.

Tidal Boundaries

The Tidal boundary was updated based on the East Solent Tidal Model built by JBA in July 2018. The model domain covering the area of interest is that of the Hayling Island model and the closest node to the Site of interest is BNDRY_5 as shown in Figure 2. The remaining nodes are located further east and south away from the Site of interest.

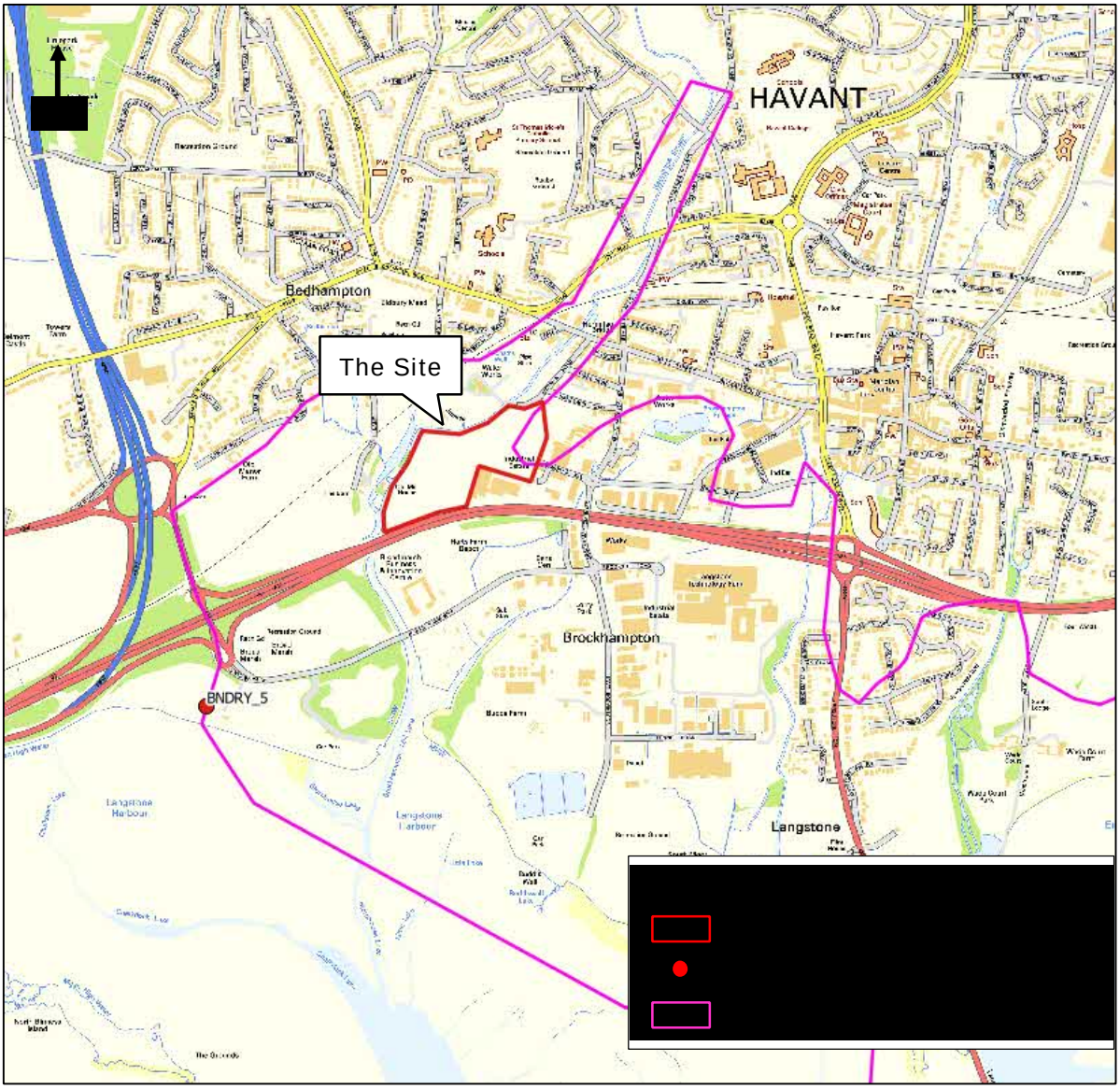


Figure 2: Hayling Island Tide Level Node Locations

The 2yr climate change tidal curve was used in the model. The 2yr present day tidal peak level, according to the East Solent Modelling study undertaken by JBA in July 2018, is 2.91m AOD. Guidance from the EA states[1] that the anticipated rise in sea level for the south east of England up to the year 2115 is expected to be 1.21 m. Therefore, this value was used for the Climate Change adjustment. Based on the above the 2yr climate change tidal peak level is 4.11m AOD.

3.0 MODEL RESULTS

The EA's Havant Model was rerun to produce the 1 in 100 + 45% CC and 1 in 100 + 105% CC flood outlines.

The model results indicated that the maximum in channel predicted flood level for the 100 + 45% Climate Change is 6.12m AOD within close proximity to the Site. The maximum in channel predicted flood level for the 100 + 105% Climate Change is 6.29m AOD.

Figure 3 and Table 1 below show the predicted flood levels within close proximity to the Site.

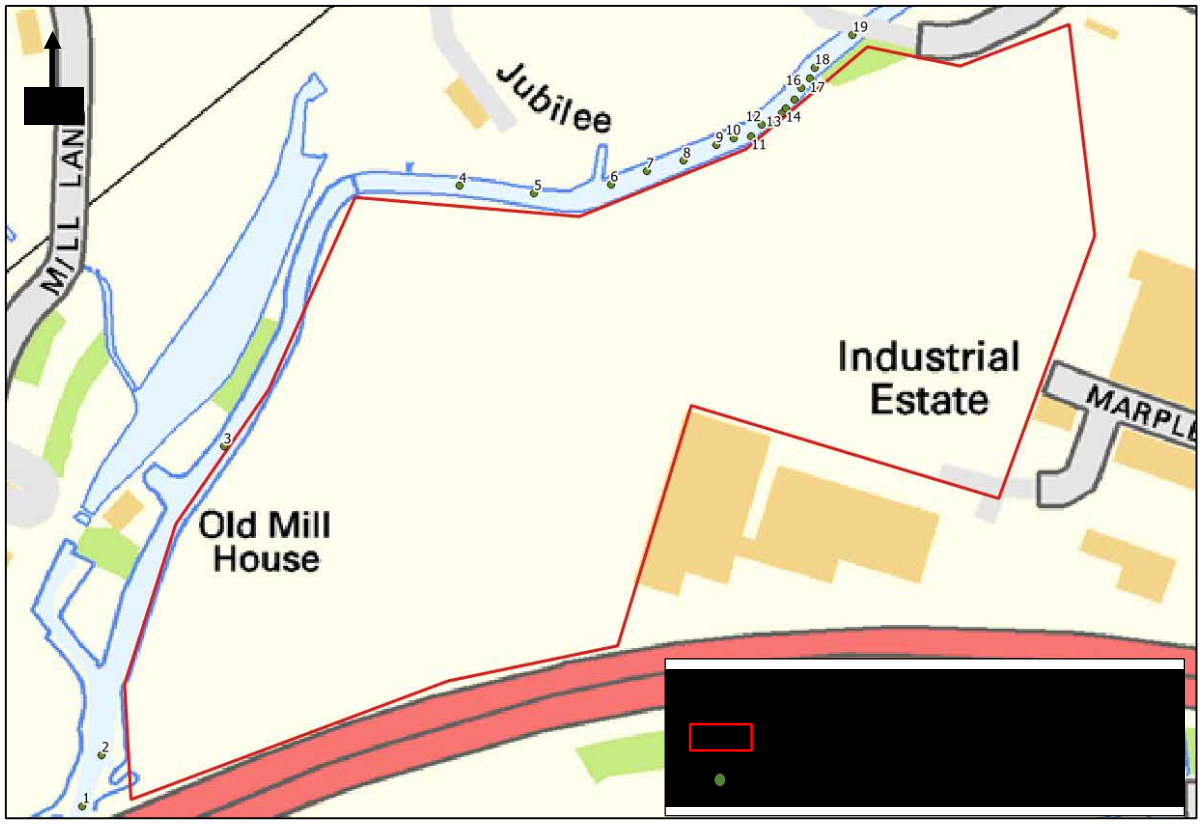


Figure 3: Node Location

[1] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#future-flood-risk-management

Table 1: Predicted Flood Levels

Node ID	1 in 100+45%CC yr event (m AOD)	1 in 100+105%CC yr event (m AOD)
1	4.26	4.35
2	4.27	4.36
3	4.28	4.37
4	4.29	4.39
5	4.31	4.42
6	4.33	4.45
7	4.35	4.46
8	4.36	4.47
9	4.37	4.49
10	4.38	4.49
11	4.39	4.5
12	5.1	5.37
13	5.19	5.39
14	5.29	5.47
15	5.51	5.68
16	5.75	5.92
17	6	6.18
18	6.12	6.29
19	5.96	6.13

The flood extents generated were taken from different in channel levels across the watercourse within close proximity to the site and interpolation was used between consecutive nodes. 1 m resolution LiDAR data were used to produce the outlines shown below.

Figure 4 below shows the predicted flood outlines for the 1 in 100yr+45%CC and the 1 in 100yr+105%CC including a 2yr+CC tidal boundary. The same figure also includes the current 100yr and 1000yr event including a 2yr tidal boundary.

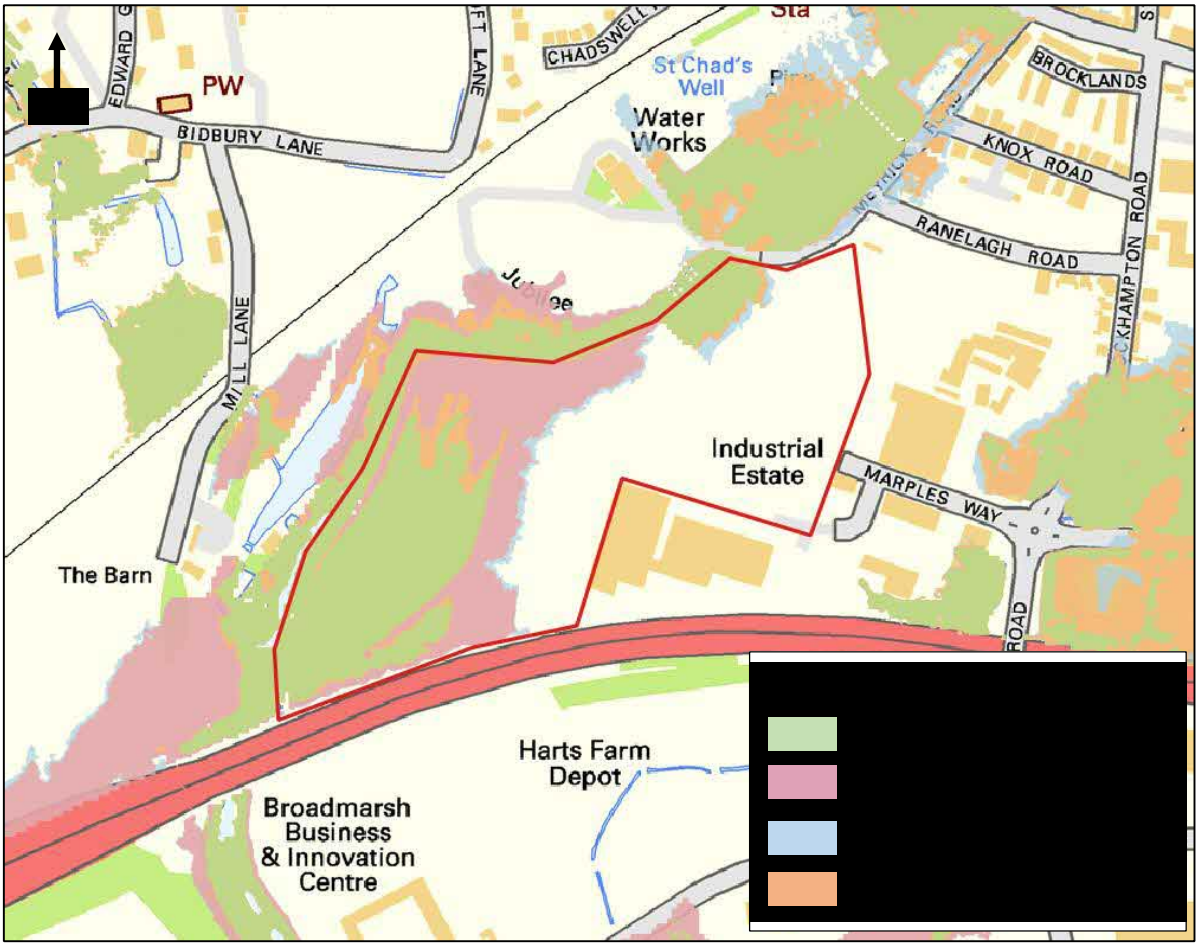


Figure 4: Flood outlines

4.0 CONCLUSIONS AND RECOMENDATIONS

Ardent Consulting Engineers (hereafter referred to as Ardent) has been commissioned by Portsmouth Water to undertake a hydraulic modelling exercise for a Site Kingscroft Farm, Portsmouth.

The purpose of this modelling task was to produce additional flood outlines for the new climate change scenarios updated in February 2016.

The existing InfoWorks RS Model of the streams which flow through the town of Havant in Hampshire was rerun using ICM software for the 100 year+45% climate change and 100 year+105% climate change events.

The maximum predicted water level for the 1 in 100 year+45% climate change event is 6.12m AOD and can be found in the northern part of the Site. Predicted water levels drop as we move towards the southern part of the site.

It is proposed that all residential development is located outside the 100 year +45% flood outline. Floodplain compensation will need to be provided for any development located within the 100 year +45% flood outline, in consultation with the EA. It is proposed that all finished floor levels for residential development are set 300mm above the 100 year +45% predicted flood. Finished Floor levels can vary across the Site.

In terms of safe access and egress in the event of a flood, the road network which serves the site remains dry during the 100 year +45% flood event. Occupants can leave the site via A27 heading east and subsequently north or west and subsequently north.

Georgia Athanasia

From:	Rabone, Anna <Anna.Rabone@environment-agency.gov.uk>
Sent:	09 March 2020 13:17
To:	Georgia Athanasia
Subject:	RE: Cost Recovered Advice: Site at Kingscroft Farm, Portsmouth: ENVPAC/1/SSD/00109 [Filed 09 Mar 2020 14:23]
Attachments:	Non-Real Time Hydraulic Model Review_Kingscroft Farm_v2.xlsm

Dear Georgia,

I hope you are well.

As promised, please find attached the full review report for our recent review of the hydraulic model. Please also note our further comments below:

Summary of the hydraulic model review

Following the second review, many of the previous 'Red' or 'Amber' comments have been downgraded. One 'Red' (Must Do) comment remains, however this is related to the extent of the modelling versus the existing Flood Map for Planning, which in this instance is due to the site also being at risk of tidal flooding.

Therefore, we deem the fluvial flood extents and levels from the ICM model suitable for use in a site specific Flood Risk Assessment (FRA).

Advice to the Applicant

As the site is also at risk of tidal flooding, the Applicant will also need to consider the tidal flood risk in their FRA, which should be used together with the fluvial flood risk to set the limits of the residential development, finished floor levels and access/egress routes.

If you have any queries regarding the review, please do not hesitate to contact me.

Thank you very much.

Kind regards,
Anna

Anna Rabone
Sustainable Places Advisor | Solent and South Downs Area
Environment Agency | Chichester Office, Oving Road, Chichester, West Sussex, PO20 2AG

Direct dial: 02077 140525





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or for litigation. Email messages and attachments sent to or from any Environment Agency address may also be accessed by someone other than the sender or recipient, for business purposes.

Appendix G

Environment Agency

Flood map for planning

Your reference
Kingscroft

Location (easting/northing)
470532/106122

Scale
1:2500

Created
16 Sep 2019 10:57

- Selected point
- Flood zone 3
- Flood zone 3: areas benefitting from flood defences
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Flood storage area

Old Mill Dam
Water Works
Weirs
Weir
Jubilee Path
Hermitage Stream
Spring
Balancing Pond
Valve
6.1m
8m Easement
5m Easement
Location of Culvert from Survey
FB
ETL
RIDGWAY
A27

Appendix H

FLOOD RESPONSE PLAN

KINGSCROFT FARM, MEYRICK ROAD
PORTSMOUTH, PO9 1NX

ARDENT CONSULTING ENGINEERS

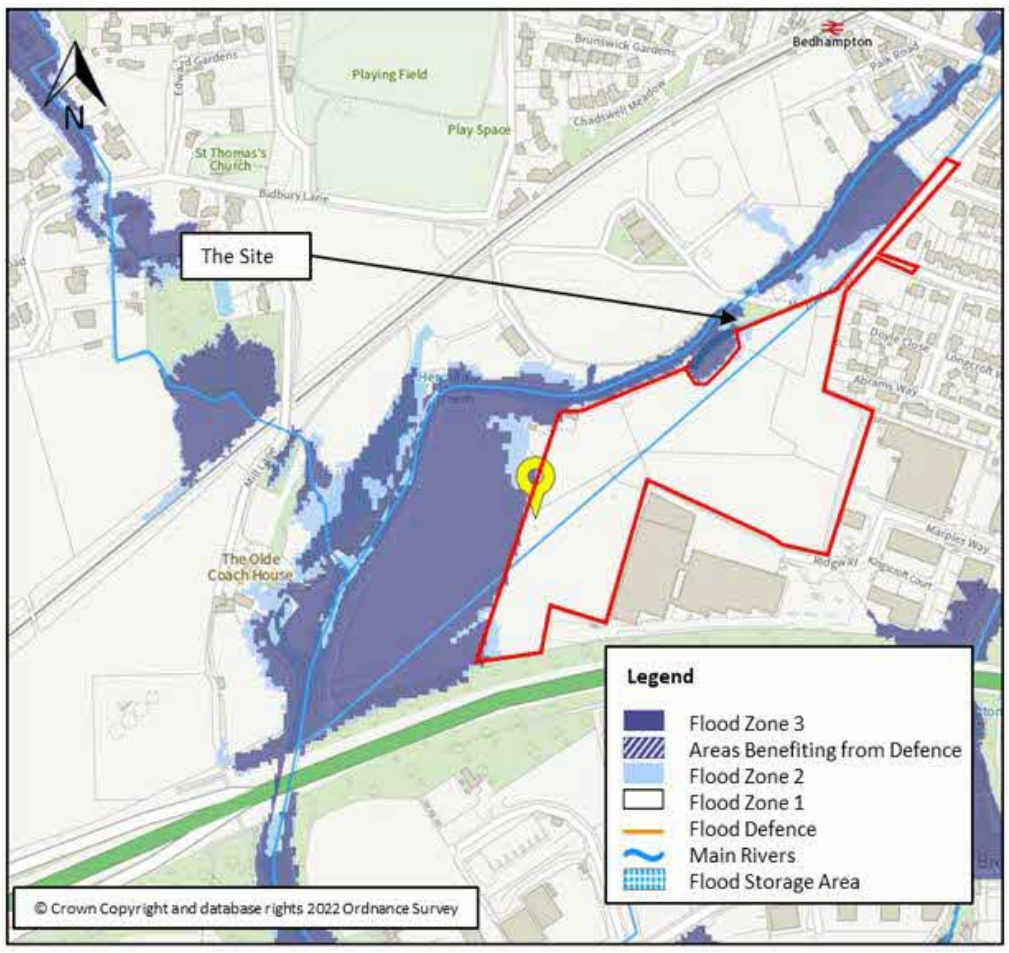
JUNE 2022

IF FLOODING IS IN PROGRESS

If the reader is referring to this plan because flooding is in progress without a flood warning at or near the site:

Sound the alarm and prepare to instruct staff and visitors;
Turn off gas, electricity and water supplies if safe to do so;
Await further information from the Emergency Services or via local radio; and,
Don't walk or drive through flood water, unless directed to by Emergency Services; six inches of fast flowing water can knock you over and two feet of water will float your car.

ENVIRONMENT AGENCY FLOOD MAP



EMERGENCY KIT

This is a useful bag that is packed with essentials in case you need to evacuate your home. It should be stored somewhere you can easily get to. Handy things to keep in your grab bag include:

- A list of useful telephone numbers (local authority, insurance company, family and friends, Corgi registered gas engineer and trained electrician).
- Mobile phone charger.
- Spare home and car keys.
- Toiletries, sanitary supplies.
- First-aid kit.
- Any essential medication
- A wind-up or battery-operated radio.
- Torch with spare batteries.
- Cash and credit cards.
- Spare clothes and blankets.
- Sensible flat shoes.
- Bottled water.
- A stock of non-perishable snack items.
- Essential items for babies or pets.

If asked by the emergency services to leave your home, please do so as quickly and calmly as possible. If you have time, turn off electricity, gas, and water supplies, unplug appliances, and lock all windows and doors. Take your grab bag with you.

Residents should listen to the advice and guidance from the emergency services at the time of an incident for actions to take. A Rest Centre will be announced at the time and widely communicated using all available media.

ENVIRONMENT AGENCY FLOOD WARNING CODES

The Environment Agency operates three levels of flood warnings as summarised below. Refer to the Environment Agency's website for details regarding Flood Warning Codes: https://www.gov.uk/government/publications/flood-warnings-what-they-are-and-what-to-do.

		
FLOOD ALERT	FLOOD WARNING	SEVERE FLOOD WARNING
Flooding is possible. Be prepared.	Flooding is expected. Act Now.	Severe flooding. Danger to life. Action Needed.
What to do: Be prepared to act on the flood evacuation plan. Prepare a flood kit of essential items. Monitor local water levels and the flood forecast. Look out for flood news updates. http://apps.environment-agency.gov.uk/river-and-sea-levels/. Stay calm − check flood warnings, tune in to BBC London	What to do: Move family, pets and valuables to a safe place. Keep a flood kit ready. Turnoff gas, electricity and water suppliers if safe to do so. Put flood protection equipment in place.	What to do: Stay in a safe place with a means of escape. Be ready should you need to evacuate from your home. Co-operate with the emergency services. Call 999 if you are in immediate danger.

EMERGENCY CONTACT NUMBERS:

Agency	Number
Emergency Services	999 or 112
Environment Agency Flood Line	0845 988 1188
Environment Agency Flood Line type talk (for the hard of hearing)	0345 602 6340
Havant Borough Council	023 9244 6019
National Gas Emergency Service	0800 111 999
UK Power Networks (power cut)	0800 028 0247
Thames Water (loss of water supply)	0800 316 9800
NHS 111 Services	111

IF THERE IS A DANGER TO LIFE ALWAYS DIAL 999 OR 112 AND ASK FOR THE APPROPRIATE EMERGENCY SERVICE.

FLOOD RESPONSE PLAN

KINGSCROFT FARM, MEYRICK ROAD
PORTSMOUTH, PO9 1NX

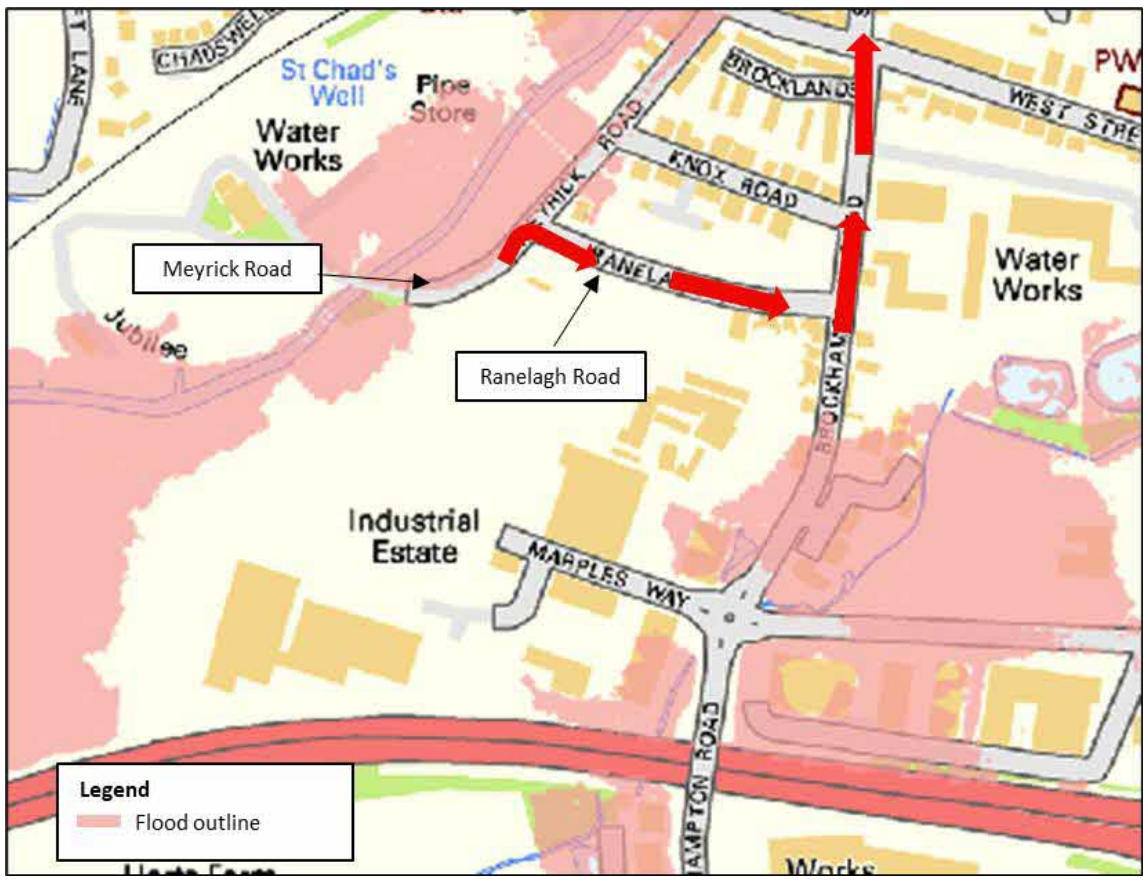
ARDENT CONSULTING ENGINEERS

JUNE 2022

SAFE ACCESS AND EGRESS ROUTES

Safe access and egress are required to enable the evacuation of people from the development and provide the emergency services with access to the development during times of flood.

If time allows and following the advice of the emergency services, it is recommended for site users to evacuate in the event of a flood. The road network which serves the site remains dry during the 100 year +45% flood event. Residents can leave the site via Meyrick Road, turning right onto Ranelagh Road and subsequently Brockhampton Road to the north of the development and away from the flood extents.



Flood Evacuation Route

An offsite refuge will be confirmed by Emergency Services during an event.
Staff and visitors should listen to the advice and guidance from the emergency services at the time of an incident.

ANNUAL REVIEW OF PLAN

Check the management team and contacts lists and update details if necessary;

Contact the Environment Agency Floodline Service to check that the flood risk to the Site has not changed;

Check if the evacuation procedures are still correct;

Undertake Flood Evacuation exercise;

In accordance with the flood risk assessment and planning requirements for the site the development has been designed and constructed to provide a safe egress.

Note the flood extents were obtained from the Environment Agency, and the information contained in this notice will be reviewed annually by the developments managing agent.

Appendix I

ICP SUDS Mean Annual Flood

Input

Return Period (years) 100 SAAR (mm) 787 Urban 0.000
Area (ha) 0.960 Soil 0.450 Region Number Region 7

Results l/s

QBAR Rural 4.8
QBAR Urban 4.8

Q100 years 15.4

Q1 year 4.1
Q30 years 11.0
Q100 years 15.4

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ICP SUDS Mean Annual Flood

Input

Return Period (years) 100 SAAR (mm) 787 Urban 0.000
Area (ha) 0.510 Soil 0.450 Region Number Region 7

Results l/s

QBAR Rural 2.6
QBAR Urban 2.6

Q100 years 8.2

Q1 year 2.2
Q30 years 5.8
Q100 years 8.2

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Appendix J

RE: APP/22/00669 - Kingscroft Farm

CF Cooper, Fiona <Fiona.Cooper@environment-agency.gov.uk>
To Georgia Athanasia
Cc Cleal, Adam

Reply | Reply All | Forward | ...

Tue 16/05/2023 12:09

You forwarded this message on 16/05/2023 14:09.

EXTERNAL EMAIL: Do not click any links or open any attachments unless you trust the sender and know the content is safe.

Hi Georgia,

Thanks for your email. I don't believe I received the meting minutes, but I might have missed them so apologies for that.

Please see our response;

Concerns from a flood risk perspective have been raised and we are satisfied with the outcomes in the minutes. Although building on top of the culvert is not our preferred option, it may be the only proposal that is achievable. It is likely a number of conditions will need to be in place when we issue a Flood Risk Activity Permit (and at planning) that ensures the structural integrity and maintenance of the culvert will not be compromised for the future.

The minutes suggest a second meeting is being proposed, is that the case and something you would look for the EA to be involved with?

Adam Cleal who attended from our Asset Performance team may have some separate comments to make, so I've CC'd him here in case there is anything further he wants to comment on.

Kind regards,

Fiona Cooper

Flood and Coastal Risk Management Officer
South East Hampshire & IOW
Solent & South Downs
Environment Agency, Oving Road, Chichester, West Sussex PO20 2AG

Email: Fiona.Cooper@environment-agency.gov.uk

From: Georgia Athanasia <gathanasia@ardent-ce.co.uk>
Sent: 15 May 2023 11:42
To: Cooper, Fiona <Fiona.Cooper@environment-agency.gov.uk>
Cc: Charlie Cooper <ccooper@ardent-ce.co.uk>
Subject: RE: APP/22/00669 - Kingscroft Farm

Appendix K

KEY

- APPLICATION RED LINE BOUNDARY
- BLUE LAND OWNERSHIP BOUNDARY
- INDICATIVE FOUL WATER SEWER
- INDICATIVE SURFACE WATER SEWER
- INDICATIVE PERMAVOID PAVING (95% VOIDS)
- ATTENUATION BASIN WITH 3m ACCESS STRIP
- INDICATIVE SURFACE WATER CONTROL CHAMBER
- INDICATIVE CELLULAR ATTENUATION TANK
- INDICATIVE HEADWALL
- EXISTING CULVERT
- 1% AEP + 45% CC FLUVIAL FLOOD OUTLINE
- EXISTING SOUTHERN WATER SURFACE WATER SEWER
- EXISTING SOUTHERN WATER FOUL SEWER
- EXISTING BYPASS CULVERT
- EASEMENT
- EXCEEDANCE FLOW ROUTE

GEO-CELLUALR ATTENUATION TANK
VOLUME 98.5m³ (95% VOID RATIO)
AREA 129.6m²
DEPTH 0.8m
CL 4.70
TOP OF TANK 4.10
IL 3.3

FLOW CONTROL MANHOLE TO RESTRICT DISCHARGE RATES TO 6.3 l/s.

GEO-CELLUALR ATTENUATION TANK
VOLUME 166.9m³ (95% VOID RATIO)
AREA 146.4m²
DEPTH 1.2m
CL 4.51
TOP OF TANK 3.15
IL 1.95

GEO-CELLUALR ATTENUATION TANK
VOLUME 120.2m³ (95% VOID RATIO)
AREA 158.2m²
DEPTH 0.8m
CL 4.42
TOP OF TANK 3.82
IL 3.02

GEO-CELLUALR ATTENUATION TANK
VOLUME 76.6m³ (95% VOID RATIO)
AREA 100.8m²
DEPTH 0.8m
CL 4.38
TOP OF TANK 3.57
IL 2.77

GEO-CELLUALR ATTENUATION TANK
VOLUME 38m³ (95% VOID RATIO)
AREA 100m²
DEPTH 0.4m
CL 6.00
TOP OF TANK 5.70
IL 5.30

GEO-CELLUALR ATTENUATION TANK
VOLUME 76m³ (95% VOID RATIO)
AREA 100 m²
DEPTH 0.8m
CL 6.55
TOP OF TANK 5.92
IL 5.12

GEO-CELLUALR ATTENUATION TANK
VOLUME 76m³ (95% VOID RATIO)
AREA 100m²
DEPTH 0.4m
CL 6.00
TOP OF TANK 5.70
IL 5.30

GEO-CELLUALR ATTENUATION TANK
VOLUME 133 m³ (95% VOID RATIO)
AREA 350m²
DEPTH 0.4m
CL 6.61
TOP OF TANK 6.31
IL 5.91

ATTENUATION POND
APPROXIMATE AREA 200m²
DEPTH 1.90

GEO-CELLUALR ATTENUATION TANK
VOLUME 133m³ (95% VOID RATIO)
AREA 80m²
DEPTH 1.2m
CL 6.00
TOP OF TANK 5.63
IL 4.23

FLOW CONTROL MANHOLE TO RESTRICT DISCHARGE RATES TO 8.1 l/s.

NOT FOR CONSTRUCTION

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RELEVANT SPECIFICATION AND ALL OTHER RELATED DRAWINGS ISSUED BY THE ENGINEER.
2. DO NOT SCALE FROM THIS DRAWING. WORK FROM FIGURED DIMENSIONS ONLY.
3. ALL DIMENSIONS SHOWN ON THIS DRAWING ARE IN METRES, UNLESS OTHERWISE STATED. ALL LEVELS SHOWN ARE IN METRES ABOVE ORDNANCE DATUM.
4. ALL DIMENSIONS, LEVELS AND SURVEY GRID CO-ORDINATES ARE TO BE CHECKED ON SITE AND THE ENGINEER NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES PRIOR TO THE COMMENCEMENT OF THE WORKS.
5. NO DEVIATION FROM THE DETAILS SHOWN ON THIS DRAWING IS PERMITTED WITHOUT PRIOR PERMISSION FROM THE ENGINEER.
6. EXISTING DRAINAGE AND UTILITIES TO BE CONFIRMED IN-SITU BY THE CONTRACTOR, PRIOR TO STARTING WORKS.
7. THE DRAINAGE STRATEGY IS INDICATIVE ONLY, TO DEMONSTRATE DESIGN INTENT AND ATTENUATION STORAGE REQUIREMENTS.
8. INDICATIVE DRAINAGE STRATEGY SUBJECT TO SOUTHERN WATER AND LEAD LOCAL FLOOD AUTHORITY APPROVAL.

PERMAVOID PAVING NOTES

LIGHT DUTY: SHOULD ONLY BE USED FOR SINGULAR OR DOUBLE DRIVES SERVING 1 OR 2 PLOTS - NOT SUITABLE FOR AREAS WHICH WILL BE SUBJECT TO CONSTRUCTION TRAFFIC OR POTENTIAL LOADING FROM HEAVY GOODS
VEHICLES inc. DELIVERY, PANTECHNICON, REFUSE COLLECTION AND FIRE RESCUE VEHICLES

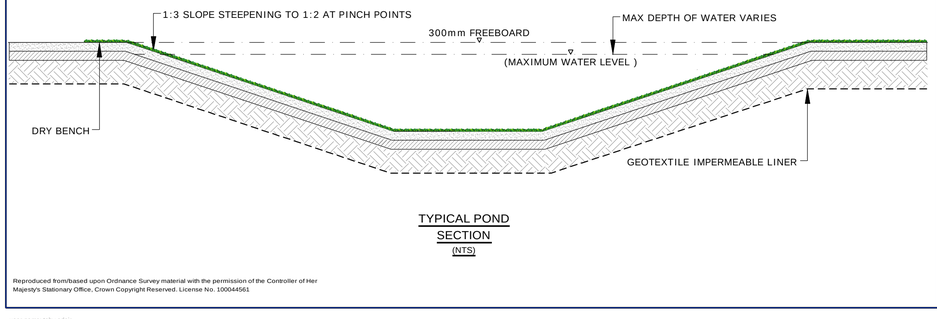
HEAVY DUTY: TO BE USED FOR ALL SHARED DRIVES, PARKING COURTS AND PRIVATE ACCESS ROADS

* THE FORMATION OF THE PERMEABLE PAVING SUB-BASE MUST NOT EXCEED A GRADIENT OF 1/40.

FOR STEEPER GRADIENTS, USE MAXIMUM GRADIENT OF 1/40 FOR FORMATION, APPLYING VERTICAL STEPS AS NECESSARY, BUT ENSURING MINIMUM SUB-BASE THICKNESS IS ALWAYS ACHIEVED.

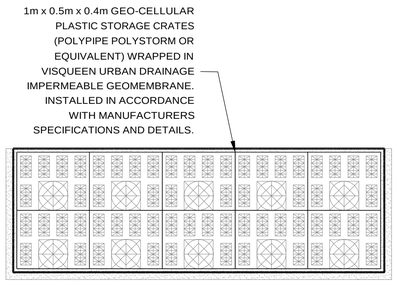
PERMAVOID PAVING CONSTRUCTION SPECIFIED ABOVE IS SUITABLE FOR CBR VALUES OF BETWEEN 2% & 5%. FOR CBR VALUES OUTSIDE OF THIS RANGE, REFER BACK TO THE ENGINEER FOR CLARIFICATION.

ALL MATERIAL SPECIFICATION AND WORKMANSHIP OF PERMEABLE PAVING CONSTRUCTION TO BE STRICTLY IN ACCORDANCE WITH RECOMMENDATIONS BY MARSHALLS.

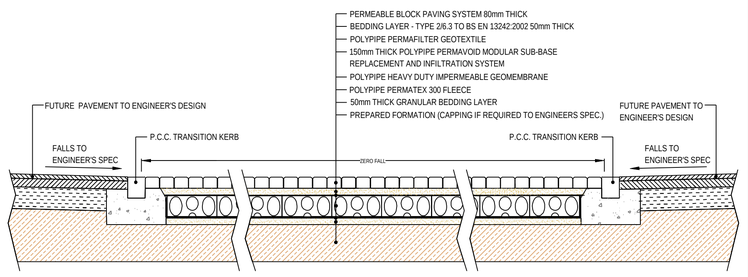


TYPICAL POND SECTION (NTS)

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CELLULAR ATTENUATION TANK CONSTRUCTION DETAILS (NTS)



TYPICAL SECTION THROUGH PERMEABLE BLOCK PAVING INCORPORATING POLYPIPE PERMAVOID SUB-BASE REPLACEMENT ATTENUATION SYSTEM (NTS)

Rev	Description	Drn	Chk	App	Date
C	Site boundary & masterplan updated	TA	CC	BC	25/ 07/ 23
B	Site boundary updated	LE	CC	BC	26/ 10/ 22
A	Exccedance routes added	LE	CC	BC	07/ 10/ 22

ARDENT | CONSULTING ENGINEERS
Third Floor
The Hallmark Building
52-56 Leadenhall Street
London
EC3M 5JE
Tel: 020 7680 4088
Web: www.ardent-ce.co.uk
E-mail: enquiries@ardent-ce.co.uk

Client: FOREMAN HOMES

Project Title: KINGSCROFT FARM

Drawing Title: FOUL AND SURFACE WATER DRAINAGE STRATEGY

A2 Scale	Date	Designed by
VARIES	OCTOBER 2022	FH
Drawn by	Checked by	Approved by
FH	CC	BC

Drawing Number: 220 0 510 -0 0 2 | Rev: C

Appendix L

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	19.600	Add Flow / Climate Change (%)	0
Ratio R	0.345	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	30.376	0.182	167.0	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	2.360	0.236	10.0	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	24.094	0.144	167.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	26.474	0.159	167.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.000	9.550	0.389	24.6	0.300	4.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	40.763	0.249	163.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	4.50	3.000	0.000	0.0	0.0	0.0	1.01	40.1	0.0
2.000	50.00	4.01	2.770	0.000	0.0	0.0	0.0	4.16	165.5	0.0
1.001	50.00	4.90	2.760	0.000	0.0	0.0	0.0	1.01	40.1	0.0
1.002	50.00	5.34	2.456	0.000	0.0	0.0	0.0	1.01	40.1	0.0
3.000	50.00	4.06	3.020	0.300	0.0	0.0	0.0	2.65	105.4	40.6
1.003	50.00	5.89	2.190	0.300	0.0	0.0	0.0	1.23	86.7	40.6

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
4.000	123.725	1.230	100.6	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit	
4.001	79.070	0.544	145.3	0.300	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	16.890	0.153	110.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	35.800	0.150	238.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
4.000	50.00	5.58	4.875	0.000	0.0	0.0	0.0	1.30	51.8	0.0
4.001	50.00	6.80	3.645	0.300	0.0	0.0	0.0	1.08	43.0	40.6
1.004	50.00	6.99	1.945	0.600	0.0	0.0	0.0	1.50	105.7	81.2
1.005	50.00	7.58	1.792	0.600	0.0	0.0	0.0	1.01	71.6«	81.2

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.005		3.550	1.642	1.750	0	0

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 10, DS/PN: 1.004, Volume (m³): 9.3

Unit Reference	MD-SHE-0103-6300-2000-6300
Design Head (m)	2.000
Design Flow (l/s)	6.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	1.945
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	6.3
Flush-Flo™	0.448	5.5
Kick-Flo®	0.920	4.4
Mean Flow over Head Range	-	5.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.5	1.200	5.0	3.000	7.6	7.000	11.4
0.200	5.0	1.400	5.3	3.500	8.2	7.500	11.8
0.300	5.4	1.600	5.7	4.000	8.7	8.000	12.1
0.400	5.5	1.800	6.0	4.500	9.2	8.500	12.5
0.500	5.5	2.000	6.3	5.000	9.7	9.000	12.8
0.600	5.4	2.200	6.6	5.500	10.1	9.500	13.2
0.800	5.0	2.400	6.9	6.000	10.6		
1.000	4.6	2.600	7.1	6.500	11.0		

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Storage Structures for Storm

Tank or Pond Manhole: 2, DS/PN: 2.000

Invert Level (m) 2.770

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	101.0	0.800	101.0	0.801	0.0

Complex Manhole: 6, DS/PN: 3.000

Tank or Pond

Invert Level (m) 3.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	158.0	0.800	158.0	0.801	0.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	21.1
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	58.6	Slope (1:X)	100.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	3
Invert Level (m)	3.900	Cap Volume Depth (m)	0.300

Tank or Pond Manhole: 9, DS/PN: 4.001

Invert Level (m) 3.645

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	130.0	0.800	130.0	0.801	0.0

Complex Manhole: 11, DS/PN: 1.005

Tank or Pond

Invert Level (m) 1.792

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	128.0	1.200	128.0	1.201	0.0

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Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	14.1
Max Percolation (l/s)	39.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	3
Invert Level (m)	1.792	Cap Volume Depth (m)	0.300

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.349
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.500	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 45

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	1	360 minute 100 year Winter I+45%	4.460	4.354	1.129	0.000	0.10
2.000	2	360 minute 100 year Winter I+45%	4.380	4.358	1.363	0.000	0.20
1.001	3	360 minute 100 year Winter I+45%	4.420	4.362	1.377	0.000	0.37
1.002	5	360 minute 100 year Winter I+45%	4.590	4.508	1.827	0.000	0.19
3.000	6	360 minute 100 year Winter I+45%	4.420	4.172	0.927	0.000	0.53
1.003	7	360 minute 100 year Winter I+45%	4.660	4.599	2.109	0.000	0.27
4.000	8	15 minute 1 year Summer I+0%	6.300	4.875	-0.225	0.000	0.00
4.001	9	360 minute 100 year Winter I+45%	5.070	4.215	0.345	0.000	0.61
1.004	10	360 minute 100 year Winter I+45%	4.930	4.787	2.542	0.000	0.08
1.005	11	360 minute 100 year Winter I+45%	4.270	1.855	-0.237	0.000	0.10

PN	US/MH Name	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1		3.6	FLOOD RISK
2.000	2		13.4	FLOOD RISK
1.001	3		13.7	FLOOD RISK
1.002	5		7.0	FLOOD RISK

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Overflow (l/s)	Pipe Flow (l/s)	Status
3.000	6		46.0	FLOOD RISK
1.003	7		22.0	FLOOD RISK
4.000	8		0.0	OK
4.001	9		25.6	SURCHARGED
1.004	10		6.9	FLOOD RISK
1.005	11		6.6	OK

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Ardent Consulting Engineers		Page 1
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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	19.500	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.600
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
6.000	75.300	0.451	167.0	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit	
7.000	10.900	0.065	167.7	0.660	4.00	0.0	0.600	o	225	Pipe/Conduit	
6.001	18.400	0.110	167.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
6.002	16.810	0.312	53.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.000	50.600	0.303	167.0	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit	
8.001	20.300	0.122	166.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
6.000	50.00	5.24	5.680	0.000	0.0	0.0	0.0	1.01	40.1	0.0
7.000	50.00	4.18	5.390	0.660	0.0	0.0	0.0	1.01	40.0«	89.4
6.001	50.00	5.55	5.229	0.660	0.0	0.0	0.0	1.01	40.1«	89.4
6.002	50.00	5.70	5.119	0.660	0.0	0.0	0.0	1.79	71.0«	89.4
8.000	50.00	4.84	5.300	0.000	0.0	0.0	0.0	1.01	40.1	0.0
8.001	50.00	5.17	4.997	0.000	0.0	0.0	0.0	1.01	40.2	0.0

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
8.002	11.440	0.069	167.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
6.003	50.100	0.501	100.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
6.004	18.900	0.284	66.5	0.250	0.00	0.0	0.600	o	225	Pipe/Conduit	
9.000	94.500	0.566	167.0	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit	
9.001	35.400	0.212	167.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
6.005	7.000	0.102	68.6	0.080	0.00	0.0	0.600	o	225	Pipe/Conduit	
6.006	10.000	0.033	303.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
8.002	50.00	5.36	4.875	0.000	0.0	0.0	0.0	1.01	40.1	0.0
6.003	50.00	6.34	4.807	0.660	0.0	0.0	0.0	1.31	52.0«	89.4
6.004	50.00	6.54	4.306	0.910	0.0	0.0	0.0	1.61	63.8«	123.2
9.000	50.00	5.56	4.800	0.000	0.0	0.0	0.0	1.01	40.1	0.0
9.001	50.00	6.15	4.234	0.000	0.0	0.0	0.0	1.01	40.1	0.0
6.005	50.00	6.61	4.022	0.990	0.0	0.0	0.0	1.58	62.9«	134.1
6.006	50.00	6.84	3.920	0.990	0.0	0.0	0.0	0.75	29.7«	134.1

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
6.006		5.540	3.887	3.690	0	0

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 13, DS/PN: 6.006, Volume (m³): 2.7

Unit Reference	MD-SHE-0114-8100-2300-8100
Design Head (m)	2.300
Design Flow (l/s)	8.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	114
Invert Level (m)	3.920
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.300	8.1	Kick-Flo®	1.016	5.5
Flush-Flo™	0.500	6.9	Mean Flow over Head Range	-	6.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.0	1.200	6.0	3.000	9.2	7.000	13.7
0.200	6.1	1.400	6.4	3.500	9.9	7.500	14.2
0.300	6.6	1.600	6.8	4.000	10.5	8.000	14.6
0.400	6.9	1.800	7.2	4.500	11.1	8.500	15.1
0.500	6.9	2.000	7.6	5.000	11.7	9.000	15.5
0.600	6.9	2.200	7.9	5.500	12.2	9.500	15.9
0.800	6.6	2.400	8.3	6.000	12.7		
1.000	5.7	2.600	8.6	6.500	13.2		

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Storage Structures for Storm

Complex Manhole: 2, DS/PN: 7.000

Tank or Pond

Invert Level (m) 5.910

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	350.0	0.400	350.0	0.401	0.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	18.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	50.0	Slope (1:X)	100.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	6.100	Cap Volume Depth (m)	0.500

Complex Manhole: 4, DS/PN: 6.002

Tank or Pond

Invert Level (m) 5.119

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	100.0	0.800	100.0	0.801	0.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	6.7
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	18.6	Slope (1:X)	100.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	6.050	Cap Volume Depth (m)	0.300

Tank or Pond Manhole: 5, DS/PN: 8.000

Invert Level (m) 5.300

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Tank or Pond Manhole: 5, DS/PN: 8.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	100.0	0.400	100.0	0.401	0.0

Complex Manhole: 6, DS/PN: 8.001

Tank or Pond

Invert Level (m) 4.997

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	100.0	0.800	100.0	0.802	0.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	6.7
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	18.6	Slope (1:X)	100.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.540	Cap Volume Depth (m)	0.300

Tank or Pond Manhole: 9, DS/PN: 6.004

Invert Level (m) 4.306

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	127.0	1.900	200.0

Tank or Pond Manhole: 11, DS/PN: 9.001

Invert Level (m) 4.234

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	80.0	1.200	80.0	1.201	0.0

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.345
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 45

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
6.000	1	15 Winter	1	+0%	100/30 Summer				5.680
7.000	2	15 Winter	1	+0%	1/15 Summer				5.914
6.001	3	15 Winter	1	+0%	1/15 Summer				5.682
6.002	4	30 Winter	1	+0%	30/30 Summer				5.275
8.000	5	15 Summer	1	+0%	100/120 Summer				5.300
8.001	6	30 Winter	1	+0%	30/120 Winter				4.997
8.002	7	30 Winter	1	+0%	30/15 Summer				5.021
6.003	8	30 Winter	1	+0%	30/15 Summer				5.025
6.004	9	240 Winter	1	+0%	1/15 Winter				4.674
9.000	10	15 Summer	1	+0%	30/60 Winter				4.800
9.001	11	240 Winter	1	+0%	1/30 Summer				4.648
6.005	12	120 Winter	1	+0%	1/15 Summer				4.704

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
6.000	1	-0.225	0.000	0.00			0.0	OK	
7.000	2	0.299	0.000	2.04		3	68.9	SURCHARGED	
6.001	3	0.228	0.000	1.78			64.1	SURCHARGED	
6.002	4	-0.069	0.000	0.82		11	51.8	OK	
8.000	5	-0.225	0.000	0.00			0.0	OK	
8.001	6	-0.225	0.000	0.00			0.0	OK	
8.002	7	-0.079	0.000	0.06			2.1	OK	
6.003	8	-0.007	0.000	0.99			49.4	OK	
6.004	9	0.143	0.000	0.29			18.7	SURCHARGED*	
9.000	10	-0.225	0.000	0.00			0.0	OK	
9.001	11	0.189	0.000	0.11			4.3	SURCHARGED	
6.005	12	0.457	0.000	0.19			8.4	SURCHARGED	

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
6.006	13	120 Winter	1	+0%	1/15 Summer				4.704

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
6.006	13	0.559	0.000	0.28			6.9	SURCHARGED	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.345
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
6.000	1	60 Winter	30	+0%	100/30 Summer				5.756
7.000	2	15 Winter	30	+0%	1/15 Summer				6.026
6.001	3	60 Winter	30	+0%	1/15 Summer				5.756
6.002	4	120 Winter	30	+0%	30/30 Summer				5.459
8.000	5	15 Summer	30	+0%	100/120 Summer				5.300
8.001	6	360 Winter	30	+0%	30/120 Winter				5.295
8.002	7	360 Winter	30	+0%	30/15 Summer				5.296
6.003	8	360 Winter	30	+0%	30/15 Summer				5.297
6.004	9	360 Winter	30	+0%	1/15 Winter				5.282
9.000	10	360 Winter	30	+0%	30/60 Winter				5.261
9.001	11	360 Winter	30	+0%	1/30 Summer				5.261
6.005	12	360 Winter	30	+0%	1/15 Summer				5.300
6.006	13	360 Winter	30	+0%	1/15 Summer				5.300

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
6.000	1	-0.149	0.000	0.01			0.3	OK	
7.000	2	0.411	0.000	2.13		11	71.9	SURCHARGED	
6.001	3	0.302	0.000	1.85			66.5	SURCHARGED	
6.002	4	0.115	0.000	0.78		27	49.3	SURCHARGED	
8.000	5	-0.225	0.000	0.00			0.0	OK	
8.001	6	0.073	0.000	0.05		191	1.7	SURCHARGED	
8.002	7	0.195	0.000	0.05			1.7	SURCHARGED	
6.003	8	0.265	0.000	0.61			30.3	SURCHARGED	
6.004	9	0.751	0.000	0.30			19.0	SURCHARGED*	
9.000	10	0.236	0.000	0.00			0.0	SURCHARGED	
9.001	11	0.802	0.000	0.07			2.6	SURCHARGED	
6.005	12	1.053	0.000	0.17			7.8	SURCHARGED	
6.006	13	1.155	0.000	0.28			6.9	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.345
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 45

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
6.000	1	480 Winter	100	+45%	100/30 Summer				6.013
7.000	2	30 Winter	100	+45%	1/15 Summer				6.252
6.001	3	480 Winter	100	+45%	1/15 Summer				6.013
6.002	4	480 Winter	100	+45%	30/30 Summer				6.003
8.000	5	480 Winter	100	+45%	100/120 Summer				5.993
8.001	6	480 Winter	100	+45%	30/120 Winter				5.993
8.002	7	480 Winter	100	+45%	30/15 Summer				5.993
6.003	8	480 Winter	100	+45%	30/15 Summer				5.993
6.004	9	480 Winter	100	+45%	1/15 Winter				5.977
9.000	10	480 Winter	100	+45%	30/60 Winter				5.966
9.001	11	480 Winter	100	+45%	1/30 Summer				5.967
6.005	12	480 Winter	100	+45%	1/15 Summer				5.968

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
6.000	1	0.108	0.000	0.00			0.1	SURCHARGED	
7.000	2	0.637	0.000	2.31		27	77.9	SURCHARGED	
6.001	3	0.559	0.000	1.28			46.2	SURCHARGED	
6.002	4	0.659	0.000	0.54			34.2	SURCHARGED	
8.000	5	0.468	0.000	0.03			1.3	FLOOD RISK	
8.001	6	0.771	0.000	0.08			2.9	FLOOD RISK	
8.002	7	0.893	0.000	0.09			3.0	FLOOD RISK	
6.003	8	0.961	0.000	0.60			30.0	SURCHARGED	
6.004	9	1.446	0.000	0.31			19.8	FLOOD RISK*	
9.000	10	0.941	0.000	0.00			0.1	FLOOD RISK	
9.001	11	1.508	0.000	0.01			0.3	FLOOD RISK	
6.005	12	1.721	0.000	0.19			8.6	FLOOD RISK	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
6.006	13	480 Winter	100	+45%	1/15 Summer				5.960

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
6.006	13	1.815	0.000	0.31			7.6	FLOOD RISK	

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Appendix M

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

Table 1: Pollution hazard indices for different land use classifications

(land use in bold applicable for the development).

	Mitigation indices		
Type of SuDS component	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Bio retention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Wetland	0.8	0.8	0.8
Proprietary treatment systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Table 2: Indicative SuDS mitigation indices for discharges to surface waters

(bold text is applicable to this development).

For surface water discharge from Residential Parking Areas and Low Traffic Roads <300 traffic movements/day			
	Required mitigation indices		
Source	TSS	Metals	Hydrocarbons
Very Low	0.2	0.2	0.05
Low	0.5	0.4	0.4
Total	0.7	0.6	0.45
Type of SuDS component provided			
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Total	1.2	1.1	1.3
Check	+0.5	+0.5	+0.85

Table 3: SuDS mitigation indices provided

Appendix N

1.0 INTRODUCTION

1.1 The development at Kingscroft Farm includes a number of Sustainable Drainage Systems (SuDS) as part of the surface water drainage system including, detention basin/ponds, attenuation tanks and permavoid paving. This Technical Note sets out an outline management plan for the aforementioned SuDS components.

1.2 The proposed SuDS components in addition to addressing climate change will bring a number of benefits in terms of water quality, environmental, and social amenity.

1.3 The maintenance of all SuDS components will be in accord with the best practices and CIRIA document C753 "The SuDS Manual". Typical maintenance activities for the proposed SuDS components have been reproduced from Table 32.1 of "The SuDS Manual" in Table 1 below. A private management company will be set up to maintain the surface water drainage network, including on-site SuDS.

Table 1: Typical SuDS Maintenance Activities

Operation and maintenance activity	SuDS component		
	Geo-cellular Tank	Permavoid Paving	Detention Basin/Pond
Regular Maintenance			
Inspection			
Litter and debris removal	☐		
Grass cutting			
Weed and invasive plant control		☐	☐
Shrub management		☐	☐
Shoreline vegetation			☐
Aquatic vegetation management			☐
Occasional Maintenance			
Sediment management			
Vegetation replacement			☐
Vacuum sweeping and brushing			
Remedial Maintenance			
Structure rehabilitation / repair	☐	☐	☐
will be required ☐ may be required			

2.0 SuDS MANAGEMENT PLAN

2.1 This plan is intended to cover all on-site drainage structures. The Site Management Team should oversee and implement the SuDS Management Plan and designate a qualified person who will be responsible for the proper operation and maintenance of the surface water drainage structures.

Water Quality Management

2.2 In line with Tables 26.2 and 26.3 of the CIRIA C753 The SuDS Manual, the proposed permaviod paving, attenuation ponds and swales would provide sufficient treatment for the surface water runoff from the Site.

2.3 The surface drainage network would also be designed to protect and enhance the quality of surface water runoff through the removal of sediment and pollutants. Catchpit manholes and silt trapped gullies will reduce the amount of pollutants entering the system. Preventive maintenance of the system will include a comprehensive source reduction program of regular sweeping and litter removal, prohibitions on the use of pesticides, and maintenance of bin areas.

Maintenance Program

2.4 The Site Management Team will conduct the SuDS Management Plan set forth in this document. The Site Management will ensure that inspections and record keeping are timely and accurate. Inspection & Maintenance Log Forms should include the date and physical conditions of the structures, depth of sediment in structures, evidence of overtopping or debris blockage and maintenance required of each structure. Records of maintenance will be kept on file on-site and copies of Inspection & Maintenance Log sheets indicating all work and inspections will be available to the Council upon request. A model Maintenance log in appended for reference.

2.5 Regular maintenance should include:

Inspect channel and gully inlet grates and remove any debris every 6 months or as determined to be reasonable based on experience with the installed systems to ensure that the gullies are working in their intended fashion and that they are free of debris;

Inspect gully sumps and bottom of drain manholes quarterly; if depth of sediment in sumps exceeds 50% capacity, sediment must be removed. Excessive sediment shall be removed and properly disposed by a licensed drainage cleaning company.

All litter shall be picked up and removed from the parking areas, and soft landscaping.

Inspect external bin stores for spillage and scattered litter must be performed on a regular basis to prevent the spread of pollutants into the surface water drainage network.

The inlets, outlet and vents and overflows of SuDS components should be checked annually and after large storms to ensure that they are in good condition and operating as designed. Regular maintenance includes inspection and identification of any areas that are not operating correctly monthly for the first 3 months and then every 6 months after.

Basin/Pond inlets, outlet/headwalls should be checked annually and after large storms to ensure that they are in good condition and operating as designed. Regular maintenance includes inspection and identification of any areas that are not operating correctly monthly for the first 3 months and then every 6 months after.

Winter Maintenance Program

2.6 Ensure that drainage structures are not blocked by ice, snow, debris or rubbish during winter months.

Operation and Maintenance requirements

2.7 Recommendations for the operation and maintenance including typical frequencies are included in Tables 2, 3 and 4 below.

Table 2: SuDS Operation and Maintenance Requirements- Permavoid paving

SUDS Element	Permavoid Paving	
Maintenance Period	Maintenance Task	Frequency
Regular Maintenance	Brushing and vacuuming	Once a year or as required
Occasional Maintenance	Stabilise and mow contributing adjacent area	As required
	Removal of weed or management using glyphospate applied directly into weeds by an applicator rather than spraying	As required
Remedial Work	Remediate any landscaping which has been raised to within 50mm of the level of the paving	As required.
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to structural performance or a hazard to users.	As required.
Monitoring	Rehabilitation of surface or upper structure by remedial sweeping	Every 10 to 15 years, or as required
	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	3 monthly, 48hrs after large storms in first 6 months

	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Table 3: SuDS Operation and Maintenance Requirements- Attenuation tank

SUDS Element	Attenuation Tank	
Maintenance Period	Maintenance Task	Frequency
Maintenance Work	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risk to performance)	Monthly
	Remove sediment from pre-treatment structures and/or internal forebays.	Annually, or as required
Remedial Work	Repair/rehabilitate inlets, outlets, overflows and vents	As required.
Monitoring	Inspect/check all inlets, outlets, vents, and overflows to ensure that they are in good condition and operating as designed	Annually.
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required.

Table 4: SuDS Operation and Maintenance Requirements - Swales

SuDS Element	Detention Basin	
Maintenance Period	Maintenance Task	Frequency
Regular Maintenance	Remove litter and debris	Monthly, or as required
	Cut the grass – for spillways and access routes	Monthly (during growing season) or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring before nesting season and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and blockages and clear as required	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt removal frequencies	Monthly (for first year) then annually or as required
	Check and penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlets and forebays	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually
Occasional Maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years or as required

	Remove sediment from inlets, outlets, forebay and main basin when required.	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is required.
Remedial Actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows.	As required
	Relevel uneven levels and reinstate design levels.	As required

Suds Management Plan- Appendix A

Drainage Operation and Maintenance Log

Site Maintenance Supervisor:_____ Date:_____

☐ Routine ☐ Response to rainfall event _ in ☐ Other:_____

BMP	Frequency	Date Performed	Comments
Gullies and Manholes	Monthly Inspections		
	Maintenance Quarterly and as necessary		
Culverts and Headwalls	Inspect and identify areas not operating property every 3 months (for the first 3 months) and every 6 months after.		
	Monthly trash screens inspection and remove debris		
Pavement Areas (parking, driveways, service areas)	Monthly Sweeping		
	Rubbish & Litter Removal as Necessary		
Landscaped & Vegetated Areas	Maintenance as necessary		

Permavoid Paving	Rubbish, litter & debris removal on a monthly basis		
	Inspect for evidence of poor operation and silt accumulation on a quarterly basis		
	Specialist sweeping, jetting and vacuuming, as required		
	Remediation of any depressions, rutting or broken paving elements, as required		
	Annual inspection of inlets, outlets, overflows and vents to ensure correct operation.		
	Survey of inside of pond to assess debris / silt build up that may affect operation and clear, as required.		
Detention Basin	Monthly clearance of debris from catchment surface		
	Annual inspection of inlets, outlets, overflows and vents to ensure correct operation.		
	Survey of inside of pond to assess debris /		

	silt build up that may affect operation and clear, as required.		

Appendix O

PRELIMINARY DRAINAGE CALCULATIONS

25/07/2023

EXISTING FOUL WATE

ARDENT
CONSULTING ENGINEERS

Unit Type	Existing Area/Units		Hours (hrs)	Foul Water Flow Rate l/day			Peak Factor	Peaked Loading l/s			Loading (l/s)
General Housing p	2	units	24	600	per	property	6.6	0.0458333	per	property	0.092

TOTAL EXISTING FOUL LOADING = 0.092

PROPOSED FOUL WATE

Unit Type	Proposed Area/Units		Hours (hrs)	Foul Water Flow Rate l/day			Peak Factor	Peaked Loading l/s			Loading (l/s)
General Housing p	120	units	24	600	per	property	6.6	0.0458333	per	property	5.500

TOTAL PROPOSED FOUL LOADING = 5.500

PRELIMINARY DRAINAGE CALCULATIONS

25/07/2023

	Dry weather flow (in litres per day)	Daily Discharge (in litres)
General Housing per property	600	4000
School per pupil	80	528
Assembly Hall per seat	10	66
Cinema per seat	10	66
Theatre per seat	10	66
Sports Hall per person	50	330
Hotel per room	550	3630
Guest House per room	200	1320
Motel per room	300	1980
Holiday Apartment per person	150	990
Leisure Park per person	220	1452
Caravan Pk standard per space	250	1650
Caravan Site serviced per space	450	2970
Camping site standard per space	200	1320
Camping site serviced per space	350	2310
Public House per seat	150	990
Restaurant/Day Care Centre per person	270	1782
Drive in restaurant per seat	380	2508
Hospital per bed	750	4950
Nursing/Care Home per bed	375	2475
Offices per 100m sq	750	4950
Shopping Centre per 100m sq	400	2640
Warehouse per 100m sq	150	990
Commercial premises per 100 m sq	300	1980
Manufacturing unit per 100m sq	550	3630
General Housing per person	150	-
Toilet Facilities (WC) per use	10	-