

Drainage Assessment
August 2021
Version 1

Land at Marl Road
Knowsley
Kirkby
L33 7UH

FORSA ENERGY

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1.0 INTRODUCTION

1.1 Background

- 1.1.1 Amber Planning Ltd. has been appointed to prepare a National Planning Policy Framework (NPPF) compliant Drainage Assessment in support of an application for a 20MW gas powered standby electricity generation plant, along with associated infrastructure and access within a 0.47ha plot of land at Marl Road, Knowsley, Kirkby, L33 7UH. The Knowsley area falls within the administrative remit of Knowsley Council.
- 1.1.2 Planning was originally granted for this facility in 2015 (Ref. 2015/00595/FUL) which has now expired. Drainage comments were provided within Condition 7 and have been reviewed as input to this assessment.
- 1.1.3 Reference to Environment Agency (EA) online Flood Maps indicates the study area to be located within Flood Zone 1 (Low Risk) for fluvial flooding. The property is also indicated to be unaffected by surface water or reservoir flooding but is located within the Total Catchment for a Groundwater Source Protection Zone, with consideration of the potential impact of groundwater on the surface water management systems required.
- 1.1.4 This Drainage Assessment has been prepared in accordance with the National Planning Policy Framework (NPPF) and its Planning Practice Guidance (PPG). The requirements of the Environment Agency and Knowsley Council have also been accounted for within this study.

1.2 Objectives

- 1.2.1 The objectives of this Drainage Assessment are to:
- Evaluate the background hydrology;
 - Consider the impacts of the development on predeveloped rates and volumes of surface water runoff;
 - Recommend the mitigation and / or management measures required to prevent detrimental impacts to surface water flooding or hydrology at the site or within downstream receptors;
 - Identify opportunities for the incorporation of Sustainable Drainage Systems (SuDS); and
 - Provide recommendations for the design and delivery of surface water management. This includes the design of a drainage scheme which accounts for the requirements of the Environment Agency and the Lead Local Flood Authority.
- 1.2.2 Local development framework documents, including strategic policy and technical studies, have been reviewed as part of this study.

1.3 Confidentiality

- 1.3.1 Amber Planning has prepared this report solely for the use of The Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from Amber Planning; a charge may be levied against such approval.

2.0 SOURCES OF INFORMATION

2.1 General

2.1.1 In preparing this assessment background information has been sought from the following sources:

- Communities and Local Government (July 2021). National Planning Policy Framework¹;
- Communities and Local Government (*Living Document*). Planning Practice Guidance²;
- UK Government Guidance (July 2021). Flood Risk Assessments: Climate Change Allowances³;
- CIRIA (2015). C753: The SUDS Manual V.6;
- Knowsley Council website, Building and Planning page⁴;
- Knowsley Council (2016). Local Plan Core Strategy;
- Knowsley Council and Sefton Council (2009). Strategic Flood Risk Assessment: Level 1;
- Knowsley Council (*Living Document*). Local Flood Risk Management Strategy;
- Gov.uk website⁵;
- Defra Magic online mapping geographical and environmental data⁶;
- British Geological Survey online mapping⁷;
- Centre for Ecology and Hydrology Flood Estimation Handbook (FEH) Web Service, hydrometric data⁸; and
- Ordnance Survey mapping data⁹.

2.2 Planning Context - National Planning Policy

National Planning Policy Framework

2.2.1 The National Planning Policy Framework (NPPF) Section 14: *Meeting the Challenge of Climate Change, Flooding and Coastal Change*, and its Planning Policy Guidance (PPG) document provide guidance on the consideration of flood risk, drainage and water quality within development design.

2.3 Planning Context - Local Planning Policy

Local Plan Core Strategy

2.3.1 The Knowsley Local Plan comprises several documents. The Core Strategy sets out the strategic framework for the growth and development of Knowsley up to 2028 and beyond. It sets out how and where new development and regeneration should take place.

2.3.2 The Core Strategy provides the strategic context for other planning policy documents, including other parts of the Local Plan.

2.3.3 Core Strategy policies relevant to the consideration of Flood Risk and Drainage are:

- SD1: Sustainable Development
- CS2: Development Principles

¹ <https://www.gov.uk/government/publications/national-planning-policy-framework--2>

² <https://www.gov.uk/government/collections/planning-practice-guidance>

³ <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#table-2>

⁴ <https://www.knowsley.gov.uk/residents/building-and-planning>

⁵ www.gov.uk

⁶ <http://magic.defra.gov.uk/MagicMap.aspx>

⁷ <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

⁸ <https://fehweb.ceh.ac.uk/GB/map>

⁹ www.promap.co.uk

- CS8: Green Infrastructure
- CS19: Design Quality and Accessibility of New Development
- CS22: Sustainable and Low Carbon Development
- CS23: Sustainable and Low Carbon Infrastructure
- CS24: Flood Risk

Strategic Flood Risk Assessment

- 2.3.4 The SFRA forms a critical part of the Council's evidence base in terms of informing / identifying appropriate locations for development. This document also underpins wider decision making within the planning process and has been reviewed as input to this study.

3.0 BACKGROUND AND DATA REVIEW

3.1 Site Setting

Property Address	Land at Marl Road, Knowsley, Kirkby, L33 7UH
National Grid Reference	343350, 399470
Area	0.47ha

Table 001: Site Setting

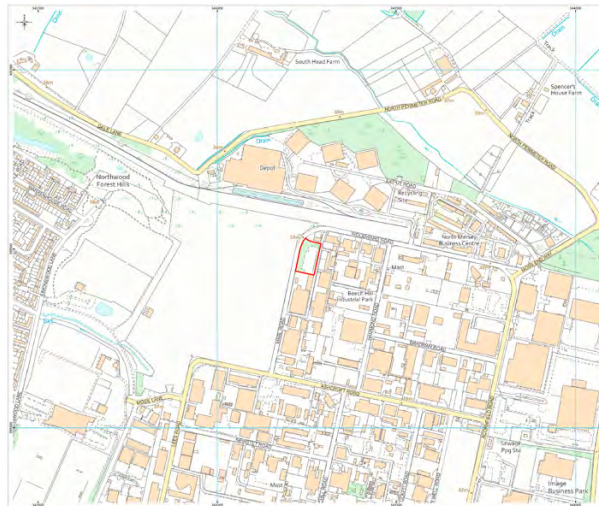


Figure 001: Site Location Plan

3.2 Current Layout



Figure 002: Existing Site Layout – Aerial Photograph

- 3.2.1 The site comprises a 0.47ha plot of brownfield land at Knowsley Industrial Park (Figure 002), located on the outskirts of Kirkby, c.2km north east of the town centre. Access is via Marl Road to the west. The surface finish is currently partially concrete with soft landscaped areas present at the perimeters, which are currently overgrown with scrub and poor quality vegetation.

3.3 Proposed Layout

- 3.3.1 The development comprises a 20MW gas powered standby electricity generation plant with access and ancillary infrastructure including:
- 10 no. 2MW engine units (55m² per unit; 550m² in total);
 - Access and turning head: 1,650m²
 - HV/LV Switch Room: 55m²
 - DNO Metering Station: 27m²
 - Control Room: 23m²
 - Store Room: 15m²
 - Transformer Compounds: 23m²
 - Car parking: 20m²
 - Gas reception kiosk: 13m²
 - Gravel Cover: 975m²
- 3.3.2 The proposals involve no significant material change to the ground profile, aside from the input of formalised level surfaces. Figure 003 provides a summary of the proposed layout, with full details contained within Drawing FE/017/389: *Proposed Site Layout*, located to the rear of this report.
- 3.3.3 The proposals are non-residential in nature, with a designated lifetime of 25 years (temporary).



Figure 003: Proposed Layout

3.4 Topography

- 3.4.1 Topographic survey data indicates surface elevations of 38m AOD on Marl Road adjacent to the site. Ground levels on Woodward Road to the north east are located at 39m AOD as are elevations on Ashcroft Road (south east). Surface elevations of 36m AOD and 37m AOD are recorded on the North Perimeter Road and Moss Lane, to the north west and south west, respectively, indicating a general reduction in ground level moving west.

3.5 Surrounding Area

Direction	Description
North	Recycling depot, Depot Road, North Perimeter Road and agricultural fields beyond.
South	Industrial Park.
East	Industrial Park.
West	Site access onto Marl Road, open scrub land beyond – subject to development.

Table 002: Site Surrounds

3.6 Hydrogeology

- 3.6.1 Regional geological mapping indicates the bedrock geology to comprise the Chester Formation – Sandstone, overlain by superficial deposits of the Shirdley Hill Sand Formation – Sand.
- 3.6.2 BGS borehole log data is available in this vicinity, although most of this data is restricted. Data from one borehole located 400m SW (SJ49NW1157, March 2007) records a water strike at 17m with a resting water level of 8.00m. A cluster of boreholes is present c.400m east, two of which (SJ49NW841, April 2001 and SJ49NW859, April 2002) record no water strikes to the depth of well, (9m bgl and 5m bgl, respectively). A further two boreholes in the same vicinity (SJ49NW840, April 2001 and SJ49NW861, April 2002) record groundwater at 0.75m bgl and 1.75m bgl, respectively. It is considered that groundwater contours dip in a westerly direction, matching the topography.
- 3.6.3 Mapping data downloaded from Defra's Magic website indicates the area to be located within the Total Catchment Area for Groundwater Source Protection Zones, with consideration required of the potential impact of groundwater on the surface water management systems.
- 3.6.4 The SFRA indicates Knowsley Groundwater levels as being Above Ordinance Datum (0m AOD) but provides no further information on potential groundwater contours in this area.
- 3.6.5 Based on the above, it is anticipated that main groundwater is located at depth with potential impacts on surface water storage and management systems likely to be limited.

3.7 Hydrology

- 3.7.1 An unnamed watercourse, likely a land drainage channel, is present c.500m north east of the site. This drains an upstream catchment of 5.86km² and flows north west passing beneath the railway line and skirting the north eastern edge of Tower Hill before discharging into the Simonswood Brook 2.5km downstream on the northern outskirts of Tower Hill. Downstream of this confluence the Simonswood Brook continues south passing through Kirkby and forming the Kirkby Brook, discharging into the River Alt downstream of the town.
- 3.7.2 A number of land drainage channels are present within the lowland area present to the north and east of the wider Knowsley Industrial Estate. These also drain in a north westerly direction, converging with the unnamed drainage channel downstream.
- 3.7.3 Catchment descriptor information has been downloaded from the CEH Flood Estimation Handbook Web Service for the area including the site which is summarised in Table 003. This indicates a small, heavily urbanised catchment, with low topographical relief, permeable geology and moderate average annual rainfall.
- 3.7.4 Flows within local watercourses are likely to be predominated by baseflow (BFIHOST), with more minor contributions from overland flow (SPRHOST) and with a moderately low catchment response to incident rainfall anticipated. At a local level the catchment response to rainfall may be elevated in urban areas or where less permeable overlying geology is present.

Catchment Descriptor	Value
AREA	5.86m ²
River Baseflow Index (BFIHOST-19)	0.573
Standard Percentage Runoff (SPRHOST)	26.18%
Drainage Path Length (DPLBAR)	2.83km
Drainage Path Slope (DPSBAR)	8.30m/km
Flood Attenuation by Rivers and Lakes (FARL)	1.000
Proportion of time soils are wet (PROPWET)	0.38
Standard Annual Average Rainfall (SAAR)	890mm
Urban Extent (URBEXT: 2000)	0.1339

Table 003: FEH Catchment Descriptor Information

3.8 Surface Water Flooding

- 3.8.1 Detailed EA pluvial mapping downloaded from the EA website, assesses three main scenarios, Low Risk (0.1%-1% probability of flooding annually), Medium Risk (3.3% - 1%) and High Risk (>3.3%). The findings of this assessment are summarised in Figure 004.
- 3.8.2 This data indicates the site to be generally at **Very Low** risk from surface water flooding, with discrete areas of **Low / Medium** Risk present at the site margins. The input of a formal drainage network, which includes on-site attenuation and controlled discharge would mitigate this risk, with no residual impact to the facility or its surface water management networks anticipated.

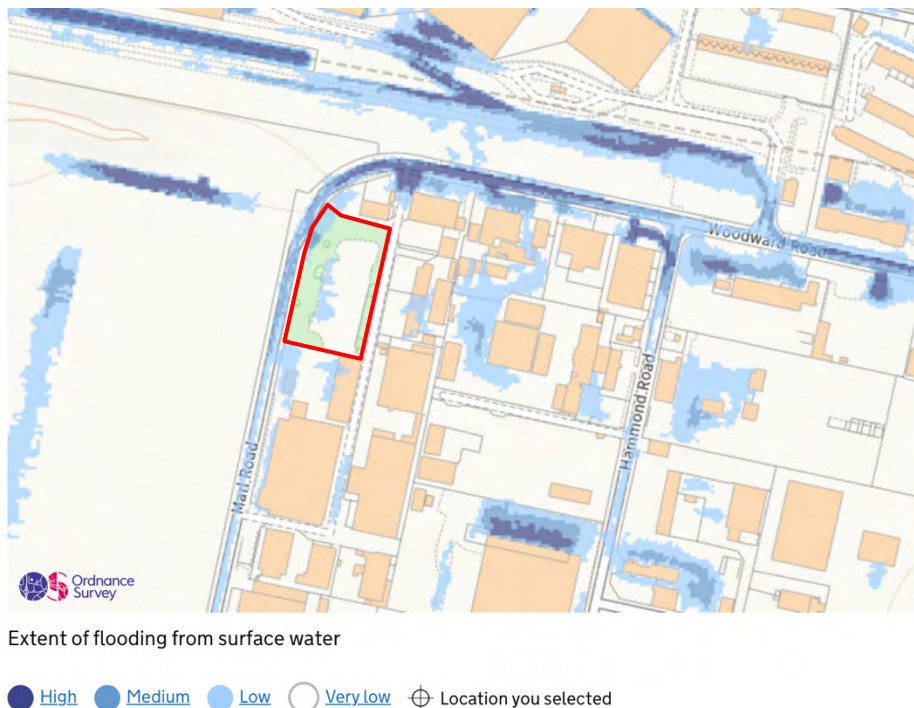


Figure 004: Environment Agency Surface Water Flood Map

3.9 Climate Change

Rainfall Allowance

- 3.9.1 Government Guidance on Climate Change Allowances to Peak Rainfall Intensity (Table 2), requires application of climate change factors of up to 20% (Upper End) to 2069, based on a development lifetime <25 years (temporary, non-residential use).

4.0 SURFACE WATER

4.1 Introduction

- 4.1.1 Proposals include the construction of a 20MW gas powered standby electricity generation plant, associated infrastructure and access within a 0.47ha plot of land off Marl Road, Knowsley, Kirkby, L33 7UH.
- 4.1.2 The subject site currently drains unattenuated via infiltration into the underlying soils, with excess runoff discharged to local drainage networks and watercourses via overland flow.
- 4.1.3 The NPPF and its PPG require that existing runoff rates be maintained, taking account of climate change and that, wherever possible, a degree of betterment is provided.
- 4.1.4 The property comprises a Brownfield plot with existing impervious surfaces present. Whilst only a minor increase in impervious area will arise from development proposals, climate change impacts may lead to detrimental impacts on the rate and volume of surface water runoff generated over time which, without mitigation, would have a consequent detrimental impact on downstream flooding.
- 4.1.5 In accordance with the NPPF new development must incorporate flood attenuation measures sized to runoff generated by formalised surfaces for return period pluvial flood events up to and including 100 years, taking account of climate change and with discharges restricted to *modified greenfield* rates. Water quality treatment is also required to mitigate potential detrimental impacts to downstream receptors, including groundwater and local watercourses.
- 4.1.6 Sustainable Drainage Systems (SuDS) must be incorporated within the design, wherever practicable.

4.2 Land Use

Land Use	Existing		Proposed	
	Area (m ²)	Runoff Coefficient	Area (m ²)	Runoff Coefficient
Soft Landscaping	2,130	0.40	1,370	0.40
Gravel Chippings	0.00	0.70	975	0.70
Impermeable (roads / hardstanding / built)	2,570	0.90	2,355	0.90
Total	4,700	0.67	4,700	0.71

Table 004: Summary of Land Use

4.3 SuDS Options for Surface Water Disposal

- 4.3.1 Initial desk based investigation suggests the presence of permeable underlying geology, with potential for surface water disposal via infiltration. Further detailed site investigation is required to establish the rate of infiltration and the absence of contaminants, given that the property comprises brownfield land.
- 4.3.2 The application area appears to be remote from land drainage networks or local watercourses into which a connection could be established for surface water disposal.
- 4.3.3 A surface water sewerage network is understood to serve the wider industrial estate with the nearest drain likely to be situated beneath Marl Road to the west. The application area comprises previously developed land and may have an existing connection present into which runoff could be discharged, with this the preferred connection.
- 4.3.4 In the absence of ground investigation data, the surface water attenuation measures have been sized based on discharge to local sewerage networks at *modified greenfield* rates. SuDS measures are proposed to maximise infiltration at source. Given that there the application area contains existing impervious surfaces, it is considered that this would result in a betterment to

the current rate and volume of runoff discharged to the surface water sewer.

4.3.5 This conforms with the discharge hierarchy as outlined within Section 3.2.3 of the SuDS Manual, as follows:

SuDS Discharge Hierarchy:

- Infiltration. Possibly – permeable underlying geology – further investigation required.
- Discharge to surface waters. No. Property is remote to watercourses.
- Discharge to surface water sewer. Yes. Preferred option – SuDS based attenuation is proposed to maximise infiltration at source.
- Discharge to combined sewer (Last Resort). NA.

4.4 Greenfield Runoff Rates

4.4.1 Greenfield runoff rates have been estimated using the WinDes Micro drainage ICPSUDS function, with input data from the Flood Estimation Handbook web service and based on linear interpolation from a 50ha catchment, in accordance with SUDS manual guidance.

4.4.2 As the application area comprises previously developed (*Brownfield*) land, the runoff rates have been calculated assuming Greenfield discharges, with the soil factor within the ICPSUDS calculations increased to 0.5 to represent hard landscaped surface finishes with this providing a '*modified Greenfield*' runoff rate. This is in accordance with SuDS Manual guidance (Section 24.5, approach 2). Table 005 summarises the results of this analysis. Full copies of these calculations are located at Appendix II: *Workings*.

Return Period (yrs.)	Runoff Rate (l/s/ha)	Runoff Rate (l/s)
Q_{BAR}	8.872	2.696
30	14.552	4.422
100	17.326	5.265

Table 005: Greenfield Runoff Rates *Based on a 0.304ha effective impermeable area

4.5 Attenuation and Controlled Discharge

4.5.1 The WinDes Micro Drainage software package has been used to estimate the surface water attenuation requirements. Storm scenarios were run for both winter and summer profiles, for a range of durations (15-10,080 minutes), taking account of land use data, greenfield runoff rates and climate change, respectively. Copies of these calculations are contained within Appendix II and are summarised below.

4.5.2 The WinDes Micro Drainage package assumes all land surface to be impermeable. Therefore, where the runoff coefficient differs (e.g. gravel / stone chipping) the total contributing area has been multiplied by the runoff coefficient to establish a 3,040m² (0.304ha) '*Effective Impermeable Area*' for assessment. Impermeable surfaces are accounted for at 100%.

Results

Return Period Rainfall Event (Yrs.)	Required Storage (m ³)
Q_{BAR} Urban	53
30	106
100	146

Table 006: Surface Water Attenuation Requirements

4.6 Drainage Layout

- 4.6.1 A maximum rainwater storage requirement of 146m³ has been estimated. This will be provided by storm cells situated beneath the turning circle in the south eastern boundary and sized to accommodate runoff for return period rainfall events up to and including the 100 year storm, without surcharge and accounting for climate change at 20% (based on a temporary development lifetime of 25 years). Refer to Drawing H8396-001 for a graphical representation of the proposed drainage layout.
- 4.6.2 The following design considerations have been assumed:
- Depth: 0.4m
 - Area: 365m²
 - Porosity: 0.95
 - Max. Water Level: 0.401m
 - Volume: 146m³
 - Overburden: >600mm
- 4.6.3 A dual outfall arrangement is proposed, with a low level outfall which will release runoff at a lower rate under standard conditions, and a high level offtake to permit an elevated discharge under flood flows. Discharge from both outfalls will be controlled by a Hydrobrake / restricted orifice fitted with a flow control slot and / or flap valve, to ensure existing (*modified greenfield*) runoff rates are maintained, and to reduce the likelihood of blockage leading to surcharge.
- 4.6.4 This configuration will promote infiltration to ground, where practicable, with excess water discharged via gravity to surface water sewers at controlled (*modified greenfield*) rates.
- 4.6.5 Topographical survey indicates ground levels of 38.1m AOD on Marl Road to the west, with invert levels on the SW sewer likely to be a minimum of 1.2m bgl. The base of the storm cells will be located at or around 1.00m bgl (37.10m AOD), with gravitational discharge deemed feasible.

4.7 Network Capacity

- 4.7.1 Roof water (where present), will drain to the attenuation facility via a piped network sized to convey surface water for rainfall events of up to 100 years, including climate change and without surcharge. Where practicable, the fall on the piped networks has been designed to promote self-cleansing.
- 4.7.2 Runoff from the hardstanding areas will be directed to the storage facility via perimeter filter drains with underlying permeable pipework. It is recommended that all filter drains / permeable pipes be lined / sleeved with a geotextile membrane to reduce sediment ingress / clogging, with a silt trap fitted at the downstream end to prevent sedimentation of the attenuation facility.
- 4.7.3 The piped networks are sized to convey runoff for return period storms up to and including 100 years, accounting climate change, without surcharge, with capacity present for short duration rainfall, e.g. the 15 minute storm. Minor ground reprofiling may be necessary to facilitate pipe protection and gravitational discharge into the storage area.
- 4.7.4 The attenuation facility is designed to be dry under normal conditions becoming operational only following intense rainfall or storm activity. Capacity is present to accommodate rainfall events up to and including the 100 year storm, accounting for climate change and without surcharge. The storm cells will be wrapped in a geotextile membrane to prevent losses in efficiency arising from sedimentation.
- 4.7.5 It is anticipated that the attenuation facility will not suffer impacts to efficiency arising from groundwater ingress. Nevertheless, where groundwater is encountered during construction clay liners should be incorporated within the design.
- 4.7.6 Intercept drainage will be placed at the site perimeter to direct runoff back into the on-site surface water management systems and prevent the uncontrolled discharge of runoff to third party property.

4.8 Water Quality

- 4.8.1 The surface water management system incorporates a number of SuDS elements which have been designed in accordance with the SuDS Manual (CIRIA report no. C753) to provide on-site water quality treatment. These measures account for the Pollution Hazard and Mitigation Indices outlined within Tables 26.2 and 26.3 of the SuDS Manual, respectively; with these summarised in Tables 007 and 008 of this report.

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
General industrial (Energy Facility)	High	0.8	0.8	0.9

Table 007: Excerpt from CIRIA 753 Table 26.2 Pollution Hazard Indices for Different Land Use Classifications

- 4.8.2 Review of the SuDS Manual Table 26.2 indicates there to be no hazard classification which applies specifically to the nature of development proposed. However, as the proposals are industrial in nature a High Hazard has been assumed.

SuDS Mitigation Indices			
SuDS Component	Total Suspended Solids	Metals	Hydrocarbons
Filter Strip	0.4	0.4	0.5
Filter Drain	0.4	0.4	0.4
Adjusted SuDS Mitigation Index¹	0.6	0.6	0.7

¹ Applies where the Mitigation Index of individual SuDS component is insufficient to treat runoff in isolation and where 2 SuDS components (or more) are required in series

Table 008: Excerpt from CIRIA 753 Table 26.3 SuDS Mitigation Indices for Discharges to Surface Waters

- 4.8.3 Review of the above data indicates the Mitigation Index for each of the SuDS Components to be below the identified Pollution Hazard Index for TSS and Hydrocarbons present within runoff generated by High Hazard Level sites.
- 4.8.4 The guidance notes within CIRIA 753, P.568 state that where the Mitigation Index of an individual SuDS component is insufficient to perform water treatment in isolation, two SuDS components (or more) in series will be required, where:

$$\text{Total SuDS Mitigation Index} = \text{Mitigation Index}_1 + 0.5 (\text{Mitigation Index}_2)$$

- 4.8.5 A factor of 0.5 is used to account for the reduced performance of secondary or tertiary components associated with already reduced inflow concentrations. For example, the adjustment for TSS would be calculated as follows:

$$\text{Total SuDS Mitigation Index (TSS)} = 0.4 + (0.5 * 0.4) = 0.60$$

- 4.8.6 The adjusted SuDS Mitigation Indices are presented in the bottom row of Table 008. Based on this adjusted data it is concluded that the proposed SuDS Mitigation measures outlined above and expanded on below, are insufficient to mitigate potential contaminants present within the runoff from the proposed facility in isolation.
- 4.8.7 It is therefore proposed to provide an oil interceptor upstream of the surface water storage area to remove silts, suspended solids and hydrocarbons from runoff and to ensure that no detrimental impacts to water quality arise from development proposals.

Water Quality Treatment

4.8.8 Based on the above analysis the following water quality treatment measures will be interspersed throughout the development and will service the different built elements as follows:

- Roof drainage to pass to the attenuation area via filter drains with no further treatment aside from silt traps located at the upstream end of all pipe runs to remove silts and sediments upstream of the SW storage facility;
- Potentially contaminated runoff from the plant, roads and hardstanding will discharge to the attenuation facility via the following water quality treatment, designed in accordance with the requirements of the SuDS Manual section 4 (Table 4.3) and Section 26 (Tables 26.2 and 26.3):
 - **Filter Strips:** 1m wide grass / crushed stone strips present between facility / car parks / roads / filter drains to slow runoff and encourage sediment deposition;
 - **Filter Drains:** Situated at the property perimeter and designed to convey runoff into the storm cells via an underlying permeable pipe. Storm cells and permeable pipework to be wrapped in membrane to prevent sediment ingress; and
 - **Oil Separator:** Situated upstream of the main flood storage facility and sized to accommodate the upstream impervious catchment area.

4.8.9 The inclusion of the above measures will encourage the settlement and retention of sediments, preventing blockage of the inlet(s) / outfall(s) and the discharge of sediment laden water to local watercourses / surface water sewers and associated scour, and will ensure that only clean water is discharged.

4.8.10 Where contamination is identified to be present within the subsoil, clay liners should be included within the design of the surface water management systems to prevent the opening of contaminant pathways between surface and groundwater receptors.

First Flush Areas

4.8.11 In line with best practise first flush storage is required to accept the first 5mm of rainfall from impervious areas and infiltrate it into the surrounding topsoil. This to reduce off-site surface water discharges during minor rainfall events.

4.8.12 A total first flush storage requirement of 15.20m³ is calculated based on an effective impermeable area of 3,040m². It is anticipated that this would be easily accommodated within the on-site SuDS measures, which include filter drains and storm cells, and which will promote the interception and infiltration of runoff at source, limiting off-site discharges under general / low flow conditions.

4.9 Management and Maintenance Responsibility

4.9.1 **Forsa Energy Gas Holdings Limited**, or its successor, will be responsible for ensuring the ongoing management and maintenance of the surface water management systems serving the application area, either directly or via an appointed contractor. The responsibility for management and maintenance will pass to the lessee, where the facility is operated by a third party, and to the purchaser where the property is subject to sale.

Inspection and Maintenance Schedule

4.9.2 It is proposed that a programme of inspection and maintenance be executed for the surface water management systems by the site facilities manager, or appointed drainage contractor. This should be undertaken in accordance with the schedule outlined below and following significant rainfall events and / or storm activity. This maintenance schedule applies for the lifetime of the development.

4.9.3 A photographic record of inspections should be undertaken to pick up long term changes that may not be apparent within a single inspection. Inspections should comply with all relevant Health and Safety legislation.

Notes

4.9.4 All waste arisings should be collected by an approved contractor and should be subject to appropriate treatment and disposal. The site facilities manager should be contacted where pollution or blockage are identified.

Element	Frequency	Notes
Gulleys / Gulley Pots / Drainage grates	Quarterly / following storm activity	- Remove grill and check for debris / blockage. - Remove accumulated debris to prevent blockage of pipework. - Rod / jet where required. Silt traps to be cleansed before and after rodding.
Manholes / Inspection Covers / pipework	Quarterly / following storm activity	- Visual inspection – remove cover, shine torch into manhole. - Check every orifice for blockage / siltation. - Pour water into each to verify through flow. - Remove debris /silt and rod / jet where required.
Silt Traps	Quarterly / following storm activity	- Visual inspection, removal of accumulated silt. - Where rodding of manholes is proposed silt traps should be cleansed before and after to prevent silt bypassing the traps.
Filter Strips	Quarterly / following storm activity	- Regular mowing and maintenance will be key to ensuring the continued efficiency of the filter strips. - Reseeding or turfing should be undertaken where bald patches or die back occur.
Filter Drains	Quarterly / following storm activity	- Visual inspection for accumulated silt / vegetation (at surface). - Check for surface clogging / ponding. Remove vegetation / silt. - Remove siltation / blockage from the stone sub-base and/or underlying pipework serving the drainage blanket.
Storm Cells	Quarterly / following storm activity	- Visual inspection for accumulated silt. Where significant siltation is seen, remedial works should be undertaken. - Visual inspection / removal of accumulated, debris, blockage.
Inlets / Outfalls	Quarterly / following storm activity	- Visual inspection for accumulated debris or blockage, at both upstream and downstream faces. - Check every orifice / inlet / outlet / structure for blockage or siltation, pour water into each to verify through flow. - Remove any debris and rod where required.
Oil Separator	In accordance with manufacturers' specification.	NA

Table 009: Drainage Inspection and Maintenance Schedule

5.0 CONCLUSIONS

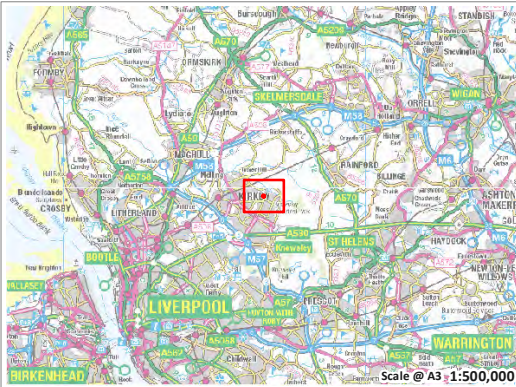
- 5.1 Amber Planning Ltd. has been appointed to prepare a National Planning Policy Framework (NPPF) compliant Drainage Assessment in support of an application for a 20 MW gas powered standby electricity generation plant along with associated infrastructure and access road within a 0.47ha plot of land at Marl Road, Knowsley, Kirkby, L33 7UH. This area falls within the administrative remit of Knowsley Council.
- 5.2 Planning was originally granted for this facility in 2015 (Ref. 2015/00595/FUL), which has now expired.
- 5.3 This Drainage Assessment has been completed in accordance with the guidance set out in the NPPF, Section 14, and its accompanying PPG for *Less Vulnerable* development within Flood Zone 1. The requirements of Local Planning Policy, including the SFRA, have also been accounted for within this assessment.
- 5.4 The application area comprises previously developed (*brownfield*) land, with existing formalised surfaces present.
- 5.5 The surface water attenuation requirements for the facility have been assessed using the WinDes Micro Drainage software package for return period rainfall events up to and including 100 years, taking account of existing runoff rates, land use data (*brownfield*) and climate change consideration, with a total storage of 146m³ proposed.
- 5.6 Controlled gravitational discharge to the surface water sewerage network on Marl Road is proposed, possibly via an existing connection, with this restricted to *Modified Greenfield* rates and with this anticipated to result in an overall beneficial impact on current rates of discharge.
- 5.7 All drainage networks have been designed to account for industry best practice with regards system capacity, with safety factors accounted for within the storage calculations to allow for successive rainfall events, fluctuations in flow and flood levels, climate change sensitivity and losses in efficiency associated with siltation.
- 5.8 It is duly presented that the provision of a formal surface water management system, which incorporates on-site attenuation and water quality treatment, will ensure that potential detrimental impacts to flood risk and water quality are suitably mitigated throughout the anticipated development lifetime, in accordance with the National Planning Policy Framework and its accompanying Planning Practice Guidance. The requirements of Local Planning Policy and Technical studies have also been accounted for within this assessment.
- 5.9 **Forsa Energy Gas Holdings Limited**, or its successor, will be responsible for the ongoing management and maintenance of the surface water management system, throughout its lifetime, either directly or via an appointed contractor. The responsibility for management and maintenance will pass to the lessee, where the facility is operated by a third party, and to the purchaser where the site is subject to sale.
- 5.10 The mitigation solutions noted within this report are subject to agreement with the Environment Agency / IDB and Knowsley Council in their respective capacities within the Lead Local Flood Authority and as part of the application process.
- 5.11 It is duly presented that the proposed facility is appropriate within the context of the NPPF and Local Planning Policy.

6.0 CLOSURE

- 6.1 This report has been prepared by Amber Planning Ltd. with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with The Client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.
- 6.2 Reliance has been placed on factual and anecdotal data obtained from the sources identified. Amber Planning Ltd. cannot be held responsible for the scope of work, or any omissions, misrepresentation, errors or inaccuracies within the supplied information. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part in the event of delay between the writing of the report and its consideration by The Client, with particular regard to submission of a planning application.
- 6.3 This report is for the exclusive use of The Client; no warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from Amber Planning.
- 6.4 Amber Planning disclaims any responsibility to The Client and others in respect of any matters outside the agreed scope of the work.



- Development Area
- Acoustic Fence (3m Height)
- Security Fence (2.4m Height)
- Commercial Vehicle Access
- Retained Trees & Vegetation



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FORSA ENERGY

Proposed Site Layout

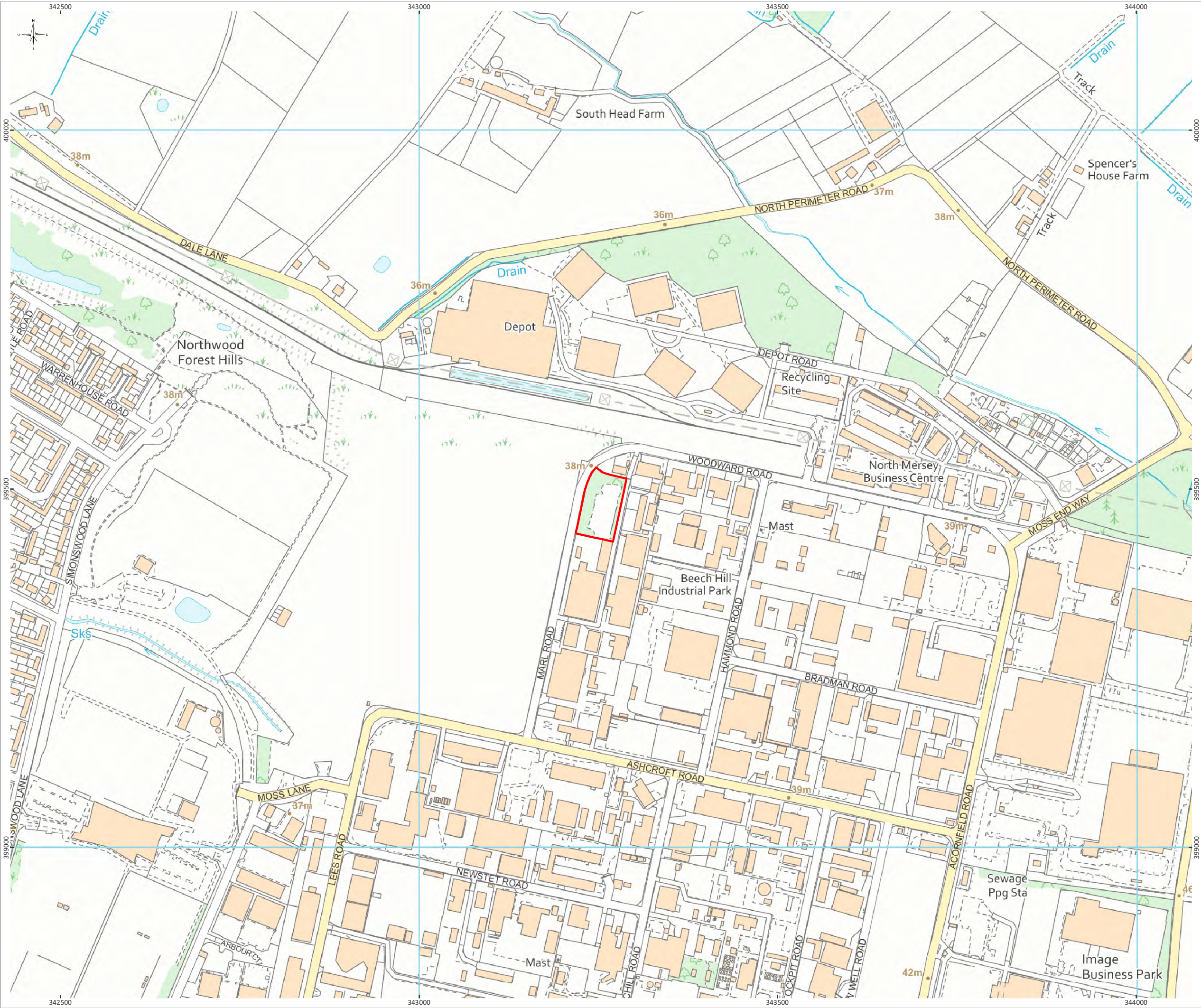
**Gas Peaking Site
Marl Road, Knowsley, Kirkby**

Notes:

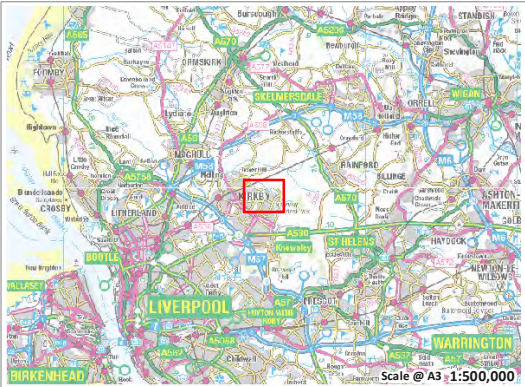
Ref: FE/017/389
Date: 08/07/2021
Produced: VM
Approved: RW

Scale @ A3
1:600
0 3 6 12 metres
0 3 6 12 yards





Development Area



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FORSA ENERGY

Site Location

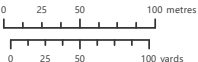
Gas Peaking Site
Marl Road, Knowsley, Kirkby

Notes:

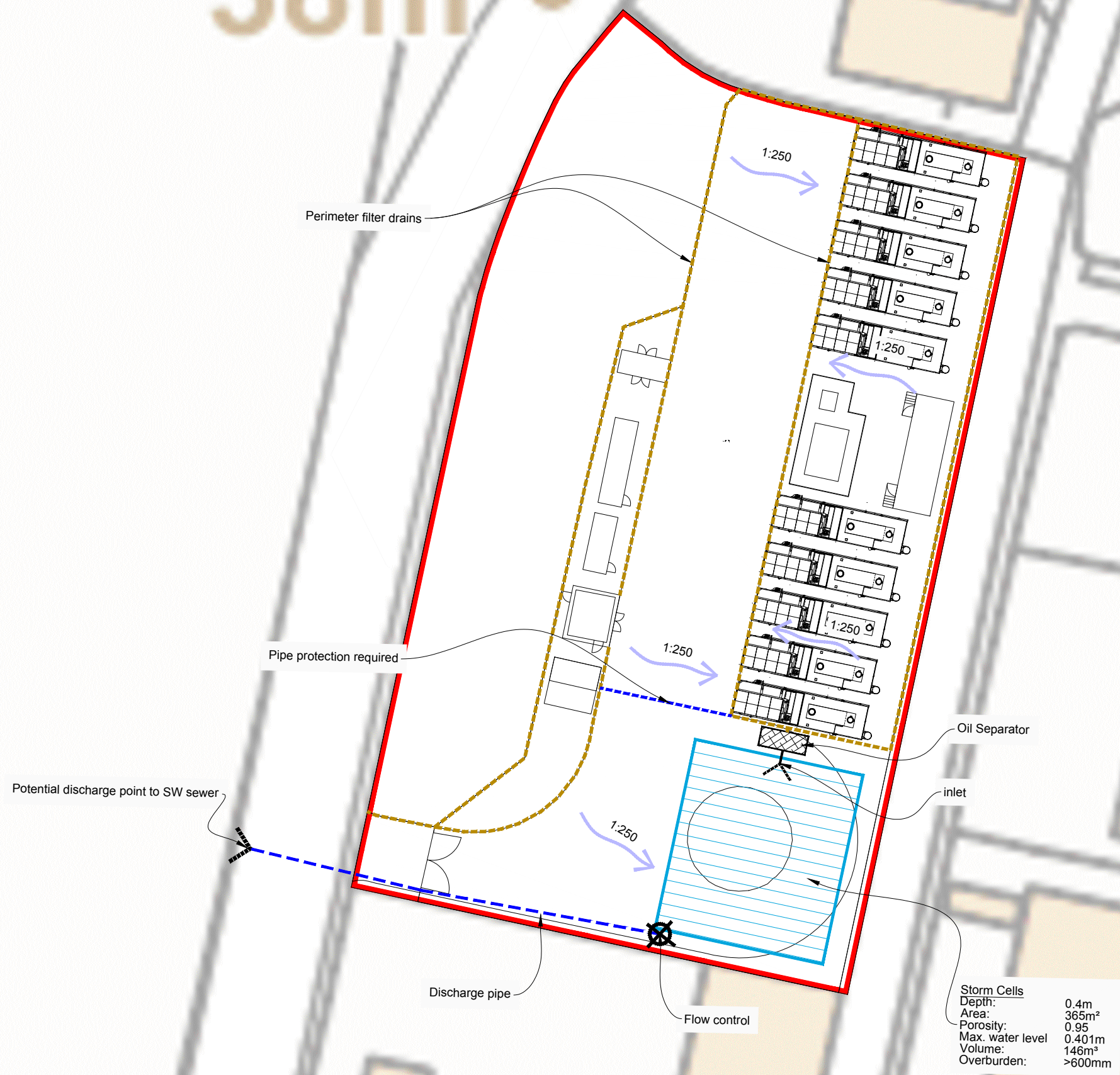
Ref: FE/017/390
Date: 08/07/2021

Produced: VM
Approved: RW

Scale @ A3
1:5,000



38m •



Storm Cells
Depth: 0.4m
Area: 365m²
Porosity: 0.95
Max. water level: 0.401m
Volume: 146m³
Overburden: >600mm

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Do not scale off drawings
All dimensions to be checked on site.

Amber Planning Ltd

www.amberplanning.co.uk
Tel. 07930 877447

- KEY
- Storm Cells
 - Linked Pipes
 - Filter Drain

SCALE
1:500 @ A3

DATE
Sept 2021

DRAWN
KR

PROJECT NO.
H8396

DRAWING NO.
H8396-001

CHECKED
KdS

PROJECT
Land at Marl Road, Knowsley, Kirkby, L33 7UH

DRAWING TITLE
Conceptual Drainage Layout

CLIENT

BOREHOLE CONSTRUCTION	SAMPLE		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	BOREHOLE NUMBER: BH201		PAGE 1 of 1	
	NUMBER	TYPE					DRILLING DATES: 10/4/01		DRILLING METHODS: Hollow Stem Auger	
							DRILLER: Cape Site Services		BOREHOLE DIAMETER: 115mm	
							LOGGED BY: M.J.Logan		SCREEN TYPE & DIAM: UPVC - 50mm	
							CHECKED BY: LCT		SCREEN SLOT SIZE: 1mm	
DESCRIPTION							COMMENTS			
TOPSOIL: Medium dense dark brown/black soil with some fine sand, rare medium gravel and occasional red brick fragments (up to 5mm.)						Dry/Damp, NVO	0.0			
MADE GROUND: Soft light brown/grey sandy clay with rare medium gravel.						Damp, NVO	0.5			
Firm light brown CLAY with rare coarse gravel. (Boulder clay).						Dry, NVO	1.0			
							1.5			
							2.0			
							2.5			
							3.0			
							3.5			
							4.0			
							4.5			
Borehole completed at 4.5mbgl.							5.0			

LOCATION / NOTES: NVO = No visual or olfactory evidence of contamination	LEGEND Disturbed Sample Undisturbed Sample Headspace Analysis Down Borehole Analysis Groundwater Table Perched Water Table	BOREHOLE LOG Job Title: Phase II Investigation & Risk Assessment Location: Kirkby, Merseyside Client: Clariant	
			App'd: SFM Date: NOV 2001 Drawn: AFF Ref: AFF/BHT/MCI Scale: As Shown Job No: 47085-004 Drg. Size: A4 BOREHOLE LOG

BOREHOLE CONSTRUCTION	SAMPLE		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	BOREHOLE NUMBER: BH202		PAGE 1 of 2	
	NUMBER	TYPE					DRILLING DATES: 11/4/01		DRILLING METHODS: Hollow Stem Auger	
							DRILLER: Cape Site Services		BOREHOLE DIAMETER: 115mm	
							LOGGED BY: M.J.Logan		SCREEN TYPE & DIAM: UPVC - 50mm	
		CHECKED BY: LCT		SCREEN SLOT SIZE: 1mm						
					0.0		DESCRIPTION	COMMENTS	0.0	
					0.5		TOPSOIL: Loose black sand with some coarse sand and fine gravels, cobbles (up to 6cm), some red brick (2mm-40mm), some black ash and some light grey limestone ballast (2mm-70mm.)	Damp, NVO	0.5	
			*39.2		1.0		MADE GROUND: Medium dense dark brown/black sandy gravel with rare soft clay and some red brick fragments (up to 1cm.)	Damp, NVO	1.0	
	0.8-1.2 TPH VOC	X	*48.2		1.5		MADE GROUND: Medium dense dark brown/black silty sandy clayey soil with some red brick fragments (up to 5cm) and rare dark red/brown wood.	Damp, black staining. Slight Hydrocarbon odour.	1.5	
	TPH Pesticides	X	*45.6		2.0		Soft/firm light brown/red silty sandy CLAY with some fine gravel.	Damp, slight black staining. Slight Hydrocarbon odour.	2.0	
					2.5		Soft/firm light brown CLAY with some coarse/medium gravel. (Boulder Clay).	Dry, NVO	2.5	
					3.0		Firm light brown CLAY with some coarse/medium gravel. (Boulder Clay).		3.0	
					3.5				3.5	
					4.0				4.0	
					4.5				4.5	
					5.0				5.0	
LOCATION / NOTES: NVO = No visual or olfactory evidence of contamination Borehole dry.						LEGEND Disturbed Sample Undisturbed Sample Headspace Analysis Down Borehole Analysis Groundwater Table Perched Water Table		BOREHOLE LOG Job Title: Phase II Investigation and Risk Assessment Location: Kirkby, Merseyside Client: Clariant App'd: SFM Date: APR 2001 Drawn: AFF Ref: AFF/BHT/MC Scale: As Shown Job No: 47085-004 Drg. Size: A4 BOREHOLE LOG		

BOREHOLE CONSTRUCTION	SAMPLE		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	BOREHOLE NUMBER: BH202		PAGE 2 of 2	
	NUMBER	TYPE					DRILLING DATES: 11/4/01		DRILLING METHODS: Hollow Stem Auger	
							DRILLER: Cape Site Services		BOREHOLE DIAMETER: 115mm	
							LOGGED BY: M.J.Logan		SCREEN TYPE & DIAM: UPVC - 50mm	
							CHECKED BY: LCT		SCREEN SLOT SIZE: 1mm	
					5.5					
					6.0	Soft light brown CLAY with some coarse gravel and rare silt.(Boulder Clay).		Slightly damp,NVO		6.0
					6.5	Soft/firm light brown CLAY with some coarse gravel. (Boulder Clay).		Dry,NVO		6.5
					7.0					7.0
					7.5	Soft light brown CLAY with some silt,fine sand and coarse gravel.(Boulder Clay).		Slightly damp,NVO		7.5
					8.0					8.0
				8.5	Very soft light brown CLAY with some fine sands and rare coarse gravel.(Boulder Clay).		Very damp,NVO		8.5	
				9.0	Borehole completed at 9.0mbgl.					9.0
				9.5						9.5
				10.0						10.0

LOCATION / NOTES: NVO = No visual or olfactory evidence of contamination Borehole dry.	LEGEND  Disturbed Sample  Undisturbed Sample  Headspace Analysis  Down Borehole Analysis  Groundwater Table  Perched Water Table	BOREHOLE LOG Job Title: Phase II Investigation and Risk Assessment Location: Kirkby,Merseyside Client: Clariant							
		 <table border="1"> <tr> <td>App'd: SFM</td> <td>Date: APR 2001</td> </tr> <tr> <td>Drawn: AFF</td> <td>Ref: AFF/BHT/MC</td> </tr> <tr> <td>Scale: As Shown</td> <td>Job No: 47085-004</td> </tr> <tr> <td>Dwg. Size: A4</td> <td>BOREHOLE LOG</td> </tr> </table>		App'd: SFM	Date: APR 2001	Drawn: AFF	Ref: AFF/BHT/MC	Scale: As Shown	Job No: 47085-004
App'd: SFM	Date: APR 2001								
Drawn: AFF	Ref: AFF/BHT/MC								
Scale: As Shown	Job No: 47085-004								
Dwg. Size: A4	BOREHOLE LOG								

BOREHOLE CONSTRUCTION	SAMPLE		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	BOREHOLE NUMBER: BH310		PAGE 1 of 1	
	NUMBER	TYPE					DRILLING DATES: 24 April 2002		DRILLING METHODS : Window Sampling	
							DRILLER : Cape		BOREHOLE DIAMETER : 70-100mm	
							LOGGED BY : ML		SCREEN TYPE & DIAM: 35mm	
				CHECKED BY : LT		SCREEN SLOT SIZE: 0.3mm				
	BH310		*720		0.0		DESCRIPTION		COMMENTS	0.0
							MADE GROUND: Reinforced concrete hardstanding.		Damp, NVO.	0.5
							MADE GROUND: Medium dense grey medium and coarse limestone gravel hardcore with some fine gravel, occasional orange brick fragments and much fine to coarse sand.			
							Soft light brown silty sandy CLAY.		Damp, slight odour.	1.0
							Soft light brown silty CLAY with occasional fine sand and rare fine gravel. Becoming firm / stiff.			
							Stiff dark brown silty CLAY with rare fine sand and occasional fine gravel.		Damp, NVO.	1.5
		2.0								
			*76.4		2.5				2.5	
			*51.7		3.0				3.0	
			*16.9		3.5				3.5	
					4.0				4.0	
					4.5				4.5	
					5.0				5.0	
LOCATION / NOTES: NVO = No visual or olfactory evidence of contamination Borehole dry.							LEGEND Disturbed Sample Undisturbed Sample Headspace Analysis Down Borehole Analysis Groundwater Table Perched Water Table		BOREHOLE LOG Job Title: Additional Soil and Groundwater Investigation Location: Kirkby, Liverpool Client: Clariant App'd: _____ Date: May 2002 Drawn: KW Ref: KW/ML/MCH Scale: As Shown Job No: 47085-009-787 Drg. Size: A4 BOREHOLE LOG	

BOREHOLE CONSTRUCTION	SAMPLE		SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	BOREHOLE NUMBER: BH312		PAGE 1 of 1				
	NUMBER	TYPE					DRILLING DATES: 23 April 2002		DRILLING METHODS : Window Sampling				
							DRILLER : Cape		BOREHOLE DIAMETER : 70-100mm				
							LOGGED BY : ML		SCREEN TYPE & DIAM: 35mm				
				CHECKED BY : LT		SCREEN SLOT SIZE: 0.3mm							
	BH312 0.5-0.7m - TPH, VOCs, Phenols		*2885			0.0	MADE GROUND: Reinforced concrete hardstanding.		Damp, moderate odour. Black staining, strong odour.	0.0			
						0.5	MADE GROUND: Medium dense light grey medium and coarse gravel limestone hardcore with some fine gravel, some fine coarse sand and occasional cobbles up to 5cm. Abundant crushed orange brick hardcore with depth.				NVO	0.5	
						1.0	Soft / firm light brown silty CLAY with some orange and grey silt mottling, occasional fine gravel and rare medium gravel. Becoming dark brown and firm.						1.0
						1.5	Firm / stiff dark brown silty CLAY with some fine gravel and rare medium gravel.						
			*392			2.0			Dry, NVO.	2.0			
			*175			2.5					2.5		
						3.0	Borehole completed at 3.0m.		3.0				
						3.5				3.5			
						4.0			4.0				
						4.5				4.5			
						5.0			5.0				

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

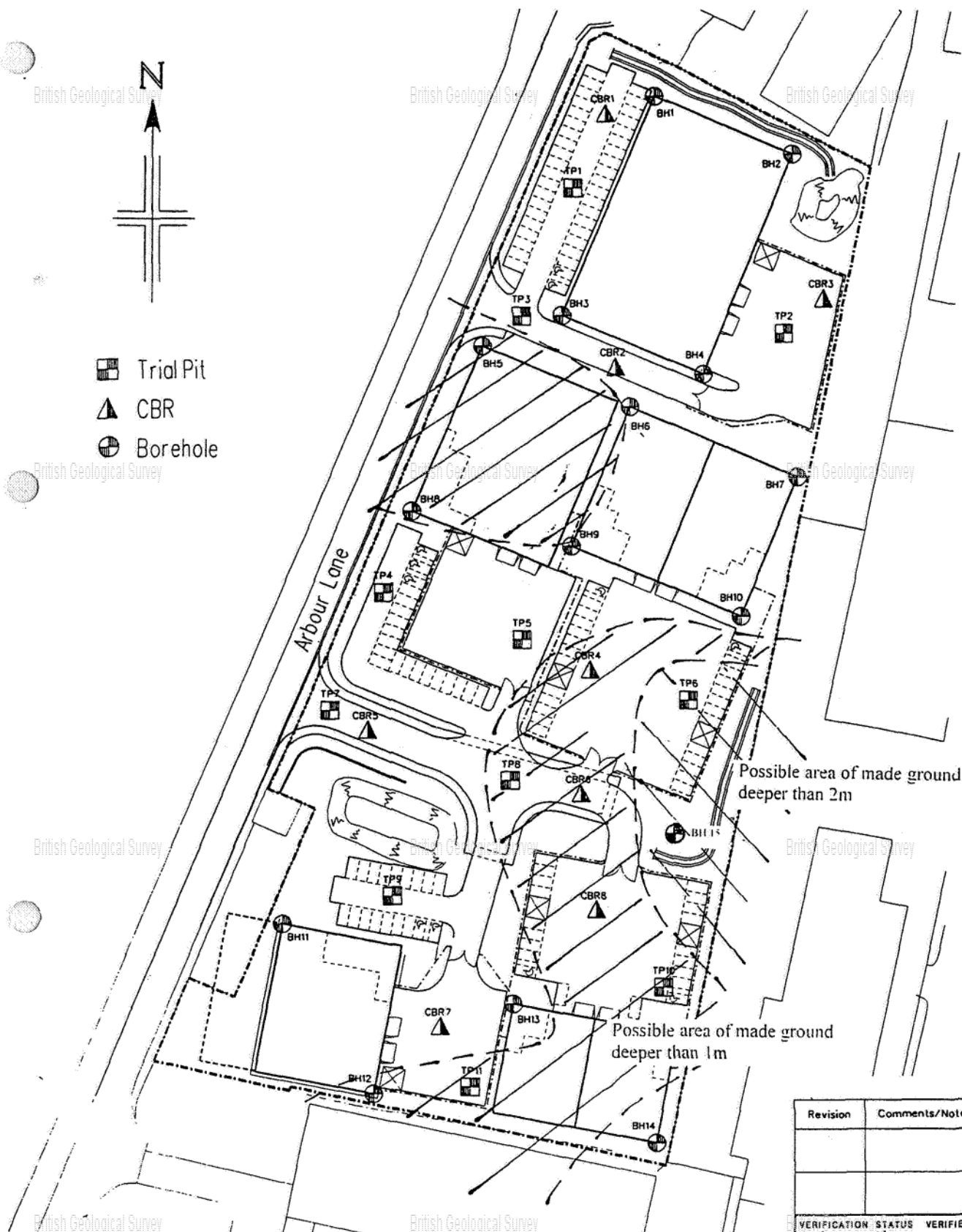
BOREHOLE LOG

Job Title: Additional Soil and Groundwater Investigation

Location: Kirkby, Liverpool

Client: Clariant

App'd:	Date: May 2002
Drawn: KW	Ref: KW/ML/MCH
Scale: As Shown	Job No: 47085-009-787
Drw. Size: A4	BOREHOLE LOG



Revision	Comments/Notes	Ck'd
VERIFICATION STATUS VERIFIED BY		
Information		

Refer to this Contract to:

Proposed Development, Lees Road,
Knowsley Industrial Park, Knowsley.

Scale: 1:1250
Drawing Number: SL7379(SK)13
Drawn: NAC
Date: Jun 2002

Subject: Trial Pit, Borehole & CBR Test Locations

Directors must verify dimensions of the site before commencing any work or making any shop drawings. No dimensions to be scaled from the drawing. Materials specified in this drawing are to be used strictly in accordance with the manufacturers recommendations and current codes of practice. All drawings and documents thereon are the copyright of Wm Saunders Partnership and must not be reproduced without permission.

WSP

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Tel 01636 704361 Fax 01636 702600
17 Regent Street, Nottingham NG1 5BS
Tel 0115 947 0536 Fax 0115 948 3453



STRUCTURAL SOILS

BOREHOLE LOG

Contract British Geological Survey Knowsley		Client British Geological Survey William Saunders Partnership		Borehole No BH 01
Job No 26619	Start 08/07/02	Ground Level (m AOD) 99.86	Co-Ordinates	Sheet 1 of 1
	End 08/07/02			

Samples and In-situ Tests				Water	Instru- mentation	Description of Strata	Depth (Thick- ness)	Legend
Depth	No	Type	Blows					
0.35 - 0.80	1	B				TOPSOIL: Medium dense grey brown fine to medium SAND.	0.30	
1.20 - 1.65	NR	SPT	13				(2.00)	
1.20 - 1.70	2	B						
1.60	4	W						
2.20 - 2.65	3	SPT	10			Soft to firm brown sandy CLAY.	2.30	
						Firm red brown sandy slightly gravelly CLAY. Gravel is fine to medium sub rounded to sub angular.	2.60	
3.00 - 3.45	NR	SPT	(77)				(1.40)	
3.00 - 3.50	5	B						
3.80 - 4.25	6	SPT	18			Very dense red brown clayey fine to medium SAND with occasional fine angular gravel of siltstone.	4.00	
4.80 - 5.19	7	SPT	*64				(1.80)	
5.50 - 5.80	8	SPT	*100				5.80	
						Borehole ends at 5.80m.		

Boring Progress and Water Observations						Chiselling			General Remarks
Date	Time	Borehole Depth	Casing Depth	Casing Diameter	Water Depth	From	To	Hours	
08/07/02		2.20	2.20	150	2.20				1. Borehole backfilled with bentonite cement grout on completion.
08/07/02	20 mins	2.20	2.20	150	1.60				
07/02		5.80	4.50	150	Dry	4.80	5.50	0.50 hrs	
All dimensions in metres						Drilled			Checked



STRUCTURAL SOILS

BOREHOLE LOG

Contract: Geological Survey	Client: British Geological Survey	Borehole No: BH 02
Knowsley	William Saunders Partnership	
Job No: 26619	Start: 09/07/02	Ground Level (m AOD): 99.94
	End: 09/07/02	Co-Ordinates
		Sheet: 1 of 1

Samples and In-situ Tests				Water	Instrumentation	Description of Strata	Depth (Thickness)	Legend
Depth	No	Type	Blows					
						TOPSOIL:	0.20	
0.60 - 1.05	1	SPT	14			MADE GROUND: Grey and black clayey GRAVEL and cobbles of brick, sandstone and concrete fragments.	(0.80)	
1.00	2	D					1.00	
1.20	3	D				Grey brown fine and medium SAND with thin beds of soft grey clay and some organic material.	(0.70)	
1.40 - 1.85	4	U	(23)				1.70	
1.85	5	D				Soft grey very sandy CLAY. Becomes gravelly with depth.	(1.10)	
2.50 - 2.95	6	SPT	6				2.80	
3.20 - 3.65	7	U	(27)			Firm red brown sandy slightly gravelly CLAY. Gravel is fine to medium sub rounded to sub angular.	(1.30)	
3.40	10	W						
3.70	8	D					4.10	
4.20 - 4.65	9	SPT	37			Dense red brown clayey fine to medium SAND with occasional fine subrounded gravel.		
5.30 - 5.75	11	SPT	51				(3.70)	
6.30	12	D						
6.70 - 7.15	13	SPT	47					
7.20 - 7.60	14	B						
7.80 - 8.25	15	SPT	50				7.80	
						Borehole ends at 7.80m.		

Boring Progress and Water Observations						Chiselling			General Remarks
Date	Time	Borehole Depth	Casing Depth	Casing Diameter	Water Depth	From	To	Hours	
09/07/02		4.20	4.20	150	4.20				1. 50 mm diameter standpipe installed on completion.
09/07/02		4.20	4.20	150	3.40				
09/07/02		6.70	5.00	150	6.00	4.60	6.70	2 hrs	
09/07/02		7.80	5.00	150	7.00	6.70	7.80	1 hr	

All dimensions in metres

Method

Drilled

Logged

Checked

SJ49/75

British Geological Survey

J P WHITTER (WATER WELL ENGINEERS) LTD
 The Potteries Garage, Smallbrook Lane, Leigh, Lancashire WN7 5PZ
 Tel: 01942 871900 Fax: 01942 896843

British Geological Survey

BOREHOLE LOG

SITE DETAILS

REF: 25/7/18682

Borehole drilled for: Sonae UK Ltd

Location: Knowsley Industrial Park, Moss Lane, Knowsley.

NGR (8 fig): SJ 4290 9920

Ground level (if known):

Drilling company: J.P Whitter

Date of drilling: March 2007

CONSTRUCTION DETAILS

British Geological Survey

British Geological Survey

Borehole datum (if not ground level) (point from which all measurements of depth are taken, eg, flange, edge of chamber, etc)	G.L.	m above/below GL			
Borehole drilled diameter:	400	mm from	0	to	26 m/depth
	300	mm from	26	to	100 m/depth
		mm from		to	m/depth
Casing material and type:	300	mm from	0	to	26 m/depth
		mm from		to	m/depth
		mm from		to	m/depth
		mm from		to	m/depth

Grouting details: Casing grouted into place using OPC grout from the bottom up using tremmy pipes and paddle mixer

Water struck at: 17m onwards (depth below datum mbd)

Rest water level on completion: 8.00 m

British Geological Survey

British Geological Survey

ST PUMPING SUMMARY

(please supply full details on forms WR-39)

Test pumping datum (if different from borehole datum)		above/below datum (mbd)			
Pump suction:	60	mbd			
Water level (start of test)	6.38	mbd			
Water level (end of test)	22.99	mbd			
Pumping rate:	46.28	m3/day : l/s	for	6	days
Recovery to:	5.66	mbd in 8days	mins : hrs : days		
Date of measurements:	21/04/08 to 21/05/08				

British Geological Survey

British Geological Survey

British Geological Survey

British Geological Survey

British Geological Survey

British Geological Survey

REF: 25/7/18682

Strata

<u>Description</u>	<u>Depth</u>	<u>Thickness</u>
Made ground	0 – 1.5 m	1.5
Clay with sandy layers	1.5 – 7 m	5.5
Soft sandstone with soft marl layers	7 – 18 m	11
Soft grey shale with bands of clay and gravel	18 – 100 m	82

Borehole record

Nicholls Boreholes



British Geological Survey
NATURAL ENVIRONMENT RESEARCH



Environment
Agency

Water Resources Act 1991 (as amended by the Water Act 2003)

A Site details

Borehole drilled for IRRIGATION CONTROL
Location LIVERPOOL FC TRAINING GROUND, MOSS LANE, L33 7XG
NGR (ten digits) SJ 42669 99164 Please attach site plan
Ground level (if known) 31m metres Above Ordnance Datum
Drilling company NICHOLLS BOREHOLES
Date drilling commenced 25/02/2019 (DD/MM/YYYY) Completed 07/03/2019 (DD/MM/YYYY)

B Construction details

Borehole datum (if not ground level)  metres (m). Please tick if this is above ☐ or below ☐ ground level.
(point from which all measurements of depth are taken, for example, flange, edge of chamber)

Borehole drilled diameter

<u>295</u>	mm from	<u>0</u>	to	<u>110</u>	m/depth
	mm from		to		m/depth
	mm from		to		m/depth
	mm from		to		m/depth

Casing material Plain Steel diameter 300 mm from 0 to 11 m/depth
and type (for example, if plain steel, plastic slotted). Please record permanent casing details, not temporary casing.

Casing material Plain Plastic diameter 225 mm from 0 to 25 m/depth

Casing material Slotted Plastic diameter 225 mm from 25 to 106 m/depth

Casing material Plain Plastic diameter 225 mm from 106 to 109 m/depth

Grouting details 160 Bags washed shingle / 23 bags of Mikolit / 1.8m Concrete to Surface

Waterstruckat 1. _____ m (depth below datum - mbd) 2. _____ m (mbd)
3. _____ m (mbd) 4. _____ m (mbd)

C Test pumping summary (Please supply full details on form WR39)

Test pumping datum _____ m. Please tick if this is above ☐ or below ☐ ground level.
(if different from borehole datum)

Pump suction depth _____ mbd

Water level (start of test) _____ mbd

Water level (end of test) _____ mbd

Type of test (for example, bailer, step, constant rate)

Pumping rate _____ m³/hour ☐ or litres/second ☐. Please tick as appropriate.
for _____ days, _____ hours, _____ mins

Recovery to _____ mbd in _____ days, _____ hours, _____ mins
(from end of pumping)

Date(s) of measurements Pump started (DD/MM/YYYY)
Pump stopped (DD/MM/YYYY)

Please supply chemical analysis if available. If you have included this please tick this box ☐

D Strata log

Geological classification (BGS only)	Description of strata	Thickness m	Depth (to base of strata) m
	* Soft sand with interbedded bands of sandstone (salmon colour)	10	10
	* Very hard sandstone (slightly darker in colour)	100	110
	(continue on separate page if necessary)		
	Other comments (for example, gas encountered, saline water intercepted)		

E Completing this form

How long did it take you to fill in this form? _____

For Official use only

Date received (DD/MM/YYYY) File

Consent number

BGS reference number

Accession number

Wellmaster number

SOBI number

NGR

LIC NO

Purpose

EA reference number

Copy number

Entered by

A.1 Preliminary Drillers log of BH2

WR38; Borehole record form

Environment
Agency

Water Resources Act 1991 (as amended by the Water Act 2003)

Borehole drilled for IRRIGATION CONTROL

Location: LIVERPOOL FOOTBALL CLUB & ATHLETIC GROUNDS LTD

NGR (ten digits) S1 42728 99212 Please attach site plan

Ground level (if known) : 310 metres Above Ordnance Datum

Drilling company NICHOLS BOREHOLES

Date drilling commenced 25/02/2019 (DD/MM/YY) Completed 07/03/2019 (DD/MM/YY)

Borehole datum (if not ground level) _____ metres (m). Please tick if this is above ☐ or below ☐ ground level.
(point from which all measurements of depth are taken, for example, flange, edge of chamber)

Borehole drilled diameter 255 mm from 0 to 110 m/depth

mm from to m/depth

mm from _____ to _____ m/depth

_____ mm from _____ to _____ m/depth

Casing material Plain Steel diameter 300 mm from 0 to 11 m/depth
and type (for example, if plain steel, plastic slotted). Please record permanent casing details, not temporary casing.

Casing material Plain PVC diameter 225 mm from 0 to 25 m/depth

Casing material Slotted PVC diameter 225 mm from 25 to 106 m/depth

Casing material: Plain PVC diameter: 225 mm from 106 to 109 m/depth

Grouting details: 0-1.8m gravel w/ coarse, 1.8-25m BGL Mihalit/ bentonite, 25-110m BGL Shingle/gravel

Water struck at 1. _____ m (depth below datum = mbd) 2. _____ m (mbd)

3. _____ m (mod) 4. _____ m (mod)

Test pumping datum _____ m. Please tick if this is above ☐ or below ☐ ground level.
(If different from borehole datum)

Pump suction depth _____ mbd

Water level (start of test) _____ mbd

Water level (end of test) _____ mbd

Type of test (for example, bailer, step, constant rate)

Pumping rate _____ m³/hour ☐ or litres/second ☐. Please tick as appropriate.
for _____ days, _____ hours, _____ mins

Recovery to _____ mbd in _____ days, _____ hours, _____ mins
(from end of pumping)

Date(s) of measurements Pump started (DD/MM/YYYY)

Pump stopped _____ (DD/MM/YYYY)

Please supply chemical analysis if available. If you have included this please tick this box ☐

WR38: Borehole record form

D Strata log

Geological classification (BGS only)	Description of strata	Thickness m	Depth (to base of strata) m
	* Soft sand with interbedded bands of sandstone (salmon colour)	10	10
	* Very hard sandstone (slightly darker in colour)	100	110
(continue on separate page if necessary)			
Other comments (for example, gas encountered, saline water intercepted)			

E Completing this form

How long did it take you to fill in this form? _____

For Official use only

Date received (DD/MM/YYYY)	File	Consent number	BGS reference number
Accession number	Wellmaster number	SOBI number	NGR
LIC NO	Purpose	EA reference number	
Copy number	Entered by		

Amber Planning Flood Risk & Hydrology		Page 1												
46 Ash Lane Wells Somerset BA5 2LS														
Date 30/07/2021 10:07 File 210730-H8396-Mar...	Designed by kirsten.d... Checked by													
Micro Drainage		Source Control W.12.6												
<u>ICP SUDS Mean Annual Flood</u> Input <table> <tr> <td>Return Period (years)</td> <td>100</td> <td>Soil</td> <td>0.500</td> </tr> <tr> <td>Area (ha)</td> <td>50.000</td> <td>Urban</td> <td>0.134</td> </tr> <tr> <td>SAAR (mm)</td> <td>890</td> <td>Region Number</td> <td>Region 10</td> </tr> </table> Results l/s QBAR Rural 365.6 QBAR Urban 443.6 Q100 years 866.3 Q1 year 385.9 Q30 years 727.6 Q100 years 866.3			Return Period (years)	100	Soil	0.500	Area (ha)	50.000	Urban	0.134	SAAR (mm)	890	Region Number	Region 10
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SAAR (mm)	890	Region Number	Region 10											
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46 Ash Lane		Marl Road					
Wells		Knowsley					
Somerset BA5 2LS		Standby Elec. Plant					
Date July 2021		Designed by KdS					
File 210730-H8396-Mar...		Checked by					
Micro Drainage		Source Control W.12.6					
<u>Summary of Results for 2 year Return Period (+20%)</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.070	0.070	1.2	0.0	1.2	25.7	0 K
30 min Summer	0.085	0.085	1.7	0.0	1.7	31.0	0 K
60 min Summer	0.101	0.101	2.1	0.0	2.1	36.7	0 K
120 min Summer	0.114	0.114	2.4	0.0	2.4	41.7	0 K
180 min Summer	0.121	0.121	2.5	0.0	2.5	44.1	0 K
240 min Summer	0.125	0.125	2.6	0.0	2.6	45.8	0 K
360 min Summer	0.131	0.131	2.6	0.0	2.6	47.8	0 K
480 min Summer	0.133	0.133	2.6	0.0	2.6	48.7	0 K
600 min Summer	0.134	0.134	2.6	0.0	2.6	48.9	0 K
720 min Summer	0.134	0.134	2.6	0.0	2.6	48.7	0 K
960 min Summer	0.132	0.132	2.6	0.0	2.6	48.1	0 K
1440 min Summer	0.125	0.125	2.6	0.0	2.6	45.6	0 K
2160 min Summer	0.114	0.114	2.4	0.0	2.4	41.7	0 K
2880 min Summer	0.106	0.106	2.2	0.0	2.2	38.5	0 K
4320 min Summer	0.091	0.091	1.9	0.0	1.9	33.4	0 K
5760 min Summer	0.082	0.082	1.6	0.0	1.6	30.1	0 K
7200 min Summer	0.076	0.076	1.4	0.0	1.4	27.7	0 K
8640 min Summer	0.071	0.071	1.3	0.0	1.3	25.9	0 K
10080 min Summer	0.067	0.067	1.2	0.0	1.2	24.5	0 K
15 min Winter	0.079	0.079	1.5	0.0	1.5	28.7	0 K
30 min Winter	0.095	0.095	2.0	0.0	2.0	34.7	0 K
60 min Winter	0.113	0.113	2.4	0.0	2.4	41.1	0 K
120 min Winter	0.129	0.129	2.6	0.0	2.6	47.0	0 K
Storm Event			Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)		
15 min Summer			46.836	0.0	33		
30 min Summer			28.932	0.0	45		
60 min Summer			17.872	0.0	70		
120 min Summer			11.040	0.0	120		
180 min Summer			8.329	0.0	152		
240 min Summer			6.820	0.0	184		
360 min Summer			5.145	0.0	252		
480 min Summer			4.213	0.0	320		
600 min Summer			3.608	0.0	388		
720 min Summer			3.178	0.0	456		
960 min Summer			2.623	0.0	588		
1440 min Summer			2.001	0.0	842		
2160 min Summer			1.526	0.0	1212		
2880 min Summer			1.259	0.0	1572		
4320 min Summer			0.937	0.0	2300		
5760 min Summer			0.759	0.0	3008		
7200 min Summer			0.645	0.0	3752		
8640 min Summer			0.565	0.0	4488		
10080 min Summer			0.505	0.0	5160		
15 min Winter			46.836	0.0	32		
30 min Winter			28.932	0.0	45		
60 min Winter			17.872	0.0	70		
120 min Winter			11.040	0.0	122		
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Date July 2021 File 210730-H8396-Mar...	Designed by KdS Checked by	
Micro Drainage Source Control W.12.6		

Model Details

Storage is Online Cover Level (m) 1.000

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	365.0	0.400	365.0

Hydro-Brake® Outflow Control

Design Head (m) 0.145 Hydro-Brake® Type Md4 Invert Level (m) 0.000
Design Flow (l/s) 2.7 Diameter (mm) 71

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.1	1.200	4.3	3.000	6.8	7.000	10.4
0.200	2.4	1.400	4.6	3.500	7.3	7.500	10.8
0.300	2.2	1.600	5.0	4.000	7.9	8.000	11.1
0.400	2.5	1.800	5.3	4.500	8.3	8.500	11.5
0.500	2.8	2.000	5.6	5.000	8.8	9.000	11.8
0.600	3.0	2.200	5.8	5.500	9.2	9.500	12.1
0.800	3.5	2.400	6.1	6.000	9.6		
1.000	3.9	2.600	6.3	6.500	10.0		

Orifice Overflow Control

Diameter (m) 0.053 Discharge Coefficient 0.600 Invert Level (m) 0.146

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Date July 2021		Designed by KdS					
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Micro Drainage		Source Control W.12.6					
Summary of Results for 30 year Return Period (+20%)							
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.165	0.165	2.7	0.1	2.8	60.1	0 K
30 min Summer	0.192	0.192	2.7	0.6	3.1	70.0	0 K
60 min Summer	0.220	0.220	2.7	1.3	3.6	80.2	0 K
120 min Summer	0.244	0.244	2.7	1.6	3.8	89.0	0 K
180 min Summer	0.252	0.252	2.7	1.7	3.9	92.0	0 K
240 min Summer	0.256	0.256	2.7	1.7	3.9	93.5	0 K
360 min Summer	0.260	0.260	2.7	1.7	3.9	95.0	0 K
480 min Summer	0.261	0.261	2.7	1.7	4.0	95.2	0 K
600 min Summer	0.259	0.259	2.7	1.7	3.9	94.5	0 K
720 min Summer	0.256	0.256	2.7	1.7	3.9	93.3	0 K
960 min Summer	0.249	0.249	2.7	1.6	3.8	91.0	0 K
1440 min Summer	0.232	0.232	2.7	1.4	3.7	84.8	0 K
2160 min Summer	0.209	0.209	2.7	1.0	3.4	76.3	0 K
2880 min Summer	0.188	0.188	2.7	0.5	3.0	68.8	0 K
4320 min Summer	0.147	0.147	2.7	0.0	2.7	53.6	0 K
5760 min Summer	0.121	0.121	2.5	0.0	2.5	44.2	0 K
7200 min Summer	0.107	0.107	2.3	0.0	2.3	38.9	0 K
8640 min Summer	0.097	0.097	2.0	0.0	2.0	35.3	0 K
10080 min Summer	0.090	0.090	1.8	0.0	1.8	32.7	0 K
15 min Winter	0.185	0.185	2.7	0.5	3.0	67.4	0 K
30 min Winter	0.215	0.215	2.7	1.1	3.5	78.6	0 K
60 min Winter	0.247	0.247	2.7	1.6	3.8	90.1	0 K
120 min Winter	0.275	0.275	2.7	1.9	4.1	100.4	0 K
Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)				
15 min Summer	110.478	0.1	33				
30 min Summer	65.380	1.7	46				
60 min Summer	38.691	5.9	72				
120 min Summer	22.897	12.1	126				
180 min Summer	16.846	16.3	174				
240 min Summer	13.550	19.3	202				
360 min Summer	9.970	23.5	266				
480 min Summer	8.019	26.1	334				
600 min Summer	6.773	27.5	402				
720 min Summer	5.900	27.9	472				
960 min Summer	4.783	27.5	606				
1440 min Summer	3.557	23.9	870				
2160 min Summer	2.646	16.2	1260				
2880 min Summer	2.145	8.4	1648				
4320 min Summer	1.556	0.0	2376				
5760 min Summer	1.239	0.0	3056				
7200 min Summer	1.038	0.0	3752				
8640 min Summer	0.899	0.0	4496				
10080 min Summer	0.795	0.0	5160				
15 min Winter	110.478	1.0	33				
30 min Winter	65.380	4.4	46				
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Micro Drainage Source Control W.12.6		

Model Details

Storage is Online Cover Level (m) 1.000

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	365.0	0.400	365.0

Hydro-Brake® Outflow Control

Design Head (m) 0.145 Hydro-Brake® Type Md4 Invert Level (m) 0.000
Design Flow (l/s) 2.7 Diameter (mm) 71

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.1	1.200	4.3	3.000	6.8	7.000	10.4
0.200	2.4	1.400	4.6	3.500	7.3	7.500	10.8
0.300	2.2	1.600	5.0	4.000	7.9	8.000	11.1
0.400	2.5	1.800	5.3	4.500	8.3	8.500	11.5
0.500	2.8	2.000	5.6	5.000	8.8	9.000	11.8
0.600	3.0	2.200	5.8	5.500	9.2	9.500	12.1
0.800	3.5	2.400	6.1	6.000	9.6		
1.000	3.9	2.600	6.3	6.500	10.0		

Orifice Overflow Control

Diameter (m) 0.053 Discharge Coefficient 0.600 Invert Level (m) 0.146

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Wells			Knowsley				
Somerset BA5 2LS			Standby Elec. Plant				
Date July 2021			Designed by KdS				
File 210730-H8396-Mar...			Checked by				
Micro Drainage			Source Control W.12.6				
<u>Summary of Results for 100 year Return Period (+20%)</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.243	0.243	2.7	1.6	3.8	88.8	0 K
30 min Summer	0.278	0.278	2.7	1.9	4.1	101.6	0 K
60 min Summer	0.314	0.314	2.7	2.2	4.5	114.5	0 K
120 min Summer	0.343	0.343	2.7	2.4	4.8	125.2	0 K
180 min Summer	0.352	0.352	2.7	2.5	4.8	128.5	0 K
240 min Summer	0.354	0.354	2.7	2.5	4.9	129.4	0 K
360 min Summer	0.356	0.356	2.7	2.5	4.9	129.9	0 K
480 min Summer	0.354	0.354	2.7	2.5	4.9	129.2	0 K
600 min Summer	0.350	0.350	2.7	2.5	4.8	127.6	0 K
720 min Summer	0.344	0.344	2.7	2.4	4.8	125.6	0 K
960 min Summer	0.334	0.334	2.7	2.4	4.7	121.8	0 K
1440 min Summer	0.309	0.309	2.7	2.2	4.4	113.0	0 K
2160 min Summer	0.274	0.274	2.7	1.9	4.1	100.2	0 K
2880 min Summer	0.245	0.245	2.7	1.6	3.8	89.4	0 K
4320 min Summer	0.198	0.198	2.7	0.7	3.2	72.3	0 K
5760 min Summer	0.161	0.161	2.7	0.1	2.7	58.9	0 K
7200 min Summer	0.132	0.132	2.6	0.0	2.6	48.2	0 K
8640 min Summer	0.116	0.116	2.4	0.0	2.4	42.2	0 K
10080 min Summer	0.105	0.105	2.2	0.0	2.2	38.3	0 K
15 min Winter	0.273	0.273	2.7	1.9	4.1	99.6	0 K
30 min Winter	0.313	0.313	2.7	2.2	4.5	114.1	0 K
60 min Winter	0.353	0.353	2.7	2.5	4.8	128.7	0 K
120 min Winter	0.387	0.387	2.7	2.7	5.2	141.1	0 K
Storm Event			Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)		
15 min Summer			162.802	8.4	33		
30 min Summer			94.495	15.0	46		
60 min Summer			54.848	23.2	72		
120 min Summer			31.835	32.8	126		
180 min Summer			23.159	38.8	180		
240 min Summer			18.478	43.1	212		
360 min Summer			13.442	49.1	274		
480 min Summer			10.725	53.1	340		
600 min Summer			9.002	55.8	408		
720 min Summer			7.802	57.7	478		
960 min Summer			6.274	60.3	614		
1440 min Summer			4.614	57.7	882		
2160 min Summer			3.394	49.6	1272		
2880 min Summer			2.729	40.3	1648		
4320 min Summer			1.957	15.9	2392		
5760 min Summer			1.546	1.1	3128		
7200 min Summer			1.287	0.0	3824		
8640 min Summer			1.109	0.0	4504		
10080 min Summer			0.977	0.0	5240		
15 min Winter			162.802	13.4	33		
30 min Winter			94.495	21.4	46		
60 min Winter			54.848	31.0	72		
120 min Winter			31.835	41.9	126		
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Date July 2021 File 210730-H8396-Mar...	Designed by KdS Checked by	
Micro Drainage		
Source Control W.12.6		

Source Control W.12.6

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
180 min Winter	0.398	0.398	2.7	2.8	5.3	145.4	0 K
240 min Winter	0.401	0.401	2.7	2.8	5.3	146.2	0 K
360 min Winter	0.399	0.399	2.7	2.8	5.3	145.6	0 K
480 min Winter	0.393	0.393	2.7	2.8	5.2	143.6	0 K
600 min Winter	0.385	0.385	2.7	2.7	5.2	140.5	0 K
720 min Winter	0.375	0.375	2.7	2.6	5.1	136.9	0 K
960 min Winter	0.357	0.357	2.7	2.5	4.9	130.3	0 K
1440 min Winter	0.319	0.319	2.7	2.2	4.5	116.4	0 K
2160 min Winter	0.269	0.269	2.7	1.8	4.0	98.3	0 K
2880 min Winter	0.230	0.230	2.7	1.4	3.7	84.0	0 K
4320 min Winter	0.172	0.172	2.7	0.2	2.8	62.8	0 K
5760 min Winter	0.125	0.125	2.6	0.0	2.6	45.6	0 K
7200 min Winter	0.105	0.105	2.2	0.0	2.2	38.4	0 K
8640 min Winter	0.094	0.094	1.9	0.0	1.9	34.2	0 K
10080 min Winter	0.086	0.086	1.7	0.0	1.7	31.4	0 K

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
180 min Winter	23.159	48.8	180
240 min Winter	18.478	53.8	230
360 min Winter	13.442	60.7	288
480 min Winter	10.725	65.4	364
600 min Winter	9.002	68.7	440
720 min Winter	7.802	71.0	514
960 min Winter	6.274	74.5	660
1440 min Winter	4.614	73.7	940
2160 min Winter	3.394	60.6	1340
2880 min Winter	2.729	43.6	1716
4320 min Winter	1.957	4.8	2512
5760 min Winter	1.546	0.0	3128
7200 min Winter	1.287	0.0	3824
8640 min Winter	1.109	0.0	4504
10080 min Winter	0.977	0.0	5240

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<u>Rainfall Details</u> <table> <tr> <td>Rainfall Model</td> <td>FEH</td> <td>D3 (1km)</td> <td>0.286</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>Return Period (years)</td> <td>100</td> <td>E (1km)</td> <td>0.287</td> <td>Shortest Storm (mins)</td> <td>15</td> </tr> <tr> <td>Site Location</td> <td></td> <td>F (1km)</td> <td>2.502</td> <td>Longest Storm (mins)</td> <td>10080</td> </tr> <tr> <td>C (1km)</td> <td>-0.023</td> <td>Summer Storms</td> <td>Yes</td> <td>Climate Change %</td> <td>+20</td> </tr> <tr> <td>D1 (1km)</td> <td>0.321</td> <td>Winter Storms</td> <td>Yes</td> <td></td> <td></td> </tr> <tr> <td>D2 (1km)</td> <td>0.348</td> <td>Cv (Summer)</td> <td>0.750</td> <td></td> <td></td> </tr> </table> <u>Time / Area Diagram</u> Total Area (ha) 0.304 <table> <thead> <tr> <th>Time (mins)</th> <th>Area (ha)</th> <th>Time (mins)</th> <th>Area (ha)</th> <th>Time (mins)</th> <th>Area (ha)</th> <th>Time (mins)</th> <th>Area (ha)</th> <th>Time (mins)</th> <th>Area (ha)</th> </tr> </thead> <tbody> <tr> <td>0-4</td> <td>0.061</td> <td>4-8</td> <td>0.061</td> <td>8-12</td> <td>0.061</td> <td>12-16</td> <td>0.061</td> <td>16-20</td> <td>0.060</td> </tr> </tbody> </table>			Rainfall Model	FEH	D3 (1km)	0.286	Cv (Winter)	0.840	Return Period (years)	100	E (1km)	0.287	Shortest Storm (mins)	15	Site Location		F (1km)	2.502	Longest Storm (mins)	10080	C (1km)	-0.023	Summer Storms	Yes	Climate Change %	+20	D1 (1km)	0.321	Winter Storms	Yes			D2 (1km)	0.348	Cv (Summer)	0.750			Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	0-4	0.061	4-8	0.061	8-12	0.061	12-16	0.061	16-20	0.060
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Model Details

Storage is Online Cover Level (m) 1.000

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	365.0	0.400	365.0

Hydro-Brake® Outflow Control

Design Head (m) 0.145 Hydro-Brake® Type Md4 Invert Level (m) 0.000
Design Flow (l/s) 2.7 Diameter (mm) 71

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.1	1.200	4.3	3.000	6.8	7.000	10.4
0.200	2.4	1.400	4.6	3.500	7.3	7.500	10.8
0.300	2.2	1.600	5.0	4.000	7.9	8.000	11.1
0.400	2.5	1.800	5.3	4.500	8.3	8.500	11.5
0.500	2.8	2.000	5.6	5.000	8.8	9.000	11.8
0.600	3.0	2.200	5.8	5.500	9.2	9.500	12.1
0.800	3.5	2.400	6.1	6.000	9.6		
1.000	3.9	2.600	6.3	6.500	10.0		

Orifice Overflow Control

Diameter (m) 0.053 Discharge Coefficient 0.600 Invert Level (m) 0.146

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