Vantage CWL13 Environmental Permit Application

Supporting Information Document

Vantage Data Centers UK Ltd.

August 2022

Notice

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This document has 513 pages including the cover and Appendices.

Document history

Document title: Supporting Information Document

Document reference: Vantage_CWL13_EP_SID

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
0.1	Draft for client comment	ES	EA	CC	-	Aug 2022
1.0	Final for issue	ES	EA	CC	SR	Aug 2022

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This document is Vantage Data Centers UK Limited's (hereafter 'Vantage' or 'the operator') technical submission to support its application for a new bespoke Environmental Permit to operate a new data centre on the outskirts of Newport, Wales.

Vantage (formerly Next Generation Data Limited (NGD)), provides wholesale out-of-town data centre space for some of the world's largest companies, including blue-chip company and government data. Due to the sensitive and significant nature of the information held at the site, a secure and reliable electricity supply is business-critical; without a continuous supply of electricity, Vantage cannot guarantee their contractual customer obligations. The first level of security of supply will be two independent grid connections so that power supply can be maintained in the event of a localised power outage. However, an additional level of protection is required in case of grid failure and this will be achieved through the installation of 60 new standby generators with an aggregated thermal input of 179 MW_{th}.

The data centre will fall under Chapter 1 of Schedule 1 of the Environmental Permitting (England and Wales) Regulations 2016 (EPR16):

Schedule 1

Section 1.1 Combustion Activities

Part A (1) (a) Burning any fuel in an appliance with a rated thermal input of 50 or more megawatts.

This application for a bespoke Environmental Permit is being submitted to Natural Resources Wales (NRW), which is responsible for the regulation of EPR16 Environmental Permits for Schedule 1 A(1) activities in Wales.

This supporting information document describes the operation of the plant, it's impact on the environment and the measures used to minimise those impacts and to ensure regulatory compliance. It presents information to supplement that provided in NRW's application forms, which are:

Application for an environmental permit:

- Part A - About you (version 1, July 2016);
- Part B2 - General: new bespoke permit (version 2, October 2018)
- Part B3 - New bespoke Installation Permit (version 3, October 2018)
- Part F1 - OPRA, charges and declarations (version 3, October 2018) and the electronic OPRA spreadsheet (V2 01, April 2019).

This document is divided into sections as described in Table 1-1.

Table 1-1 - Structure of the Supporting Information Document

Section Number	Title	Content
-	Introduction	Purpose of the application and the supporting information document.
1	Non-Technical Summary	Background information, including applicant information, context and applicable legislation. Non-technical summary of the proposed Installation including its operation, emissions, environmental impacts, control measures.
2	Process Description	A detailed description of the proposed Installation.
3	Techniques for Process and Emissions Control and BAT Assessment	A description of the techniques proposed to minimise emissions and Vantage's approach to managing the permitted activities. This includes information on: environmental management and control systems, noise, odour, raw materials, waste, energy management and site conditions.
4	Proposed Emissions and Monitoring	Identification of emissions from the proposed Installation and the monitoring arrangements / techniques / systems that will be in place.

Section Number	Title	Content
5	Impact on the Environment	Identification and assessment of environmental impacts resulting from the operation of the proposed Installation. An environmental risk assessment is summarised in this Section (the detailed modelling / assessment reports are provided in the Appendices).
Appendices	Further supporting information, including drawings / site plan, technical assessments, a site condition report, details of pre-application discussions and company information.	

1. Non-Technical Summary

1.1. Application Information

Table 1-1 - Application Information

Type of Application	Bespoke Environmental Permit
Installation Name	CWL13
Installation Address	Bougues, Vantage Data Centre, North Lake Drive, Newport, NP10 8UL. See Appendix A for a location plan.
Application Reference No.	PPN-00849
Company Registration No.	06132144
Registered Address	Vantage Data Centers UK Ltd, 06132144, 2 Old Bath Road, Newbury, Berkshire, England, RG14 1QL.
Installation Grid Reference	NGR 328489 184490 (ST 2848 8449)[(a)]
Pre-Application Discussions	See Appendix B.
Legal Status of Operator	The operator is a limited company, trading as Venture Data Centers UK Ltd. Company certificates have been provided in this application in Appendix C.
Application Contact	Glenn Kitchen
Operational Contact	gkitchen@vantage-dc.com +44 (0) 7494 450 968

Table Notes:

(a) This is grid reference for the centre of the Installation Boundary, which is inside the Data Hall building.

1.2. Background and Rationale for Application

Vantage currently operates a data centre facility at Imperial Park. Natural Resources Wales (NRW) is the regulator for the existing Installation. The existing facility has an Environmental Permit to operate 77 standby generator sets in an area called CWL11. An application to vary the permit to operate a further 125 standby generator sets (65 sets at CWL11 and 60 sets at the adjoining CWL12 site was submitted to NRW in September 2021. The permit variation application for the combined CWL11/12 site was 'duly made' in February 2022 and is in the process of being determined.

Due to the success of the existing Vantage facility and the significant demand for data facilities, the business has an ongoing requirement for additional capacity. A new data centre is proposed by Vantage at a site known as CWL13. The CWL13 facility will be located to the south east of the existing data centre (see Appendix A for a location plan showing CWL11/12 and CWL13). The new site is accessed via North Lake Drive and Celtic Way, from the junction with the A48 to the north west.

Planning consent has been granted for the development, subject to the close-out of a number of pre-operational planning conditions. No Environmental Statement was prepared for the facility; however a noise assessment was prepared to support the planning application.

The facility is a Tier 3 data centre. Due to the sensitive and significant nature of the information held at the site, a secure and reliable electricity supply is business-critical. The first level of power security will be two independent grid connections so that power supply can be maintained in the event of a localised power outage. However, an additional level of protection is required in case of grid failure and this will be achieved through the installation of standby emergency generators. The proposed development comprises a two storey data centre building containing ten Data Halls and the installation of 60 new standby generators.

Although the equipment, activities and operations at CWL13 would be generally the same as those at CWL11/12, it is proposed that CWL13 is treated as a standalone Installation, with its own permit, as opposed to being an addition to the existing CWL11/12 Installation.

There are a number of reasons for this, and they include:

- the two facilities (CWL11/12 and CWL13) are physically distant to one another and are not physically connected in any way;
- the two facilities are not electrically connected;
- the two facilities are not logistically connected, they have different entrances and different transport risks;
- the business models are dissimilar - CWL11/12 has multiple clients, whereas CWL13 has been designed to be operated for the protection of a single client's data; and
- the two facilities will be operated separately (though both would be operated and managed by Vantage) as the sites could be divested differently in the future[1]. There is an option to sell CWL13 either to the client or ANO in the future.

1.3. Description of the Site and its Surroundings

CWL13 will be located on a brownfield site in the south eastern corner of Imperial Park approximately 3 miles south west of from Newport city centre. Imperial Park is located off the A48 near Junction 28 of the M4. The CWL13 site is accessed via North Lake Drive and Celtic Way, from the junction with the A48.

Imperial Park houses a number of industrial, distribution and administration facilities. The overall development area for CWL13 is approximately 2.5 ha and over 50% of this area will be taken up by the main data centre building, which is central to the site. The Installation is defined as the land within the permit application boundary (Appendix A), which is an irregular rectangular shape, and which excludes the data centre building. The elevation of the site is generally flat, approximately 14.5 m above ordnance datum (AOD), with limited gradient changes. The site will comprise a mix of hardstanding and soft landscaping.

The immediate surrounding land use can be summarised as follows:

- north: undeveloped open land, and car park associated with the IQE's Newport Semiconductor Facility;
- east: South Lake Drive with Imperial Courtyard Business Park beyond;
- south: vegetated scrub, shrubs and trees with landscaped parkland beyond; and,
- west: undeveloped open land and IQE Building.

There are no air quality management areas (AQMA) within close proximity of the site, the nearest is located in excess of 2.5 km, to the north, at the M4 at Junction 27. The nearest residential properties are on Pencarn Avenue, approximately 210 metres to the north. There are also residential properties on Edmundsbury Road approximately 250 m to the north east and on Powis Close approximately 260 m to the south east. The nearest discrete human receptor to CWL13 is a non-residential property in Imperial Courtyard, approximately 50 metres to the east of the CWL13 data centre building. A children's nursery is 650 metres to the north west near the Holiday Inn, between the A48 and the M4 motorway.

There are no environmentally sensitive land uses located on the site or adjacent to the site. The nearest internationally designated site (the Severn Estuary Ramsar site / Special Protection Area (SPA) / Special Area of Conservation (SAC)) is over 2.5 km to the south east at its closest point. There is only one further European Site within 10 km (River Usk SAC). There is only one nationally designated site within 2 km: Gwent Levels Site of Special Scientific Interest (SSSI) which is located approximately 260 m south east of the site at its closest point. The nearest non-statutory designated ecological site is LG Duffryn Site 1 Site of Interest for Nature Conservation (SINC) - 60 m to the south of the site boudary, designated for its pond / reedbed habitat. There are three other SINCs within 1 km. There are a number of areas of semi-natural and restored ancient woodland in the vicinity of the site, the nearest area is 640 m to the north of CWL13.

There are no surface water features located on or directly adjacent to the site. The nearest surface water feature to the site is an unnamed man-made lake, located 70 m south of the site, between South Lake Drive

[1] Although there is an option to sell CWL13 in the future, there are no plans in place to sell the facility and so the permit application has been undertaken on the basis that it will be owned and operated by Vantage.

and North Lake Drive. The closest surface watercourse to the site is Blackwall Reen, 130 m to the east, flowing in a southerly direction.

The site is not within a Source Protection Zone (SPZ) - the nearest SPZ is 18 km to the south east on the other side of the Bristol Channel.

The NRW online flood risk map and online development advice map indicate that the site is not located in a flood risk zone and is land that is considered to be at ‘very low risk’ of flooding (less than 0.1% chance per year).

1.4. Overview of the Facility and Activities

The proposed development comprises a two storey data centre building containing ten data halls and the installation of 60 new standby generators. The sole purpose of the generators is to provide power under emergency conditions. The generators will not be operated during Triads periods, or under a Short Term Operating Reserve (STOR) agreement, or in any other capacity or balancing market mechanism. The engines will be maintained and tested on a regular basis to ensure they are operational and to conform with manufacturer’s recommendations.

The generator sets will be Kohler units, which incorporate the KD45V20-5DES engine, with a thermal input of just under 3 MWth. The engines are grouped into ‘cells’, and there will be 10 cells, each with six generator sets. There will be 30 generators located along the north western side of the main building and 30 along the south eastern side (see Appendix A). The generators will be housed in individual containers, on a concrete base.

The engines will burn hydrotreated vegetable oil (HVO), although diesel may be used as an alternative fuel in the event of supply issues. The two fuels can be used interchangeably. As diesel fuel gives rise to higher emissions of combustion products, the air quality assessment (see Appendix D) has assumed the use of diesel as this approach provides the most robust and conservation assessment.

Selective catalytic reduction (SCR) abatement technology will be installed on the CWL13 engines to reduce NOx emissions. SCR is to be achieved through the injection of a urea solution (AdBlue).

Hours of operation for testing are strictly limited to:

- 09.00 to 17.00 (8 hours per day); and
- Monday to Friday, excluding bank holidays.

The limits of the combustion activity associated with the operation of the standby generators for emergency use and testing / maintenance are from receipt of raw materials to combustion of fuel, release of exhaust gases to atmosphere and distribution of emergency power to the data centre. As part of maintenance and testing small quantities of wastes will be generated (these will not be stored onsite).

In addition, the following directly associated activities will be carried out at the proposed Installation:

- fuel storage - from receipt of fuel to dispatch for use in the standby generators; and
- surface water drainage system servicing the area in which the schedule 1 activity takes place - the limits of which are input to the site drainage system until discharge to the wider business park drainage system.

There will be no sub-surface bulk storage tanks or process pipework. The only below ground pipework is for the mains water supply and surface water drainage.

1.5. Overview of Emission Sources

1.5.1. Point Source Emissions to Air

Each engine will have an individual flue that exhausts at one metre above the parapet of the building. The locations of the 60 point source release points are shown in Appendix A. This stack height was determined through a stack height sensitivity study.

The main emissions of interest are oxides of nitrogen. SCR abatement technology will be installed on the CWL13 engines to reduce these emissions. Other exhaust gas pollutants have also been considered in a proportionate manner.

A detailed assessment of combustion gas emissions has been undertaken, the study concluded that the routine testing of the individual engines and cells would not present a significant adverse effect on air quality at the nearest sensitive receptors for human health and vegetation. The Air Quality Assessment can be found in Appendix D.

A feasibility study was undertaken to determine the potential cumulative impacts if routine testing (individual engines and / or cells (known as black building tests)) were to take place at CWL13 at the same time as testing at CWL11/12 The findings demonstrated that the additional emissions from CWL13 would have no material impact and it was concluded that the operational testing regime for CWL13 could be managed independently to that of CWL11/12.

Hypothetical full emergency outage scenarios were modelled for CWL13 alone, and in combination with CWL11/12. The modelling shows that for a full outage of CWL13 there could be exceedences of the AQS standard for hourly NO_2 but the AEGL-1 for acute non-disabling health effects is not exceeded. The assessment demonstrates that there would be no significant impacts on air quality due to the operation of the CWL13 facility alone, during an emergency scenario.

For a full emergency scenario at CWL13 in combination with CWL11/12, exceedances of both the hourly NO_2 AQS standard and the AEGL-1 could occur, were a full outage to coincide with the very least favourable hours of meteorological data for dispersion; however, the probability of this happening is extremely low. Calculations have shown that, even in the unlikely event of 24 hours of power outage in a year, the probability of an exceedance of the AQS objective for a cumulative outage across both sites is below 5% for sensitive locations. The contribution of the CWL13 facility to the hourly exceedances in a cumulative scenario is minimal, when compared to the equivalent modelled results for CWL11/12, with a 0 to 6% modelled increase in the number of hourly NO_2 exceedances in combination.

An Air Quality Management Plan (AQMP) is in place for the existing CWL11 facility and this has recently been updated to reflect the expanded CWL11/12. Although CWL11/12 and CWL13 will be operated separately, Vantage will ensure that there is coordination and cooperation between the two permitted facilities in the event of an emergency outage. Once the CWL13 Permit has been determined the CWL11/12 AQMP can be further updated (if considered necessary and in consultation with NRW) to reflect the low potential for cumulative impacts from CWL13 emissions and to ensure that actions to be taken to protect human health, in the event of emergency operation, consider the potential for cumulative impacts across the two facilities.

No ongoing monitoring is proposed due to the short and infrequent operation of the engines during testing / maintenance.

1.5.2. Point Source Emissions to Water

The only point source emission to water will be uncontaminated surface water runoff, which will ultimately be discharged into the wider business park drainage system via the site's surface water drainage system. There will be two emission points from the CWL13 surface water drainage system (W1 and W2, see Appendix A). The drainage system is a Sustainable Drainage System (SuDS) design. There will be oil interceptors at the proposed refuelling bay areas and there will be an onsite control valve within the facility's drainage system. Outside the proposed Installation boundary, within the wider business park drainage system, there are additional interceptors which would act as further protection to surface water receptors.

There will be no discharges to sewer.

There will be no process effluent releases to water.

There will be no planned emissions to groundwater.

1.5.3. Fugitive Emissions

It is considered unlikely that offsite nuisance as a consequence of dust or odour will occur, as a result of the operation of the Installation. Release of fugitive emissions to land and water will be prevented through appropriate infrastructure and management controls.

1.6. Noise and Vibration

Sources of noise from the Installation are limited to noise from the generators during testing / maintenance and emergency operation. The new generators have been selected to minimise noise and have a sound power level specification of 88 dB(A).

A detailed and conservative assessment of noise has been undertaken, concluding that noise impacts from routine individual engine tests and black building tests at CWL13 are not considered to be significant. No further mitigation measures are proposed. The Noise Assessment can be found in Appendix E.

The assessment of concurrent routine generator testing (individual engines tests and / or black building tests) across the two facilities demonstrates that sound levels and resulting impact magnitudes would be dominated by the sound emissions from generators at CWL11/12, with CWL13 only notably influencing the overall cumulative sound levels at Powis Close. Testing generators at CWL13 at the same time as CWL11/12 would not be significant. It is considered that the operational testing regime for CWL13 can be managed independently to that of CWL11/12.

The emergency scenario for CWL13 in isolation shows that most impacts at sensitive receptors would be negligible or minor adverse, which are not considered to be significant. Moderate adverse impacts were predicted at Powis Close. The likelihood of this impact being realised (i.e. the likelihood of a full emergency power outage) is very low and in this context it is considered that impacts from the emergency scenario for CWL13 alone are not significant.

The cumulative emergency scenario, where all engines on CWL11/12 and CWL13 operate simultaneously shows several moderate or major adverse impacts occurring, generally from generators at CWL11/12. As the CWL13 generators are more than 10 dB lower than some of the originally permitted engines at CWL11, and given the distance from some receptors, the contribution to the overall combined emergency noise level from the CWL13 generators would predominantly be low. Given that this scenario is very unlikely to occur (as described above for CWL13 alone), these impacts are not considered to be significant.

No ongoing monitoring is proposed due to the short and infrequent operation of the engines during testing / maintenance.

1.7. Materials and Wastes

1.7.1. Raw Materials

As part of the proposed operations the following substances will be used and stored:

- fuel - HVO or diesel;
- engine oil;
- antifreeze / coolant; and
- AdBlue (urea solution).

1.7.2. Waste Generation

The proposed facility will generate minimal waste, which will comprise predominantly maintenance fluids such as lubrication oil and used antifreeze / coolant. Wastes will not be stored on site, they will be removed by the maintenance contractor and disposed of via a licenced contractor. Most wastes are recycled. This will be included in the scope of the Installation's Integrated Management System (IMS).

1.8. Energy Use

The total net thermal capacity of the 60 standby generators is 179 MWth and they are capable of producing 72 MWe. As each engine is routinely tested for a total of approximately 5 hours per year; the site has a theoretical annual thermal input of approximately 896 MW hours per year (excluding any emergency operation).

The site's global warming potential (GWP) will be 224 tCO_2eq/yr. The GWP has been calculated in accordance with the guidance for assessing the impact of air emissions on global warming. Further details can be found in Section 5.4.

1.9. Management and Controls

The operator will maintain and operate the Installation in accordance with an IMS for quality, health & safety, information security and environment. The relevant sections of the IMS will be certified to ISO 14001:2015.

1.10. Accidents and their Consequences

As per the existing CWL11/12 facility, the operator will maintain an Accident Management Plan (AMP) for CWL13, this can be found in Appendix F of this application.

Potential accidents which may arise during the operation of the Installation have been considered and assessed using three elements:

- identification of hazards;
- assessment of risks (and possible consequences); and
- identification and implementation of techniques to reduce the risk of accidents (and contingency plans for any accidents that may occur).

A qualitative risk assessment has been carried out for the foreseeable accident scenarios which concludes that the site poses a low risk to the environment when control measures are taken into account.

1.11. Overall Environmental Impact

The potential for impact on the environment as a consequence of the operation of the Installation (i.e. testing of engines and cells) has been assessed. The main emissions to air are products of combustion and their impact has been assessed in Section 5.3 of this application and quantified within the Air Quality Assessment, which is included in Appendix D. The assessment predicts that there will not be any significant impacts as a result of routine testing at CWL13. The only point source emission to water will be uncontaminated surface water runoff, which will ultimately be discharged into the wider business park drainage system via the site's surface water drainage system. This is discussed in Section 5.5. Noise levels have been quantified in a Noise Assessment, included in Appendix E, which concludes that the overall impact of testing is not considered significant.

1.12. Monitoring and Reporting

The operating hours for testing (routine or unplanned) will be recorded.

The following will be reported on an annual basis (as per the existing data centre Installation):

- annual report;
- performance parameters: fuel use and operating hours (routine and non-routine / emergency hours);
- annual emissions to air (oxides of nitrogen (NOx), carbon monoxide (CO), particulate matter (PM) and sulphur dioxide (SO_2) - reported via the UK Pollutant Release and Transfer Register (PRTR); and
- annual waste generation - reported via the PRTR.

No ongoing monitoring of air or water emissions, or noise is proposed.

1.13. Applicable Legislation

The data centre will fall under Chapter 1 of Schedule 1 of the Environmental Permitting (England and Wales) Regulations 2016 (EPR16): Schedule 1, Section 1.1 Combustion Activities, Part A (1) (a) Burning any fuel in an appliance with a rated thermal input of 50 or more megawatts. The Installation will require a Part A(1) Environmental Permit from NRW.

2. Process Description

2.1. Activities

The operator is applying for a bespoke Environmental Permit for the operation of a Part A (1) Installation Activity under the EPR16. The Installation comprises activities listed in Schedule 1 of the EP Regulations and directly associated activities. These are shown in Table 2-1, which is based on the existing Environmental Permit for CWL11.

Table 2-1 - Schedule 1 Listed Activities and Directly Associated Activities

Table S1.1 Activities		
Activity Listed in Schedule 1 of the EP Regulations	**Description of Specified Activity**	**Limits of Specified Activity**
Section 1.1: Part A (1) (a) Burning any fuel in an appliance with a rated thermal input of 50 megawatts or more	Operation of emergency standby generators burning fuel (HVO or diesel) solely for the purpose of providing electricity to the data centre in the event of a failure of supply from the National Grid comprising: • 60 (A1-A60) standby generators with an aggregated thermal input of 179 MWth. Also testing and maintenance operations.	From receipt of raw materials to combustion of fuel and release of exhaust gases to atmosphere. Distribution of emergency standby electrical power to the data centre. Electricity produced at the Installation shall not be used to provide commercial services to the National Grid or Distribution Network Operator. The hours of operation for the testing of the standby generators shall be restricted to 0900 to 1700 Monday to Friday and at no times on weekends or Bank or Public Holidays. There shall be no overlapping of testing scenarios at CWL13. Only one black building test will be undertaken at CWL13 in any one day.
Directly Associated Activities		
Directly associated activity	Fuel storage - fuel tanks provide generators with fuel (HVO or diesel) for the above schedule 1 activity	From receipt of fuel to despatch for use in emergency standby generators. All fuel storage tanks must be stored on hardstanding.
Directly associated activity	Surface water drainage system servicing area in which Schedule 1 activity takes place	Input to site drainage system until discharged into wider business park drainage system.

2.2. Engine Type and Configuration

The 60 standby generator sets will be Kohler type KD1650, which incorporate the KD45V20-5DES engine with a thermal input of just under 3 MWth. The combined maximum thermal input for the 60 engines is 179 MWth and the combined maximum electrical output is 72 MWe.

The engines are grouped into ‘cells’, and there will be 10 cells, each with 6 generator sets. The cells are designed on an ‘n+1’ redundancy basis for additional security of supply.

The engines will typically run at 100% of prime power. Each engine will be fitted with SCR technology to reduce the emissions of NOx to 500 mg/Nm^3 (at reference conditions, 5% oxygen). This value is consistent with the MCPD emission limit for comparable engines in a standard running role. However, it should be noted that although the engines are designed to meet this limit, the emission limit does not apply to the engines at CWL13, as they are for emergency use only and exempt from the emission limit and monitoring requirements of the MCPD. The SCR technology involves injection of a urea solution (see Section 3.3.4) into the engine exhaust gases, which then pass through an ammonia slip catalyst (ASC) before being exhausted to atmosphere.

The noise specification for the generator sets is 65 dB(A) at 1 m.

The proposed new engines will not use F-Gases.

2.3. Fuel

The engines will burn hydrotreated vegetable oil (HVO), although diesel may be used as an alternative fuel in the event of supply issues. HVO fuel can be used as a 'drop-in' replacement for white or red diesel without the need to adjust engines and without affecting reliability and performance. It conforms to EN15940 and ASTM D975 standards for paraffinic and diesel fuels and the Fuel Quality Directive 2009/30/EC Annex 2.

HVO is a second generation bio-fuel and is a low-emission and low-carbon synthetic fuel alternative to regular diesel. It is completely fossil-free and is instead produced using renewable waste materials from the food industry such as waste cooking oil. HVO has a number of advantages over diesel fuel. It is considered one of the cleanest fuel alternatives, eliminating net CO_2 emissions by up to 90%. HVO also reduces emissions of NOx, CO and PM, it contains very low concentrations of sulphur (<0.001%) and no aromatics. It is 100% biodegradable, odourless, and virtually non-toxic. It can be stored at higher and lower temperature than diesel and it can be stored for up 10 years.

As diesel fuel gives rise to higher emissions of combustion products, the air quality assessment (see Appendix D) has assumed the use of diesel as this approach provides the most robust and conservative assessment.

2.4. Overview of Operating Modes

As the standby generators are for back-up emergency power generation there is no 'routine operation'. However, there are two testing scenarios for the engines that take place during routine servicing and maintenance activities:

- testing of individual engines; and
- testing the cells (known as a black building test).

In addition to routine testing, there may also be unplanned events. These are:

- testing of the engines after an unplanned repair (called a 'break-fix' event) - where possible these are tied into the planned testing that takes place during servicing and maintenance; and
- emergency scenario (i.e. operation in the event of a grid failure).

The 'operating hours', testing regimes and emergency operation of engines are summarised below.

In order to complete the annual maintenance and testing regimes for all engines at CWL13 there may be a need for the routine testing of the CWL13 engines to overlap with testing at the CWL11/12 facility. This may arise for either the individual engine tests, or for the black building tests. Studies have been undertaken for air quality and noise to assess the feasibility of concurrent testing at CWL13 and CWL11/12 (see Appendix D and Appendix E). The studies show due to the physical distance between the two sites, and the abatement proposed for CWL13, then any in-combination effects from short-term operation are anticipated to be minimal. The studies concluded that the operational testing regime for CWL13 could be managed independently of that of CWL11/12 without significant effects on receptors.

2.5. Planned Operation

2.5.1. Routine Testing of Individual Engines

Each engine is tested during servicing / maintenance as follows:

- testing will be carried out on a quarterly basis (calendar year);

- twice per year (alternating quarters) individual engines will be run for 15 min each;
- twice per year (alternating quarters) individual engines will be run for 2 hours each;
- individual engines may be tested sequentially but no coincident individual engine tests will be undertaken at CWL13; and
- individual engine tests will not take place at the same time as, or overlapping with, any other testing at CWL13 (i.e. black building tests).

2.5.2. Routine Testing of Cells (Black Building Test)

In the black building test all engines in an individual cell will be run concurrently as follows:

- the test will take place twice per year per cell;
- each test duration will be 15 mins per cell;
- the test typically will involve all engines in a cell being fired up, with automated load shedding down to the required output occurring within 10 minutes. However, for the purposes of modelling air emissions and noise, load shedding is not accounted for and it is assumed that all engines in a cell run concurrently for the full 15 minutes;
- this testing mode will not be carried out at the same time or overlapping with any other testing mode at CWL13 (i.e. individual engines tests);
- there will be no more than one black building test per day; and
- black building tests may be followed sequentially by testing individual engines from any cell.

2.5.3. Summary of Routine Testing

On the basis of the planned testing / maintenance, each engine would typically be operational for only five hours a year (i.e. a total of 300 hours per year of operation for the 60 engines at CWL13).

2.6. Unplanned Operation

2.6.1. Emergency Scenario

This is a theoretical scenario to simulate what could happen in the event of a major grid outage. The purpose of the engines is to provide electrical backup to the site's National Grid connection. This is an integral part of Vantage's service offering and a contractual obligation to its clients.

In an emergency scenario, all engines would start up simultaneously, a process which takes up to 21 seconds. During this time, a battery uninterruptible power supply (UPS) would meet the data centre power demand. The engines could provide a maximum combined electrical output of 72 MWe. Once all the engines are synchronised, automated load shedding down to the required output would occurring within 10 minutes. However, for the purposes of modelling air emissions and noise at CWL13, a conservative approach has been taken and load shedding is not accounted for - consequently it has been assumed that all 60 engines at the site run concurrently for the full duration of this scenario.

It is expected that the Permit (if granted) will contain a condition limiting the hours of emergency operation to 500 hours per year. This is in accordance with the EA's Data Centre FAQ Headline Approach Guideline document[2] states that: '*Permits will include a maximum 500 hour 'emergency/standby operational limit' for any or all the plant producing on-site power under the limits of the combustion activity*'. Paragraph 7 of the Data Centre FAQ Headline Approach Guideline[2] document goes on to state that: '*Emergency hours' operation includes those unplanned hours required to come off grid to make emergency repair of electrical infrastructure associated but occurring only within the data centre itself*'.

The probability of an emergency scenario occurring is very low (the Office of Nuclear Regulation (ONR) identifies a conservative value for an outage of up to 2 hours as a 1 in 20 year event; longer events have a lower probability); this probability is reduced further by the dual connections to the grid, either of which could be used in isolation if the other were to fail. As the facility has a direct connection to the National Grid, an emergency scenario would only occur in the event of a regional outage. The duration of this type of event would

[2] Data Centre FAQ Headline Approach, Draft Version 11.0 (Release to Industry), H Tees, Environment Agency, May 2020.

be outside the operator's control, however it would be addressed by National Grid as a high priority. The existing CWL11 Vantage facility has not experienced a full emergency since operation commenced in 2009. The overall reliability of supply for the National Grid Electricity Transmission System (NGETS) in England and Wales over the last few years is as follows[3]:

Table 2-2 - Reliability of Supply of the NGETS Since 2014

Year	Reliability
2020-21	99.99997%
2019-20	99.99997%
2018-19	99.99998%
2017-18	99.999984%
2016-17	99.999964%
2015-16	99.999998%
2014-15	99.999996%

Although a full emergency scenario, is extremely unlikely, the potential environmental impact from a hypothetical emergency scenario has been modelled in the air quality and noise assessments (see Appendix D and Appendix E).

The emergency scenario has been assessed for CWL13 alone, as well as in conjunction with full emergency operation at CWL11/12.

2.6.2. Unplanned Testing for Break-fixes

Even though the engines are regularly serviced and well maintained, occasionally an engine fault requiring repair (known as a break-fix) may occur outside of the planned servicing and maintenance periods. Part of the repair requires running the engine for a period of time to establish that the repair has been successful. Where feasible the repair activities will be coordinated with planned maintenance activities; however this is not always possible. Normally a minimum of 15 minutes is required to confirm generator operation following a repair, however this can be longer, consequently it is assumed that on average a break-fix test run could take up to 30 minutes. On the basis of historical data for CWL11 it is proposed that a suitable 'cap' for unplanned testing would be 15 hours per year. This scenario has not been specifically assessed as it is bounded by the assessment of the routine individual engine tests.

2.6.3. Hours of Operation for Testing

Hours of operation for testing (both planned / routine tests or unplanned testing) will be strictly limited to:

- 09.00 to 17.00 (8 hours per day); and
- Monday to Friday, excluding bank / public holidays.

2.7. Site Drainage

The site will have a SuDS surface water drainage system. Uncontaminated surface water runoff will be discharged into the wider business park drainage system via the site's surface water drainage system. There will be two emission points from the CWL13 surface water drainage system (W1 and W2, see Appendix A). There will be oil interceptors (with alarms) at each of the refuelling bay areas and an onsite isolation control valve within the facility's drainage system. Outside the proposed Installation boundary, within the wider business park drainage system, there are additional interceptors.

[3] National Grid: National Electricity Transmission System Performance Report 2016 – 2017 and National Grid, Annual Report and Accounts 2020/21.

2.8. Materials Use, Handling and Storage

2.8.1. Raw Materials

The main raw material is fuel. Typically the engines will burn HVO; however diesel may be used in the event of supply chain issues. The estimated annual throughput of materials is provided in Table 2-3.

Table 2-3 - Raw Materials

Material	Use	Annual through-put (kg)	Storage	Fate	Hazards
HVO	Fuel for engines	81,000[(a)]	Fuel storage tanks.	Consumed during combustion in engines and combustion gases emitted to atmosphere.	Health Hazard: may be fatal if swallowed and enters airways. Repeated exposure may cause skin dryness or cracking.
Diesel	Secondary fuel for engines	83,000[(b)]	Fuel storage tanks.	Consumed during combustion in engines and combustion gases emitted to atmosphere.	Toxic to aquatic life with long lasting effects. Harmful to health: may be fatal if swallowed and enters airways, causes skin irritation, harmful if inhaled, may cause cancer, may cause damage to organs through prolonged or repeated exposure.
Engine oil	Lubricating oil for engines	12,000	Within engines (not stored on site).	Waste oil removed during oil changes (recycled).	Toxic to aquatic life with long lasting effects. Harmful to health: irritating to skin, risk of serious eye irritation.
Antifreeze	Coolant for engines	5,000[(c)]	Within engines (not stored on site).	Removed every 2-3 years during maintenance (recycled).	Harmful to health: harmful if swallowed, may cause damage to organs through prolonged or repeated exposure.
AdBlue	SCR reagent	5,600	Stored in tanks.	Used in the conversion oxides of nitrogen in engine exhaust into nitrogen and water vapour.	Not classified.

Table Notes:

a) Diesel is typically only to be used as a fuel in the event of supply issues with HVO. The diesel usage given is the theoretical annual use if all of the engines were run on diesel (based on 5 hours testing per engine per year); however in reality diesel use should be negligible or very low.

b) HVO usage assumes no diesel use (i.e. this is the maximum usage, based burning HVO during the 5 hours testing per engine per year).

c) Antifreeze is typically only changed every 2.5 to 3 years, this is the maximum usage in the year that antifreeze is changed.

In addition to the materials listed above, there will be ASC present in the SCR catalyst housing (mounted on top of the generator). The catalyst is a metal (platinum) oxide filter and as it forms a integral part of the SCR reactor it is not considered as a 'raw material'. No ASC will be stored on site and is unlikely to be brought onto site as it should not need replacing within the life span of the engines (as it is only requires changing after 6,000-8,000 hours of use, and the engine will only be used for approximately 5 hours per year for routine testing / maintenance).

2.8.2. Materials Storage and Delivery

2.8.2.1. Fuel

Each generator set will be housed in its own container on a concrete base. Each engine sits on top of an individual above ground ‘belly tank’. This arrangement means that no external pipework is required which helps to reduce the risk of leaks. Each tank will be double skinned, integrally bunded (with 110% capacity) and complete with alarm and integral fill point. The capacity of the fuel tanks is 16 m^3 each, which is sufficient for 48 hours of operation. The total onsite fuel storage capacity is 960 m^3.

Fuel will be delivered by road tanker and transfered to the fuel tanks will be via a flexible hose. There will be six hardstanding tanker bays for refuelling activities, which are spilt into two sets of three bays, one set on each side of the site. Each set of bays is connected to an oil interceptor which will be alarmed. A drip tray will be present beneath the fill point in the fill cabinet.

2.8.2.2. AdBlue

The AdBlue tanks will be re-filled via a bowser. The AdBlue tank for each engine will sit underneath the discharge attenuator and on top of the fuel tank. The AdBlue tanks will be integrally bunded (with 110% capacity) with bunded fill point cabinets. Each engine has an AdBlue tank with a 1 m^3 capacity, sufficient for 48 hours of operation. The total onsite storage capacity is 60 m^3.

2.8.2.3. Ancillary Materials

Antifreeze / coolant and engine oil will be present in the engines, within the containers but will not be stored on the site. These materials will be brought on to site by an external maintenance team as required. Drip trays will be used when topping up engine oil and antifreeze / coolant within the engines. Any spills / leaks would be contained within the engine container, which effectively acts as a bund.

2.9. Waste

The wastes produced by the Installation are minimal and are associated with the testing and maintenance of the engines. Most wastes are produced annually; however, waste antifreeze is only generated every 2-3 years. Wastes are not expected to be stored onsite, they will be removed by the maintenance contractor as they are generated and disposed of / recycled offsite.

Table 2-4 - Annual Waste Generation Estimates

Description	EWC Code	State	Fate	Quantity (kg)
Hazardous Wastes				
Engine oil	13-02-05	Liquid	Recycling	4,000
Filter oil / fuel	15-02-02	Liquid	Recycling	800
Antifreeze	16-01-15	Liquid	Recycling	2,500
Batteries	16-01-17	Solid	Recycling	2,800
Other (socks, mats, rags etc.)	Various	Solid	Disposal	110
Non-Hazardous Wastes				
Air filters	15-02-03	Solid	Recycling	240
Mixed recycling (engine parts)	16-01-09	Solid	Recycling	240

2.10. Applicable Legislation

The total thermal capacity of the standby generators is > 50 MW net thermal input, which falls within the remit of Section 1.1 Combustion Activities of the EPR16 and means that the Installation requires a Part A (1) Environmental Permit from NRW.

The engines have thermal capacities of less than 15 MWth, which means that although the facility falls within the remit of Section 1.1 Combustion Activities of the EPR16, it does not fall within Chapter III of the Industrial Emissions Directive (IED): Special Provisions for Large Combustion Plant.

The Medium Combustion Plant Directive (MCPD) does apply to the generators as they are between 1 and 50 MWth. However, combustion plants operating for fewer than 500 hours per year are exempted from complying with the emissions limits set out in Part 2 of Annex II. As the generators will be operated for significantly less than 500 hours per year, it is considered that the exemption applies.

In addition to the MCPD, the UK government also introduced Generator Controls to specified generators in England and Wales through the 2018 amendments to the EPR16 (via Schedule 25B). These also do not apply to the generators as they fall under Chapter II of the IED and as they are operated for the purpose of testing for fewer than 50 hours per year.

3. Techniques for Process and Emissions Control and BAT Assessment

This section of the application describes the techniques adopted for carrying out the activities at the Installation, including control of point source and fugitive emissions, specifically addressing the indicative Best Available Techniques (BAT) contained in the relevant technical guidance.

The following guidance documents have been consulted to establish indicative BAT for the operation:

Table 3-1 - Reference Documents Used to Assess BAT

Title	Author	Year
How to comply with your environmental permit, v.8(a)	Natural Resources Wales	2014
Data Centre FAQ Headline Approach, Draft Version 11.0 (Release to Industry)	H Tee, Environment Agency	2020

The NRW guidance note 'How to comply with your environmental permit, Additional guidance for: Combustion Activities,' (EPR 1.01) was withdrawn in 2018. It has been replaced with the BAT reference document (BREF) technical guidance for large combustion plant, which comprises the following:

- Best Available Techniques (BAT) Reference Document for the Large Combustion Plants, Industrial Emissions Directive 2010/75/EU, December 2017; and
- Establishing Best Available Techniques (BAT) Conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for Large Combustion Plants, November 2021 (the 'Combustion BATc')

These documents do not apply to the size and application of plant at the Installation; they only apply to combustion plant which on aggregate exceeds 50 MWth and with individual plants above 15 MWth (i.e. aligned with the definition of LCP stated in Chapter III of the IED). This means that there are no directly applicable BAT reference documents for combustion to apply to the Installation. However, there are broadly applicable elements of the Combustion BATc, such as management techniques and prevention of fugitive releases that are relevant.

Although withdrawn, the EPR 1.01 guidance still provides good framework and indicative guidance for the demonstration of BAT for the combustion process and this document is referred to herein. Other standards / regulations are referred in the following sections, where relevant.

Consequently, the approach to addressing BAT has been undertaken on the same basis as the BAT assessment in the original application and the recent variation application. As a result, this BAT assessment provides the same level and types of information as previous permit applications for the existing Vantage facility at Newport, with the addition of any further elements from the latest version of the Data Centre FAQ[2].

3.1. Measures to Minimise Emergency Operation

The sole purpose of the generators is to provide power under emergency conditions. Optimising grid reliability within the site as part of general BAT to minimise hours of emergency operation. Vantage has taken the need to limit the potential for an emergency scenario into consideration in the design, operation and management of the facility.

The Data Centre FAQ[2] states that, 'evaluation is needed within the permit application on the Tier reliability standard under ISO27001 and uptime'. There are four 'tiers' of data centres, Figure 3-1 offers a high-level overview of the tiers. CWL13 will be a Tier 3 facility, which has an expected uptime of 99.982% per year. CWL13 will be certified to ISO 27001, which is an international standard outlining best practices for an information security management system (ISMS), which is a framework of policies and procedures that includes all legal, physical, and technical controls involved in an organisation's information risk management processes. It's the only auditable standard that deals with the overall management of information security, rather than just which technical controls to implement. ISO 27001 certification demonstrates that Vantage is committed to best practices and robust security procedures.

Figure 3-1 - Data Centre Tier Summary

PARAMETERS	TIER 1	TIER 2	TIER 3	TIER 4
Uptime guarantee	99.671%	99.741%	99.982%	99.995%
Downtime per year	<28.8 hours	<22 hours	<1.6 hours	<26.3 minutes
Component redundancy	None	Partial power and cooling redundancy (partial N+1)	Full N+1	Fault tolerant (2N or 2N+1)
Concurrently maintainable	No	No	Partially	Yes
Price	$	$$	$$$	$$$$
Compartmentalization	No	No	No	Yes
Staffing	None	1 shift	1+ shift	24/7/365

The facility will have its electricity supply provided through two independent direct connections to the National Grid. Both of the connections can supply power concurrently under normal operational conditions, and both could be used in isolation if the other part of the National Grid supply system were to fail. There are no local distribution centres between the site and the National Grid; consequently local power outages should not result in prolonged or extensive emergency operation. This is regarded as unique for data centres and is fundamental in further reducing the likelihood of emergency operation at the Vantage site.

Emergency operation due to onsite power failures is minimised through systems that enable rapid response by key personnel (through business continuity plan), stocking of critical spares, routine checks / maintenance and the implementation of a replacement programme.

3.2. Selection and Arrangement of Engines and Fuel

It is generally accepted that oil fired diesel engines are presently the default technology for standby power generation in data centres[2]. Diesel generators have a proven reliability and a very good cold start capability. The main alternative would be gas as a fuel and gas turbines. However, gas is not suitable as a fuel for safety risk and storage issues and gas turbines are not responsive enough. As noted in Section 2.3, HVO will be used as a fuel, with diesel as back-up fuel. HVO has a number of environmental benefits when compared to diesel, including lower emissions, no odour, 100% biodegradability and lower toxicity.

The new Kohler generator sets are considered to be the ‘best’ and most recent technology for their intended use. The modular designed topology minimises operational risk of customer downtime as there is greater redundancy and in turn resilience within its design. A larger number of smaller diesel generators is considered BAT largely due to the modular nature of the site. In addition, small units provide more flexibility and allow more accuracy in relation to modulating the power requirements during an outage.

There is a built-in redundancy to the number of standby generators present on site to ensure that the data centre can always provide the required support in the event of a grid outage. In the case of the Vantage facility, generators are arrayed on an ‘n+1’ redundancy basis, so there is 1 extra engine in a cell to allow the cell to meet the demand from a data hall in the event that one engine fails.

3.3. Point Source Emission to Air

3.3.1. Overview

There will be a total of 60 emission points to air, one from each of the engines. The locations of the engines are shown in Appendix A. As the engines will burn HVO or diesel fuel, the emissions from the exhaust gas will comprise levels of:

- Oxides of nitrogen (NOx);
- Particulates (PM_{10} and $PM_{2.5}$);
- Carbon monoxide (CO);
- Carbon dioxide (CO_2); and
- Sulphur dioxide (SO_2)

There will be no ammonia slip as a result the installation of SCR abatement on the engines (see Section 3.3.5 for the justification for this).

Although the over-riding requirement for the standby generators is the uninterrupted provision of client-critical services, Vantage has identified and assessed potential measures to control point source emissions to air to ensure BAT are adopted. Operation under the environmental permitting regime prioritises the prevention of emissions to the environment by primary techniques above their abatement by secondary techniques. This philosophy has been considered in this BAT assessment.

3.3.2. Stacks

Stacks are not joined as ductwork failure could then take out two or more engines, undermining reliability and redundancy. In addition, having common windshields is not considered to be BAT as this would compromise the redundancy arrangements as, if one stack was unable to be used, then multiple generators may not be able to operate. The engines are most efficient with minimal ducting and stack height - hence a multi flue stack would reduce engine efficiency. Routing stacks to common windshields is also problematic due to the amount of pipework and support structures necessary.

To ensure adequate dispersion, a stack height sensitivity study was undertaken to determine the appropriate stack height. Each stack extends to 1 m above the parapet of the main data centre building.

3.3.3. Plant Design and Maintenance

For all combustion plant, plant design features and planned preventative maintenance are important primary measures to maintain optimum emissions in line with manufacturer's performance specification for the units. Such controls include:

- plant design;
- manual and automatic tuning;
- process parameter monitoring; and,
- planned preventative maintenance and corrective action.

These controls are discussed in the following paragraphs.

3.3.3.1. Plant Design

Through research and development, engine manufacturers have found that combustion chamber design (including cylinder, piston crown and valve configuration) affects combustion efficiency and exhaust emission levels. Consequently, they have developed a range of combustion chamber configurations for specific applications, thereby providing inherent control of exhaust emissions and energy efficiency, and these have been incorporated into engine design. The generators will use turbo-charging to further improve fuel efficiency.

3.3.3.2. Tuning

Manual and automatic tuning of the engines provides the means for maintaining peak performance to control exhaust emissions at the required levels, whilst also providing consistently good combustion and energy efficiency.

3.3.3.3. Process Monitoring and Corrective Action

To control the combustion conditions within the engine, an electronic engine management system (or Engine Control Unit (ECU)) will be used. The key parameters recorded by the control systems that are used to manage the operation of the engines (and hence may be considered to be surrogate environmental monitors) are listed as follows:

- fuel flow rate to each unit;
- fuel delivery system pressure;
- air flow rate, temperature and pressure;
- cylinder temperatures and pressures; and,
- oil temperature and pressures.

These measurements are used by the ECU to adjust the engine ignition timing, air flow from the turbocharger and temperatures in the engine's system. If any of the measured process parameters exceeds levels specified in the process control manuals, an alarm is raised, requiring operator action.

3.3.3.4. Maintenance and Corrective Action

Maintenance is a key component of operational control at the Installation, particularly for ensuring air emissions and energy efficiency are maintained at the required levels. Maintenance activities may be either planned or reactive (e.g. break fixes). A high level of preventative maintenance has been designed to avoid unscheduled down time, maximising the plant availability and its ability to control emissions and maintain an efficient level of operation between overhauls. It is an important component of the measures to keep the combustion units at peak efficiency and optimum emissions performance.

The following measures are in place to minimise engine emissions to atmosphere during an incident and to minimise the duration of such an incident where the cause is due to internal malfunctions rather than external factors that are outwith the control of Vantage (e.g. grid outages):

- equipment is maintained in line with the manufacturers' recommendations / industry standards. Robust service level agreements for the critical supply chain ensure rapid respond to business-critical incidents.
- the engines are tested throughout the year on a quarterly cycle both individually, and twice a year as cells;
- the number of times that engines are tested for and the duration of the test has been minimised as far as is practicable - each engine will typically operate for five hours a year, which meets the Data Centre FAQ[2] target of < 50 hours per engine per year;
- no cell testing can be undertaken concurrently across the CWL13 facility, so as to reduce impacts on local air quality;
- intervals between equipment servicing and replacement will be minimised where practicable;
- significant volume of critical spares will be kept on site to minimise engine down time due to malfunctioning; and
- engineers will be on site 24 hours a day to ensure a timely response and investigation of any alarms and an on-call engineering Chief or Manager can respond to site out of hours and escalate any outages or major instances to the Senior Management Team (SMT).

3.3.4. NOx Control

The primary pollutant of concern for the standby generation plant is NOx.

The most important oxides of nitrogen with respect to releases from combustion processes are nitric oxide (NO), nitrogen dioxide (NO_2) (together comprising NOx) and nitrous oxide (N_2O). Nitric oxide forms over 95% of the total NOx in emissions from most types of combustion plant.

There are three recognised NOx formation mechanisms:

- "Fuel NOx" by conversion of chemically bound nitrogen in the fuel;
- "Thermal NOx" by fixation of nitrogen in the combustion air; and
- "Prompt NOx" by a mechanism in which molecular nitrogen is converted to NO via intermediate products in the early phase of the flame front with hydrocarbons participating in the reactions.

The first two mechanisms are the only ones of major importance in most combustion plants.

Fuel NOx formation depends on the nitrogen content of the fuel; as the nitrogen content of HVO / diesel fuel is negligible, fuel NOx is not an important source of NOx formation for diesel-fuelled plant. Thermal NOx formation requires temperatures greater than 1,000°C, therefore reducing peak temperatures below this value reduces thermal NOx formation. The thermal NOx formation route is the most important source of NOx emissions from oil and gas-fired plant.

Baseline NOx emissions from unabated internal combustion (reciprocating) engines vary with engine size and speed. Larger, lower speed engines will generally produce more NOx than smaller high-speed engines.

BAT for NOx emissions from data centre engines is typically the TA Luft[4] emissions limit of 2,000 mg/Nm^3 at 5% oxygen[2]. The usual primary combustion control techniques for NOx will be implemented (e.g. optimised fuel / air mixing, combustion chamber, piston crown and valve configuration, tuning etc.). Secondary techniques to reduce NOx are not usually considered to be appropriate for engines for the provision of standby emergency power. The costs of installing and operating such techniques is largely considered to be disproportionate in relation to the potential environmental benefit. However, for CWL13 selective catalytic reduction (SCR) abatement technology will be installed on the CWL13 engines to reduce NOx emissions to 190 mg/m^3 at 15% oxygen, at 100% load (equivalent to 500 mg/Nm^3 at 5% oxygen). This value is consistent with the MCPD emission limit for comparable engines in a standard running role. However, it should be noted that although the engines are designed to meet this limit, the emission limit does not apply to the engines at CWL13, as they are for emergency use only and exempt from the emission limit and monitoring requirements of the MCPD. The SCR technology involves injection of a urea solution into the engine exhaust gases, which then pass through an ammonia slip catalyst (ASC) before being exhausted to atmosphere.

The AdBlue injection will commence at approx. 200°C at which point <20% NOx reduction would be achieved; however, very little NOx is produced at this stage because NOx is formed at higher in-cylinder temperatures and pressures. As load and temperature increases so will NOx conversion - for example at 50% load (achieved in <10 minutes) and approximately 250°C around 70% NOx reduction can be expected. The optimum operational window for SCR is when the exhaust temperature reaches 350-450°C. See Table 3-2 for data supplied by the manufacturer.

Table 3-2 - NOx Concentrations with SCR at Varying Load and Temperature

Load	Approx. Exhaust Gas Temperature	NOx reduction	NOx with SCR mg/m^3 at 15% oxygen
50%	250°C	70%	186
75%	400°C	90%	144
100% (ESP)	450°C	90%	172

3.3.5. Ammonia Slip

The rate of AdBlue injection is controlled electronically so that dosing is automatically and quickly adjusted to meet the required level of emissions reduction. This process uses a ‘closed loop control” which involves NOx sensors to measures both ‘engine out NOx’ and ‘tailpipe NOx’. This is linked to the ECU in the electronic control panel that provides precise control of the AdBlue injection rate. Any faults will be electronically logged and alarms will show what / where the fault is so that it can be corrected.

When commissioning the system the NH_3/NOx ratio (referred to as the ANR or alpha ratio) will be set to be between 0.9 and 1 which is the optimum setting (similar to stoichiometric) to minimize any ammonia slip while still providing the required NOx reduction. This finite control should ensure that there will be no ammonia slip.

If the alpha ratio were to be increased to >1, higher NOx reductions would be achieved but at the risk of ammonia slip. In this instance an ASC could be used to eliminate the ammonia slip. The SCR reactor to be used will use both techniques - the ANR / alpha ratio will be set to control the amount of ammonia being

4 Technische Anleitung zur Reinhaltung der Luft (TA Luft), Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU), 2002

injected into the system and, as a secondary prevention measure an ASC is used on the outlet end of the SCR reactor to remove any ammonia from the exhausted gas.

The ASC is present in the SCR catalyst housing (mounted on top of the generator). The catalyst is a metal (platinum) oxide filter and it is an integral part of the SCR reactor. As it is only requires changing after 6,000-8,000 hours of use, and the engines will only be used for approximately five hours per year for routine testing / maintenance, the ASC should not need replacing within the life span of the engines.

If both measures fail and ammonia is present in the exhaust gas, this will be picked up by the tailpipe NOx sensor as increased NOx. The NOx sensors do not distinguish between NOx and ammonia, but if ammonia slippage were to occur then the tailpipe NOx sensor will read this as an increase in NOx. If the tailpipe NOx sensor does not detect any increase in NOx compared to engine out NOx, then this is the evidence to show that there has been no ammonia slippage.

A procedure has been included in the commissioning documentation that involves conducting tests to demonstrate that that the Closed Loop Control system is working and that it is accurately controlling the ammonia injection rates to prevent any ammonia slip.

3.3.6. Sulphur Dioxide

In combustion processes, the fuel is the source of sulphur in the gaseous emissions. Therefore, SO_2 emissions from the engines are controlled via the primary technique of fuel selection. EPR 1.01 states that '*for smaller scale combustion plant, use of low sulphur fuels (i.e. less than 1.2% sulphur) may be sufficient in the consideration of BAT for control of oxides of sulphur emissions'.* The Balancing Market BAT Review[5] identifies that the use of low sulphur diesel (compliant with Sulphur Content of Liquid Fuels (England and Wales) Regulations 2007, as amended (SCOLF 2007)) is considered one of the key BAT for SO_2 control.

The diesel fuel used in the engines is regulated to no more than 0.1% sulphur by mass[6], which substantially limits the potential for sulphur dioxide emissions from fuel combustion. The sulphur content of HVO has a sulphur content of <0.001%. This within the requirements of the SCOLF 2007 of 0.1% (1,000 ppm) for diesel fuel, and also TA Luft 2002[4] which recommends <0.2% sulphur.

It is considered that the primary techniques employed to control SO_2 emissions represent BAT for the Installation.

3.3.7. Particulates Control

3.3.7.1. Emission Limits

For liquid fuelled combustion plant, the control of PM emissions is mainly dependent on those measures which secure optimised combustion efficiency, since particulate production is typically a function of incomplete or inefficient combustion. Prevention of particulate emissions is especially dependent on fuel quality.

As described above, UK specification low-sulphur fuel is used at the Installation. The Balancing Market BAT Review[5] notes that the process to produce low sulphur fuels removes ash, which also reduces particulate emissions. The Report concludes that secondary measures for particulate control are not technically or economically feasible for plant operating in the balancing market, and it also states that no primary measures for particulate control are identified for plant operating in the balancing market. In addition, it is noted that the use of particulate abatement on standby generation plant is undesirable in any case, as the introduction of particulate filters increases the risk of blockage and has an adverse effect on reliability.

The Data Centre FAQ[2] proposes an emission limit for particulates and dust of 130 mg/Nm^3 at 5% O_2. TA Luft 2002 proposes an emission limit for standby engines burning liquid fuel of 80 mg/Nm^3 at 5% O_2. When running on diesel at 100% prime power, the Kohler engines are designed to meet a PM concentration of 3 mg/Nm^3 at 5% O_2 and so PM emissions are well within BAT limits.

It is considered that the use of the primary controls of fuel quality, regular and effective maintenance, and combustion efficiency represent BAT for the control of PM from the combustion plant.

5 Developing Best Available Techniques for combustion plants operating in the balancing market (Balancing Market BAT Review), Amec Foster Wheeler Environment and Infrastructure UK Limited, Department for Energy and Climate Change, 2016

6 https://www.legislation.gov.uk/uksi/2014/1975

3.3.8. Carbon Monoxide Control

Carbon monoxide (CO) emissions from the generator engines are minimised by the control of the combustion process. The Data Centre FAQ[2] proposes an emission limit for carbon monoxide of 650 mg/Nm^3 at 5% O_2. TA Luft 2002 proposes an emission limit for standby engines burning liquid fuel of 300 mg/Nm^3 at 5% O_2. When running on diesel at 100% prime power, the Kohler engines are designed to meet a CO concentration of 88 mg/Nm^3 at 5% O_2. Emissions when burning HVO may be lower still. The anticipated CO emissions are considered to be representative of BAT.

3.3.9. VOC Control

The emission of VOCs from the generator engines will be controlled in the same way as CO emissions, i.e., via combustion efficiency techniques. Measures to control VOC emissions from storage tanks and filling operations are identified in Section 3.4.

The Data Centre FAQ[2] proposes an emission limit for hydrocarbons of 150 mg/Nm^3 at 5% O_2. When running on diesel at 100% prime power, the Kohler engines are designed to meet a hydrocarbon concentration of 10 mg/Nm^3 at 5% O_2. Emissions when burning HVO may be lower still. The anticipated hydrocarbon emissions are considered to be representative of BAT.

3.3.10. CO_2 Control

Measures for the reduction of fuel use, i.e., those measures described above for the optimisation of combustion efficiency, will inherently reduce CO_2 emissions. The global warming potential of the engines is discussed in Section 5.4.

3.3.11. Metals, Halogens and Dioxins

Metals are present at very low levels in diesel fuels and levels are even lower in HVO. Measures to control particulate emissions will control trace metal emissions and no further abatement is proposed.

Halogens in the form of hydrogen chloride (HCl) and hydrogen fluoride (HF) are produced from the combustion of fuels if they contain chlorine and fluorine. The quantities produced by combustion of diesel / HVO are low due to the very low concentrations of fluorine and chlorine in the fuels and are not considered to require any specific abatement measures.

Dioxins can be produced by the combustion of any carbon containing fuel in the presence of trace quantities of chloride. Due to the low chloride levels in the fuels and short duration intermittent operating regime, no additional abatement of dioxins is proposed.

3.3.12. Indicative BAT Summary

Table 3-3 - Indicative BAT for Point Source Emissions to Air

Relevant Indicative BAT	Compliance Measure
NOx Control	
Control emissions of NOx by a combination of standard primary measures and secondary abatement technology (SCR).	Plant design is a key measure to control emissions, through efficient combustion, and this is maintained through monitoring and controls as well as planned maintenance and testing. All the generators on site utilise turbo charging to improve fuel efficiency. The use of secondary control measures (SCR) is not typically considered to be BAT due to the short term intermittent nature of the standby plant; however SCR will be installed on the Kohler engines to reduce NOx to 500 mg/Nm^3 at 5% oxygen.
Where air quality standards or other environmental standards must be met, you must use SCR or SNCR for smaller plant (<100 MW).	The Installation is not located in an AQMA. See comments on SCR above.

Relevant Indicative BAT	Compliance Measure
SO_2 Control	
Use low sulphur fuels as a primary measure.	Low sulphur fuels will be used.
Consider dry sorbent injection for pulverised and liquid fuel furnaces which are too small to justify FGD.	Primary SO_2 control techniques considered BAT.
PM Control	
Where particulate abatement is required, the options include: • ESPs; • fabric filters; • ceramic filters; • wet scrubbers; and, • cyclones. For combustion ignition (CI) engines, particulate removal efficiency is very dependent upon fuel quality. For many CI engines, particulate abatement may not be required. New CI engines should be capable of achieving the given unabated release levels.	High quality fuels are used, and fuel in storage is routinely tested to ensure quality. This, combined with combustion control, is considered among BAT to minimise PM emissions. The use of filters on standby plant is not regarded to be within BAT, as the potential for filter blockages reduces the reliability and availability of the standby power generation plant: in addition, the design of particulate filters for use of diesel engines requires the engines to run to “burn off” the particulate. This increases emission of pollutants. Manufacturer’s guarantee that emission concentrations will be much lower than the standards quoted in the Data Centre FAQ[2].
CO, VOC, CO_2 Control	
Elevated CO and VOC emissions indicate poorly controlled combustion and may also indicate higher releases of other pollutants. Good combustion conditions are required to minimise releases.	Use of combustion control and maintenance regime to control emissions. Manufacturer’s guarantee that CO and hydrocarbon emission concentrations will be much lower than the standards quoted in the Data Centre FAQ[2].
All measures to reduce fuel use will also reduce CO2 emissions.	Standby plant is only used occasionally for testing required for safety reasons. Primary controls identified for plant increase combustion efficiency and reduce fuel use.
Metals, halogen and dioxin control	
Controlling particulate levels and selecting residual fuel oils with a low ash content will control levels of most metals.	Use of high-quality fuels. Use of combustion control and maintenance regime to control particulate emissions.
Techniques used for abating SO_2 will also reduce halogens.	Use of high-quality fuel reduces contaminants present in lower distillate fuels. Halogen content is very low in diesel fuels.
Dioxins are usually present in both the particulate and vapour phases and accordingly measures to reduce PM emissions will also significantly reduce emissions of these compounds.	Use of high-quality fuel reduces contaminants present in lower distillate fuels. Halogen content very low in diesel fuels. Use of combustion control and maintenance regime to control particulate emissions.

3.4. Fugitive Emissions to Air

Potential sources of fugitive emissions to air arise from the storage of liquid fuel. There will be no external storage of solid raw materials or waste which may generate fugitive dust emissions

Fugitive emissions of hydrocarbons may arise from the storage of fuel. These emissions occur due to the displacement of hydrocarbon-containing air above the fuel in tanks as a result of thermal expansion due to temperature variation, or volume displacement from filling the tanks. Measures to control fugitive emissions from fuel storage have been adopted at the Installation, and include:

- selection of fuel which has relatively low volatility (HVO / diesel);
- the use of enclosed storage vessels; and
- regular inspection and maintenance to reduce the occurrence of leaks and spills.

As the engines are infrequently used the number of fuel deliveries is also limited.

TA Luft 2002[4] identifies a range of additional control measures to prevent fugitive emissions to air from liquids, however it states that these do not apply to inflammable liquids such as diesel.

Vantage considers the current measures for the control of fugitive emissions to air to be in line with BAT.

Table 3-4 - Indicative BAT for Fugitive Emissions to Air

Relevant Indicative BAT	Compliance measure
The following control measures may be appropriate to control VOCs: • enclose open vessels and fit abatement equipment to vents; • install sealed transfer (vapour balance) systems; • use sub-surface filling; • floating roof tanks and bladder roof tanks; • treat releases by adsorption or condensation; • tank vent systems that minimise breathing losses, for example the use of pressure / vacuum valves, and fit knock-out pots and appropriate abatement equipment where necessary; • inventory management; • reduce leakage from pipework or fluid transport systems; and, • use white paint, insulation and active temperature control to reduce the temperature in storage tanks.	The fuel has relatively low volatility, which reduces fugitive emissions. Measures taken to further reduce fugitive emissions are: a. the use of enclosed storage vessels; b. reduction of leakage from pipework; and c. regular inspection and maintenance to reduce leaks and spills.
Pumps, valves and sampling points should be sealed to prevent escape of volatiles to the atmosphere.	Pumps and valves are fully contained within the bunded tanks and sealed to prevent volatiles escaping.

3.5. Point Source Emissions to Water

No process effluent is produced. Point source emissions to water from the Installation are limited to uncontaminated surface water runoff from within the proposed Installation boundary. Surface water runoff will be discharged into the wider business park drainage system via the site's surface water drainage system. There will be two emission points from the CWL13 surface water drainage system (W1 and W2, see Appendix A). There will be oil interceptors (with alarms) at each of the refuelling bay areas and an onsite isolation control valve within the facility's drainage system. Outside the proposed Installation boundary, within the wider business park drainage system, there are additional interceptors.

Vantage will use the following key measures to prevent the contamination of rainwater draining from areas with the potential to cause contamination (see also fugitive emissions controls identified in Section 3.6.):

- primary and secondary containment of fuel and AdBlue tanks;
- bunding is such that rainwater will not collect within the bunds;
- cooling and lubrication systems are closed loop systems and are within engine containers;
- raw materials deliveries will be subject to Vantage management arrangements and will be supervised at all times;
- there will be alarmed interceptors beneath the fuel delivery bays;
- fill points will be bunded;
- fuel tank levels will be carefully checked during deliveries, and tanks will be alarmed; and
- there will be an onsite drainage isolation system in place and there are interceptors installed within the wider business park drainage system.

In the event of a fire, firefighting water would collect within the drainage system due to the drain isolation system that will be in place.

There are no planned releases to sewer or groundwater. Measures to avoid accidental releases to groundwater are described in Section 3.6.

Table 3-5 - Indicative BAT for Point Source Emissions to Water

Relevant indicative BAT	Compliance measure
'How to Comply with Your Environmental Permit'	
Apply the following general principles in sequence to control emissions to water: • minimise water use and re-use or recycle wastewater; • minimise the risk of contaminating process water, surface water or groundwater; • wherever possible use closed loop cooling systems and minimise blowdown; and, • prevent potentially harmful materials from entering the water circuit.	Water is not used by the Installation. Measures to prevent potentially harmful materials from entering the surface-water drainage system are identified in Sections 3.5 (above) and 3.6 - these ensure the safe storage of potentially harmful raw materials.
EPR 1.01	
Fuel storage Fit a high-level alarm to oil tanks. Drain decanted water from oil storage tanks and storm water from bunded areas to a water treatment plant; or direct it to an appropriate disposal facility. Use oil removal facilities such as partition chambers or plate separators for water contaminated with oil.	Fuel tank levels are carefully checked during deliveries, and tanks are alarmed. Bunding is internal (double skinned tanks), which means that rainwater will not collect within the bunds.
Site drainage including rainwater Use an efficient oil / water separation / interceptor system. Further treatment may be required to remove dissolved hydrocarbons. Direct discharge to controlled waters will only be allowed where discharges will meet discharge requirements under all conditions.	The delivery bays are fitted with oil interceptors with alarms. The on-site drainage system has a drainage isolation system (see Section 3.6.5). Outside the proposed Installation boundary there are also interceptors installed within the wider business park drainage system which act as a further protection to surface water receptors.

3.6. Fugitive Emissions to Surface Water, Ground and Groundwater

3.6.1. Overview

Potential sources of fugitive emissions to surface water, ground or groundwater may arise from the storage and handling of:

- fuel ;
- lubrication oil;
- antifreeze; and
- AdBlue.

Wastes are not stored on site, they are removed as they are generated in small quantities for offsite recycling / disposal and so are not considered likely to pose a risk in relation to fugitive emissions.

Fugitive emissions may arise as a result of:

- engine (lubrication) oil leaks;

- storage tank / container leaks and fuel distribution pipe leaks;
- delivery leaks and spills, including tanker and flexible hose leaks / disconnections; and
- drainage system.

EPR 1.01 does not specify BAT to control fugitive emissions to water, ground and groundwater. BATs are derived from 'How to Comply with your Environmental Permit'.

Vantage operates a range of measures to minimise the risk of unintended releases of potentially polluting materials to water, ground or groundwater from the Installation. Specific measures are described below.

3.6.2. Engine Leaks

Antifreeze / coolant and engine oil will be present in the engines, within the containers but will not be stored on the site. These materials will be brought on to site by an external maintenance team as required. Drip trays will be used when topping up engine oil and antifreeze / coolant within the engines. Any spills / leaks would be contained within the engine container, which effectively acts as a bund with a capacity in excess of 110%. All on-site staff operating the Installation have access to spillage containment equipment and are appropriately trained.

3.6.3. Deliveries

Raw materials will be delivered to the site by road, using authorised carriers. Materials will be delivered within plastic containers, bowser or tanker. Material unloading, storage, handling and use of raw materials will be undertaken in accordance with local site procedures. Offloading activities will be supervised at all times (in accordance with site procedures).

Fuel will be transferred to the fuel tanks via a flexible hose which conforms to British Standards. The AdBlue tanks will be re-filled via a bowser. During fuel and AdBlue deliveries, the supplier will be escorted at all times by spill-trained site staff who watch for leaks / spills and who will be trained in the site's Tanker Transfer of Diesel Procedure (which will also apply to HVO). Tanks are not filled above the safe working capacity to prevent overfilling.

There will be six hardstanding tanker bays for refuelling activities, which are spilt into two sets of three bays, one set on each side of the site. Each set of bays is connected to an oil interceptor which will be alarmed.

A drip tray will be present beneath the fill point in the fill cabinets for fuel and AdBlue which would collect drips and small accidental releases. For small spills in the fuel delivery bays there would be no contamination of soil or groundwater as the spill would be captured by the oil interceptors from which the fuel could be removed.

In the event of a large scale accidental release during refuelling (for example as a result of hose connection failure) fuel would spread out in the vicinity of the fill cabinets. Some of the spill may run onto the tanker bay areas and into the interceptor. Otherwise the spill would run onto permeable paving. The paving will have a geotextile liner which forms a barrier to prevent the fuel from entering soil or groundwater. The fuel would be 'trapped' above the liner in a crushed stone drainage layer, from which it could be removed and the pavement remediated. If a spill was sufficiently large it could potentially enter the surface water drainage system. There will be an onsite isolation control valve within the downstream drainage system which would be closed in the event of a spill. The oil that collected in the drainage system could then be removed. Outside the proposed Installation boundary, within the wider business park drainage system, there are a number of interceptors which act as further protection to surface water receptors.

Spill kits will be provided in delivery areas and procedures to cover spills / leaks will be incorporated into the site IMS. Procedures for dealing with spills can be found in the Accident Management Plan in Appendix F.

As part of the commissioning / handover, a spillage risk assessment will be undertaken to determine if any additional measures, e.g. use of larger portable drip tray or spill pads/mats, are required to protect the permeable paving in the vicinity of the fill point during refuelling.

3.6.4. Storage and Distribution Pipe Leaks

Vantage will follow the relevant legislative requirements (including the Water Resources (Control of Pollution) (Oil Storage) (Wales) Regulations 2016), technical standards and good practice guidance in the design of fuel and storage areas to ensure they address the indicative BAT listed in Table 3-6.

Each generator set will be housed in its own container on a concrete base. Each engine sits on top of an individual above ground 'belly tank'. This arrangement means that no external pipework is required which helps to reduce the risk of leaks. Each tank will be double skinned, integrally bunded (with 110% capacity) and complete with alarm and integral fill point. The tanks will be protected from vehicle impact by vehicle crash / deflection barriers will be provided if / where necessary. There is a 5 mile per hour speed limit at the site.

The AdBlue tank for each engine will sit underneath the discharge attenuator and on top of the fuel tank. Consequently, the tanks are protected from vehicle impact. The AdBlue tanks will be integrally bunded (with 110% capacity) with bunded fill point cabinets.

Tanks / generators will undergo regular visual inspection for their condition.

3.6.5. Drainage system

The site will have a SuDS surface water drainage system. Uncontaminated surface water runoff will be discharged into the wider business park drainage system via the site's surface water drainage system. There will be two emission points from the CWL13 surface water drainage system (W1 and W2, see Appendix A).

There will be oil interceptors (with alarms) at each of the refuelling bay areas and an onsite isolation control valve within the facility's drainage system. Outside the proposed Installation boundary, within the wider business park drainage system, there are additional interceptors.

Drainage pipework will be engineered to minimise leaks.

3.6.6. Surfacing

The site will comprise a mix of hardstanding and soft landscaping. The generators will be located on concrete bases, with permeable paving for vehicular areas and pedestrian areas located beyond these. Hardstanding tanker bays for refuelling will be located within the permeable paving for vehicular areas. There will be three bays on each side of the building. Soft landscaped areas will be largely present to the north, east, and south west of the building and comprise a mix of grassland, shrubs, trees and rain garden. Further details are provided on the Landscape Softworks and Hardworks plans provided in the Site Condition Report (Appendix G).

3.6.7. Subsurface Structures

There will be no subsurface bulk storage tanks or process pipework. The only below ground pipework is for the mains water supply and surface water drainage.

3.6.8. Indicative BAT Summary

Table 3-6 - Indicative BAT for Preventing Fugitive Emissions to Surface Water, Ground and Groundwater

Relevant indicative BAT (How to Comply with your Environmental Permit)	Compliance Measure
Sub-surface structures: • establish and record the routing of all site drains and sub-surface pipework; • identify all sub-surface sumps and storage vessels; • engineer systems to minimise leakages from pipes and ensure swift detection if they do occur, particularly where hazardous substances or non-hazardous pollutants are involved; • fit oil separators where appropriate to surface water drainage systems to protect them from contamination by oil; and, • provide secondary / tertiary containment and / or leakage detection for sub-surface pipework, sumps and storage vessels.	All structures relating to the delivery of fuel, including tanks and pipework, are above-ground. The main sub-surface structures are the surface-water drainage system. The drainage plan, which will be maintained onsite, is provided in Appendix A. The tanker delivery bays are fitted with oil interceptors.
Sumps (other than those within bunds - see below) must be: • impermeable and resistant to stored materials;	There are no sumps.

Relevant indicative BAT (How to Comply with your Environmental Permit)	Compliance Measure
• looked at regularly and any contents removed after checking for contamination; • where not frequently inspected, fitted with a high-level probe and alarm; and, • regularly inspected for their condition (normally visual, but extending to hydraulic testing where structural integrity is in doubt).	
Make sure all above-ground tanks containing liquids whose spillage could be harmful to the environment are bunded. Bunds must: • be impermeable and resistant to the stored materials; • have no outlet (no drains or taps) and drain to a blind collection point; • have pipework routed within bunded areas with no penetration of contained surfaces; • be designed to catch leaks from tanks or fittings; • have a capacity greater than 110% of the largest tank or 25% of the total tankage, whichever is the larger. When calculated, do not use the design capacity of the tank or tanks, instead use the maximum physical capacity of the tank or tanks - assuming it is/they are over-filled to the point of spillage; • be looked at regularly and any contents removed after checking for contamination; • be fitted with a high-level probe and an alarm, where not frequently inspected; • have tanker connection points within the bund where possible (otherwise adequate containment should be provided at the connection point); and, • be regularly inspected for their condition (normally visual, but extending to hydraulic testing where structural integrity is in doubt).	Bunds are designed to meet the Water Resources (Control of Pollution) (Oil Storage) (Wales) Regulations 2016. All above-ground tanks are located on hard standing and bunded to 110% of their capacity. The fuel storage tanks are double skinned and fitted with alarms All fill cabinets are fitted with drip trays. The tanker delivery bays hardstanding and are fitted with oil interceptors. Permeable paving has a geotextile liner which forms a barrier and traps fuel to prevent it from entering soil or groundwater. There will be an onsite isolation control valve within the downstream drainage system which would be closed in the event of a spill. Outside the proposed Installation boundary, within the wider business park drainage system, there are a number of interceptors which act as further protection to surface water receptors. Tanks are formally visually inspected every 12 months, as described in PM18-16. See Section 3.6.4 for more details.

3.7. Emissions to Land

There are no emissions to land.

3.8. Odour

Potential sources of odour from the Installation would be from fugitive releases of VOCs from diesel storage (HVO is odourless) and the emission of combustion products.

TA Luft 2002 states that appropriate measures for controlling odour include appropriate storage of substances, products and wastes along with process control and encasement of installations or parts of installations. Measures to control fugitive emissions to air from fuel storage are described in Section 3.4. These are regarded as BAT and, combined with the low volatility of diesel fuel, it is not considered likely that storage of diesel (the back-up fuel) and filling will give rise to levels of odour which may cause nuisance at nearby receptors.

Combustion emissions are discharged via stacks which have been designed to ensure adequate dispersion of combustion products (see Section 3.3.2). As a result of this, combustion products are not considered likely to give rise to an odour nuisance at local receptors.

There are no indicative BATs relating to odour in the Sector Guidance Note (EPR 1.01), and the combustion activity is not an inherently odorous activity listed in '*How to comply with your environmental permit*', so further risk assessment and an odour management plan is not required.

3.9. Noise and Vibration

Information on sources of noise and vibration at the Installation and the results of noise modelling and assessment of impacts are provided in Appendix E.

The engines will be housed in containers. In recognition of the location of noise sensitive receptors, the new engines have been specifically selected to have low sound power levels (the noise specification for the generator sets is 65 dB(A) at 1 m). Table 3-7 below compares the indicative BAT for installations provided on the NRW guidance document *'How to comply with your Environmental Permit'*.

Table 3-7 - Indicative BAT for Minimising Noise and Vibration

Relevant Indicative BAT	Compliance Measure
Monitoring noise levels at different places and times to find where the problem is coming from.	In the event of a noise complaint, investigation will be carried out to determine the source and impact of the noise.
Maintaining equipment specifically to reduce noise levels, for example balancing fans and fixing loose covers.	All critical plant and equipment, including potentially noise generating plant, are subject to a planned preventative maintenance programme which includes items to reduce the risk of noise and vibration.
Enclosure or abatement, for example acoustic enclosures, silencers, keeping doors and other openings in buildings closed.	Engines are enclosed in containers to mitigate potential impact on noise sensitive receptors. The Noise Assessment Appendix E) does not indicate that further mitigation measures are required.
Timing, for example avoiding noisy work during evenings and weekends.	Routine testing of engines does not take place outside of 09:00 to 17:00, or on weekends or bank holidays.
Siting away from sensitive receptors, for example of delivery or vehicle routes or noisy plant.	The Installation is located within an industrial area. The immediate vicinity is not considered to be a noise sensitive area.
Switching off plant, vehicles and ventilation units when not in use.	The engines are only operated for around five hours per year.
Reducing or stopping your activities that are causing the noise until either the circumstances have changed or other appropriate measures have been put in place to allow the operations to recommence without significant noise.	In the event of a noise complaint, investigation will be carried out to determine the source of the noise. If unacceptable and it is safe to do so, activities will cease or reduce.

3.10. Environmental Management System

Vantage will maintain and operate the Installation in accordance with an IMS for quality, health & safety, information security and environment. The existing IMS for CWL11/12 will be extended to incorporate CWL13. The IMS includes an ISO14001 accredited environmental management system (EMS). It is considered that this applies the BAT for combustion activities. A summary of the environmental aspects of the existing IMS is presented below.

3.10.1.1. Commitment from Senior Management

Top management is responsible for the overall effectiveness of the IMS and through clear leadership and commitment will promote continual improvement in all aspects of the IMS. Top management defines the environmental policy and strategy and ensures that it is appropriate to the nature and scale of the organisation's activities, products and services.

3.10.1.2. Training and Competency

Vantage ensures that all persons performing tasks for it, or on its behalf, are deemed competent on the basis of having appropriate education, training, skills and experience. There are systems and procedures in place to identify key skills and competency requirements and to ensure that plans are in place to provide, assess and record the provision of such training.

3.10.1.3. Operating Techniques

Vantage identifies and, where appropriate, documents the environmental operating controls required at its facility and ensures that they are suitable and sufficient to minimise the environmental impact from plant activities.

Vantage has established, implemented and maintains the processes required to prepare for, and respond to, potential emergency situations (see also Section 3.10.1.9). In such an event, Vantage would respond to prevent or mitigate the environmental impact of the event.

3.10.1.4. Monitoring and Measurement

Vantage has in place arrangements for the monitoring and measurement of its activities that could have a significant environmental impact were such monitoring arrangements not in place. To ensure accuracy, reliability and consistency of measurements performed, measurement equipment is identified and its calibration and / or monitoring status recorded.

3.10.1.5. Internal Audit Program

Vantage maintains an annual audit schedule to monitor and evaluate all key activities undertaken that fall within the scope of the IMS. Records of such audits are maintained within the IMS system as controlled documents.

3.10.1.6. Management Review

The IMS is periodically reviewed at planned intervals to ensure its continuing suitability and effectiveness. The management review contains all the items detailed in clause 9.3 of ISO 14001:2015, as well as any additional information considered relevant to the review. The outputs from the management review are documented and communicated within the organisation.

3.10.1.7. Non-Conformity and Corrective Action

Vantage has arrangements in place to identify and address deviations from the expected norm which may compromise the overall effectiveness of the IMS, or which may lead to an impact upon the environment. All incidents will be recorded.

3.10.1.8. Continual Improvement

Vantage ensures that the IMS is used as the basis for driving continual improvement in all aspects of its operations.

3.10.1.9. Accident Prevention / Management Plans

An Accident Management Plan (AMP) has been included in the Permit Application in Appendix F.

An Air Quality Management Plan (AQMP) is in place for the existing CWL11/12 facility and this has recently been updated (July 2022). The AQMP is an integral part of the EMS and it identifies the emergency operating conditions when local air quality may be adversely impacted by emissions to air. Although CWL11/12 and CWL13 will be operated separately, Vantage will ensure that there is coordination and cooperation between the two permitted facilities in the event of an emergency outage. Once the CWL13 Permit has been determined the CWL11/12 AQMP can be further updated (if considered necessary and in consultation with NRW) to reflect the low potential for cumulative impacts from CWL13 emissions and to ensure that actions to be taken to protect human health in the event of emergency operation consider the potential for cumulative impacts across the two facilities.

3.10.1.10. Closure

A Closure Plan will be developed for the Installation within six months of commencement of operations.

3.10.1.11. Management Techniques Summary

NRW's Guidance Document 'How to comply with your Environmental Permit' requires the following elements to be included in an IMS. Table 3-8 compares these requirements with the operator's IMS.

Table 3-8 - Indicative BAT for Environmental Management Techniques

Relevant Indicative BAT	Compliance Measure
Site Plan including: • Activities • Discharge points • Drainage plant (foul and surface water) • Location of waste activities • Location of oil and chemical storage facilities • Receptors • Potentially contaminated land	Site plans can be found in Appendix A of this document.
Normal and Abnormal Operation	Normal and emergency scenarios are considered in planning and procedures.
Maintenance	The operator has in place a robust programme of planned preventative maintenance for all critical plant and equipment. This is included in the overarching site management system.
Accidents and incidents	The operator has in place an Accident Management Plan, provided in Appendix F.
Site Security	The site will be secured by a perimeter fence with one designated entrance and exit. The site gate will be controlled vehicle barrier / gate and is operated and monitored by security 24 hours a day. The site also will have a 24-hour CCTV monitoring system with multiple cameras in strategic locations across the site.
Non-compliance	As detailed in Section 3.10.1.7, procedures are in place to respond to non-compliance.
Closure	A site closure plan will be developed for the facility as detailed in Section 3.10.1.10.
Complaints	All communications regarding environmental matters including external complaints, compliance obligations and requests for information will initially be processed by the Environment Manager or a nominated representative who will then co-ordinate appropriate actions according to the nature of the communication. External complaints will be immediately notified to top management for action. As detailed in Section 3.10.1.7, procedures will be in place to respond to non-compliance.
Sufficient competent persons, resources and training	Roles and responsibilities relating to the IMS are clearly defined and the operator is committed to providing sufficient training to ensure staff competency.
Emissions and monitoring	See Section 4.
Records	Records will be maintained for all documents associated with the Permit as required by conditions.
Access to Permit	The Permit and IMS will be made available to key staff and contractors via the share point system or upon request.

In summary, it can be concluded that the Installation meets indicative BAT for EMSs as laid out in NRW Guidance Document 'How to comply with your Environmental Permit'.

3.11. Raw and Auxiliary Materials

The estimated annual throughput of materials, what they are used for, method of storage, fate and their associated hazards are provided in Table 2-3.

Fuel is the main raw material. Typically the engines will burn HVO; however diesel will be used in the event of supply chain issues. The justification of fuel selection is provided in Sections 2.3 and 3.2.

The other key raw materials are engine oil and antifreeze / coolant. These are industry standard materials with no practicable alternatives.

Vantage's primary approach to quality assurance of raw materials is to purchase materials from dedicated suppliers according to pre-established material specifications, which will include environmental requirements. Consideration would be given to the use of less environmentally harmful alternative chemicals wherever practicable and subject to manufacturer specifications. Suppliers and delivered materials are audited to provide added assurance that the specified standards are maintained and, therefore, the environmental impact caused by the materials is minimised.

In line with current NRW requirements and guidance, Vantage will:

- take appropriate measures to ensure that raw materials and water are used efficiently in the activities by carrying out routine resource efficiency audits;
- maintain records of raw materials and water used in the activities;
- review and record at least every 4 years whether there are suitable alternative materials that could reduce environmental impact or opportunities to improve the efficiency of raw material and water use; and
- take any further appropriate measures identified by a review.

It is considered that the proposed Installation meets indicative BAT for raw material use laid out in the available NRW guidance.

3.12. Avoidance, Recovery and Disposal of Waste

Typical annual waste generation is presented in Table 2-4. The wastes produced by the Installation are minimal and are associated with the testing and maintenance of the engines. The main hazardous wastes are used engine oil (approximately 4 tonnes per year), batteries (2.8 tonnes per year) and waste antifreeze / coolant (2.5 tonnes every 2 to 3 years).

Wastes are not expected to be stored onsite, they will be removed by the maintenance contractor as they are generated and disposed of / recycled offsite. Vantage's approach to managing waste applies the 'Waste Hierarchy' to maximise materials re-use, prevent waste, minimise waste generation and maximise recycling and recovery of waste. With the exception of the 'other' (socks, mats, rags etc) solid waste stream all of the other wastes are sent for recycling.

In line with Environmental Permit requirements, the operator will take appropriate measures to ensure that:

- the waste hierarchy referred to in Article 4 of the Waste Framework Directive (WFD) is applied to the generation of waste by the activities;
- any waste generated by the activities is treated in accordance with the waste hierarchy referred to in Article 4 of the WFD; and
- where disposal is necessary, this is undertaken in a manner which minimises its impact on the environment.

The operator will review and record at least every four years whether changes to those measures should be made and take any further appropriate measures identified by a review.

Table 3-9 describes measures for compliance with the BAT and compares the measures against regulatory guidance.

Table 3-9 - Indicative BAT for Avoidance, Recovery and Disposal and Waste

Applicable Indicative BAT from EA Guidance / Typical Permit Conditions.	Compliance Measures
Store, handle and transport all waste streams to prevent the release of waste, dust, VOC, leachate or odour.	Waste is not stored on site Waste handling is minimised; waste is collected from the point of generation and stored in a secure location, awaiting transport off-site by suitably licenced carriers.
Recycle materials back into the process whenever possible, e.g. re-using partially reacted lime.	Filters are fitted on the lubricating oil systems to prolong the life of the lubricating oil. Fuels, oils and liquids will be treated and managed according to relevant waste legislation and regulations. Most wastes are recycled.
Where recycling or re-use is not possible, then consider regeneration of other materials or return to the manufacturer.	Only one waste stream is not recycled ('other' (socks, mats, rags etc)). No opportunities to regenerate or return these materials have been identified.
Requires application of the waste hierarchy, i.e. consider prevention, prepare for re-use, recycling and recovery options rather than automatically choosing the cheapest waste disposal option and select the option which minimises its impact on the environment.	Suitable alternatives to disposal will be considered during routine waste audits.
Review and record at least every four years whether changes to those measures should be made and take any further appropriate measures identified by a review.	The IMS will contain procedures to ensure this is carried out.
Comprehensively characterise and quantify each waste stream arising from the regulated facility.	Waste streams are characterised and quantified, and records maintained.
Use government guidance to decide how each waste stream is to be prepared for re-use, recycled, recovered or disposed to landfill.	Decisions on waste stream management will be based on guidance in force at the relevant time and recorded according to the IMS.
Operators must be capable of justifying decisions that deviate from best practice.	The reasons for any decisions on waste management which depart from best practice will be recorded.
In cases of proposed disposal: explain why re-use, recycling or recovery is technically and economically unviable; and, describe the measures planned to avoid or reduce any impact on the environment.	Any decision to send a waste stream for disposal will be justified and the reasoning recorded.

It is concluded that the Installation will meet typical BAT requirements for waste.

3.13. Energy Efficiency

The Installation will not be a large user of energy. The engines will be operated only occasionally, for short periods of routine testing; each generator will typically operate for only five hours per year. Energy efficiency is therefore of much less relevance than to plant operating on a more frequent or constant basis. The prime requirements for the standby diesel generators are reliability, availability and resilience.

Energy efficiency is assured as far as possible through planned maintenance. Given the low level of energy use, no further measures are considered necessary. The operator will regularly (four-yearly) review energy use and if opportunities to reduce energy consumption are identified an Energy Efficiency Plan will be developed for the Installation.

Table 3-10 below shows energy generation and on-site fuel consumption per annum.

Table 3-10 - Generator Energy Efficiency

Energy Source	Maximum Thermal Input (MWth)	Maximum Electrical Output (MWe)	Efficiency
HVO / Diesel	179	72	40%

3.14. Site Condition and Site Closure Plan

3.14.1. Site Condition Report

The area upon which the Installation will be located is brownfield land. Full details of historical use are provided in the Site Condition Report (Appendix G).

The area of operations is predominantly situated on hard standing. Any activities occurring in areas not on hardstanding are carefully controlled both by local containment and operational techniques.

Substances used and stored on-site are recorded in Table 2-3, no waste will be stored on the site. All potentially polluting substances are provided with adequate primary and secondary containment, which meets NRW guidelines.

Any incidents that arise, which could impact on the site condition will be documented by Vantage in line with the regulator's lifetime records approach, along with the measures taken to mitigate their impact on the site condition.

It can be concluded that pollution to groundwater or the ground, from the proposed activities is unlikely. The mitigation, management and control measures that will be in place should ensure that operations during the life of the Permit will not lead to deterioration of the state of the land.

3.14.2. Site Closure Plan

A site closure plan will be produced within 12 months of issue of the Permit.

4. Proposed Emissions, Monitoring and Reporting

4.1. Emissions to Air

Emissions of NO_x, CO, PM and VOC for the proposed engines are within those stipulated as the minimum appropriate standard in working draft guide for data centres[2]. Emissions of SO_2 are limited through the low sulphur content of the fuel (<0.1%).

A detailed assessment of emissions has been undertaken, summarised in Section 5.3 and presented in Appendix D, which has found that the occasional operation of the individual engines and cells will not present a significant adverse effect on air quality at the nearest sensitive receptors for human health and vegetation.

As the plant does not fall under IED Chapter III, the monitoring requirements in Annex V, Part 3 do not apply and continuous emissions monitoring is not required. The same applies to the requirements in the LCP BAT Conclusions and BAT-AELs. Given the capacity and occasional planned operation of the combustion plant, continuous monitoring is not considered appropriate.

The MCPD, transposed into UK legislation by an amendment to the EPR, applies to the generators as they are between 1 and 50 MWth. However, combustion plants operating for fewer than 500 hours per year are exempted from complying with the emissions limits set out in Part 2 of Annex II of the MCPD. As the generators will be operated for significantly less than 500 hours per year, the exemption applies.

At noted previously, the Generator Controls to Specified Generators in England and Wales do not apply to the generators, as each generator is operated for the purpose of testing / maintenance for fewer than 50 hours per year, and as the Installation is an IED ChII installation.

It is therefore proposed that, due to the Installation's exemption from the above regulations, emission limit values (ELVs) to air (and thus emissions monitoring) are not required. This is in line with the Permit conditions of the original CWL11/12 facility.

4.2. Emissions to Water

Uncontaminated surface water arises from the general collection of rainwater which will be discharged to the business park's main surface water drainage system at release point W1 and W2 (as shown on the Installation Boundary Plan in Appendix A). As this discharge comprises only clean, uncontaminated surface water only, no monitoring is proposed.

4.3. Reporting

The operating hours for testing (routine or unplanned) will be recorded.

The following will be reported on an annual basis (as per the existing CWL11/12 data centre Installation):

- annual report - reporting on the performance of the activities over the previous year;
- performance parameters: fuel use and operating hours (routine and non-routine / emergency hours);
- annual emissions to air (oxides of nitrogen (NOx), carbon monoxide (CO), particulate matter (PM) and sulphur dioxide (SO_2) - reported via the UK Pollutant Release and Transfer Register (PRTR); and
- annual waste generation - reported via the PRTR.

5. Impact on the Environment

5.1. Scope of Assessment

An environmental risk assessment has been undertaken to determine the environmental risks posed by the proposed Installation to ensure that there will be no significant impacts on the environment or human health.

In accordance with NRW guidance and appropriate to the nature of the activities and potential impacts on site, the following assessments have been carried out:

- air quality;
- noise;
- GWP;
- site waste; and
- fugitive releases & accidents.

The operation of the facility is not odorous; therefore odour has been screened out as a risk to the environment or human health. There are no point source releases to ground, groundwater, or surface water therefore only the potential impact from fugitive releases has been considered.

Techniques to minimise the environmental impacts are discussed in Section 3. Risk assessment summary tables can be found in Section 5.9.

5.2. Important and Sensitive Receptors

The sensitive receptors which may be affected by the Installation are discussed and summarised below. Further information and illustrative figures are provided in the air quality and noise modelling and assessment reports (see Appendix D and Appendix E respectively) and there are further details on the geology and hydrogeology of the site and hydrological receptors in the Site Condition Report (Appendix G).

5.2.1. Human Receptors

The nearest residential properties are on Pencarn Avenue, approximately 210 metres to the north. There are also residential properties on Edmundsbury Road approximately 220 m to the north east and on Powis Close approximately 260 m to the south east. The nearest discrete human receptor to CWL13 is a non-residential property in Imperial Courtyard, approximately 50 metres to the east of the CWL13 data centre building. A children's nursery is 650 metres to the north west near the Holiday Inn, between the A48 and the M4 motorway. Further information and illustrative figures are provided in the air quality and noise modelling and assessment reports (see Appendix D and Appendix E).

There are no air quality management areas (AQMA) within close proximity of the site, the nearest is located in excess of 2.5 km, to the north, at the M4 at Junction 27.

5.2.2. Ecological Receptors

All European and International ecologically designated sites and nationally designated sites have been considered within 10 km[7] of the proposed Installation boundary, as well as national and local non-statutory local wildlife sites within 2 km. The site is not subject to any environmentally sensitive designations.

The nearest internationally designated site (the Severn Estuary Ramsar site / Special Protection Area (SPA) / Special Area of Conservation (SAC)) is over 2.5 km to the south east at its closest point. The River Usk SAC is approximately 4 km to the north east. There are no other European sites within 10 km.

The nearest nationally designated site is Gwent Levels Site of Special Scientific Interest (SSSI) which is located approximately 260 m south east of the site at its closest point. The features of interest that are common to all of

7 Although searches for combustion plant >50 MWth in aggregate are often carried out up to 15 km,10 km is the distance in permitting guidance and that accepted by NRW for the CWL11 permit application. This is because the facility, despite having a combined thermal input of over 50 MW, is a combination of intermittently operated engines with relatively low stacks. The maximum impacts occur in the near field, which is not the case for some large combustion plant with very tall stacks where the concentrations can be higher further from the source

the SSSIs within the Gwent Levels are the reen (drainage ditch) habitats, which support a varied assemblage of aquatic flora and fauna. There are no other nationally designated sites within 2 km.

The nearest non-statutory designated ecological site is LG Duffryn Site 1 Site of Interest for Nature Conservation (SINC) - 60 m to the south of the site boudary, designated for its pond / reedbed habitat. There are 3 other SINCs within 1 km (LG Duffryn Site 2, Duffryn Ponds and Celtic Springs).

There are a number of areas of semi-natural and restored ancient woodland, the nearest area is 640 m to the north of CWL13.

Further information and illustrative figures are provided in the air quality assessment report (see Appendix D)

5.2.3. Geological, Hydrogeological, Hydrological Receptors and Flooding

The superficial deposits beneath the site are River Terrace Deposits typically comprising sand and gravel with lenses of silt, clay or peat. The bedrock is the Mercia Mudstone Group. The River Terrace Deposits are classified as a secondary A aquifer. The Mercia Mudstone Group is classified as a secondary B aquifer.

There are no surface water features located on or directly adjacent to the site. The nearest surface water feature to the site is an unnamed man-made lake, located 70 m south of the site, between South Lake Drive and North Lake Drive. There are a further three lakes within 500 m. All of the lakes are hydraulically isolated from the site.

The closest surface watercourse to the site is Blackwall Reen, 130 m to the east, flowing in a southerly direction. Percoed Reen water course is down hydraulic gradient, 700 m to the south east, on the Gwent Levels. Nant y Moor Reen water course is 900 m to the south west.

There are no licensed groundwater abstractions on the site; there is one groundwater abstraction within 1 km of the site, located 150 m to the south, which is for “amenity use: make up or top-up water” for an adjacent lake. There are no licenced surface water abstractions within 1 km of the site.

The site is not within a Source Protection Zone (SPZ) - the nearest SPZ is 18 km to the south east on the other side of the Bristol Channel.

The NRW online flood risk map and online development advice map indicate that the site is not located in a flood risk zone and is on that is at little or no risk of flooding (less than 0.1% chance per year).

The above information has been based on the Geo-Environmental Desk Study that was undertaken for CWL13 in October 2020[8]. Further information on the site, its geology and hydrogeology and on nearby hydrological receptors can be found in the Site Condition Report (Appendix G).

5.3. Air Quality

There will be a total of 60 emission points to air (A1 to A60), one from each of the engines. The locations of the engines are shown in Appendix A. As the engines will burn HVO or diesel fuel, the emissions from the exhaust gas will comprise levels of:

- Oxides of nitrogen (NOx);
- Particulates (PM_{10} and $PM_{2.5}$);
- Carbon monoxide (CO);
- Carbon dioxide (CO_2); and
- Sulphur dioxide (SO_2)

There will be no ammonia slip as a result the installation of SCR abatement on the engines (see Section 3.3 for the justification for this)

Sections 3.3 and 3.4 discuss the techniques employed to minimise emissions to the atmosphere.

An atmospheric dispersion modelling study of emissions from the standby emergency generators at the Vantage CWL13 facility in Newport, has been undertaken. The detailed assessment uses an internationally accepted atmospheric dispersion model, AERMOD, to evaluate the environmental impact on human health and ecological receptors.

The detailed modelling study has considered the planned (routine) testing of CWL13, as well as operation in the event of a full grid outage emergency scenario. The potential for cumulative impacts as a result of the

8 Next Generation Data DC3, Newport, Geo-Environmental Desk Study, Atkins, October 2020

nearby Vantage data centre CWL11/12 has also been addressed. The modelling was undertaken on the basis of the engines being fuelled with diesel (although this is the backup fuel) rather than HVO, as this is the most conservative approach.

5.3.1. Routine Testing at CWL13

Overall, the routine testing of the individual engines and cells of engines at the CWL13 facility, is found not to be significant. No exceedences of the nitrogen dioxide hourly mean AQS objective were identified at sensitive human health receptors for the individual engine testing (planned or unplanned) and black building test scenarios. The contribution to NO_2 annual mean, when factored for the expected number of hours of testing in a year, is negligible.

The maximum modelled process concentrations of CO, PM_{10}, VOCs and SO_2 from CWL13 are less than one percent of relevant short and long air quality objectives at sensitive receptors, both for the testing of individual engines and for black building tests.

No exceedences of the non-statutory daily mean guideline for oxides of nitrogen for the protection of vegetation were identified at the closest designated ecological sites for the planned testing scenarios. The estimated contributions to annual mean critical levels, and critical loads for nitrogen and acid deposition, are very low even under the conservative assessment approach.

Overall, the occasional operation of the individual engines and cells at CWL13, for the routine testing regime, is concluded not to present a significant adverse effect on air quality at the nearest sensitive receptors for human health and vegetation.

5.3.2. Routine Testing at CWL13 and at CWL11/12

A feasibility study was undertaken the determine the potential cumulative impacts if routine testing (individual engines and / or black building testing) were to take place at CWL13 at the same time as testing at CWL11/12 (see Appendix C to the Air Quality Assessment in Appendix D to this report). The findings demonstrated that, with the enhanced pollutant dispersion and emissions abatement at CWL13, and the short duration of black building tests, the additional emissions from CWL13 have no material impact on the maximum modelled hourly NO_2 concentrations for CWL11/12, which are below the AQS hourly standard. On the basis of this study, it was concluded that the operational testing regime for CWL13 can be managed independently of that of CWL11/12 and that should tests be undertaken concurrently, there is an extremely low likelihood of cumulative impacts.

5.3.3. Emergency Scenario at CWL13

Hypothetical full emergency outage scenarios were modelled for CWL13 alone, and in combination with CWL11/12. The modelling shows that for a full outage of CWL13 there could be exceedences of the AQS standard for hourly NO_2 but the AEGL-1 for acute non-disabling health effects is not exceeded.

The assessment demonstrates that there will be no significant impacts on air quality due to the operation of the CWL13 facility alone during an emergency scenario.

5.3.4. Emergency Scenario at CWL13 and CWL11/12

For a full emergency scenario at CWL13 in combination with CWL11/12, exceedances of both the hourly NO_2 AQS standard and the AEGL-1 could occur, were a full outage to coincide with the very least favourable hours of meteorological data for dispersion but the probability of this happening is extremely low. Calculations have shown that, even in the unlikely event of 24 hours of power outage in a year, the probability of an exceedance of the AQS objective for a cumulative outage across all sites is below 5% for sensitive locations. The contribution of the CWL13 facility to the hourly exceedances in a cumulative scenario is minimal when compared to the equivalent modelled results for CWL11/12, with a 0 to 6% modelled increase in the number of hourly NO_2 exceedances in combination.

An AQMP is in place for the existing CWL11 facility and this has recently been updated to reflect the expanded CWL11/12. Although CWL11/12 and CWL13 will be operated separately, Vantage will ensure that there is coordination and cooperation between the two permitted facilities in the event of an emergency outage. Once the CWL13 Permit has been determined the CWL11/12 AQMP can be further updated (if considered necessary and in consultation with NRW) to reflect the low potential for cumulative impacts from CWL13 emissions and to ensure that actions to be taken to protect human health in the event of emergency operation consider the potential for cumulative impacts across the two facilities.

5.4. Global Warming Potential

The global warming potential (GWP) of the Installation has been calculated in accordance with the Guidance for assessing the impact of air emissions on global warming[9].

The calculation is based on the Installation having a total thermal input of 179 MWth, with each engine operating for 5 hours per year as part of the testing regime. The total GWP score for the facility is 224 tCO_2eq/year which is derived from direct carbon dioxide emissions from the combustion of diesel fuel in the engines. This is a conservative assessment as combustion of HVO reduces carbon dioxide (CO_2) emissions compared to diesel[10].

Table 5-1 - Global Warming Potential

Energy	Source	Annual Rate (MWh/year)	Energy Conversion Factor	CO_2 Conversion Factor	GWP tCO_2eq/year
Direct Emissions	Engines	896	1	0.2	224

5.5. Surface Water

There will be two point source emissions to water, which are of uncontaminated surface water. This will discharge into the wider business park's drainage system at point W1 and W2 as shown in Appendix A. Techniques for preventing polluting materials from entering the drainage system are discussed in Sections 3.5 and 3.6. Impacts associated with surface water runoff are not considered to be significant.

5.6. Noise

The new engines have been selected with sound levels to limit potentially significant impacts at receptors during routine testing. Section 3.9 discusses the techniques employed to minimise emissions to the atmosphere in more detail.

A BS 4142 worst case assessment of the impact of sound from CWL13 has been undertaken with reference to baseline conditions and manufacturer sound data. To fully assess impacts, BS 4142 requires the context to be considered. The study has considered the planned (routine) testing of CWL13, as well as operation in the event of a full grid outage emergency scenario. The potential for cumulative impacts as a result of the nearby Vantage data centre CWL11/12 has also been addressed.

5.6.1. Routine Testing

Predicted impacts from the 15 minute and 2 hour quarterly testing of individual engines are generally negligible. Receptors on Powis Close are predicted to receive a minor adverse impact during the 15 minute quarterly testing. These impacts would only occur during the testing of engines closest to the receptor and impacts would therefore be lower during the testing of other engines on the site. In all cases internal sound levels would not exceed 35 dB as recommended in BS8233. The impacts from black building testing would be negligible at all receptors except Powis Close where minor impacts are predicted.

The noise impacts from individual engine tests and the black building tests at CWL13 are not considered to be significant.

5.6.2. Emergency Scenario

The emergency scenario for CWL13 in isolation shows that most impacts at sensitive receptors would be negligible or minor adverse, which are not considered to be significant.

Moderate adverse impacts were predicted at Powis Close. The likelihood of this impact being realised (i.e. the likelihood of a full emergency power outage) is very low and in this context it is considered that impacts from the emergency scenario for CWL13 are not significant.

9 Assess the impact of air emissions on global warming - GOV.UK (www.gov.uk) / https://www.gov.uk/guidance/assess-the-impact-of-air-emissions-on-global-warming#risk-assessment-tool

10 https://eibip.eu/publication/hydrotreated-vegetable-oil-hvo-biodiesel/

5.6.3. Cumulative Impacts from Testing and Emergency Conditions (CWL11/12 and (CWL13)

The assessment of concurrent routine generator testing (individual engines tests and / or black building tests) across the two facilities demonstrates that the predicted specific sound levels and resulting impact magnitudes would be dominated by the sound emissions from CWL11/12, with CWL13 only notably influencing the overall cumulative sound levels at Powis Close. Impacts from testing generators at CWL13 at the same time as CWL11/12 would not be significant. It is considered that the operational testing regime for CWL13 can be managed independently to that of CWL11/12.

The cumulative emergency scenario, where all engines on CWL11/12 and CWL13 operate simultaneously, shows that several moderate or major adverse impacts would occur generally from CWL11/12. As the CWL13 generators are more than 10 dB lower than some of the originally permitted engines at CWL11, and given the distance from some receptors, the contribution to the overall combined emergency noise level from the CWL13 generators would predominantly be low. Given that this scenario is very unlikely to occur (as described above for CWL13 alone), these impacts are not considered to be significant.

5.7. Waste

The wastes produced by the Installation are minimal and are associated with the testing and maintenance of the engines (see Section 2.9 and Table 2-4). Wastes are not expected to be stored onsite, they will be removed by the maintenance contractor as they are generated and disposed of / recycled offsite.

For any wastes generated the waste hierarchy as defined within the Waste Framework Directive will be applied, with the option of disposal only considered once all other options have been considered. It is anticipated that only one waste stream (various solid wastes such as socks, mats, rags etc.) will need to be disposed of, all other wastes are expected to be recycled. Details of measures to minimise waste and quantities of waste generated, are described in Section 0.

5.8. Fugitive Emissions

Emissions not controlled by limits, or 'fugitive emissions', may arise from leaks, spills, releases in the event of accidents or adverse weather, or other abnormal scenarios.

5.8.1. Fugitive Emissions to Air

Potential sources of fugitive emissions to air arise from the storage of liquid fuel. Preventive measures are discussed in Section 3.4. On the basis of the nature of any fugitive emissions and the control / management measures that will be in place, fugitive emissions to air are not considered likely to result in significant impacts.

5.8.2. Fugitive Emissions to Land / Water

Spills and / or leaks related to the bulk storage and delivery of fuel is the main risk in relation to fugitive releases to land / water. Activities will be managed and operated in accordance with the Operator's IMS, which will incorporate the Accident Management Plan (AMP) (see Appendix F) and an ISO14001 accredited EMS.

There will be oil interceptors (with alarms) at each of the refuelling bay areas and an onsite isolation control valve within the facility's drainage system. Outside the proposed Installation boundary, within the wider business park drainage system, there are additional interceptors which would act as further protection to surface water receptors.

Further details of the control measures for fugitive releases are discussed in Sections 3.4 and 3.6. Further details of control measures to minimise the impact of accidents are described in the AMP in Appendix F.

On the basis of the controls that will be in place the risk of impacts from fugitive emissions is not considered likely to be significant.

5.9. Risk Assessment Summary

Table 5-3 to Table 5-5 describe and assess the main risks to the environment. The risk assessment for CWL13 has been based on the risk assessment for Vantage's existing data centre facility at CWL11/12. Once CWL13 is fully operational the assessment should be reviewed and updated (if required) to ensure it is fully aligned with the operation, management and control systems for CWL13.

Potential hazards have been assessed and evaluated in relation to the level of environmental risk they pose to receptors. For each hazard, the probability of exposure (likelihood) and consequence level have been categorised, and these used to establish an overall risk level using the following matrix:

Table 5-2 - Risk Rating Matrix

Risk Matrix		Consequence		
		High	Medium	Low
Likelihood	High	High	High	Medium
	Medium	High	Medium	Low
	Low	Medium	Low	Low

The principles of applying a certain likelihood and consequence rating are described below.

Likelihood of exposure

Low - An incident that is highly unlikely to occur.

Medium - A reasonably likely incident.

High - An incident that is highly likely to occur.

Consequence

Low - An incident that would cause a negligible impact on receptors.

Medium - An incident that would cause a slight impact on receptors.

High - An incident that would cause a serious threat to human health or the environment.

The risk is initially assigned without accounting for mitigation, management and control measures. The residual risk level is then established through consideration of the measures that will be in place to mitigate that risk.

Table 5-3 - Emissions to Air

Hazard	Normal or Accidental	Source	Pathway	Receptor	Probability of Exposure	Consequence	Magnitude of Risk	Risk Management	Residual Risk
Emission of combustion waste gases	N	Engines	Release to air via stack	Local atmosphere Global atmosphere Site personnel Local residents Workforce at local businesses and amenity sites Local ecological sites	High	Low	Medium	Engines are maintained regularly. Pollutants in engine exhaust gases are below the standards in the Data Centre FAQ[2]. Ammonia slip is prevented via three mechanisms: (accurate control of AdBlue injection, ASC and monitors (with alarms) that would detect ammonia in the tail gas. For further details see Section 3.3.	Low
Emission of combustion waste gases	A	Engines	Release to air via stack	Local atmosphere Global atmosphere Site personnel Local residents Workforce at local businesses and amenity sites Local ecological sites	Low	High	Medium	Engines are maintained regularly. Pollutants in engine exhaust gases are below the standards in the Data Centre FAQ[2]. Ammonia slip is prevented via three mechanisms: (accurate control of AdBlue injection, ASC and monitors (with alarms) that would detect ammonia in the tail gas. For further details see Section 3.3 and see Section 3.10 in relation to the AQMP.	Low
Release of VOCs from fuel storage tanks / odour[(1)]	A	Fuel storage tanks	Release to air	Local atmosphere Site personnel Local residents Workforce at local businesses and amenity sites Local ecological sites	Low	Low	Low	Fuel with low volatility is used. Storage vessels are enclosed and double skinned. Tanks undergo regular inspection and maintenance For further detail see Section 3.4.	Low

Hazard	Normal or Accidental	Source	Pathway	Receptor	Probability of Exposure	Consequence	Magnitude of Risk	Risk Management	Residual Risk
Smoke from accidental fire at site	A	Engines. May be caused by: • Maintenance activities / hot works, external fires igniting fuels, electrical failure. • Vandalism, arson, or other unauthorised activity. • Lightning strike.	Air transport of smoke then inhalation / deposition	Local atmosphere Site personnel Local residents Workforce at local businesses and amenity sites Local ecological sites	Low	Medium	Low	An AMP has been compiled to manage foreseeable risks from the Installation (see Appendix F). Activities will be managed and operated in accordance with a management system (which includes the AMP), which includes procedures and actions required in the event of a fire to control and minimise its spread. Any construction or maintenance procedures are conducted away from area where flammable materials are stored as far as practicable. Applicable hot works being conducted on site require a permit to work. All plant and equipment and electrical installations are kept maintained and in good working condition and subject to routine inspection and maintenance. Good housekeeping measures are in place including the cleaning of small leaks of oils or other flammable liquids immediately. The site enforces a No Smoking Policy which is strictly enforced. Control or elimination of potential sources of ignition and combustible materials. Site has good access for emergency vehicles. Training and simulation / testing of emergency systems.	Low

Hazard	Normal or Accidental	Source	Pathway	Receptor	Probability of Exposure	Consequence	Magnitude of Risk	Risk Management	Residual Risk
								Site security measures to prevent unauthorised access will include total fencing of the site and security gates. Site is fully fenced and guarded by 24-hour security to prevent unauthorised vehicle entry. The site also has a 24-hour CCTV monitoring system with multiple cameras in strategic locations across the site. All fuel storage tanks, engines and pipework are located away from site traffic. All fuel storage tanks are double skinned. Staff are trained to direct and guide delivery vehicles and visitors to appropriate areas away from hazards.	

Table Notes:

(1) Note, only relevant to diesel, HVO is odourless.

Table 5-4 - Noise Emissions

Hazard	Normal or Accidental	Source	Pathway	Receptor	Probability of Exposure	Consequence	Magnitude of Risk	Risk Management	Residual Risk
Loss of noise containment	N	Engines	Noise propagation through the air	Local atmosphere Site personnel Local residents Workforce at local businesses and amenity sites Local ecological sites	High	Low	Medium	Engines with low noise levels selected. Plant maintenance, including planned preventative maintenance, minimises noise generation and vibration. Operational procedures are in place to deal with complaints about noise, with records maintained.	Low
Loss of noise containment	A	Engines - emergency operation	Noise propagation through the air	Local atmosphere Site personnel Local residents Workforce at local businesses and amenity sites Local ecological sites	Low	Medium	Low	Engines selected with low noise levels. Plant maintenance, including planned preventative maintenance, minimises noise generation and vibration. Operational procedures are in place to deal with complaints about noise, with records maintained.	Low
Noise from delivery vehicles	N	Delivery vehicles	Noise propagation through air	Local atmosphere Site personnel Local residents Workforce at local businesses and amenity sites Local ecological sites	Medium	Low	Low	Operational procedure in place to deal with complaints about noise with records maintained.	Low

Table 5-5 - Emissions to Land and Water

Hazard	Normal or Accidental	Source	Pathway	Receptor	Probability of Exposure	Consequence	Magnitude of Risk	Risk Management	Residual Risk
Contaminated surface water run-off from site surfaces	A	Contamination from materials stored on site	Percolation through and into soils Direct run-off from site across the ground and entering surface water drains or natural channels / ditches	Workforce Groundwater Surface water	Medium	Medium	Medium	All potentially polluting liquids will be provided with secondary containment at least 110% of the volume of the container. Bunding is such that rainwater will not collect within the bunds. Pipe work is minimal are and is deployed away from site traffic. Fill cabinets are bunded. The tanker delivery bays are hardstanding and are fitted with oil interceptors. Permeable paving has a geotextile liner which forms a barrier and traps fuel to prevent it from entering soil or groundwater. There will be an onsite isolation control valve within the downstream drainage system which would be closed in the event of a spill. Outside the proposed Installation boundary, within the wider business park drainage system, there are a number of interceptors which act as further protection to surface water receptors. Spill kits will be distributed at key locations across the site in the event of a spill. A spill procedure will be in place and all staff trained. Records will be available and will be kept up to date for all drainage structures, including the routing of all drains. Preventative maintenance, inspection and test regimes are in place. For further details can found be found in Section 3.5 and 3.6.	Low

Hazard	Normal or Accidental	Source	Pathway	Receptor	Probability of Exposure	Consequence	Magnitude of Risk	Risk Management	Residual Risk
Accidental release of potentially substances through flooding	A	Loss of containment on site	Percolation through soils Direct run-off from site across the ground and entering surface water drains or natural channels / ditches	Users of local amenity sites Local residents	Low	Medium	Low	Containers of potentially polluting materials are secured to ground, where required, to prevent release during flood conditions. The site subscribes to NRW's flood warning system.	Low
Spill of fuel from delivery vehicle / pipework	A	Loss of containment on site	Percolation through soils Direct run-off from site across the ground and entering surface water drains or natural channels / ditches	Workforce Groundwater Surface water	Low	Medium	Low	All potentially polluting liquids will be provided with secondary containment at least 110% of the volume of the container. The fill cabinets are fitted with drip trays. Fuelling of tanks is conducted by a trained contractor and supervised by Vantage staff. Pipework is minimal and is deployed away from site traffic. The tanker delivery bays are hardstanding and are fitted with oil interceptors. Permeable paving has a geotextile liner which forms a barrier and traps fuel to prevent it from entering soil or groundwater. There will be an onsite isolation control valve within the downstream drainage system which would be closed in the event of a spill. Outside the proposed Installation boundary, within the wider business park drainage system, there are	Low

Hazard	Normal or Accidental	Source	Pathway	Receptor	Probability of Exposure	Consequence	Magnitude of Risk	Risk Management	Residual Risk
								a number of interceptors which act as further protection to surface water receptors. Pipework is regularly inspected and maintained. Spill kits distributed at key locations across the site, and there will be a spill procedure in place in which all staff trained.	
Overfilling of lubricating oil canister / tank	A	Loss of containment on site	Percolation through soils Direct run-off from site across the ground and entering surface water drains or natural channels / ditches	Workforce Groundwater Surface water	Low	Low	Low	Engines are in containers which would effectively act as a bund to contain spills, with in excess of 110% capacity Oil levels checked prior to filling to ensure levels do not exceed the required amount. Drip trays used during filling procedures. Refilling / topping up is conducted by a trained contractor. Spill procedure in place and all staff trained.	Low
Spill while re-filling antifreeze in engines	A	Loss of containment on site	Percolation through and into soils Direct run-off from site across the ground and entering surface water drains or natural channels / ditches	Workforce Groundwater Surface water	Low	Low	Low	Engines are in containers which would effectively act as a bund to contain spills, with in excess of 110% capacity Antifreeze levels checked prior to filling to ensure levels do not exceed the required amount. Drip trays used during filling procedures. Refilling / topping up is conducted by a trained contractor. Spill procedure in place and all staff trained.	Low

Hazard	Normal or Accidental	Source	Pathway	Receptor	Probability of Exposure	Consequence	Magnitude of Risk	Risk Management	Residual Risk
Catastrophic tank failure	A	Loss of containment on site	Percolation through and into soils Direct run-off from site across the ground and entering surface water drains or natural channels / ditches	Workforce Groundwater Surface water	Low	High	Medium	Diesel fuel tanks double skinned with 110% capacity and fitted with alarms. AdBlue tanks are bunded with 110% capacity. Tanks will be inspected regularly for leaks and infrastructural damage The tanker delivery bays are hardstanding and are fitted with oil interceptors. Permeable paving has a geotextile liner which forms a barrier and traps fuel to prevent it from entering soil or groundwater. There will be an onsite isolation control valve within the downstream drainage system which would be closed in the event of a spill. Outside the proposed Installation boundary, within the wider business park drainage system, there are a number of interceptors which act as further protection to surface water receptors.	Low
Failure of fuel tank secondary containment	A	Loss of containment on site	Percolation through and into soils Direct run-off from site across the ground and entering surface water drains or natural channels / ditches	Workforce Nearby natural habitats Groundwater Surface water	Low	High	Medium	The tanker delivery bays are hardstanding and are fitted with oil interceptors. Permeable paving has a geotextile liner which forms a barrier and traps fuel to prevent it from entering soil or groundwater. There will be an onsite isolation control valve within the downstream drainage system which would be closed in the event of a spill. Outside the proposed Installation boundary, within the wider business park drainage system, there are a number of interceptors which act as further protection to surface water receptors.	Low

Hazard	Normal or Accidental	Source	Pathway	Receptor	Probability of Exposure	Consequence	Magnitude of Risk	Risk Management	Residual Risk
Release of potentially contaminated fire water	A	Fire fighting	Percolation through and into soils Direct run-off from site across the ground and entering surface water drains or natural channels / ditches	Workforce Groundwater Surface water	Low	High	Medium	There will be an onsite isolation control valve within the downstream drainage system which would be closed in the event of a fire. Outside the proposed Installation boundary, within the wider business park drainage system, there are a number of interceptors which act as further protection to surface water receptors. Firewater to be sampled and analysed prior to transfer offsite	Low
Vehicle colliding with fuel storage tank or engine, leading to loss of containment of fuel	A	All on-site machinery and vehicles and fuel tanks	Percolation through and into soils Direct run-off from site across the ground and entering surface water drains or natural channels / ditches	Drivers, on-site staff Local human population after gaining unauthorised access to the Installation Ground Groundwater Surface water	Low	Medium	Low	Site security measures to prevent unauthorised access will include total fencing of the site and security gates. Site is fully fenced and guarded by 24-hour security to prevent unauthorised vehicle entry. The site also has a 24-hour CCTV monitoring system with multiple cameras in strategic locations across the site. All fuel storage tanks, engines and pipework are located away from site traffic. All fuel storage tanks are double skinned with 110% containment capacity. Vantage staff are trained to direct and guide delivery vehicles and visitors to appropriate areas away from hazards. The site has a 5 mph speed limit. An AMP is in place to manage foreseeable risks from the Installation.	Low

Hazard	Normal or Accidental	Source	Pathway	Receptor	Probability of Exposure	Consequence	Magnitude of Risk	Risk Management	Residual Risk
High winds causing damage to fuel tanks if object was blown	A	Loss of containment	Percolation through and into soils Direct run-off from site across the ground and entering surface water drains or natural channels / ditches	Workforce Groundwater Surface water	Low	Medium	Low	All infrastructure is secured and it unlikely to be affected by high wind speeds.	Low
Extreme temperatures causing damage to fuel storage, and engines.	A	Loss of containment	Percolation through and into soils Direct run-off from site across the ground and entering surface water drains or natural channels / ditches	Workforce Nearby natural habitats Groundwater Surface water	Low	Low	Low	All generators contain anti-freezing mechanisms to prevent freezing of essential equipment. Site infrastructure and equipment are inspected regularly. All generators contain cooling mechanisms to prevent overheating of equipment. All fuel storage tanks are double skinned to prevent heat transfer to fuel. Site infrastructure and equipment are inspected regularly.	Low
Vandalism leading to release of substances to ground or water	A	Un-authorised access	Percolation through and into soils Direct run-off from site across the	Workforce Nearby natural habitats Groundwater	Low	High	Medium	Site security measures to prevent unauthorised access will include total fencing of the site and security gates. Site is fully fenced and guarded by 24-hour security to prevent unauthorised vehicle entry.	Low

Hazard	Normal or Accidental	Source	Pathway	Receptor	Probability of Exposure	Consequence	Magnitude of Risk	Risk Management	Residual Risk
			ground and entering surface water drains or natural channels / ditches	Surface water				The site also has a 24-hour CCTV monitoring system with multiple cameras in strategic locations across the site. An AMP is in place to manage foreseeable risks from the Installation.	

Appendices

Appendix A. Site Plans and Drawings

A.1. Site Location Plan

A.2. Site Plan

A.3. Installation Boundary and Emissions Points

A.4. Drainage Plan

Appendices

Appendix A. Site Plans and Drawings

A.1. Site Location Plan

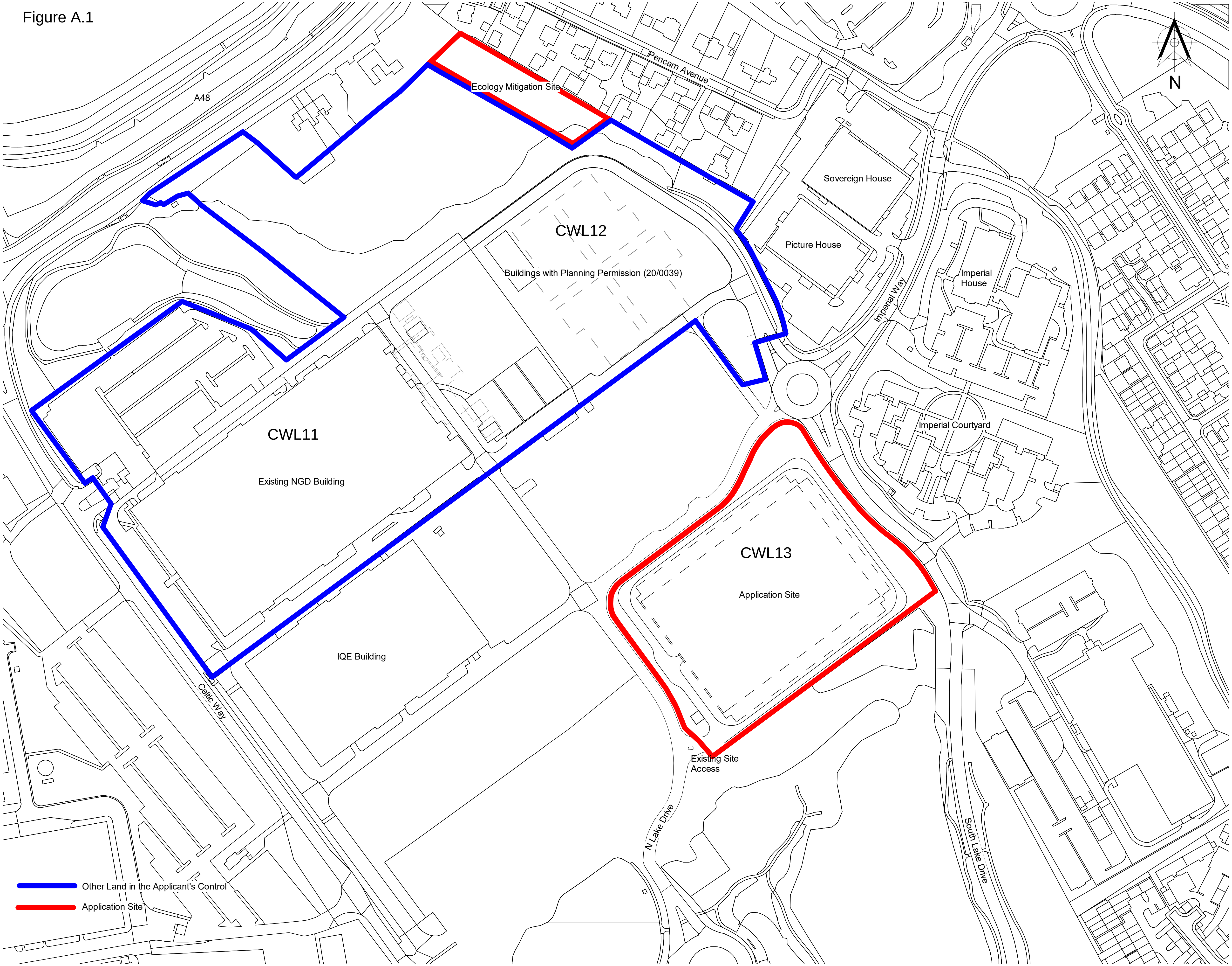
A.2. Site Plan

A.3. Installation Boundary and Emissions Points

A.4. Drainage Plan

Millimetres 0 10 100

Figure A.1



SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

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

CONSTRUCTION

MAINTENANCE/CLEANING

DECOMMISSIONING/DEMOLITION

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

Rev.	Date	Description	By	Chk'd	App'd
P3	04/12/20	PLANNING	JS/ SJM	LB	NS
P2	23/10/20	Issued for Planning	JS/ SFM	LB	NS
P1	06/10/20	Stage 2 Architectural Design Freeze	JS/ SFM	LB	NS

Drawing Status: **PLANNING**

Suitability: **S2**

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Client

Next Generation Data (DC3)

NGD
THE DATA CENTRE SUPER POWER

Project Title

Data Centre Three

Drawing Title

SITE LOCATION PLAN

Scale	Designed	Drawn	Checked	Authorised
1 : 2500	JS	SFM	LB	JP
Original Size	Date	Date	Date	Date
A3	06/10/20	06/10/20	06/10/20	06/10/20

Drawing Number: DC3-ATK-02-Z0-DR-AR-021001

Revision: P3

Atkins Project Number: 5197938

CLASSIFICATION - CONTAINS SENSITIVE INFORMATION

Figure A.2

DO NOT SCALE

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

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

CONSTRUCTION

MAINTENANCE/CLEANING

DECOMMISSIONING/DEMOLITION

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

Rev.	Date	Description	By	Chk'd	App'd
P5	10/06/21	PLANNING	CMS	LB	NS
P4	04/12/20	PLANNING	JS/ SJM	LB	NS
P3	23/10/20	Issued for Planning	JS/ SFM	LB	NS
P2	06/10/20	Stage 2 Architectural Design Freeze	JS/ SFM	LB	NS
P1	21/09/20	Issue for Pre-Application Meeting	JS	LB	JP

Drawing Suitability: **PLANNING**

Status: **S2**

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Client: Next Generation Data (DC3)

NGD
THE DATA CENTRE SUPER POWER

Project Title: Data Centre Three

Drawing Title: PROPOSED SITE PLAN (ROOF PLAN)

Scale	Designed	Drawn	Checked	Authorised
1 : 500	LB	JS	LB	NS
Original Size	Date	Date	Date	Date
A1	18/19/20	18/19/20	21/09/20	21/09/20

Drawing Number: DC3-ATK-02-Z0-DR-AR-021003

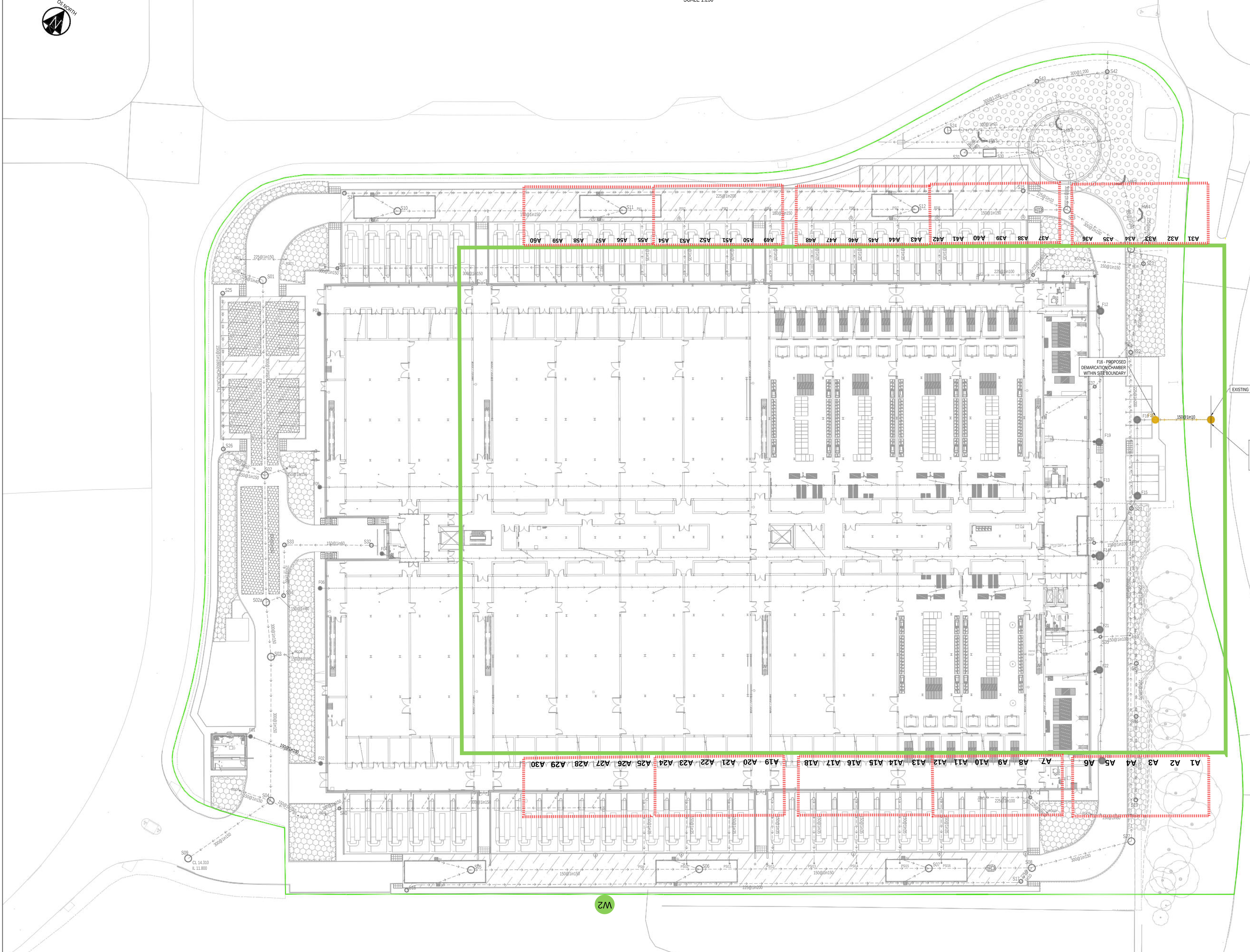
Revision: P4

Atkins Project Number: 5197938

Figure A.3

DRAINAGE LAYOUT PLAN

SCALE 1:250



ADOPTED DRAINAGE NOTES

FOUL WATER & SURFACE WATER SEWER (3m MAXIMUM PIPE LENGTHS)

ALL PIPES AND FITTINGS FOR DIAMETER OF 100/110mm TO BE EITHER:

* FLOLINE EN1401 DRAINAGE SYSTEM.
* HEPWORTH PLASTIDRAIN SYSTEM.
* MARLEY SOLID WALL UNDERGROUND DRAINAGE PIPE SYSTEM.
* OSMADRAIN BUILDING DRAINAGE SYSTEM.
* POLYPIPE EN1401-1 STANDARD UNDERGROUND DRAIN SYSTEM.

ALL PIPES AND FITTINGS FOR DIAMETERS OF 150mm - 300mm TO BE EITHER:

* MARLEY TWINWALL SYSTEM
* UPONOR ULTRA-RIB SYSTEM
* WAVIN OSMA ULTRA-RIB SYSTEM
* POLYPIPE CIVILS POLYSEWER TWINWALL SYSTEM

3m MAXIMUM LENGTH PVC-U PIPES INSTALLED BY BPF/PPG ACCREDITED CONTRACTOR - COPY OF CERTIFICATE REQUIRED.

USE OF DIFFERENT PIPE SUPPLIER OR SPECIFICATION MUST BE APPROVED BY STATUTORY UNDERTAKER.

ALL PIPEWORK MANUFACTURED IN UNPLASTICIZED POLYVINYL CHLORIDE (PVC-U). PVC-U DRAINAGE SYSTEMS WITH FLEXIBLE JOINTS TO BS EN1401-1:1998, BS 4660 OR BS 5481. PVC-U PIPES INSTALLED BY BRITISH PLASTICS FEDERATION - PLASTIC PIPES GROUP - MANUFACTURER APPROVED INSTALLERS. PLEASE PROVIDE COPY OF CERTIFICATION TO RCA PRIOR TO LAYING ANY PIPEWORK.

WHEN SEWERS ARE LOCATED WITHIN A PUBLIC HIGHWAY, THE OUTSIDE OF THE SEWER SHOULD BE IN THE VEHICLE CARRIAGEWAY (NOT FOOTPATH) AND BE AT LEAST 1m AWAY FROM THE KERBLINE. THE OUTSIDE OF MANHOLE CONSTRUCTIONS SHOULD BE AT LEAST 0.5m AWAY FROM THE KERBLINE.

THE DEVELOPER MUST SELF-VET AND CERTIFY THAT THE DESIGN CRITERIA, MATERIAL STANDARDS AND WORKMANSHIP SPECIFICATIONS FOR THE PROPOSED POTENTIALLY ADOPTABLE SEWERS ARE IN ACCORDANCE WITH THOSE SET OUT IN "SEWERS FOR ADOPTION - A DESIGN AND CONSTRUCTION GUIDE FOR DEVELOPERS" 7th EDITION AND THE REQU[illegible]TS OF THE STATUTORY UNDERTAKER DWR CYMRU WELSH WA[illegible]CWW) AND CONFIRM THE SAME IN WRITING TO THE ADOPTION AUTHORITY.

THE CONTRACTOR SHALL ENSURE THAT AN UP TO DATE COPY OF SEWERS FOR ADOPTION 7th EDITION TOGETHER WITH ALL ITS CURRENT DWR CYMRU WELSH WATER ADDENDUM AND WELSH GOVERNMENT MINISTERS' STANDARDS DOCUMENTS IS AVAILABLE ON SITE FOR COMPLIANCE.

THIS PROJECT HAS BEEN DESIGNED TO COMPLY WITH SEWERS FOR ADOPTION 7th EDITION AND WELSH GOVERNMENT MINISTERS' STANDARDS.

NOTES

KEY

- SURFACE WATER SUB BASE PIPE
- SURFACE WATER PIPE
- S00 SURFACE WATER MANHOLE
- RGI0 RAIN GARDEN INLET / OUTLET
- S00 SURFACE WATER FLOW CONTROL
- RAIN GARDEN
- ATTENUATION BASIN
- CARRIAGEWAY - PERMEABLE PAVING
- CELLULAR STORAGE TANK
- PROPOSED FOUL SEWER
- PROPOSED FOUL MANHOLE
- EXISTING SURFACE WATER PIPE
- EXISTING FOUL PIPE
- PROPOSED SURFACE WATER LINEAR CHANNEL
- SU PROPOSED SURFACE WATER SUMP UNIT
- SITE BOUNDARY
- S104 FOUL MAQNHOLE
- S104 FOUL SEWER
- PROPOSED SITE BOUNDARY

GENERAL NOTES:

1. DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT PROJECT DRAWINGS
2. USE OF THIS DRAWING DOES NOT ABSOLVE THE CLIENT FROM HIS RESPONSIBILITIES UNDER THE HEALTH AND SAFETY: THE CONSTRUCTION DESIGN AND MANAGEMENT REGULATIONS 2015. THE PRINCIPAL DESIGNER IS REQUIRED TO CONTACT HYDROCK CONSULTANTS PRIOR TO PERMITTING THIS DRAWING TO BE USED IN CONNECTION WITH ANY CONSTRUCTION WORKS.
3. THE DRAWING SHALL BE READ IN CONJUNCTION WITH THE HEALTH AND SAFETY INFORMATION PROVIDED AND/OR WITHIN THE PRE-CONSTRUCTION INFORMATION.
4. BEFORE COMMENCEMENT OF WORKS ASSOCIATED WITH THE DRAWING REFER TO ALL RELEVANT HEALTH AND SAFETY INFORMATION FOR THE WORKS INCLUDING RESIDUAL RISK INFORMATION.
5. THE DRAWING HAS BEEN BASED ON INFORMATION PROVIDED BY OTHER PARTIES AND HYDROCK DO NOT WARRANT THE ACCURACY OF THIS INFORMATION.
6. THE DRAWING SHALL BE USED FOR THE INTENDED PURPOSE ONLY AND HYDROCK DOES NOT WARRANT THE ACCURACY OF THIS INFORMATION.
7. DIMENSIONS SHALL NOT BE SCALED FROM THE DRAWING AND THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL DIMENSIONS AND LEVEL'S ON SITE FOR THE ACTUAL SETTING OUT OF THE WORKS.
8. HYDROCK IS NOT RESPONSIBLE FOR CHECKING DIMENSIONS ON SITE.
9. HYDROCK IS NOT RESPONSIBLE FOR SETTING OUT GRID LINES, BUILDING LINE ETC
10. HYDROCK IS NOT RESPONSIBLE FOR DIMENSIONS USED IN THE ORDERING AND MANUFACTURING OF EQUIPMENT AND THIS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
11. ALL FIGURED LEVELS ARE IN METRES AND RELATED TO EXISTING SURVEY GRID & DATUM UNLESS NOTED OTHERWISE
12. ALL FIGURED DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.

GENERAL DRAINAGE NOTES:

1. THE PLANNING, DESIGN AND CONSTRUCTION OF ALL ADOPTED SEWERS SHALL BE IN ACCORDANCE WITH SEWERS FOR ADOPTION 7TH EDITION, A DESIGN AND CONSTRUCTION GUIDE FOR DEVELOPERS, THE CIVIL ENGINEERING SPECIFICATION FOR THE WATER INDUSTRY 7TH EDITION AND DCWW WATER AMENDMENTS TO CESWI.
2. ALL ADOPTABLE SEWERS WITHIN ADOPTABLE HIGHWAY WITH LESS THAN 1.2M COVER TO HAVE REINFORCED CONCRETE SLAB PROTECTION. ALL ADOPTABLE SEWERS WITHIN GRASSED AREAS WITH COVER LESS THAN 0.9M TO HAVE REINFORCED CONCRETE SLAB PROTECTION. ALL AREAS WITH GREATER COVER THAN THE MINIMUM REQUIRED TO HAVE TYPE S BED AND SURROUND.
3. SEALED AND LOCKABLE COVERS TO BE SUPPLIED WHERE SPECIFIED ON MANHOLE SCHEDULE.
4. ALL PRIVATE DRAINAGE TO COMPLY WITH CURRENT BUILDING REGULATIONS, BS EN-752 DRAIN AND SEWER SYSTEMS OUTSIDE BUILDINGS AND OTHER RELEVANT BRITISH STANDARDS AND CODES OF PRACTICES.
5. ALL SEWERS TO BE LAID SOFFIT TO SOFFIT UNLESS OTHERWISE SHOWN.
6. IT IS THE CONTRACTORS RESPONSIBILITY TO LOCATE EXISTING SERVICES ON SITE ACCURATELY.
7. THE CONTRACTOR SHOULD COMPLY WITH HS(G) 47 "AVOIDING DANGER FROM UNDERGROUND SERVICES" WHEN EXCAVATING AROUND EXISTING SERVICES.
8. THE CONTRACTOR IS TO VERIFY THE LINE, LEVEL AND DIAMETER OF EXISTING SEWERS BEFORE COMMENCING DRAINAGE WORKS.
9. ALL LEVELS ARE TO OS DATUM.
10. COMPLIANCE WITH HEALTH & SAFETY MATTERS ON ANY TRENCH/MANHOLE IS OBLIGATORY AND A PERMIT TO ENTER A CONFINED SPACE IS REQUIRED WHEN CONNECTING SITE DRAINAGE TO THE EXISTING PUBLIC SEWERAGE SYSTEM. A PERMIT TO ENTER A CONFINED SPACE WILL BE OBTAINED FROM DCWW PRIOR TO THE WORKS COMMENCING ON ANY PUBLIC SEWERAGE SYSTEM.
11. PROPOSED ADOPTABLE SEWERS ARE ONLY PERMITTED TO HAVE OTHER SEWER/GULLY CONNECTIONS AND OTHER SERVICES LAID AT AN ANGLE OF BETWEEN 45° AND 90° ACROSS THE LINE WITH A VERTICAL CLEARANCE IN EXCESS OF 300MM.
12. WHERE SEWERS ARE TO BE CONSTRUCTED INSIDE THE RESTRICT TREE ZONE A SUITABLE TRESS PROTECTION BARRIER IS TO BE INSTALLED TO THE LANDSCAPE ARCHITECTS SPECIFICATION.
13. ALL SVP AND RWP POSITIONS SHOWN ARE APPROXIMATE ONLY. FOR CONSTRUCTION OF SVP'S AND RWP'S REFER TO ARCHITECTS DETAILED CONSTRUCTION DRAWINGS. ANY DISCREPANCIES TO BE REPORTED TO THE ENGINEER PRIOR TO CONSTRUCTION.
14. ALL PRIVATE PIPEWORK SHOWN IS 100MMØ UNLESS OTHERWISE

MANHOLE NAME / COORDINATES	MANHOLE DETAILS						PIPE DETAILS			
	COVER LEVEL	CHAMBER INVERT	DEPTH TO SOFFIT	SIZE	TYPE	COVER TYPE & SIZE	CONNECTION PLAN		INVERT	DIAMETER
F16 E = 328550.921 N = 184562.327	14.822	10.588	4.084	1.200	1	D400 600x600(mm)		0 1	10.588 10.588	150mm 150mm

THE DEVELOPER MUST SELF-VET AND CERTIFY THAT THE DESIGN CRITERIA,MATERIAL STANDARDS AND WORKMANSHIP SPECIFICATIONS FOR THE PROPOSED POTENTIALLY ADOPTABLE SEWERS ARE IN ACCORDANCE WITH THOSE SET OUT IN " SEWERS FOR ADOPTION - A DESIGN AND CONSTRUCTION GUIDE FOR DEVELOPERS" 7th EDITION AND THE REQUIREMENTS OF THE STATUTORY UNDERTAKER DCWW AND CONFIRM THE SAME IN WRITING TO THE ADOPTION AUTHORITY.

REVISIONS

Rev	Date	Description	By	Ckd	App
P04	09/05/22	Site boundary amended to suit clients comments	AS	CS	CS
P03	08/01/22	Site boundary amended to suit legal boundary supplied by client	HS	CS	CS
P02	20/10/21	Updated to DCWW Comments.	HS	CS	TH
P01	23/08/21	First Issue.	HS	CS	TH

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CLIENT
BOUYGUES UK

PROJECT
VANTAGE DATA CENTERS - CWL13

TITLE
S104 LAYOUT PLAN

HYDROCK PROJECT NO.	SCALE @ A0
C-18877-C	1:250

STATUS DESCRIPTION	STATUS
STAGE 5	S3

DRAWING NO. (PROJECT-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER)	REVISION
DC3-HYD-SW-XX-GA-C-600608	P04

A4-Stage 4 Complete 'Accepted' (A) 20/01/2022

Figure A.4

Appendix B. Pre-Application Discussions and Advice

B.1. Details of the Pre-Application Process

- A pre-application meeting was arranged between NRW, Vantage and Atkins for May 2022.
- A briefing note was issued in advance of the meeting on 05/05/2022 (see Section B.4).
- The pre-application meeting was held 10/05/2022.
- Following agreement from all that the minutes were an accurate record of the meeting, the final meeting minutes were issued on 31/05/2022 (see Section B.3).
- Comments were received from NRW following internal discussions relating to the CWL13 Environmental Permit application on 01/06/2022 (see Section B.2).

B.2. NRW Comments 01/06/2022

From: Ian James

Sent: 01 June 2022 09:33

To: Emma Spence (Atkins)

Cc: Glenn Kitchen (Vantage); John Dickson (Atkins) and Elizabeth Parr (NRW)

Subject: CWL13 discussion - notes and comments

Please see the comments below in relation to the discussions we had internally around the CWL13 application.

Key area of discussion was Air Quality with a focus on the AQMP and how responses to unplanned use of generators is managed.

In addition to this the issue of aggregations of engines on a site or collection of sites in a specific area/campus and how these are controlled is of concern. Coordination of testing would be an option, but this could potentially be between competitors and could be considered a risk.

An appreciation of the Operator's requirement for a separate permit, as no technical link, again with the concerns above re. 'campus' and how to control emissions in both routine and emergency situations. Key the Operator makes clear the rationale for New Application v Variation of existing.

It was acknowledged that the use of SCR on new developments might well be seen as the default and was discussed whether there are options to look at retro-fitting current installations. Claims for zero ammonia slip would need evidencing, quantifying.

Conversation between UK agencies is ongoing and there will probably be updated guidance in due course. This may be impacted in Wales by the publication of the proposed Clean Air Act.

Any modelling would be expected to use the most recent data available, any deviation from this requires justification.

I appreciate some of these thoughts will have crossed into the discussions we had yesterday and the Sch 5 for the current substantial variation for CWL11/12. Whilst keen to separate them out, particularly if CWL13 goes ahead as a standalone permit application, there are clearly areas of overlap that will need considering in the round as the 'campus' evolves. Hopefully it gives a flavour of the areas we feel are perhaps a little more challenging and where guidance might be developed in future.

I will briefly mention the discussion yesterday. I felt the overall message was appropriate in terms of the Operator having systems in place to evidence the ongoing impact of potential incidents, in addition to standing mitigation measures already in place. From a NRW perspective this would give greater confidence to permit continued Operations in the unlikely event of a sustained grid outage incident.

B.3. Minutes from the Pre-Application Meeting

ATKINS
Member of the SNC-Lavalin Group

Meeting Notes

Project:	Vantage Data Centers UK Ltd - CWL13 Permit Application - Pre-App Meeting		
Subject:	Pre-Application Meeting Minutes		
Meeting place:	Teams Meeting	Meeting no:	1
Date and time:	10 May 2022, 11am	Minutes by:	Emma Spence
Present:	Phil Smith (PS) Gareth Richards (GR) Ian James (IJ) John Dickson (JD) Emma Spence (ES) Sarah Horrocks (SH) Matt Edwards (ME) Adam Lawrence (AL)	Representing:	Vantage NRW NRW Atkins Atkins Atkins Atkins Atkins

All attendees introduced themselves.

PS provided an introduction to the Project, including discussion of Vantage's Project Programme.

ES ran through the previously distributed briefing note - attached as Annex 1 to these minutes - assisted by Sarah Horrocks (air quality assessment) and Adam Lawrence (noise assessment).

The operation of CWL13 is largely the same as that for CWL11/12. CWL13 will operate the same Kohler engines as those proposed for the recent expansion at CWL11/12. The key differences / items of note are:

- The engines will be fitted selective catalytic reduction (SCR) to reduce NOx emissions and the stack heights are higher, improving dispersion of air emissions.
- Whereas there will not be any coincident testing within CWL13 (apart from the back building tests where all engines in 1 cell are tested at the same time, which is the same as CWL11/12) it is likely that some of the testing at CWL13 will need to occur at the same time as testing at CWL11/12.

A summary of the key discussion points is documented below, these are presented in the same order as the discussion points at the end of the briefing note.

Next meeting:	TBA		
Distribution:	All present		
Date issued:	11 May 2022	File Ref:	5199429.101.Pre-App MoM

NOTE TO RECIPIENTS:
These meeting notes record Atkins understanding of the meeting and intended actions arising therefrom.
Your agreement that the notes form a true record of the discussion will be assumed unless adverse comments are received in writing within five days of receipt.

Item 1: CWL13 - standalone permit

It was proposed that CWL13 is treated as a standalone installation with its own permit (as opposed to being an addition to the existing CWL11/12 installation (see page 2, Section titled 'The Installation and Site Layout' of the briefing note in annex one for the rationale).

NRW felt this was appropriate, especially given the lack of technical connection.

Item 2: Potential issues in relation to BAT

PS discussed future evolving technologies and Vantage's commitment to looking at alternatives to diesel generators but stated that at present diesel generators were the only viable option. With this in mind Vantage has procured some of the quietest engines and has gone beyond the 'default' BAT for NOx emissions for data centres (to meet TA Luft Standard for NOx emissions) by installing SCR. With SCR the proposed Kohler engines will meet the MCPD ELVs for NOX emissions which are approximately four times lower than TA Luft.

IJ noted that SCR was the right way forward.

GR noted that NRW are in close contact with the EA and are working to ensure a consistent approach to permitting data centres across Wales and England.

Item 3: Operating regime and coincident testing at CWL11/12 with CWL13

As noted above, the operating regime for CWL13 is essentially the same as that for CWL11/12. However it is likely that testing at the two sites may overlap on occasion.

GR noted that coincident testing at the two sites would be a worst case scenario and that if the testing could not be coordinated then NRW would need the assessment to demonstrate that this was not an issue.

ES explained that sensitivity studies had been carried out for air quality and noise for coincident testing at the two sites. The studies looked at the worst case combinations of engines and test. Both studies concluded that the routine operational testing of CWL13 could be undertaken and managed independently of that for CWL11/12.

ES/SH/AL confirmed that the impact assessment for the permit application for CWL13 would look at the impact of CWL13 alone and also in combination with routine testing (and emergency operation) for CWL11/12.

Item 4 - Timeframe for granting of permit.

Vantage needs to start operation of the first module at CWL13 in October 2022.

GR said that the permitting 'queue' has reduced to 3-4 months and there can be no guarantees that it will be feasible to determine a permit in this timeframe. If the permit application is still sitting with NRW by October, further discussion would be required.

PS asked if there was a way to finance additional resources to expedite the determination. GR said that he was not aware of any arrangements of this nature.

GR said that the best way to facilitate the determination was to submit a good quality application.

IJ noted that as this is effectively a repeat determination process (due to the variation application for CWL11/12) the process could be quicker, especially if the same permitting officer was involved (i.e. David Poole).

GR said they could speak to the permitting team, give them upfront notice and impress upon them the importance of the timeframe, but there can be no promises.

Item 5 Use of meteorological data

SH explained that it was proposed to use the same met data for the CWL13 assessment as that that has been used for the CWL11/12 permit variation application (Cardiff 2011-2015). It was noted that a review of met data for several years had been undertaken as part of the duly making process for CWL11/12 which indicated that there was not substantial variation between the that data and more recent data. GR requested that this information be submitted with the permit application.

GR could not see a problem with this approach providing it was documented and justified in the variation but noted that the ultimate decision would be made by the NRW air quality specialists.

Item 6 - Other concerns in relation to the air quality assessment?

None were identified at this stage - should be straight forward; however, GR/IJ to check with NRW's air specialists - Atkins to join discussions as or if necessary, ES to supply contact details for Atkins personnel.

SH noted that there may be a new daily mean NOx EAL, SH to check if this is a change, or if it's still undergoing consultation.

SH noted that we'd not had comments back from David Poole in relation to the additional air quality assessment information / approach sent to David Poole for the CWL11/12 application and that it would be useful to have feedback on this as soon as possible. This would be particularly useful in relation to the proposed proportionate approach to the more minor pollutants and nitrogen and acid deposition. ES to contact David.

It was noted that the SCR should not result in ammonia slip. GR asked if there was any manufacturer's data to support this so that it could be demonstrated in the application that ammonia emissions will be zero. PS/ES to ask the engine suppliers. GR noted if there was not data and if NRW was still concerned an improvement condition could be included in the permit to undertake some one-off testing.

Item 7: Noise assessment source data and background levels.

AL explained that noise source data would be that measured for the same engine types in December 2020. Baseline noise levels to be used are proposed to be the 2018/19 levels, this is a conservative approach and avoids background creep.

IJ noted this sounded fine and covers the issue of background creep.

GR/IJ to check with NRW's noise specialists - Atkins to join discussions as or if necessary, ES to supply contact details for Atkins personnel.

Item 8: Noise assessment - other concerns.

None identified.

Item 9 - Other issues / concerns

NRW was invited to raise any other concerns / issues in relation to the approach, scope and content of the proposed permit application. None were identified at this stage.

GR asked about the proposed timeframe for submission of the permit application. ES to get back on this subject to data collection and availability.

JD noted that historically, dealing with different people has resulting in Atkins receiving differing advice at pre-app to the requirements of the permitting team which has led to delays and re-work. In order to avoid this JD asked if GR / IJ would be having internal discussions with the permitting team.

GR said they would speak to the air and noise teams and see if they can look at anything earlier on in the process so that they can identify any potential issues as soon as possible.

GR asked about the Site Condition Report. ES confirmed that there would be a new standalone Site Condition Report for CWL13 that would make use of the recent Phase 1 Desk Study Report and Phase 2 Ground Investigation (GI) Report. The report will be presented as an Appendix to the 'supporting information document' that will form part of the Permit Application documentation.

Actions

ITEM	DESCRIPTION AND ACTION [Post-meeting responses / comments are given in square brackets]	DEADLINE	RESPONSIBLE
1.	NRW to arrange internal meetings with their air quality and noise specialists [Meeting planned for w/c 16/05/2022]	Within 1 week (subject to availability of staff)	NRW - GR / IJ
2.	Atkins to provide contact details for the Atkins team for attendance at the meetings noted under item 1 above. [ES to provide central point of contact]	Email sent 11/5/22	Atkins - ES
3.	Check status of new EAL for daily mean NOx. [It is a change as of 29/04/2022]	Email sent 11/5/22	Atkins - SH
4.	Contact David Poole for feedback on addition information sent as part of the duly making process for CWL11/12. [No response as of 11/05/2022]	Email sent 10/5/22	Atkins - ES
5.	Ask the engine suppliers about test data for SCR in relation to ammonia slip. [No response as of 11/05/2022]	Email sent 10/5/22	Atkins - ES
6.	Provide estimate of date for submission of the permit application. [End of July 2020}	Email sent 11/5/22	Atkins - ES

B.4. Pre-Application Meeting Briefing Note

Memo

To:	Ian James and Gareth Richards		
From:	Dr Emma Spence	Email:	emma.spence@atkinsglobal.com
Date:	05 May 2022	Phone:	01332 225635
Ref:	5199429.101	cc:	Phil Smith (Vantage), John Dickson (Atkins), Sarah Horrocks (Atkins) and Adam Lawrence (Atkins)
Subject:	Vantage Data Centers - CWL13 Permit Application - Pre-Application Meeting		

Background

Vantage Data Centres (Vantage) currently operates a data centre facility at Imperial Park. Natural Resources Wales (NRW) is the regulator for the existing installation. The CWL11 facility has an environmental permit (EPR/BB3599CW) to operate 77 generator sets. An application to vary the permit to operate a further 125 generator sets (65 sets at CWL11 and 60 sets at the adjacent CWL12 site) was submitted to NRW in September 2021. The permit variation application was 'duly made' in February 2022 and is in the process of being determined.

A new data centre is proposed by Vantage at a site called CWL13 (see Figure 1-1). The proposed development comprises a two storey data centre building containing 10 Data Halls and the installation of 60 new standby generators.

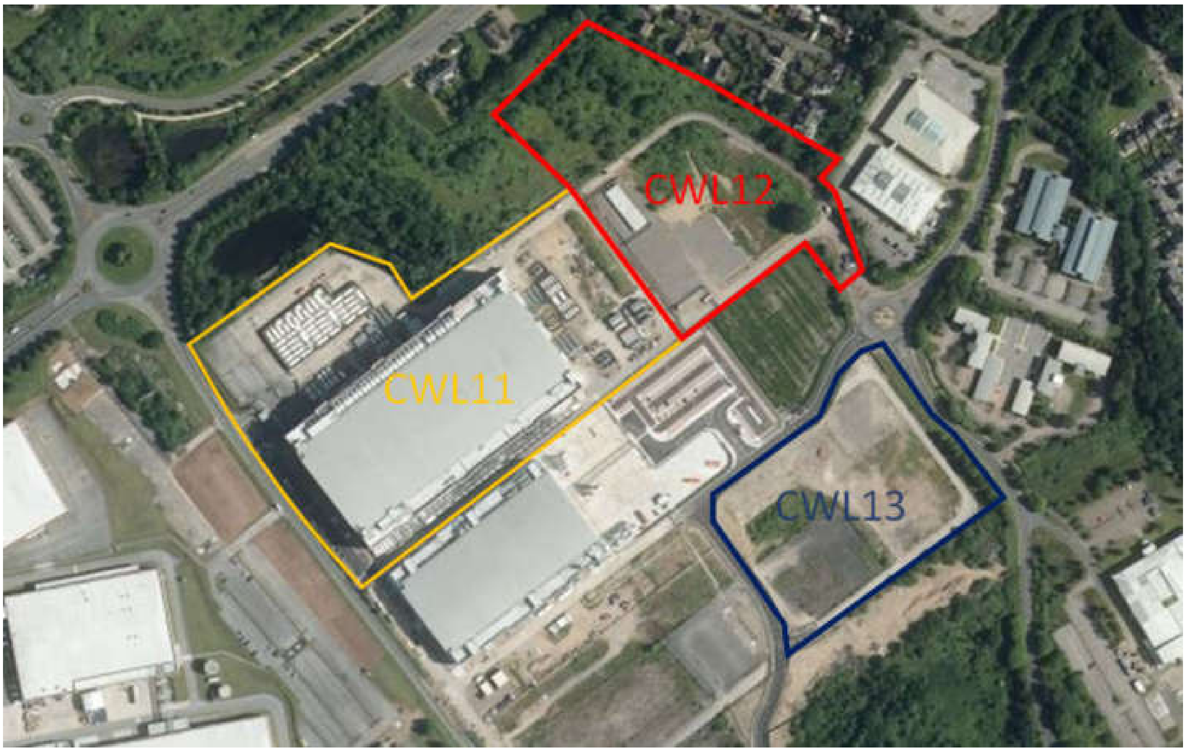
The CWL13 facility will be located to the south east of the existing data centre. The new site is accessed via North Lake Drive and Celtic Way, from the junction with the A48 to the north west. Planning consent has been granted for the development, subject to the close-out of a number of pre-operational planning conditions.

Rationale / Need

Due to the success of the existing Vantage facility and the significant demand for data facilities, the business has an ongoing requirement for additional capacity associated with the existing location near to Celtic Way. Vantage remains an important employment generator in the local area and is excited about growth at this site and constructing additional data facilities in Newport.

As per the CWL11/12 facility, due to the sensitive and significant nature of the information held at the site, a secure and reliable electricity supply is business-critical. The first level of power security will be two independent grid connections so that power supply can be maintained in the event of a localised power outage. However, an additional level of protection is required in case of grid failure and this would be achieved though the installation of standby generators.

Figure 1-1 - Location Plan



The Installation and Site Layout

Although the equipment, activities and operations at CWL13 would be generally the same as those at CWL11/12, it is proposed that CWL13 is treated as a standalone installation, with its own permit, as opposed to being an addition to the existing CWL11/12 Installation. [See discussion point 1 at the end of this note.]

There are a number of reasons for this, and they include:

- The two facilities (CWL11/12 and CWL13) are physically distant to one another and are not physically connected in any way.
- The two facilities are not electrically connected.
- The two facilities are not logistically connected, they have different entrances and different transport risks.
- The business models are dissimilar - CWL11/12 has multiple clients, whereas CWL13 has been designed to be operated for the protection of a single client’s data.
- The two facilities will be operated separately (though both would be operated by Vantage) as the sites could be divested differently in the future. There is an option to sell CWL13 either to the client or ANO in the future.

Figure 1-2 - Site Layout

Proposed Development

The 60 generator sets will be Kohler type KD1650 (as per the new engines for CWL11/12), all of which incorporate the KD45V20-DES engine with a thermal input of just under 3 MW_{th}. The combined thermal input for the 60 engines is 179 MW_{th} and the combined electrical output is 72 MW_{e}. The engines are grouped into 'cells', and there will be 10 cells, each with 6 generator sets. The cells are designed on an 'n+1' redundancy basis for additional security of supply.

Each engine will have an individual flue that exhausts at one metre above the parapet of the building. This stack height has been determined through a stack height sensitivity study.

The noise specification for the generator sets is 65 dB(A) at 1 m (as per the new CWL11/12 engines).

Typically BAT for NOx emissions from data centre engines is the TA Luft emissions limit of 2,000 mg/Nm^3 at 5% oxygen. However, for CWL13 selective catalytic reduction (SCR) abatement technology will be installed on the CWL13 engines to reduce NOx emissions. The Kohler engines have been designed to meet the MCPD NOx emission requirement of 190 mg/m^3 at 15% oxygen, at 100% load within 20 minutes of start-up (equivalent to 500 mg/Nm^3 at 5% oxygen). SCR is to be achieved through the injection of a urea solution (AdBlue).

The AdBlue injection will commence at approx. 200°C at which point <20% NOx reduction would be achieved; however, very little NOx is produced at this stage because NOx is formed at higher in-cylinder temperatures and pressures. As load and temperature increases so will NOx conversion – for example at 50% load (achieved in <10 minutes) and approximately 250°C around 70% NOx reduction can be expected. The optimum operational window for SCR is when the exhaust temperature reaches 350-450°C. See the table below for data supplied by the manufacturer.

Table 1-1 - NOx Concentrations with SCR at Varying Load and Temperature

Load	Approx. Exhaust Gas Temperature	NOx reduction	NOx with SCR mg/m^3 at 15% oxygen
50%	250°C	70%	186
75%	400°C	90%	144
100% (ESP)	450°C	90%	172

The rate of injection is controlled electronically so that dosing is automatically and quickly adjusted to meet the required level of emissions reduction. Any faults will be electronically logged and alarms will show what/where the fault is so that it can be corrected. This finite control should ensure that there is no ammonia slip. As a secondary prevention measure an ammonia slip catalyst (ASC) is used on the outlet end of the SCR reactor to remove any ammonia from the exhausted gas.

The fuel storage arrangements will be as per those for the new CWL11/12 engines (i.e. each generator set is in its own container which sits on top of an individual above ground, double skinned ‘belly tank’ which is complete with an integral fill point). The AdBlue tanks will sit underneath the discharge attenuator and on top of the fuel belly tank.

Operating Regime

As engines are for back-up power generation there is no ‘routine operation’. However, there are two testing scenarios for the engines that take place during routine servicing and maintenance:

- testing of individual engines; and
- testing the cells (known as a black building test).

In addition to routine testing, there may also be unplanned events. These are:

- testing of the engines after an unplanned repair (called a ‘break-fix’ event) - where possible these are tied into the planned testing that takes place during servicing and maintenance; and
- emergency operation (i.e. operation in the event of a grid failure).

The ‘operating hours’, testing regime and emergency operation of engines is summarised below.

In order to complete the annual maintenance and testing regimes for all engines at CWL13 there may be a need for testing of CWL13 engines to overlap with testing at the CWL11/12 site. This may arise for either the individual engine tests, or for the black building tests. Preliminary studies have been undertaken for air quality and noise to assess the feasibility of concurrent testing at CWL13 and CWL11/12. The conclusions of these preliminary studies indicated that it is possible that the operational testing regime for CWL13 could be managed independently of that of CWL11/12 without significant effects on receptors. [See discussion point 3 at the end of this note.] Due to the physical distance between the two sites, and the abatement proposed for CWL13, any in-combination effects from short-term operation are anticipated to be minimal.

Planned Operation

Routine Testing of Individual Engines

Each engine is tested during servicing / maintenance as follows:

- testing will be carried out on a quarterly basis (calendar year);
- twice per year (alternating quarters) individual engines will be run for 15 min each;
- twice per year (alternating quarters) individual engines will be run for 2 hours each;
- individual engines may be tested sequentially but no coincident individual engine tests will be undertaken at CWL13; and
- individual engine tests will not take place at the same time as, or overlapping with, any other testing at CWL13 (i.e. testing of cells).

Routine Testing of Cells (Black Building Test)

In the black building test all engines in an individual cell will be run concurrently as follows:

- the test will take place twice per year per cell;
- each test duration will be15 mins per cell;
- the test typically will involve all engines in a cell being fired up, with automated load shedding of engines down to the required output occurring within 10 minutes. However, for the purposes of modelling air emissions and noise, load shedding is not accounted for and it is assumed that all engines in a cell run concurrently for the full 15 minutes;
- this testing mode will not be carried out at the same time or overlapping with any other testing mode at CWL13 and there will be no more than 1 black building test per day; and
- black building tests may be followed sequentially by individual engine testing.

Unplanned Operation

Emergency Scenario

This is a theoretical scenario to simulate what could happen in the event of a major grid outage.

In an emergency scenario, all engines would start up simultaneously. The engines could provide a combined electrical output of 72 MWe. However, this is a very unlikely scenario as there will be redundancy built into the generation capacity. In the event of a power failure, all engines would start up at the same time, after which, for CWL11/12 an automated system would instruct load-shedding to take place to match power requirements. This occurs within 10 minutes of initial start-up. However, for CWL13 load shedding does not occur and it is assumed that all engines in a cell run concurrently for the duration of this scenario (1 hour).

The emergency scenario will be assessed for CWL13 alone, and in conjunction with CWL11/12.

Unplanned Testing for Break-fixes

Even though the engines are regularly serviced and well maintained, occasionally an engine fault requiring repair (known as a break-fix) may occur outside of the planned servicing and maintenance periods. Part of the repair requires running the engine for a period of time to establish that the repair has been successful. Where feasible the repair activities are coordinated with planned maintenance activities; however this is not always possible. Normally a minimum of 15 minutes is required to confirm generator operation following a repair, however this can be longer, consequently it is assumed that on average a break-fix test run could take up to 30 minutes. This scenario will not be specially assessed as it is bounded by the assessment of the routine individual engine tests.

Hours of Operation for Testing

Hours of operation for testing (both planned / routine tests or unplanned testing) are strictly limited to:

- 09.00 to 17.00 (8 hours per day); and
- Monday to Friday, excluding bank / public holidays.

Emissions

The principal emissions, as identified though previous permit application and variation for CWL11/12 are oxides of nitrogen (though other exhaust gas pollutants will be considered in a proportionate manner) and noise.

There is no ammonia slip as a result of the SCR due to the application of the ASC.

There is not expected to be any odour as a result of SCR, including the use and storage of urea solution.

The only point source emission to water will be uncontaminated surface water, which will ultimately be discharged into the business park drainage system. There will be no discharges to sewer. There will be no process effluent releases to water. There will be no planned emissions to groundwater.

Permit Application Overview

The key elements of the permit application will be the BAT assessment, air quality assessment and the noise assessment. In addition, as this is a 'new' site a standalone Site Condition Report will be required.

The approach to the rest of the application will be largely the same as that for the original permit application and the recent variation application. New forms will be produced and a Supporting Information Document (SID) will be prepared to accompany the application. The SID will include:

- non-technical summary;
- process description;
- techniques for process emissions control and BAT assessment;
- proposed emissions and monitoring;
- environmental risk assessment (associated with air quality, surface water, global warming potential, waste, noise, fugitive emissions and accidents); and
- appendices including:
    - plans and drawings (Vantage to supply),
    - engine specifications,
    - the air quality and noise assessments,
    - global warming potential assessment,
    - accident management plan, and
    - site condition report[1].

It is not proposed to produce an Air Quality Management Plan (AQMP) for the management of emissions in an emergency as part of the permit application documentation as modelling undertaken for the planning application has shown that CWL13 alone does not result in exceedences of the AEGL-1.

Air Quality Assessment

The air quality assessment will refer to the advice provided by NRW for previous Vantage permit applications as well as Environment Agency online guidance for air dispersion modelling[2], air dispersion modelling guidance for data centres[3] and the Environment Agency FAQ guidance for data centres[4].

The existing air quality baseline conditions as previously reported will be updated to reflect the most recently available data (excluding temporary impacts of the Covid pandemic and lockdown). The air quality assessment will be undertaken largely as per that for the recent CWL11/12 permit variation application including the comments and information requests received during the duly making process. The main difference in the modelling for CWL13 is that the NOx emission concentration used in the model will reflect the application of SCR as abatement.

Pollutants and Standards

The modelling will focus on oxides of nitrogen, the primary combustion product from diesel generators. Previous applications have shown that emissions of carbon monoxide, sulphur dioxide, particulates and hydrocarbons are not significant. Nevertheless assessments of these pollutants will also be presented for completeness.

Ammonia emissions do not need to be considered within the air dispersion modelling study as the ASC will remove this pollutant.

The main focus of the assessment will be on potential short term impacts, i.e. exceedences of the hourly air quality objective for nitrogen dioxide at nearby residential properties and the daily critical

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[1] The Site Condition Report will make use of the existing Phase 1 Desk Study Report and Phase 2 Ground Investigation (GI) Report.

[2] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#detailed-modelling

[3] https://www.gov.uk/guidance/specified-generators-dispersion-modelling-assessment

[4] Data Centre FAQ Headline Approach, Draft v11, as provided by NRW

level for oxides of nitrogen at ecological sites. The contribution of NOx emissions during testing to long-term environmental standards for human health and ecology will also be considered in a proportionate approach.

Impacts of nitrogen / acid deposition will also need to be addressed, through a proportionate approach. Initially, the lowest critical levels and loads for the most sensitive habitats and maximum modelled concentrations will be applied to determine if a more detailed approach is necessary.

Meteorological Data

It is proposed to use the meteorological data used for the CWL11/12 permit variation application (Cardiff 2011-2015). This will enable direct comparison with the recent CWL11/12 variation application modelling results. Although more recent data are available, we do not consider there to be material differences in the two datasets for this study of occasional engine running. [See discussion point 5 at the end of this note.]

Scenarios

The model will be run for all working hours of the year, for a five year meteorological dataset. The highest ground level concentrations will be identified for each operational scenario for CWL13, i.e. the maximum concentrations at relevant receptors for specific engines within each cell during the individual testing, or when operating all engines in each cell concurrently during the black building test. The conclusions will be based on a robust assessment for a selection of engines on each site.

Cumulative Impacts

Routine testing for CWL13 may overlap with testing at CWL11/12 but this is not anticipated to cause a material change to the results for CWL11/12. A sensitivity test will be presented for this.

As a national grid outage event could affect all three Vantage sites concurrently, the cumulative impacts for a combined emergency operational scenario will also be addressed. The modelling will use factored emission rates to account for load shedding after 10 minutes for cells at CWL11 and CWL12 (no load shedding will apply for CWL13). An analysis of the results, in terms of the number of exceedences of acute air quality thresholds, will be presented.

As well as the AQS objective for hourly mean nitrogen dioxide, the modelling of emergency operation will consider short-term concentrations of nitrogen dioxide in the context of the USEPA acute exposure guideline levels (AEGL).

Noise Assessment

The noise assessment scope and methodology will be the same as that undertaken for the recent CWL11/12 permit variation application (i.e. in accordance with BS4142:2014+A1:2019). However, in addition to assessing the effects of noise from CWL13 alone, the combined effects of coincident testing and emergency operation of CWL13 with CWL11/12 will also be assessed. Consideration of noise sources other than CWL11/12 are excluded.

As testing at CWL13 may overlap with testing at CWL11/12 and the noise assessment will look at the potential cumulative impacts for coincident operation of the sites for both routine testing, as well as for emergency operation.

Noise Source Data

Measurement of noise source data and tonal characteristics from the existing Kohler engines at CWL11/12 were taken in December 2020. The noise levels are slightly higher than the manufacturer’s data and so the assessment of noise for the CWL13 permit application would use the measured source levels. The assessment would also use the updated tonality information. [See discussion point 7 below].

Background Noise Levels

No noise surveys / measurements will take place and all background levels will be derived from data used for CWL13 at the planning stage.

The baseline noise levels to be used for the CWL13 assessment were measured during 2018/2019 prior to the proposed expansion at CWL11/12. Once the new engines (as per the recent permit variation) are operational baseline noise levels at receptors may be higher than the 2018/2019 levels. However, using a lower baseline noise level provides a conservative approach as it ignores any creep in baseline noise levels. Consequently it is proposed to use the same (2018/2019) baseline noise levels as this provides the worst case assessment scenario. [See discussion point 7 below].

Timeframe

Vantage needs to be able to operate the site by October 2022. Atkins is aware that there is a backlog in determining permit applications. Is there any way that the process can be expedited or ‘fast-tracked’? If this is not feasible, is an interim ‘local’ agreement a possibility? [See discussion point 4 below].

Discussion Items

General

1. Is NRW in agreement that the facility can be operated under a standalone environmental permit?
2. Does NRW have any potential issues in relation to BAT?
3. Does NRW have any comments on the operational regime, particularly in relation to the possible coincident testing of engines at CWL11/12 with CWL13?
4. Timeframe for granting of permit.

Air Quality Assessment

5. NRW to confirm (or otherwise) that the meteorological data used for the CWL11/12 permit variation application (Cardiff 2011-2015) is deemed suitable for the CWL13 application.
6. NRW to raise any concerns / issues in relation to the proposed approach to the air quality assessment.

Noise Assessment

7. NRW to confirm (or otherwise) the approach to noise source data and background noise levels.
8. NRW to raise any concerns / issues in relation to the proposed noise assessment.

Any Other Issues?

9. NRW to raise any other concerns / issues in relation to the approach, scope and content of the proposed permit application.

Appendix C. Company Information / Change of Name

FILE COPY

CERTIFICATE OF INCORPORATION ON CHANGE OF NAME

Company Number **6132144**

The Registrar of Companies for England and Wales hereby certifies that under the Companies Act 2006:

NEXT GENERATION DATA LTD

a company incorporated as private limited by shares, having its registered office situated in England and Wales, has changed its name to:

VANTAGE DATA CENTERS UK LIMITED

Given at Companies House on **7th January 2021**

* N061321448 *

The above information was communicated by electronic means and authenticated by the Registrar of Companies under section 1115 of the Companies Act 2006

Companies House

REGISTRAR OF COMPANIES FOR ENGLAND AND WALES

THE OFFICIAL SEAL OF THE REGISTRAR OF COMPANIES

Companies House

NM01(ef)

Notice of Change of Name by Resolution

Company Number: **06132144**

Company Name: **NEXT GENERATION DATA LTD**

Received for filing in Electronic Format on the:**06/01/2021**

Notice is hereby given that the company has changed its name as set out in the attached resolution

Authorisation

Authenticated

This form was authorised by one of the following:

Director, Secretary, Person Authorised, Administrator, Administrative Receiver, Receiver, Receiver manager, Charity Commission Receiver and Manager, CIC Manager

COMPANIES ACT 2006
SPECIAL RESOLUTION ON CHANGE OF NAME

Company number: 06132144

Existing company name:
NEXT GENERATION DATA LTD

The following special resolution to change the name of the company was agreed and passed by the members.

On the 5th January 2021

That the name of the company be changed to:
VANTAGE DATA CENTERS UK LIMITED

Appendix D. Air Quality Assessment

CWL13 Permit Application

Air Quality Assessment

Vantage Data Centers UK Ltd

August 2022

Notice

This document and its contents have been prepared and are intended solely as information for Vantage Data Centers UK Ltd and use in relation to the Environmental Permit application for CWL13.

Atkins Limited assumes no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

This document has 67 pages including the cover.

Document history

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
V0.1	Issue to Vantage	MDL	ME	SH	ES	09/08/22
V1.0	Final for issue	MDL	ME	SH	ES	17/08/22

Contents

Tables

Figures

1. Introduction

This report is in support of an environmental permit application for the proposed CWL13 data centre at the Vantage Data Centers UK Limited (Vantage) facility at Bouygues, Vantage Data Centre, North Lake Drive, Newport, NP10 8UL. An Environmental Permit is required due to installation of 60 generator sets to provide backup power in the event of an emergency loss of power event.

This report describes an atmospheric dispersion modelling study of emissions to evaluate the environmental impact on human health and ecology of the operation of the engines during testing, and in an emergency scenario.

1.1. Background

The existing Vantage facility in Newport, CWL11, is the largest data centre facility in Europe. It is a highly secure data storage facility and, in addition to two independent connections to the national grid, it comprises several levels of backup power to ensure data integrity.

CWL11 operates under an environmental permit (EPR/BB3599CW). The backup power facilities at CWL11 were originally provided by 77 diesel engine powered generators, arranged in 12 cells of engines. An Environmental Permit variation application was made in 2021 to increase the number of engines on the site by 125, giving a total of 202 engines; this variation for the expanded CWL11 and CWL12 (CWL11/12) facility has been duly made and is pending determination at the time of writing.

The proposed CWL13 facility, which is the subject of this assessment, is a new and separate data centre. It requires the installation of 60 standby generators. These additional generators will be Kohler KD45V20 units, each of which has a thermal input capacity of just under 3 MW. The generators will be arranged in ten cells of six (5 duty + 1 contingency configuration), around a central building.

The engines will be fuelled with hydrotreated vegetable oil (HVO), although diesel may be used as an alternative fuel in the event of supply issues. The two fuels can be used interchangeably. As diesel fuel gives rise to higher emissions of combustion products, the air quality assessment has assumed the use of diesel as this approach provides the most robust and conservation assessment.

As for CWL11/12, the operation of these generators is only required in case there is an emergency power outage, in order to ensure customer data and critical systems continue to run. The generators will, however, require periodic testing to ensure performance and availability should an unplanned or emergency loss of power occur. There are two routine test regimes for the standby generators:

- on a quarterly basis, individual engines are tested, non-concurrently, either for 15 minutes, or (in alternating quarters), for two hours; and
- twice per year, to simulate mains failure, each “cell” of six engines is tested for approximately 15 minutes (a “black building” test).

In addition, unplanned “break fix” testing may be required on a small number of engines per year, of approximately half an hour duration - see Section 2.6.1 in the main Supporting Information Document for more details.

Typically each engine runs for no more than around five hours in any year under the planned testing regimes (i.e. a total of 300 hours per year of operation for the 60 engines at CWL13).

Hours of operation for testing (both planned / routine testing or unplanned testing) are strictly limited to 09:00 and 17:00 Monday to Friday (excluding bank holidays). Furthermore, the black building testing mode will not be carried out at the same time or overlapping with any other testing mode at CWL13 and there will be no more than one black building test per day i.e. the cells of engines are not operated concurrently during testing. In order to complete the annual maintenance and testing regimes for all engines at CWL13 there may be a need for the routine testing of the CWL13 engines to overlap with testing at the CWL11/12 facility. This may arise for either the individual engine tests, or for the black building tests.

1.2. Approach

The approach adopted, which was discussed with NRW prior undertaking the work (see Appendix B of the main Supporting Information Document for the permit application), is consistent with that for the CWL11 permit application and subsequent CWL11/12 permit variation application for the expanded site. The methodology applied also takes on board the feedback from NRW during the permit determination process for each facility. The air quality assessment is in line with Environment Agency online guidance on Air Emissions Risk Assessment for your Environmental Permit[1] which is supported by Natural Resource Wales (NRW), and meets the requirements set in the NRW's online guidance Environmental Guidance: air dispersion modelling report[2], in accordance with accepted good practice.

This report provides:

- a description of existing conditions and sensitive receptors;
- a summary of model input data including the flow rates and emission rates;
- a dispersion modelling study using meteorological data for a five-year period;
- an assessment of pollutant concentrations at human health and ecological receptors;
- a comparison of pollutant concentrations against air quality criteria;
- consideration of cumulative impacts during routine and emergency testing;
- conclusions regarding the acceptability of the findings.

[1] Available at: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit, accessed July 2022 (latest version dated 7 October 2020)

[2] Available at: https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports, accessed July 2022

2. Existing Conditions

2.1. Introduction

The Vantage site lies wholly within the Newport City Council (NCC) local authority area. It is located within the Imperial Park commercial and business park, approximately three kilometres (km) to the south west of Newport. The site is accessed via North Lake Drive and Celtic Way, from the junction with the A48 to the north west. The CWL13 facility is to the south east of the existing and expanded data centre facility building and east of the IQE Newport Semiconductor Facility. The surroundings are primarily industrial/commercial, with open fields to the south.

There are no air quality management areas (AQMA) within close proximity of the site, the nearest located in excess of 2.5km, to the north, at the M4 at Junction 27.

The nearest residential properties are on Pencarn Avenue, approximately 230 metres to the north-east of the nearest CWL13 engines. Some 250 metres to the south east there are residential properties on Powis Close. The nearest discrete receptor to CWL13 is a non-residential property in Imperial Courtyard, approximately 50 metres to the east of the CWL13 building. A children's nursery is 650 metres to the north west near the Holiday Inn, between the A48 and the M4 motorway.

The Vantage site is located approximately 0.26 km north west of the Gwent Levels-St Brides Site of Special Scientific Interest (SSSI), and 2.6 km north west of designated areas in the Severn Estuary. In addition, there are numerous sites with local designations (see Section 3.7.3).

2.2. Air quality criteria

Due to the very restricted generator run time over the year, the short-term nature of the emissions from the engine testing regime mean that the hourly criteria are the focus of the assessment. Nevertheless consideration has also been made of the contribution to long term air quality objectives.

The main focus of the assessment is on oxides of nitrogen, which is the primary combustion product from diesel or HVO, however, the emissions of carbon monoxides, particulate matter and volatile organic compounds (VOCs) have also been considered in this assessment. A high level assessment has been undertaken for sulphur dioxide based on diesel fuel sulphur content.

2.2.1. Human health criteria

Table 2-1 - Air quality criteria

Pollutant	Criterion	Value
Nitrogen dioxide (NO_2)	1 hour mean	200 µg/m^3, not to be exceeded more than 18 hours per year
	Annual mean	40 µg/m^3
Carbon monoxide (CO)	1 hour mean	10,000 µg/m^3
	8 hour mean	30,000 µg/m^3
Particulate matter (PM_{10})	24 hour mean	50 µg/m^3 not to be exceeded more than 35 times a year
	Annual mean	40 µg/m^3
Particulate matter ($PM_{2.5}$)	Annual mean	25 µg/m^3
Benzene	24 hour mean	30 µg/m^3
	Annual mean	5 µg/m^3
Sulphur dioxide (SO_2)	1 hour mean	350 µg/m^3 not to be exceeded more than 24 times per year
	15 min mean	266 µg/m^3 not to be exceeded more than 35 times per year
	24 hour mean	125 µg/m^3 not to be exceeded more than 3 times per year

Emissions of oxides of nitrogen (NOx) form NO_2 in the atmosphere in the presence of sunlight; it is the latter which has an impact on human health and for which air quality criteria are set. Emissions of hydrocarbons (HC) or VOCs have been assessed against air quality criteria for benzene, to provide a very conservative assessment in line with online permitting guidance (this is because there will be many individual VOCs emitted, and typically benzene is a very small proportion of these).

Thresholds for acute exposure, such as the Defra Daily Air Quality Index (DAQI) and the US EPA Acute Exposure Guideline Levels (AEGLs), can be useful when evaluating short-term elevated concentrations during high pollution episodes or unusual situations such as those which may arise during an emergency power outage.

The DAQI[3] for nitrogen dioxide is based on the hourly mean concentrations shown in Table 2-2. Note that the primary purpose is to generate a daily, regional index for multiple pollutant exposure to ambient air, rather than occasional, very localised areas of impact from individual combustion sources.

Table 2-2 - DAQI categories for hourly nitrogen dioxide

Index	1	2	3	4	5	6	7	8	9	10
Band	Low	Low	Low	Moderate	Mod-erate	Mod-erate	High	High	High	Very High
µg/m³	0-67	68-134	135-200	201-267	268-334	335-400	401-467	468-534	535-600	601 or more

For nitrogen dioxide, the US EPA acute exposure guideline level[4] AEGL-1 threshold of 0.5 ppm (approximately 940 µg/m^3) is the concentration above which the general population, including susceptible individuals, could experience discomfort, irritation, or certain asymptomatic non-sensory effects over short exposures up to 8 hours. These effects are transient and reversible upon cessation of exposure (non-disabling effects). The AEGL-2 level of 12 ppm over one hour or 8 ppm over four hours, is the concentration that could lead to irreversible or other serious, long-lasting adverse health effects (disabling effects).

2.2.2. Ecological criteria

The daily average non-statutory guideline value for oxides of nitrogen concentration for the protection of vegetation is 75 µg/m^3, or in cases where there are low background SO_2 and ozone (O_3) concentrations, 200 µg/m^3.

The Institute of Air Quality Management (IAQM) "Guide to the assessment of air quality impacts on designated nature conservation sites"[5] provides explanation to the origin of the non-statutory guideline of 75 µg/m^3 recommended by the World Health Organisation (WHO) in 2000. The CD ROM version of the 2000 WHO guidelines notes that: "*Experimental evidence exists that the critical level decreases from around 200 µg/m^3 to 75 µg/m^3 when in combination with O_3 or SO_2 at or above their critical levels. In the knowledge that short-term episodes of elevated NOx concentrations are generally combined with elevated concentrations of O_3 or SO_2, 75 µg/m^3 is proposed for the 24 h mean.*"

Ozone (O_3) and SO_2 concentrations are typically low in the UK compared to many other countries, so 200 µg/m^3 is the most appropriate short-term critical level, rather than 75 µg/m^3. The annual average concentration of SO_2 according to the Air Pollution Information System (APIS) website[6] is less than 2 µg/m^3 for the grid squares encompassing the nature sites closest to the Vantage facility. This is less than ten percent of the long-term critical level of 20 µg/m^3 for SO_2. There is no single critical level for ozone, however mapping and monitoring data from Air Quality Wales suggests an annual mean of 28 µg/m^3 in 2018 and less than 25 days with 8-hour mean concentrations above 120 µg/m^3.

Nitrogen and acid deposition are compared against critical loads on APIS for the relevant habitat type.

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[3] https://uk-air.defra.gov.uk/air-pollution/daqi?view=more-info&pollutant=no2#pollutant, accessed July 2022
[4] https://www.epa.gov/aegl/nitrogen-dioxide-aegl-program, accessed July 2022
[5] https://iaqm.co.uk/text/guidance/air-quality-impacts-on-nature-sites-2020.pdf, accessed July 2022, (version 1.1,May 2020)
[6] https://www.apis.ac.uk/, Accessed July 2022

2.3. Monitoring data

There is an urban background air quality monitoring station in Newport (UKA00380) which forms part of the UK monitoring network[7]. The site description is as follows:

> *"The monitoring station is located in a self contained, air conditioned housing in the north-west corner of St Julian's School. The nearest road is the M4, with the station approximately 60 metres south of lane 1 protected by a barrier of trees. Further residential access roads surround the site. The surrounding area is urban residential."*

The Newport continuous monitoring station (CMS) is located 6.4 km to the north east of the Vantage facility. The annual average nitrogen dioxide and particulate matter concentrations measured at the urban background location are shown in Table 2-3 to for the last eight years with complete ratified data.

Table 2-3 - Newport AURN site annual average concentrations, μg/m^3

Year	2014	2015	2016	2017	2018	2019	2020	2021
NO_2	22	21	22	20#	19^	20	15*	15*
PM_{10}	16	16#	16	15#	14#	15	13*	12*
$PM_{2.5}$	12	10	10	12#	8#	10	8*	7*

* concentrations may have been affected by the lockdown during the Covid-19 pandemic
^ low data capture <50%
# data capture <85%

The annual mean nitrogen dioxide concentrations in Table 2-3 showed little variance between 2014 and 2019, ranging between 19 and 22 μg/m^3. A reduction was observed in 2020 and 2021 however, this follows UK wide trends during the COVID-19 pandemic. The 2019 urban background NO_2 concentration of 20 μg/m^3 is used in the interpretation of the results of the atmospheric dispersion modelling study, being the last year not affected by the changes due to the Covid-19 pandemic. This is likely to be a slightly conservative estimate for the area adjacent to the CWL13 facility, given the proximity of the CMS to the heavily trafficked M4 (approximately 60 metres to the south).

This measured values for NO_2, PM_{10} and $PM_{2.5}$ are used in preference to the DEFRA background mapped concentrations[8] which, are lower.

Carbon monoxide and sulphur dioxide are not measured at the Newport CMS and estimates are not included in the latest published DEFRA background maps; the 2001 mapped estimates are used.

Benzene is measured as part of the DEFRA hydrocarbon network of CMS. As a conservative approach the maximum annual average recorded at a roadside CMS in London is used.

The values used in the assessment are summarised in Table 2-4

Table 2-4 - Summary of background concentrations used in the assessment, μg/m^3

Year	Value	Source	Comment
NO_2	20	NCC CMS 2019	More conservative than DEFRA maps (12-17 μg/m^3)
PM_{10}	15	NCC CMS 2019	More conservative than DEFRA maps (14 μg/m^3)
$PM_{2.5}$	10	NCC CMS 2019	More conservative than DEFRA maps (8 μg/m^3)
CO	300	DEFRA map 2001	No longer included in latest maps
SO_2	3	DEFRA map 2001	No longer included in latest maps
Benzene	1	London Marylebone CMS 2017	UK roadside concentration

[7] https://uk-air.defra.gov.uk/networks/site-info?site_id=NPT3, accessed June2022
[8] https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html, accessed June 2022

3. Methodology

3.1. Software

The atmospheric dispersion modelling was undertaken using the latest version of the US EPA model AERMOD (21112), as incorporated by Trinity Consultants Inc. in the software BREEZE AERMOD (currently v10.0.0.15). This model is the result of many years development by the US EPA and the American Meteorological Society. It has been developed as a regulatory model that incorporates the current understanding of atmospheric physical processes. This model is used by regulatory agencies, consultants and industry worldwide to assess the impact of air emissions from point sources.

AERMOD includes two data pre-processors for streamlining data input: AERMET, a meteorological pre-processor, and AERMAP, a terrain pre-processor. The model can address both local topography and building downwash effects concurrently, as is relevant to this study. The model provides reasonable estimates over a wide range of meteorological conditions and modelling scenarios. The building downwash algorithms in AERMOD PRIME, using parameters calculated by the Building Parameter Input Program (BPIP), distinguish this model from earlier versions of AERMOD, which used simpler procedures to address downwash.

The AERMOD model produced for the CWL11/12 permit variation was updated to include information on the CWL13 building dimensions, source locations, engine container dimensions and heights, and other pertinent information provided by Vantage and its suppliers. The specific model options for addressing meteorology, terrain, building downwash and source characteristics are described below.

Files for post-processing were selected as an option in the model, thus generating binary files for each “source group”. These files each contain over 43,000 hourly results for the five year period modelled. Post-processing using the BREEZE 3DAnalyst software entails the conversion of modelled NOx to nitrogen dioxide and the addition of a background component to derive the total concentration at each receptor. The software then facilitates the counts of the number of exceedances of user specified NO_2 thresholds to be calculated for the five year period of meteorological data used, and for individual years as required.

3.2. Meteorological data

3.2.1. Site selection

The most appropriate meteorological station with adequate records in the format required for the dispersion modelling study is at Cardiff Airport. This station is located approximately 28 km to the south west of the Vantage facility. The general topography of the area is such that Cardiff Airport records will be representative of conditions further along the Bristol Channel at the Vantage site; furthermore, the airport and the facility are at comparable distances from the coastline.

3.2.2. Years modelled

The Government online dispersion modelling guidance for industrial permitting states that a minimum of three years but a recommended five years of meteorological data should be used in a modelling study. To maintain consistency with other permit applications submitted to NRW, the hourly sequential meteorological data for the same five-year period (2011 to 2015) were used in the dispersion model.

The decision to use the same five years was made in order to present the changes due to the additional facility independently of external variables introduced by use of an alternative meteorological dataset. This allows an understanding of the impact of the CWL13 facility on a common basis with the original permit application for CWL11 and permit variation for CWL11/12. The online risk assessment for permitting guidance specifies that the choice of meteorological data requires justification but there is no stated requirement that the meteorological data should be the five most recent years available. The meteorological data file contains over 43,000 hourly records with good data capture provided by a qualified meteorologist and is a robust characterisation of local meteorology in terms of both extreme events and long-term average conditions, particularly for the assessment of standby emergency plant.

The degree of interannual variability is likely to be similar to that in other five year periods. To illustrate this, the individual windroses for Cardiff Airport for the period 2011 to 2021 are provided in Appendix A. These show that the wind patterns are similar and interannual variances have been adequately assessed using the recommended five year dataset for 2011 to 2015.

3.2.3. Land use parameters

In accordance with the US EPA guidance for AERMOD, the near-field land use within a one kilometre radius of the site was evaluated to determine the surface roughness length[9]. Land uses are specified by directional sector; in this case two sectors were designated as predominantly urban and cultivated land, as shown in Table 3-1. The Bowen ratio[10] and albedo[11] were determined by the land use categories within the far-field, represented by a ten by ten kilometre square centred on the site. A determination of the percentages of each type of land use was made based on inspection of Ordnance Survey mapping and aerial photography. The land use proportions are simply averaged over the area and are independent of distance or direction from the site.

Land use categories and sectors were defined in the AERMET software to generate site surface characteristics for use in the model. The US EPA annual average default values for the land types stated were applied in AERMET. The model parameters used to represent the area around the Vantage facility are shown in Table 3-1.

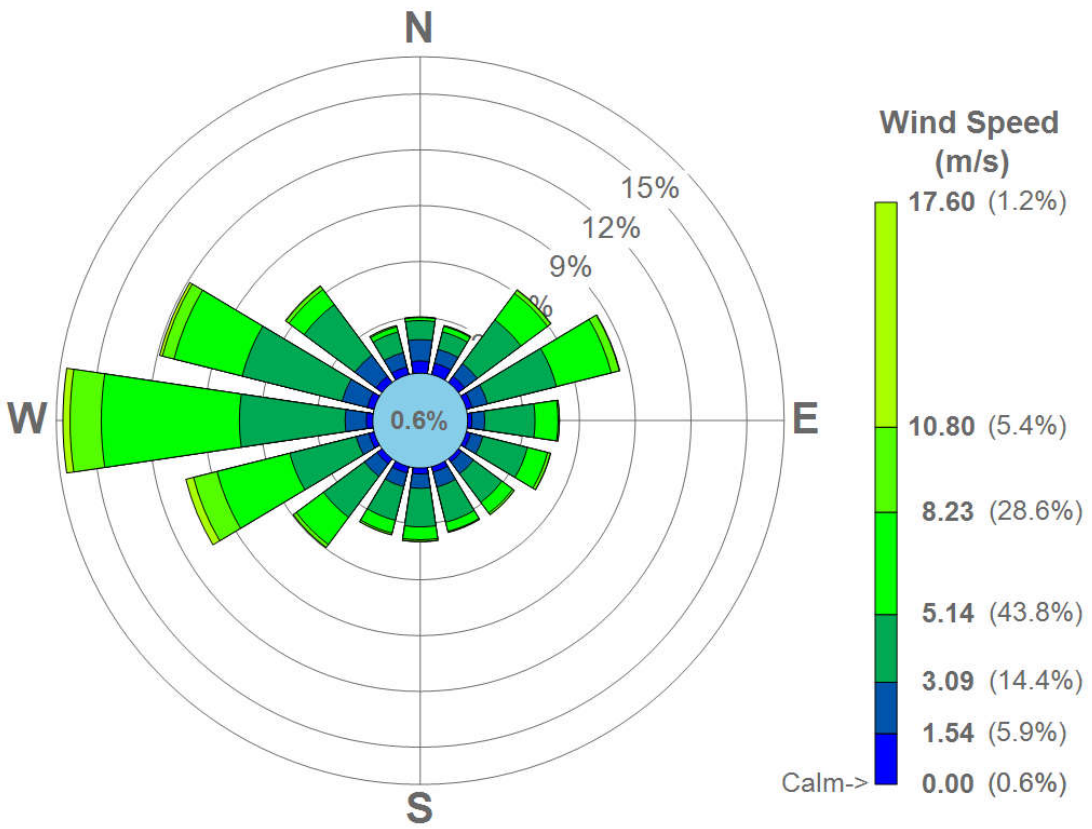
Table 3-1 - Site surface characteristics

Sector	Degrees	Albedo	Bowen Ratio	Surface Roughness
Urban	0 - 130	0.22	1.04	1.00
Cultivated land	130 - 210	0.22	1.04	0.0725
Urban	210 - 360	0.22	1.04	1.00

The processed meteorological data were used to generate a five year frequency distribution of wind speed and direction. This meteorological data is presented as a wind rose in Figure 3-1. It is evident from the data that there is a primary prevailing wind from the west and adjoining sectors; there is a secondary prevailing wind from the east north east.

[9] Surface roughness length is a measure of the height of obstacles to wind flow. It is not equal to the physical dimensions of obstacles but is generally proportional to them.
[10] The Bowen ratio is a measure of the amount of moisture at the earth's surface. This influences other parameters which in turn affect atmospheric turbulence.
[11] Noon-time albedo is the fraction of incoming solar radiation reflected from the ground when the sun is directly overhead. Adjustments are made in AERMET to incorporate the variation in the albedo with solar elevation angle.

Figure 3-1 - Cardiff Airport windrose, 2011 to 2015



3.3. Source characteristics

The proposed CWL13 facility lies on land to the south east of CWL11/12. It will require the installation of 60 HVO / diesel powered generator sets; these will be operated as ten cells of six engines, with each cell serving one of ten data halls.

Each of the new cells will be composed of six Kohler KD45V20-5DES engines, of which five are nominally operational and one is reserve (an "n + 1" arrangement in order to provide contingency). These are arranged in equal numbers immediately to the north and south of the main CWL13 data centre building.

Each CWL13 engine will be housed within a container and fitted with an individual vertical stack. Emissions will be exhausted at a height of 1 m above the CWL13 building, equivalent to 21.2 metres above the made ground level of the facility.

Site plans showing the engine container locations for each of the cells were used to assign stack locations in the model. The modelled stack location coordinates for all engines considered in this assessment are provided in Table B-2 and shown by the red dots in Figure B-1 in Appendix B .

The CWL13 engines will typically run at 100% of prime power. Each engine will be fitted with urea injection (Selective Catalytic Reduction (SCR)) in order to reduce the emissions of NOx to 500 mg/Nm^3 (at reference conditions, 5% oxygen). This value is consistent with the Medium Combustion Plant Directive (MCPD) emission limit for comparable engines that operate in a standard running role. However, it should be noted that although the engines are designed to meet this value, CWL13 engines will be exempt from the emission limit and monitoring requirements of the MCPD as they are for emergency use only. The SCR system proposed for the CWL13 engines includes an Ammonia Slip Catalyst (ASC) which the manufacture has stated will avoid ammonia slippage[12].

The engine emission characteristics used in the dispersion modelling study for the additional Kohler KD45V20-5DES engines are presented in Table 3-2.

[12] This is addressed further in the main supporting information document for the application, Section 3

The engine emissions were derived from information in the manufacturer's data sheets, information provided by the engine supplier and where appropriate, using a bespoke approach based on engineering principles. In the case of the latter, where data gaps were identified requiring the derivation of flow and/or mass emission rates, the linear relationship between fuel consumption, thermal input, power output, normalised volumetric flow rate and mass emission for the exemplar MTU engine was used (as described in the original permit application Schedule 5 notice response).

Normalised flow rates and concentrations in Table 3-2 are expressed as at 273.1K, 101.3 kPa, 5% oxygen, (dry basis). This is consistent with the datasheet concentrations which are expressed in terms of the TA Luft standard of 2,000 mg/Nm^3 and of the MCPD limit of 500 mg/Nm^3 at those reference conditions.

A cumulative assessment has also been undertaken to consider the combined effect of emissions during emergency operation concurrently at CWL13 with CWL11/12. A study to look at the cumulative effects of routine testing at CWL13 at the same time as testing at CWL11/12 is reported in Appendix C.

Where cumulative impacts have been considered, the CWL11/12 facility was modelled in accordance with the permit variation submission. A summary of all the engines included in the dispersion model is provided in Table B-1. Information on the CWL11/12 engines is provided in Table B-3 in Appendix B.

3.3.1. Derivation of emissions data

A robust process was applied to derive the required model parameters from the available Kohler engine data, based on the underlying premise that the generators all use the same diesel fuel [13], and that the combustion of that fuel in similar type and size of compression ignition engine will give a normalised volumetric exhaust flow rate that is directly proportional to the rate of fuel consumption (itself, the basis for the thermal input).

The pollutant emission rates for the CWL13 engines were derived from calculated normalised flow rates and the manufacturer's stated pollutant emission concentrations and are considered to be robust. For CO, the manufacturer's provided emission concentration of 667 mg/Nm^3 used in the CWL11/12 application was used to calculate the modelled emission rate. Note that more recent emission testing data obtained from the manufacturer indicates lower emission concentrations at full power (88 mg/Nm^3) however the more conservative value was applied. An exception to the manufacturer provided data was made for NOx which instead uses a value representative of the MCPD emission limit concentration of 500 mg/Nm^3, which will be achieved through the installation of SCR.

The emission rates for the CWL11 and CWL12 engines were taken from the assessment for the 2021 Environmental Permit variation.

The relationship between actual and normalised flow rate for the MTU 12V1600G20F engine, derived for the CWL11 application, was applied to the Kohler engine data for CWL13. A value for water vapour content was not available from the data sheet. A correction for water content was not applied since, based on professional experience of emissions from similar sized diesel engines without heat recovery, this is not a significant factor in terms of the sensitivity of the resultant exhaust stack velocity. Were a correction for water content of the exhaust gas to be made, it would increase the exit velocity by a few metres per second and as such the model remains conservative.

The actual flow rate is used by the model to calculate the exhaust stack velocity, which in the case of the new Kohler engines is over 30 m/s. Therefore, the sensitivity of modelled results to small uncertainties in actual volumetric flow rates, such as would arise from assumptions for water content, is small in the context of the emissions from the types of engines under consideration in this study, which have very high exhaust gas discharge velocities and exhaust gas temperatures which create substantial buoyancy.

The fuel used in the engines is regulated to no more than 0.1% sulphur by mass[14] which substantially limits the potential for sulphur dioxide emissions from fuel combustion. The ultra low sulphur diesel backup fuel has a lower sulphur content of 10 mg/kg or 0.001%, while HVO[15] should be even lower. A high level assessment for sulphur dioxide is presented based on the results for oxides of nitrogen and fuel sulphur content. The fuel consumption for the Kohler engine is 252 kg/h at full load. For a 0.1% sulphur content, this equates to a sulphur mass of 0.07 g/s within the fuel used. This mass of sulphur,

[13] HVO or diesel may be used in these engines but the manufacturer expects the emissions to be similar
[14] https://www.legislation.gov.uk/uksi/2014/1975
[15] https://kohlerpower.com/en/engines/press-release/2022/february/kohler-engines-approves-use-of-hvo-for-all-its-diesel-engines-in-europe

when combusted, equates to an emission rate of 0.14 g/s as sulphur dioxide, compared to 0.533 g/s for NO_x. At the expected maximum 0.001% fuel sulphur content, the emission rate is 0.0014 g/s.

Table 3-2 - CWL13 engine source characteristics

Parameter	KD45V20-DEP	Source
Thermal input, MW	2.987	Quoted
Prime power (PRP), kW	1330	Quoted by supplier
Fuel consumption (FSP), g/kWh	-	Quoted by supplier
Fuel consumption, kg/h	251.9	Quoted
Fuel calorific value, MJ/kg	42.8	Library value
Stack height, m	21.2	Design value
Stack diameter, m	0.35	Design value
Discharge temp., °C	499	After turbocharger
Normalised flow rate, Nm^3/s (at reference conditions 273.15K, 101.3 kpa, 5% oxygen, dry basis)	1.065	Derived from fuel consumption/thermal input specific factors
Oxygen content, % dry	5	Not required
Water content, %	10	Not required
Actual flow rate, m^3/s	4.583	Calculated
Efflux velocity, m/s	43.31	Calculated
NOx emission rate, g/kWh	-	Quoted
NO_x conc^n., mg/Nm^3	500	MCPD limit, at 5% O_2 (with SCR)
NO_x emission rate, g/s	0.533	Calculated
CO conc^n., mg/Nm^3	667	Quoted, at 5% O_2
CO emission rate, g/s	0.711	Calculated
PM conc^n., mg/Nm^3	3	Quoted, at 5% O_2
PM emission rate, g/s	0.003	Calculated
VOCs (as HC) conc^n., mg/Nm^3	10	Quoted, at 5% O_2
VOCs (as HC) emission rate, g/s	0.011	Calculated
SO_2 emission rate, g/s	0.14**	Calculated, from fuel S content

* Note that more recent emission testing data obtained from the manufacturer indicates lower emission concentrations at full power (88 mg/Nm^3) however the more conservative value was applied.

** this is the emission rate for fuel with a 0.1% sulphur content, based on regulatory requirements, the HVO fuel used at CWL13 will have a maximum 0.001% fuel sulphur content and so the emission rate will be 0.0014 g/s.

Fuel consumption specific factor:

Nm^3/s per kg/hour of fuel consumed: 0.00424

Thermal input specific factor:

Nm^3/s per kW_{th}: 0.00036

3.4. Operational scenarios

Two operational scenarios have been considered in this modelling study:
Routine testing:

- Individual engine tests - each CWL13 engine is tested individually once per quarter, for either 15 minutes or 2 hours' duration in alternating quarters;
- Black building tests - each cell of engines is tested twice per year for 15 minutes - on a conservative basis, the modelling has been undertaken without accounting for load shedding.

Emergency outage:

- CWL13 only - theoretical full site outage, with all 60 engines operating concurrently;
- Cumulative scenario with all CWL11, CWL12 and CWL13 engines operating[16] concurrently.

The model was set up to report the maximum hourly, eight hourly, daily and annual average concentrations of oxides of nitrogen, carbon monoxide, particulate matter and VOCs found at each discrete receptor point. As AERMOD was run with a five-year meteorological data file the maximum hourly result at each receptor is the highest in over 43,000 hours processed.

Cumulative assessment of the potential for overlapping routine testing at CWL 13 and CWL11/12 has not been specifically conducted as part of this assessment. However, a feasibility study was undertaken at an early design stage to provide an understanding of the potential for cumulative impacts from undertaking routine testing at CWL13 at the same time as testing at the CWL11/12 facility.

3.4.1. Routine testing

Planning conditions require all maintenance testing to be carried out between 09.00 and 17.00 hours on weekdays (excluding public holidays and weekends). No more than one engine, or one cell, at CWL13 would operate at any time for the quarterly tests or black building tests (i.e. no concurrent running in these tests). It is possible that black building tests may be followed by individual engine testing on any one day and testing may overlap across the two sites (i.e. CWL11/12 and CWL13).

Individual testing

For the quarterly testing of individual engines, each engine would run for up to 15 minutes or, on alternating quarters, for up to two hours. In theory, individual engines could run consecutively for up to eight hours per day, though this is unlikely.

For this scenario, all CWL13 engines were modelled individually, to identify the maximum hourly and daily mean concentrations. To maintain a conservative assessment, emissions were modelled for all working hours in the year i.e. assuming testing of engines is undertaken sequentially without breaks in between. Factors were applied to the annual mean to represent the actual planned total hours of tests per year.

Black building tests

For the black building tests, the model was set up with individual source groups for the relevant cells of engines representing each data hall. As these tests only last for 15 minutes, and only one cell will be tested in any hour, a factor of 0.25 was applied to the modelled concentration to provide an hourly average concentration that represents the test duration. The modelled output for the eight hour average concentration is based on a cell being tested each hour of the working day, a very conservative scenario. Factors were applied to the annual mean to represent the actual planned hours in which testing would be conducted per year.

Cumulative testing

A feasibility study was undertaken at design stage to understand the potential for cumulative impacts of the CWL13 individual (and cell) routine testing if it needed to be undertaken concurrently with testing at the CWL11/12 facility. The study used an earlier design for CWL13, but one which differs only marginally to that modelled in this assessment for the permitting application. The differences are not a key consideration in determining the potential for plumes to interact, given the distance between the two facilities. Core parameters such as stack height are unchanged. An earlier AERMOD version was used, however, the main model algorithm is unchanged.

[16] Load shedding on a number of engines per cell after 10 minutes applied for CWL11/12 in the cumulative scenario.

The findings of the study are presented in Appendix C. The study clearly demonstrates the very limited potential for emissions from CWL11/12 to combine with those of CWL13 during testing and thus coincident testing is extremely unlikely to result in additional exceedences of the AQS objective compared to testing at CWL11/12 alone. The study concluded that the operational testing regime for CWL13 could be managed independently of that for CWL11/12 and that, should tests be undertaken concurrently, there is an extremely low likelihood of cumulative impacts.

3.4.2. Emergency outage

Likelihood

The modelled emergency scenario represents an extremely unlikely situation where there is a sustained and complete loss of power to the facility (a loss of offsite power (LOOP) event). The CWL13 Vantage facility is connected directly to the National Grid via two independent connections. Both supply power concurrently under normal operational conditions, and both could be used in isolation if the other part of the grid supply system were to fail. The majority of power outages in the UK occur between the National Grid and the user; the National Grid network itself is highly reliable.

The existing Vantage facility has not experienced an electrical supply failure since operation commenced in 2009. The overall reliability of supply for the National Grid Electricity Transmission System (NGETS) in England and Wales as an eight year average is 99.99995% with little variation over the last few years[17]:

- 2020-21 99.99997%[18]
- 2019-20 99.999974%
- 2018-19 99.999984%
- 2017-18 99.999984%

The duration of a LOOP event is uncertain. For the purposes of modelling, a one hour continuous outage is appropriate, taking into consideration the likelihood and duration of such an event based on historical reports. This represents an extremely unlikely event of only one or two hours duration in a 20 year period (this is based on the Office for Nuclear Regulation [ONR] loss of off-site power event frequencies for use in nuclear power station safety assessments to support the UK Generic Design Assessment process, see footnote[17] for link).

Other events involving partial site outages of substantially lower intensity (e.g. a few engines or cells) may typically be of longer duration (over eight hours) than a full outage scenario. Two less "intense" power outages affecting a small number of cells have occurred at the Vantage Newport facility in the last few years:

- a phase failure relay fault occurred, simulating mains failures and transferring the load to the backup generators - this resulted in 1 cell of 5 engines operated for 4 hours and 34 minutes; and
- a solar flare resulted in a power dip on the National Grid, the systems worked as intended but when the power stabilised Vantage was unable to return fully to mains supply as a result of a component failure with the 3-phase failure relay - this resulted in the operation of 1 cell (4 engines) for less than twenty minutes, 1 cell (5 engines) for less than 4 hours and 1 cell (6 engines) for less than 5 hours.

Full site outage

Atmospheric dispersion modelling has been undertaken for a hypothetical emergency scenario at CWL13 which addresses a worst case, i.e. full site outage, LOOP event with all 60 engines operating at full load. This hypothetical scenario provides the maximum hourly concentrations and a theoretical number of exceedences per year for use in the hypergeometric probability calculation for likelihood of the AQS objective being exceeded.

In an emergency power outage, all CWL13 generators would be fired up and customer demand evaluated. Load shedding has not been modelled for the CWL13 engines, thus it is assumed that all six (n+1) engines per cell will operate giving a conservative output for any subsequent hours of outage.

[17] O9NR Regulatory Observation RO009 - http://www.onr.org.uk/new-reactors/uk-abwr/ro-res-plan.htm
[18] National Grid: National Electricity Transmission System Performance Report 2019-20 and National Grid, Annual Report and Accounts 2020/21.

Cumulative site outage

As a national grid outage event could affect all three Vantage sites concurrently, a scenario has been modelled to assess the cumulative impacts of CWL11, CWL12 and CWL13 combined; the intention of this scenario is to illustrate the additional impact of CWL13 rather than to re-evaluate the impacts of CWL11/12, which has been considered extensively during the permit determination process and has a dedicated air quality management plan (AQMP) to address impacts. Only nitrogen dioxide is considered in this scenario, as this is the only pollutant with the potential of exceeding relevant short-term criteria.

In the cumulative scenarios, all CWL11, CWL12 and CWL13 engines (202 + 60 generator sets) are assumed to operate concurrently. For the CWL11/12 cumulative scenario, the modelling assumes a selection of engines within each of the cells would be load shed after ten minutes to meet the required residual demand for the remainder of the hour. This is represented in the model with variable emissions factors of 0.167 for the load shed engines (see the CWL11/12 permit variation application air quality assessment for full details).

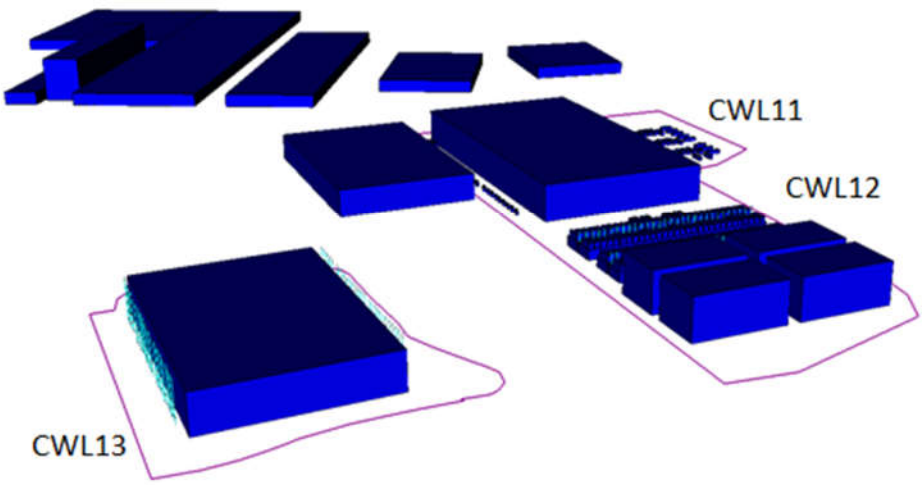
3.5. Building downwash

Buildings close to point source plume discharges that are more than 40% of the stack height may potentially cause downwash effects. The BPIP programme within AERMOD was used to calculate for each wind sector the direction specific building downwash parameters for each stack. The BPIP programme determines which structures are significant for each of the 360 degree wind directions and modifies the AERMOD input files with the appropriate parameters.

The new CWL13 facility comprises an individual rectangular building of 20.2 m height. The CWL13 building and associated 60 new engines are shown in the foreground of Figure 3-2 as viewed from the north east. The CWL11 and CWL12 facilities are also shown in the figure, these are located to the north west and north of the CWL13 facility respectively.

The existing CWL11 building was included in all model runs, with a roof ridge height of at 23.5 m; as was the IQE facility building, slightly lower at 17.6 m, and other nearby buildings which may have potential downwash effects. The proposed CWL12 structures comprise four approximately rectangular structures each 23.95 m in height. The downwash effects of all these buildings have been considered in the modelling scenarios along with that for CWL13.

Figure 3-2 - Schematic view of Vantage Newport data centre sites



3.6. Terrain

Terrain elevations (above Ordnance Datum (aOD)) for all off-site receptor points (grids and discrete receptors) were included in the dispersion model, as derived from Ordnance Survey digital terrain data files. The finished floor level for the CWL13 building and stacks were set at 15m aOD as per site layout drawings.

Terrain elevations for on-site model objects within CWL11 (stacks, containers and buildings) and CWL12 (stacks only) were set at +14.16 m aOD, whilst the CWL12 building, further to the east, was set at 15.15 m aOD as per site layout drawings. Offsite structures were modelled at elevations imported from the elevation files.

3.7. Receptors

Pollutant concentrations were modelled using nested Cartesian receptor grids covering wide and local areas. A 100 m resolution grid over a 2 by 2 km wide area centred on the CWL13 facility was used in combination with a smaller, local square grid 1.2 x1.2 km wide set at a 25 m resolution. The high-resolution local grid improves the spatial resolution of the model results in those areas subject to the highest concentration gradients close to the site boundary. Boundary receptors were also used to delineate the extended site boundary encompassing the proposed CWL13 facility and that for the CWL11/12 facility.

All grid and discrete receptors were specified at a height of 1.5 m above local ground elevation to represent breathing zone. The same height was used for ecological receptors[19].

3.7.1. Human health

Nearby receptors that are sensitive to the effects of air pollution on human health are listed in Table 3-3. These locations were included as discrete receptors in the model. The most sensitive properties are those where members of the public will be frequently present and where more vulnerable receptors (e.g residential/schools/care home etc) may be found are numbers 1 to 10. Receptors 11 and 12 are commercial/mixed use locations and are considered to be of lower sensitivity.

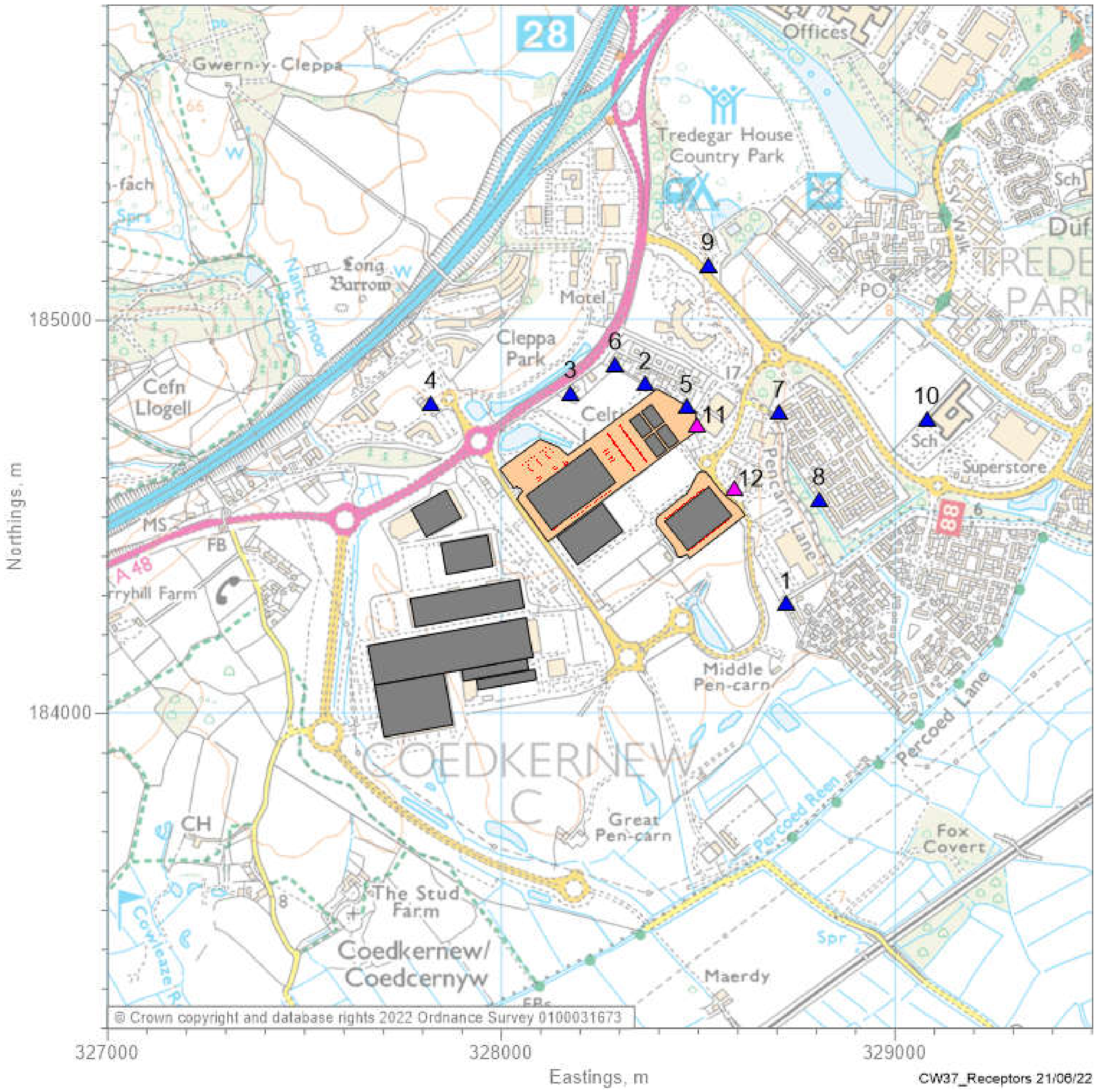
The discrete receptors are shown in plan view in Figure 3-3 as numbered blue (residential) and purple (non-residential) triangles. The Vantage facilities are highlighted in sand colour and the buildings themselves are grey with the stacks denoted by red dots. Other surrounding industrial facilities are also shown in grey.

Table 3-3 - Selected local human health receptors

I.D.	Address	Eastings, m	Northings, m
1	47 Powis Close	328723	184280
2	18 Pencarn Avenue	328366	184839
3	Celtic Springs Guest House	328176	184816
4	Teddies Nursery	327822	184790
5	11 Pencarn Avenue	328470	184780
6	24 Pencarn Avenue	328290	184888
7	2 Sir Briggs Avenue	328705	184766
8	95 Edmundsbury Road	328807	184544
9	Tredegar House Caravan Site	328525	185140
10	St Joseph's High School	329080	184750
11	Imperial Way, non-residential	328498	184736
12	Imperial Courtyard, non-residential	328590	184574

[19] There would be no material impact on the assessment findings were the ecological sites to have been modelled at ground level, given the conservative approach taken in other areas, while the height is considered to be a reasonable midpoint for both grassland and woodland.

Figure 3-3 - Selected local human health receptors



3.7.2. Industrial sites

DEFRA technical guidance (LAQM.TG16)[20] states that the hourly air quality standards and objectives in the Air Quality Strategy apply to locations where members of the public are regularly present for the duration of the exposure period.

The Environment Agency's Specified Generator modelling guidance[21] similarly states that "*Relevant exposure for an air quality assessment includes locations where members of the public have access, are regularly present and can be exposed for a significant portion of the averaging time of the standard*." It goes on to state that air quality standards "*do not apply where health and safety at work provisions exist and where members of the public do not have access*".

Members of the public do not have access to the grounds of Vantage nor that of surrounding industrial facilities such as IQE and therefore such locations are not included in the air quality assessment. IQE and Vantage workers are not considered to be members of the public for the purposes of the air quality assessment and are covered by separate, health and safety at work provisions. In any event, employees would not spend a relevant amount of time outdoors of the industrial facility, such as in the

[20] https://laqm.defra.gov.uk/technical-guidance/ (accessed June 2022, version April 2021)
[21] https://www.gov.uk/guidance/specified-generators-dispersion-modelling-assessment

car park. For this reason, locations within these industrial boundaries were not included in the air quality assessment.

3.7.3. Ecological sites

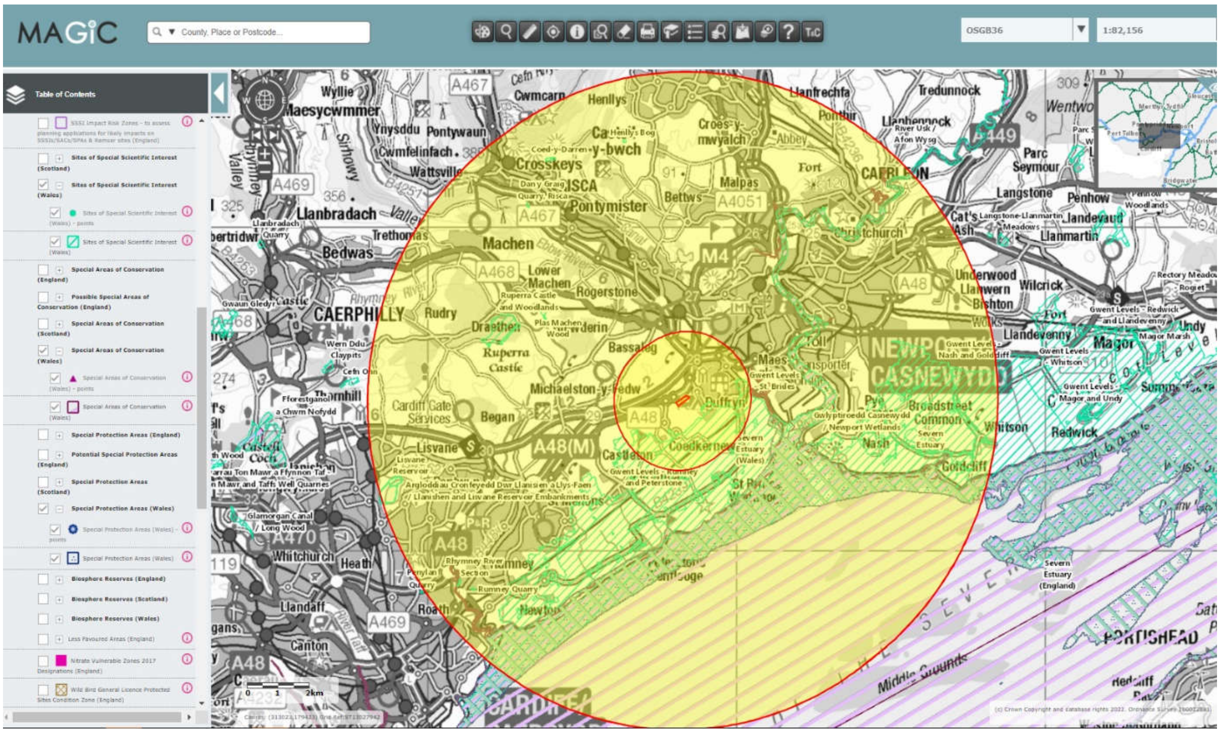
Figure 3-4 shows the search area considered for the assessment and Table 3-4 summarises the discrete receptors included in the model to represent the relevant locations.

There is only one SSSI within 2 km of CWL13 and that is the Gwent Levels and St Brides SSSI to the south east. Figure 3-5 denotes the closest points of these sites (Receptors A and B) with green inverted triangles.

Further afield, approximately 2.6 km to the south east of the Vantage facility at its closest point, is the Severn Estuary Special Protection Area (SPA) and Ramsar site; here, it is coincident with the River Usk Special Area of Conservation (SAC). The SAC is also found approximately 4 km to the north east. These two locations are represented by Receptors I and J respectively in the model.

There are no other European sites within 10 km, the distance in permitting guidance[22] and accepted by NRW for the CWL11 permit application. This is because the facility, despite having a combined thermal input of over 50 MW, is a combination of intermittently operated engines with relatively low stacks. The maximum impacts occur in the near field, which is not the case for some large combustion plant with very tall stacks where the concentrations can be higher further from the source.

Figure 3-4 - Magic map graphical output (2 km and 10 km)



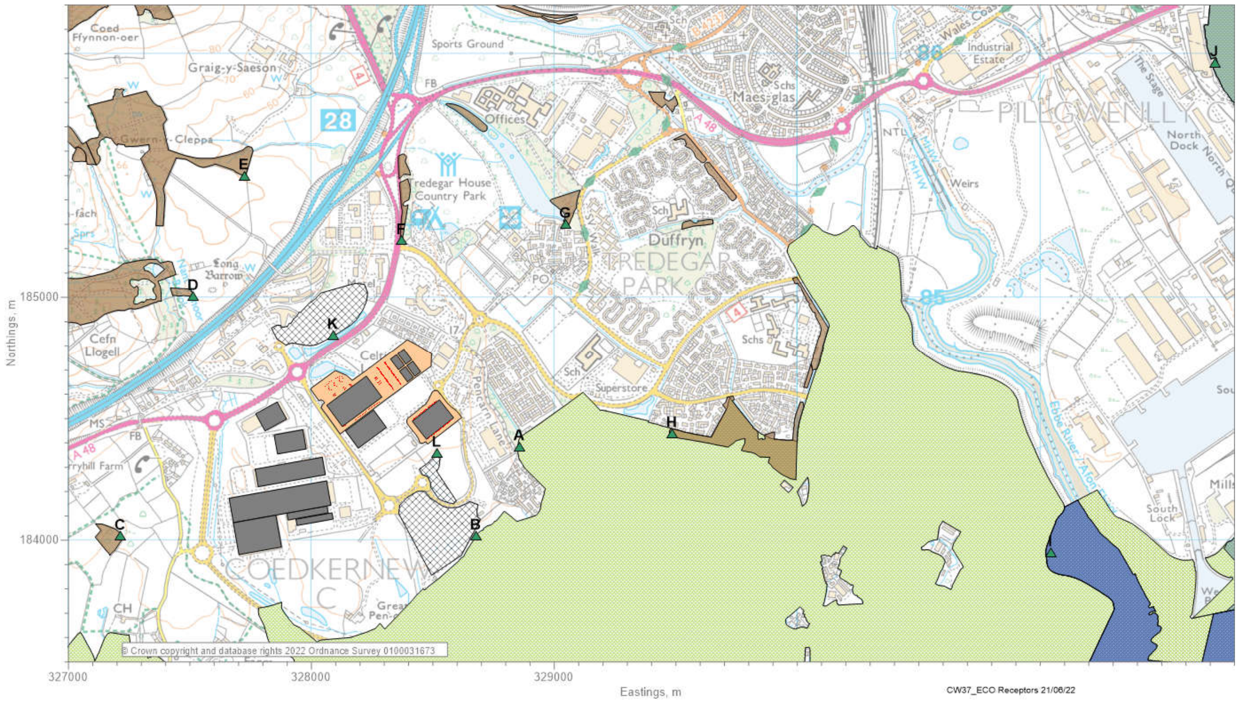
There are a number of areas of semi-natural and restored ancient woodland (those within one kilometre of the site have been considered as specific receptors in the modelling study, Receptors C to H in Figure 3-5). There are also local wildlife sites (LWS) known as Sites of Importance for Nature Conservation (SINCs) in the vicinity; the closest points of the various sites are represented by Receptors K and L in the dispersion model.

[22] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit

Table 3-4 - Selected ecological receptors

I.D.	Site designation	Eastings, m	Northings, m
A	Gwent Levels St Brides SSSI	328857	184386
B	Gwent Levels St Brides SSSI	328677	184019
C	Ancient woodland	327214	184018
D	Ancient woodland	327514	185005
E	Ancient woodland	327723	185500
F	Ancient woodland	328370	185234
G	Ancient woodland	329047	185301
H	Ancient woodland	329485	184440
I	Severn Estuary SPA/SAC/Ramsar	331044	183950
J	River Usk SAC	331720	185964
K	Celtic Springs SINC	328100	184800
L	LG Duffryn Site 1 and 2 SINC (including Duffryn Pond SINC)	328525	184300

Figure 3-5 - Modelled ecological receptors



The core features of interest within the designated sites in one kilometre of the Vantage facility, where maximum concentrations will be found, are shown in Table 3-5. The river environment is not sensitive to the potential effects of air quality on vegetation[23]. The APIS website does not provide any critical loads for the River Usk SAC or its designated species[24]. The Severn Estuary SPA is considered sensitive to nitrogen deposition given the potential presence of saltmarsh habitat.

[23] https://naturalresources.wales/media/662000/SSSI_1232_Citation_EN001606d.pdf
[24] http://www.apis.ac.uk/srcl/select-a-feature?site=UK0013007&SiteType=SAC&submit=Next

Table 3-5 - Features of designated sites within 1 km of the application site

Designated Site	Location of Designated Site[25]	Features of Interest (including qualifying features[26])[27]
Gwent Levels-St Brides SSSI	~260 m south east (at closest point)	Gwent Levels: green (drainage ditch) habitats, which support a varied assemblage of aquatic flora and fauna. St Brides: supports a number of interesting plant species and rich invertebrate communities.
Celtic Springs SINC	~ 430 m north west	Post-industrial mosaic habitat, neutral grassland and calcareous grassland.
LG Duffryn Site 1 (South Lake Drive) SINC & Duffryn pond SINC	~ 60 m south	Open standing water, designated for its pond / *Phragmites* reedbed habitat which supports a Schedule 1 bird species, Cetti's warbler.
LG Duffryn Site 2 SINC	~ 150 m south	Large area of neutral grassland adjacent to the Gwent Levels.

3.8. Post processing

For oxides of nitrogen, conversion to nitrogen dioxide is required to allow a comparison with the human health air quality criteria; a conversion factor of 0.35 was applied for the hourly mean, in line with Environment Agency specified generator modelling guidance[22]. For comparison with annual mean criterion for nitrogen dioxide, the modelled oxides of nitrogen concentrations were multiplied by a factor of 0.7, in line with the Environment Agency recommendation for long-term process contributions. This is considered to be a conservative approach given the proximity of sensitive receptors for human health, within a few hundred metres of the site boundary, and the exhaust velocity of the engines implying limited time for conversion.

The BREEZE post processing software 3DAnalyst was used to derive counts of exceedences of specified hourly average nitrogen dioxide concentrations thresholds, both over the entire five year period modelled and also for individual annual periods of meteorological data for comparison with the AQS objective of 200 µg/m^3 and the AEGL-1 threshold for acute non disabling health effects of 940 µg/m^3.

Post-processing in 3DAnalyst facilitates the conversion of the modelled NOx to nitrogen dioxide, by enabling the factoring and the addition of a background component to derive the total concentration or predicted environmental concentration (PEC) for each receptor. A short-term background component of 40 µg/m^3 was derived from twice the 2019 Newport urban background annual mean nitrogen dioxide concentration (see Table 2-3).

Analysis was undertaken to identify the maximum pollutant concentrations in each of the relevant averaging periods resulting from the operation of an individual engine or engine cell during routine testing and the maximum number of exceedences of thresholds in each of the years modelled.

The annual mean concentrations were multiplied by a factor accounting for the total number of operational hours in each year for each scenario i.e.:

- a factor of (270/2016) was applied to the individual testing output to represent the 60 engines being tested for 15 minutes in two quarters and for two hours in alternating quarters, out of the total modelled working hours (0900 to 1700 on weekdays, excluding bank holidays);

[25] Where designated sites are situated outside of the Application Site boundary, the distance and direction are for the closest point of the designated site from the Application Site.
[26] Qualifying features relate to internationally designated sites: Special Protection Areas (SPA), Special Areas of Conservation (SAC), Ramsar wetlands, potential SPA and candidate SAC sites. (Data site accessed July 2019).
[27] SSSI Citation: Natural Resources Wales https://naturalresources.wales/media/640899/SSSI_0341_Citation_EN0014d9a.pdf
SINC citations: Newport Local Development Plan 2011-2026 http://www.newport.gov.uk/documents/Planning-Documents/LDP-2011-2026/Sites-of-Importance-in-Nature-Conservation-(SINC)-January-2013.pdf

- a factor of (20/2016) was applied to the black building output to represent the ten cells of engines each of which are tested twice a year, out of the total modelled working hours (0900 to 1700 on weekdays, excluding bank holidays)[28];
- a factor of (24/8760) was used in the emergency scenario to represent a hypothetical full power outage lasting 24 hours out of the total modelled hours in a year;

To estimate the daily mean concentrations of NO_x, PM_{10} and VOCs for comparison to human health criteria:

- for the individual testing, the assumption was the engines were tested continuously in all eight hours in a working day throughout the five year model run and the maximum result reported. No factor was applied in the post processing of the results;
- for the black building testing, the engines were treated as operational for 15 minutes in all eight hours of the working days throughout the five year model run and the maximum result reported. No factor was applied in the post processing of the results;
- for the emergency scenarios, the maximum modelled hourly concentrations were divided by 24 to give a conservative estimate of the daily average concentration associated with one hour of a full power outage.

For the CO eight hour mean, no factoring was applied so the result presented is the highest eight hour period average in a five year model run for the least favourable engine or cell of engines.

The approaches represent very robust assumptions regarding the number of operational hours under each of these regimes.

3.9. Sensitivity

All dispersion modelling studies have inherent areas of uncertainty, including:

- Input data (activity data, emission rates);
- Simplifications in model algorithms and empirical relationships that are used to simulate complex physical and chemical processes in the atmosphere;
- Background concentrations; and
- Meteorological data.

Uncertainty in the modelling and associated sensitivity in the output concentrations has been addressed in the following ways:

- Uncertainty associated with engine emissions data has been minimised by undertaking modelling at the manufacturer's guaranteed emission rate for the maximum engine load (100% PRP) and for oxides of nitrogen, at the MCPD emission concentration in all hours, without load shedding.
- Uncertainty associated with model algorithms and empirical relationships have been minimised by the latest version of a regulatory dispersion model (AERMOD) that has been extensively and independently validated and is accepted by the regulator for use in permitting.
- The 2019 annual mean NO_2 concentration measured at the urban background AURN monitoring station in Newport was used in preference to DEFRA background maps which gave a more conservative estimate of the 2021 background concentrations at the site.
- The maximum results from five years of hourly sequential meteorological data were used to calculate process contributions. The meteorological data were provided by an approved supplier and subject to robust quality checks. The key limiting assumption is that conditions in the future will be the same as in the past; however, in reality no two years are the same. To address some of this uncertainty, the short-term model results were presented for the maximum in the five year dataset and all possible operational hours were modelled.
- To account for uncertainty associated with the potential timing of engine operation, the results of the air quality assessment are based on the maximum hourly, eight hourly and daily average pollutant concentrations. This assumes that testing/emergency operation of engines coincides with the least favourable hour(s) of meteorological data in a five year dataset. The maximum

[28] Note, a variable emission factor of 0.25 was applied within the model for the cell testing, to reflect the fact that there is only one such test in any working hour, therefore in determining the annual mean, the total number of hours (20) of testing is required, rather than total test duration. This differs to the individual cell testing in which 15 minute tests may be consecutive within an hour.

values reported represent the single engine, or cell, that gives the highest ground level concentration at a sensitive receptor. There will in fact be a wide range of hourly results below the maximum presented, at each modelled receptor and for each engine.

4. Human health assessment

The following sections describe the results for the assessment of impacts on human health. The focus is on nitrogen dioxide, with a short description of the pattern of dispersion, and a discussion of the results at the closest sensitive receptors. Results for other pollutants are also presented and briefly discussed.

4.1. Nitrogen dioxide

The maximum modelled process contributions (PC) at selected receptors for nitrogen dioxide are summarised in Table 4-1 for the hourly and annual mean for individual engine and black building (cell) testing.

Table 4-1 - Maximum nitrogen dioxide process contributions at sensitive receptors, µg/m^3

I.D.	Receptor	Hourly mean		Annual mean^	
		Individual testing	Cell testing	Individual testing	Cell testing
1	47 Powis Close	9.1	13.4	0.02	<0.01
2	18 Pencarn Ave	8.9	13.0	0.01	<0.01
3	Celtic Springs	9.7	14.4	0.01	<0.01
4	Teddies Nursery	6.8	10.1	<0.01	<0.01
5	11 Pencarn Ave	8.0	11.9	0.01	<0.01
6	24 Pencarn Ave	7.7	11.4	0.01	<0.01
7	2 Sir Briggs Ave	8.8	12.9	0.01	<0.01
8	95 Edmundsbury	11.6	17.3	0.04	<0.01
9	Tredegar House	5.6	8.3	<0.01	<0.01
10	St Joseph's	4.5	6.6	0.01	<0.01
11*	Imperial Way	7.5	11.1	-	-
12*	Imperial Courtyard	17.5	25.5	-	-
Field max		17.5	45.1	0.16	0.02

** Location not relevant for annual mean exposure*

^ Results factored for anticipated total number of hours of testing in a year

4.1.1. Individual engine testing

4.1.1.1. Maximum hourly mean

The maximum modelled hourly mean nitrogen dioxide process contribution for the planned testing of individual engines at CWL13 is 17.5 µg/m^3 at Receptor 12 (non-residential property in Imperial Courtyard); this result is associated with engine no.6 serving data hall number 9 (DH9) and is less than 10% of the AQS standard of 200 µg/m^3. This is the maximum result in a five year meteorological data set, so is a very robust finding.

A concentration isopleth (contour) plot for the maximum modelled hourly mean nitrogen dioxide concentrations is presented in Figure 4-1 to illustrate the pattern of dispersion across the study area. The plotted concentrations depict the maximum result assuming continuous testing in all working hours of the year; each engine is only planned to be tested in this way for up to five hours per year.

The results for nitrogen dioxide for individual engines demonstrate that none of the 60 additional engines, when combined with a 40 µg/m^3 background contribution, would result in an exceedance of the 200 µg/m^3 air quality standard at any of the modelled sensitive receptors.

Statistical analysis to determine compliance of CWL13 with the hourly mean AQS is not required.

Cumulative Impacts

A feasibility study was undertaken previously to understand the potential for cumulative impacts of the CWL13 individual (and cell) testing should it needed to be undertaken concurrently with routine testing at CWL11/12. The study used an earlier design for CWL13, but one which differs only marginally to that modelled in this assessment for the permit application. The differences are not a key consideration in determining the potential for plumes to interact, given the distance between the two facilities. Core parameters such as stack height are unchanged. An earlier AERMOD version was used, however, the main model algorithm is unchanged.

The findings of the study are presented in Appendix C. The study clearly demonstrates the very limited potential for emissions from CWL11/12 to combine with those of CWL13 during coincident testing and thus routine testing at the two facilities at the same time is extremely unlikely to result in additional exceedences of the AQS objective compared to testing at CWL11/12 alone.

4.1.1.2. Annual mean

The maximum annual mean nitrogen dioxide process contribution resulting from a single CWL13 engine assuming continuous testing in all working hours throughout the year is 0.3 µg/m^3, at Receptor 8 (a residential property on Edmundsbury Road, approximately 250 metres east of CWL13).

CWL13 planned hours of testing for individual engines total 270 hours per year or around 10% of working hours. This gives a factored annual mean of 0.04 µg/m^3 at Receptor 8, a negligible increment in the context of the AQS objective.

With a background concentration of 20 µg/m^3, and the similarly very small process contribution from cell testing (see Section 4.1.2.2), the predicted environmental concentration (PEC) will continue to be comfortably below the AQS objective of 40 µg/m^3.

4.1.2. Black building test

4.1.2.1. Maximum hourly mean

The maximum hourly mean nitrogen dioxide process contribution for a 15 minute black building test is 25.5 µg/m^3 at Receptor 12 (non-residential property in Imperial Courtyard to the east). This maximum result is associated with engine cell DH9 and it represents the highest modelled hourly concentration from all working hours in a five year meteorological dataset.

An isopleth (contour) plot is presented in Figure 4-2 to illustrate the pattern of dispersion across the study area.

The maximum hourly concentrations (including background, i.e. PEC) at any receptor is 65.5 µg/m^3 i.e. well below the AQS standard of 200 µg/m^3 for hourly mean NO_2.

As there are no PEC above 200 µg/m^3 no further analysis is required to determine compliance with the hourly mean AQS objective.

Cumulative Impacts

A feasibility study was undertaken at early design stage to understand the potential for cumulative impacts of the CWL13 cell testing if undertaken concurrently with black building tests at CWL11/12.

The test demonstrated that concurrent cell testing on CWL13 would not result in significant cumulative impacts. Although the study is based on a previous version of the modelling, the core parameters included are still valid and so are its conclusions. Details of the study are presented in Appendix C.

4.1.2.2. Annual mean

The maximum annual mean nitrogen dioxide process contribution resulting from a CWL13 cell test in all working hours throughout the year is 0.4 µg/m^3, at Receptor 8.

The total number of hours within which cell testing is planned is just 20 per year, or less than 1% of all working hours. This gives a factored annual mean of less than 0.01 µg/m^3, a negligible increment. With a background concentration of 20 µg/m^3, the PEC is well below the AQS objective of 40 µg/m^3, even if combined with the contribution from individual engine testing.

Figure 4-1 - Maximum modelled hourly mean nitrogen dioxide concentrations (µg/m³) - DH9 individual engine testing

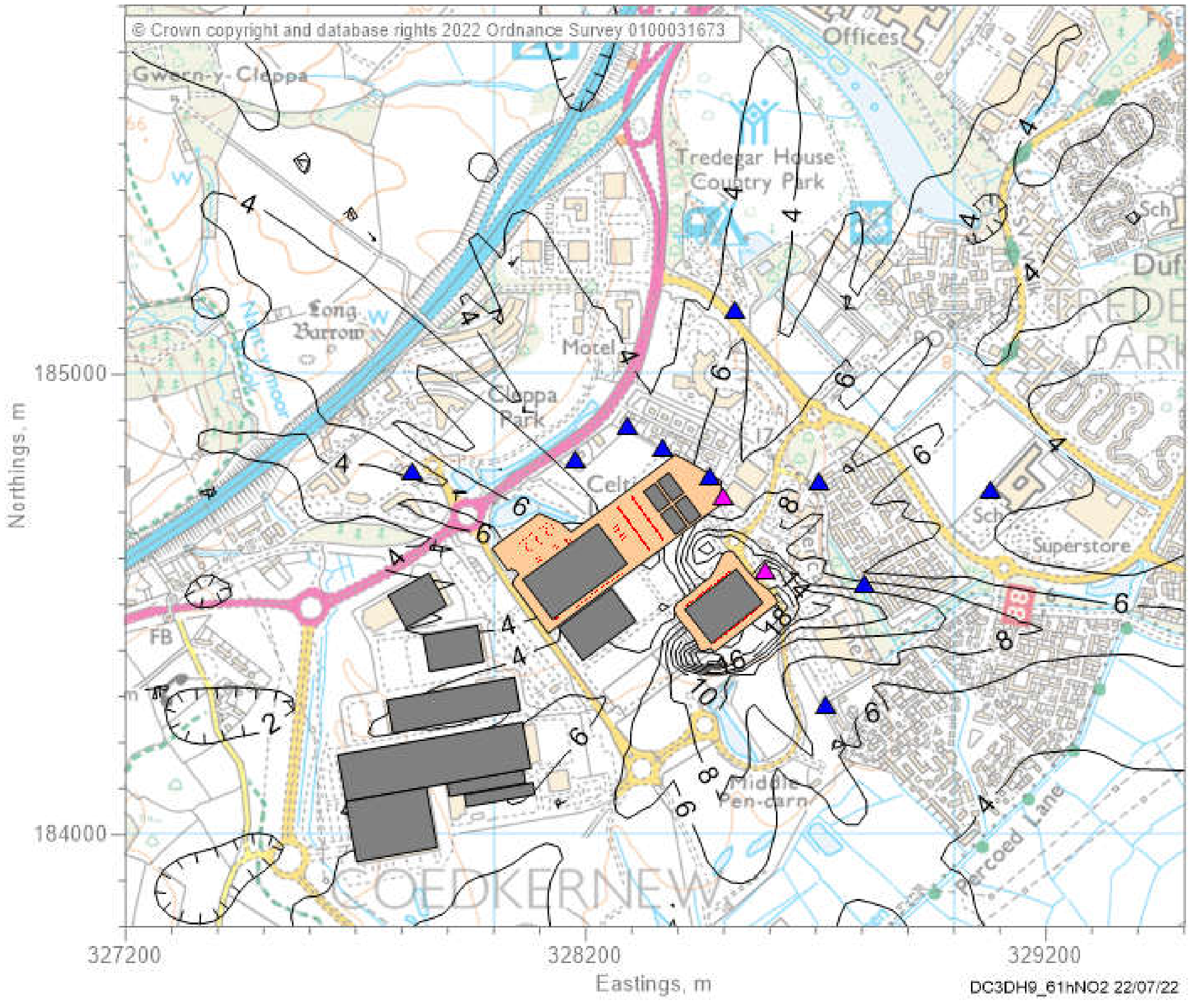
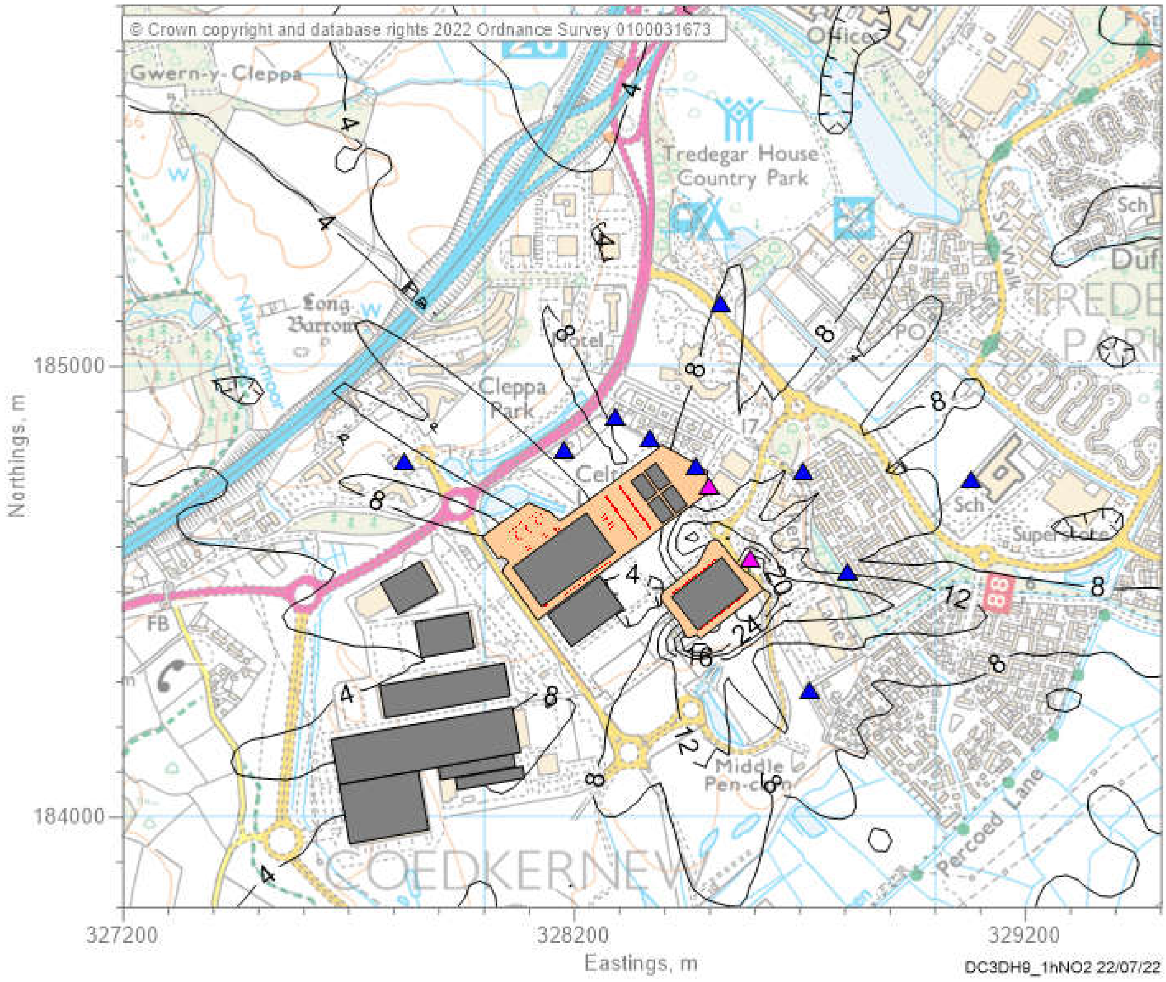


Figure 4-2 - Maximum modelled hourly mean nitrogen dioxide concentrations (µg/m³) - DH9 cell testing



4.1.3. Emergency scenario

The maximum hourly mean nitrogen dioxide PEC (total including background) and counts of modelled exceedences of the AQS hourly mean standard per calendar year for a hypothetical, continuous outage of all CWL13 engines, are presented in Table 4-2.

Table 4-2 - Emergency scenario for CWL13 - hypothetical full continuous outage

I.D.	Receptor	Max hourly NO_2 PEC. µg/m^3	Number of modelled hours with PEC above 200 µg/m^3				
			2011	2012	2013	2014	2015
1	47 Powis Close	423	211	300	309	240	220
2	18 Pencarn Ave	566	146	132	122	159	143
3	Celtic Springs	519	84	62	59	77	64
4	Teddies Nursery	392	10	9	11	14	11
5	11 Pencarn Ave	**696**	194	171	145	221	163
6	24 Pencarn Ave	515	118	74	87	96	90
7	2 Sir Briggs Ave	523	103	83	57	99	75
8	95 Edmundsbury	387	142	120	100	122	109
9	Tredegar House	447	53	35	36	50	45
10	St Joseph's	351	13	15	15	9	11
11	Imperial Way	684	208	177	157	239	186
12	Imperial Courtyard	641	**2714**	2470	1958	2523	2581

The maximum hourly mean PEC as nitrogen dioxide is 696 µg/m^3 at Receptor 5 (11 Pencarn Ave, to the north east); this is well below the AEGL-1 threshold of 940 µg/m^3, the most appropriate human health criterion for infrequent emergency outages.

The maximum hourly mean concentrations are classified as "high" or "very high" according to the DAQI (see descriptors in Table 2-2) at all receptor locations except Receptor 10 ("moderate"). This represents the least favourable hour of meteorological data in over 43,000 modelled hours

The maximum hourly mean PECs at all receptors exceed the AQS standard of 200 µg/m^3. The maximum number of exceedances of the standard is found at Receptor 12 (non-residential property in Imperial Courtyard). This finding assumes continuous operation of a full outage throughout the year and is purely to serve for the statistical analysis (presented below in Section 4.1.3.2).

4.1.3.1. Cumulative emergency scenario

As a sensitivity check for cumulative impacts, a full outage of CWL13 was modelled in combination with a full outage at CWL11/12. The findings are presented in Appendix D. The highest PEC as NO_2 is 5,987 µg/m^3 at Receptor 7 (2 Sir Briggs Ave), which is the same as for CWL11/12 alone, demonstrating that in this worst case, CWL13 does not contribute to the highest result in five years. The greatest change with CWL13 in combination with CWL11/12 is a 6% increase in the maximum hourly NO_2 PEC at Receptor 1 (47 Powis Close). The maximum theoretical number of exceedances is modelled at Receptor 12 (non-residential property in Imperial Courtyard) and this increases from 3,722 to 5,036 with CWL13 due to proximity to the new facility. The statistical significance of this increase is explored below in Section 4.1.3.2).

4.1.3.2. Hypergeometric mean

The number of exceedances of the short-term AQS standard and the AEGL-1 threshold in each year at the modelled sensitive receptors for a full emergency outage, assuming a hypothetical continuous outage throughout the year is presented in Table 4-3.

Between 9 and 2,714 hours were found to exceed 200 µg/m^3 (as PEC) in a single year for CWL13 only, between 551 and 3,722 hours for CWL11/12 only and between 647 and 5,036 hours in combination.

These are theoretical exceedences for a hypothetical, continuous full site outage in each scenario, are intended to inform a statistical analysis of the probability of exceedance occurring based on a more realistic (but still highly unlikely) total duration of emergency outages in a year.

Table 4-3 - Range of exceedences of NO_2 hourly thresholds in a full outage scenario (all modelled hours in a year, all engines concurrently operating)

	CWL13 only				CWL11/12				CWL11/12 + CWL13			
	> 200		> 940		> 200		> 940		> 200		> 940	
Year	min	max	min	max	min	max	min	max	min	max	min	max
2011	10	2714	0	0	621	3618	113	2122	731	4957	120	2128
2012	9	2470	0	0	568	3722	84	1922	656	5036	93	1931
2013	11	1958	0	0	551	3100	72	1412	647	4296	81	1420
2014	9	2523	0	0	703	3168	99	1768	828	4630	105	1777
2015	11	2581	0	0	635	3521	89	1976	726	4972	96	1982

The hypergeometric mean calculation for each scenario is presented in Table E-3 in Appendix E and summarised here for a full emergency outage totalling 24 hours per year:

- For CWL13 in isolation
  - The probability of exceeding the AQS objective at a residential receptor (Receptor 1) is <0.0001%
  - The probability of exceeding the AQS objective at a non-residential receptor is 0.0004%
- For CWL11/12 in isolation
  - The probability of exceeding the AQS objective at a residential receptor (Receptor 5) is 0.002%
  - The probability of exceeding the AQS objective at a non-residential receptor is 0.07%
- For CWL13 in combination with CWL11/12
  - The probability of exceeding the AQS objective at a residential receptor (Receptor 5) is 0.007%
  - The probability of exceeding the AQS objective at a non-residential receptor is 5.72%

These results at the modelled residential receptors indicate that it is very unlikely there would be an exceedence of the AQS objective with 24 hours of outages in a year, as the hypergeometric mean is substantially below 5% (the indicative threshold for likely exceedences given in Environment Agency guidance for specified generators[29]).

The results are interpreted using statistical analysis and in the context of information on the notional frequency of power outages. The probability of values above the air quality standard, as reported for the above example emergency scenarios, arising is approaching zero at residential receptors.

The hypergeometric mean is marginally above 5% (5.72%) at a non-residential receptor with operation of CWL13 in combination with CWL11/12. The Environment Agency guidance indicates that for a probability more than or equal to 5% "*there is the potential for exceedances and the regulator will consider if acceptable on a case by case basis*". Given the unlikely nature of an emergency two hour outage occurring in the first place (i.e. a 1 in 20 year event), and that longer duration or repeated events are even more unlikely, this result is considered to overstate the probability of an AQS objective exceedance.

The maximum modelled hourly mean NO_2 concentrations (PC) and the number of exceedances for the years giving the worst case results for three scenarios are presented in form of contour plots in Figure D-1 to Figure D-6 in Appendix D.

[29] https://www.gov.uk/guidance/specified-generators-dispersion-modelling-assessment

4.1.3.3. Acute exposure guidelines

For the modelling of emergency outages, it is assumed that all CWL13 engines would be running at 100% load, for a hypothetical scenario in which the outage occurs in all hours in a year. The modelling identified that there are some meteorological conditions that could result in hourly mean NO_2 concentrations above the AQS objective of 200 µg/m^3. Consideration is therefore given to the US EPA AEGLs which provide thresholds for non-disabling and disabling effects at human health receptor locations[30]. No exceedences were modelled of the AEGL-2, which represents the threshold for disabling effects, in either scenario.

The number of hours above the AEGL-1 threshold in each modelled year at the selected sensitive receptors for the three emergency scenarios (CWL13, CWL11/12 and CWL11/12/13) are presented in Table 4-3. The results are shown graphically in Figure 4-3 and Figure 4-4 for CWL11/12 and CWL11/12/13 respectively, for the year giving the highest number of exceedences at a receptor (2011).

No exceedances of the AEGL-1 as an hourly mean were modelled for a full outage affecting the 60 CWL13 engines in isolation. (Note that average concentrations would be lower than the maximum hourly, should an exceedence continue over a longer time period).

In line with previous modelling for the CWL11/12 permit application, exceedences were found for the CWL11/12 facility for a full site outage affecting this facility alone. As such, exceedences were also modelled with CWL13 in combination. Between 72 and 2,122 hours were modelled above the 940 µg/m^3 threshold (as the NO_2 PEC) in the years 2011 to 2015 for CWL11/12 alone, and between 81 and 2,128 for CWL11/12/13 for a hypothetical continuous emergency outage. The results indicate the very minor contribution due to the operation of CWL13 in combination, which adds 6 to 9 exceedances (i.e. less than 1% of the total number) compared to the continuous emergency operation of CWL11/12 alone.

Mitigation

There are two independent connections to separate grid supply for the site, which provide a built in fail safe system. As provided in Section 3.4.2, grid reliability is extremely good, and there have to date been no LOOP outages at CWL11 which have required all engines to operate in a full emergency situation since it began operating.

As well as the measures described above that limit the potential for a grid failure to affect the site, Vantage has an air quality management plan (AQMP) in place for CWL11 and this has been updated to reflect the expanded CWL11/12 facility and will be regularly reviewed thereafter.

The plan describes the process that would be followed in the event of an emergency, depending on the risk (which is based on the likelihood of exceedences according to time of day, season and prevailing wind speed and direction; and the severity of the incident, which is linked to the number of cells or engines operational after an outage lasting two hours).

Although CWL11/12 and CWL13 will be operated separately, Vantage will ensure that there is coordination and cooperation between the two permitted facilities in the event of an emergency outage. The CWL11/12 AQMP will be updated, if found necessary in consultation with NRW, once the CWL13 permit has been determined, to ensure actions to be taken to protect human health in the event of emergency operation consider the potential for cumulative impacts across the two facilities.

[30] https://www.epa.gov/aegl/nitrogen-dioxide-aegl-program

Figure 4-3 - 2011 AEGL-1 Exceedances, CWL11/12

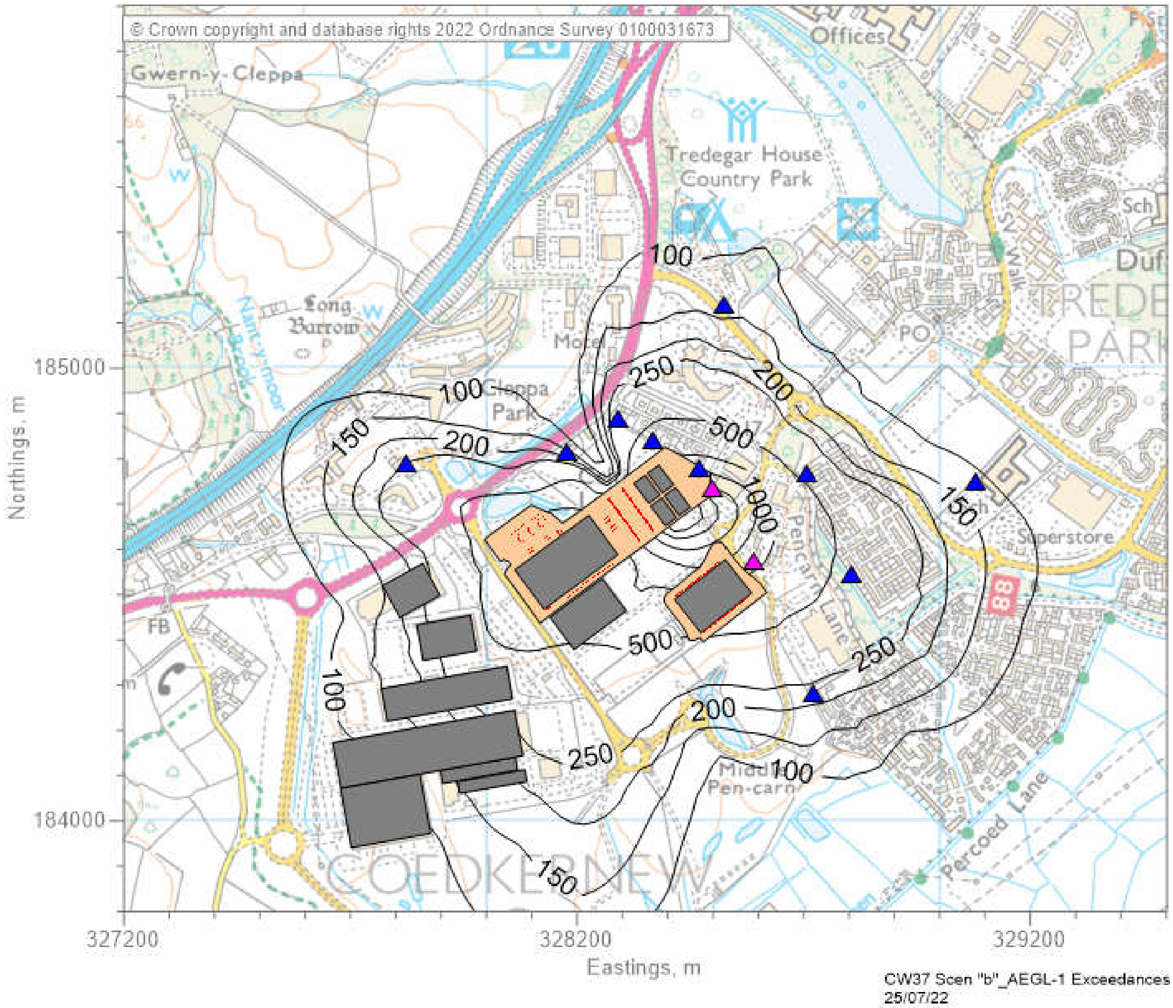
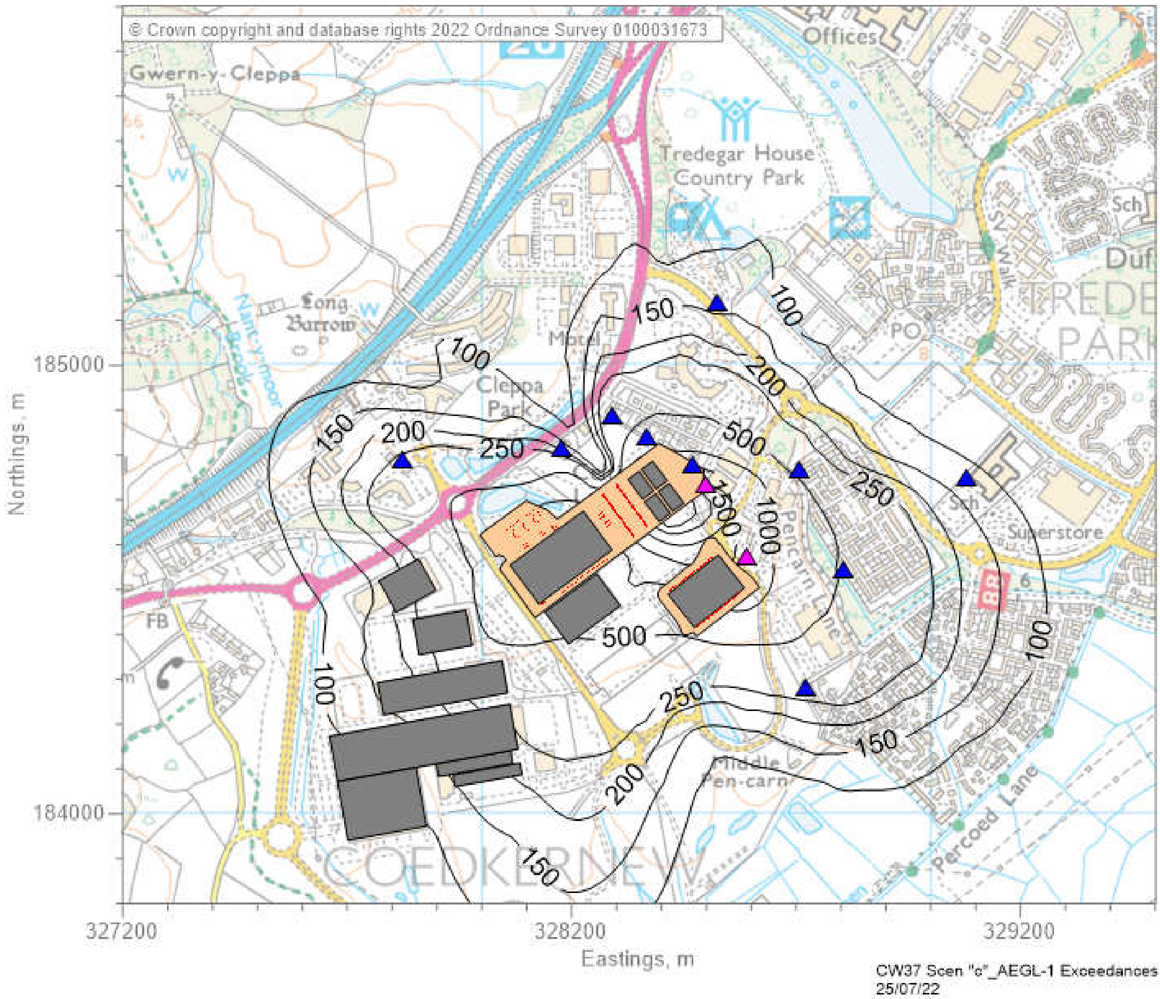


Figure 4-4 - 2011 AEGL-1 Exceedances, CWL11/12 + CWL13



4.2. Other pollutants

4.2.1. Carbon monoxide, particulate matter and VOCs

The maximum process contributions for individual engine testing, black building tests and emergency operation, for CWL13 are presented in Table 4-4 for CO, PM and VOCs. All the highest results for testing were found at Receptor 12, a non-residential property immediately to the east of CWL13 in Imperial Courtyard. For emergency the highest results were at Receptor 5 (Pencarn Avenue) for the hourly and 24 hourly means and at Receptor 12 for the eight hourly and annual means

These results demonstrate that, even for the maximum result in a five year dataset, the air quality objectives for human health are met at modelled receptors under all testing scenarios for CO, PM and VOCs (as benzene).

Table 4-4 – Maximum modelled process contributions (µg/m^3), all other pollutants

Pollutant	Averaging period	Individual		Black building		Emergency	
		Max PC	PC as % of EAL	Max PC	PC as % of EAL	Max PC	PC as % of EAL
CO	1 hour	66.8	0.2	97.2	0.3	2499	8.3
	8 hour	35.2	0.4	52.4	0.5	1333	13.3
PM_{10}	24 hour^	0.7	1.4	1	2.1	5.4	10.8
	Annual *	0.02	<0.1	<0.01	<0.1	0.05	0.1
$PM_{2.5}$	Annual*	0.02	0.1	<0.01	<0.1	0.05	0.2
VOCs as benzene	24 hour^	0.2	0.7	0.3	1	1.6	5.4
	Annual*	<0.01	0.1	<0.01	<0.1	0.01	0.3
SO_2	1 hour	0.05	<0.1	0.07	<0.1	1.7	0.5
	15 min	0.06	<0.1	0.09	<0.1	2.3	0.9
	24 hour^	0.03	<0.1	0.04	<0.1	0.2	0.2

^ daily mean for the emergency scenario calculated using the maximum hourly concentration divided by 24.

* *Annual mean factored to represent number of hours' testing or emergency operation in a year as described in Section 3.8.*

4.2.2. Sulphur dioxide

The maximum sulphur dioxide process concentrations were derived for the individual engine and cell that gave the highest oxides of nitrogen concentration at a sensitive receptor. The results are included in Table 4-4. For example, applying the derived ratio of SO_2 to NO_x emission rates, based on the anticipated 0.001% fuel sulphur content, this gives a maximum hourly SO_2 PC of 0.05 µg/m^3 for a single engine test. Factoring this result by the peak to mean factor suggested by DEFRA[22], 1.34, for the 15 minute mean gives a PC of 6 µg/m^3 for individual testing

All values are very much lower than the AQS standards for sulphur dioxide of which a number of exceedences are allowed each year.

Even if the upper value of fuel sulphur content of 0.1% is applied to estimate the maximum hourly SO_2 concentration in an emergency scenario, this gives 344 µg/m^3 i.e. less than the 350 µg/m^3 criterion during the least favourable dispersion conditions in the five year modelled period (approximately 43,000 hours).

These results demonstrate that even for the maximum result in a five year dataset, there is a negligible risk of the short-term sulphur dioxide air quality objectives for human health being exceeded at sensitive receptors under any of the testing scenarios.

5. Ecological impacts

5.1. Oxides of nitrogen

The results for oxides of nitrogen as shown in Table 5-1 are the highest modelled results (PCs) at each of the designated ecological sites for the testing of individual engines and cells of engines, and for a hypothetical emergency outage at CWL13 affecting all engines. The probability of these results, taken from a five year dataset, occurring given the infrequent testing or emergency operation of the engines, is highly remote.

Table 5-1 - Daily and annual mean oxides of nitrogen concentrations (µg/m^3) for CWL13

Receptor ID	Daily mean PC			Annual mean PC*		
	Individual	Cell	Emergency^	Individual	Cell	Emergency
A	2.9	4.2	43	0.04	<0.01	0.2
B	1.0	1.5	44	<0.01	<0.01	<0.1
C	0.5	0.7	30	<0.01	<0.01	<0.1
D	0.6	0.9	36	<0.01	<0.01	<0.1
E	0.5	0.7	31	<0.01	<0.01	<0.1
F	1.2	1.7	46	<0.01	<0.01	<0.1
G	0.8	1.2	39	<0.01	<0.01	<0.1
H	1.5	2.2	38	0.01	<0.01	<0.1
I	0.2	0.3	16	<0.01	<0.01	<0.1
J	0.1	0.1	5	<0.01	<0.01	<0.1
K	1.9	2.8	52	0.01	<0.01	<0.1
L	4.0	6.0	43	0.01	<0.01	0.1

^ The daily mean results for testing scenarios have not been factored, while for emergency operation the result is based on the maximum hourly mean divided by 24.

**Annual mean results were factored by the total number of hours in each operational mode as described in Section 3.8.*

5.2. Daily mean

An assessment has been undertaken for comparison to the non-statutory daily average guideline for the protection of vegetation of 75 µg/m^3 oxides of nitrogen (a conservative choice, compared to using the higher value of 200 µg/m^3 for low pollution areas).

5.2.1. Individual engine testing

The maximum modelled daily hourly mean oxides of nitrogen process contribution (assuming continuous running of a single engine for eight hours in a working day) at a designated ecological site for individual engine testing is 4.0 µg/m^3. This maximum result, modelled at receptor L (LG Duffryn Site 1/2 SINC) for cell DH3 engine 5, is less than 10% of the 75 µg/m^3 non-statutory criterion.

The daily average oxides of nitrogen concentrations are around a quarter of this value at the closest SSSI (receptor A) and an order of magnitude lower at the SPA and SAC (receptors I and J).

5.2.2. Black building test

The maximum modelled 24 hour mean at any designated ecological site for CWL13 cell testing (without factoring for there only being one 15 minute cell test per working day) is 6 µg/m^3 at receptor K (the LG Duffryn LWS) for cell DH3, which is less than 10% of the 75 µg/m^3 non-statutory criterion.

The daily average oxides of nitrogen concentrations are 30% lower at the closest SSSI (receptor A) and an order of magnitude lower at the SPA and SAC (receptors I and J).

5.2.3. Emergency scenario

This scenario represents an outage coinciding with the least favourable hours of meteorological data in a five year modelled period, assuming concurrent operation of all engines as if in the first hour of grid failure mode; such an emergency outage is considered to be a one in twenty year event.

The contribution to daily mean NOx at the closest ecological sites was estimated using a very conservative approach, taking the maximum modelled hourly mean and dividing by 24 (an approach recommended by NRW for the CWL11 permit and subsequently adopted for CWL11/12 variation).

The results are shown in Table 5-2. The maximum modelled process contribution for the emergency operation of CWL13 in a five year modelled period, is 52 μgm^3, at receptor K (Celtic Springs LWS). This is below the 75 μg/m^3 non-statutory criterion.

Table 5-2 - Maximum modelled daily mean oxides of nitrogen concentrations (μg/m^3) for a hypothetical continuous emergency outage

ID	Receptor	CWL13	CWL11/12	CWL11/12+13
A	Gwent Levels St Brides SSSI	43	450	482
B		44	276	276
C	Ancient woodland	30	429	429
D	Ancient woodland	36	461	485
E	Ancient woodland	31	310	337
F	Ancient woodland	46	484	487
G	Ancient woodland	39	454	454
H	Ancient woodland	38	476	495
I	River SPA	16	241	254
J	River SAC	5	119	121
K	Celtic Springs LWS	52	455	455
L	LG Duffryn LWS	43	392	393

Cumulative impacts

A sensitivity test looking at the impact of an emergency outage at CWL13 concurrently with CWL11 and CWL12, and at the results for CWL11/12 alone, is also presented in Table 5-2. The maximum daily mean for the operation of CWL13 in combination with CWL11 and CWL12 is 495 μgm^3 at receptor H representative of ancient woodland, compared to 476 μgm^3 modelled at the same receptor for CWL11/12 alone. Although there is a negligible probability of such high results occurring, given the very low likelihood of a full site outage coinciding for a whole day comprising the hours with least favourable meteorological conditions in five years (see discussion in Section 4.1.3), the results show that the contribution of the operation of CWL13 to the cumulative impacts is minimal.

5.3. Annual mean

The relative importance of the long-term mean compared to the short-term mean in terms of ecological impacts is reflected in several studies which state that the UNECE Working Group on Effects strongly recommends the use of the annual mean value, as the long term effects of oxides of nitrogen are thought to be more significant than the short-term effects.

Long term impacts should not present a concern for data centre facilities as their engines are infrequently operated other than for planned testing. An estimate of annual mean oxides of nitrogen has nevertheless been made as well as consideration of impacts including nutrient nitrogen deposition. For the latter, a conservative approach has been taken using the maximum concentrations modelled at any of the ecological sites within a 10 km radius of the facility combined with the lowest relevant critical load.

5.3.1. Oxides of nitrogen

5.3.1.1. Individual test

The maximum process contribution to annual mean oxides of nitrogen for individual engine testing, assuming testing in all working hours of the year, is 0.31 µg/m^3 at the Gwent Levels SSSI (Receptor A). When factored to represent the 270 hours of planned testing of the 60 engines in a year, out of the 2,016 working hours in a calendar year, this gives 0.04 µg/m^3 or 0.1% of the critical level of 30 µg/m^3.

5.3.1.2. Black building test

The annual mean oxides of nitrogen concentration for black building testing, for the least favourable cell of engines, and assuming testing in all working hours of the year is 0.46 µg/m^3, at the Gwent Levels SSSI (Receptor A) . When factored to represent the total of 20 modelled hours in which cell tests are undertaken in a year, out of the 2,016 working hours in a calendar year, this gives 0.005 µg/m^3 or 0.01% of the critical level of 30 µg/m^3.

5.3.1.3. Emergency operation

The maximum annual mean oxides of nitrogen for the hypothetical emergency scenario of all CWL13 engines running at full load concurrently, in all hours of the year, is 71 µg/m^3 at the Gwent Levels St Brides SSSI. When factored for a theoretical 24 hours' full emergency outage in a year, this gives a PC of 0.2 µg/m^3 or 0.7% of the critical level of 30 µg/m^3.

Even if combined with the PCs from the planned testing regime, the annual mean process contribution would not exceed 1% of the critical level.

5.3.2. Nitrogen deposition

The lowest critical load for a relevant habitat identified on APIS (i.e. 3 kg/ha/yr for standing open water and canals, as relevant to the SSSI Gwent Levels) has been used in the assessment. The background nitrogen deposition rate for the grid square encompassing this site is 12.9 kg/ha/yr.

Using the AQTAG conversion rate of 0.144 for grassland, the nitrogen deposition rate is calculated as 0.006 kg/ha/yr, for individual testing and 0.0006 kg/ha/yr for cell testing. These rates are equivalent to 0.2% and 0.02% of the lowest identified critical load of 3 kg/ha/yr. The impacts of the annual testing regime on annual mean deposition rates are not significant.

For the emergency scenario, the oxides of nitrogen process contribution, factored for a 24 hour outage, gives a nitrogen deposition rate of 0.03 kg/ha/yr, equivalent to 0.9% of the lowest identified critical load of 3 kg/ha/yr or 0.2% of background for the Gwent Levels SSSI. The impacts of such a highly unlikely emergency operation (a 2 hour outage is a 1 in 20 year event) on annual mean deposition rates are not significant. For the process contribution to exceed 1% of the lowest identified critical load, this would require more than 25 hours of emergency operation of all engines annually, all coinciding with the least favourable meteorological conditions.

5.3.3. Acid deposition

No critical loads for acid deposition have been identified from APIS for the relevant habitats in the study area:

- For the Severn Estuary SPA, the Site Relevant Critical Loads (SRCL) tool states, "No expected negative impact on the species due to impacts on the species' broad habitat".
- For the River Usk SAC and Severn Estuary SAC, the SRCL tool states "Potential negative impact on species due to impacts on the species' broad habitat" but no critical loads are given.
- The Gwent Levels St Brides SSSI standing open waters habitat is reported on APIS as sensitive but has no associated critical loads for acid deposition to freshwater.
- General entries for broadleaved/mixed/yew woodland, coniferous woodland, acid grassland and coastal and floodplain grazing marsh similarly give no critical loads for acid deposition.

The maximum modelled PC for nitrogen deposition for black building and individual testing combined is equivalent to 0.0005 keq/ha/yr as N acid deposition, just 0.05% of the average background N acid deposition rate of 1 keq/ha/yr for the Gwent Levels SSSI. The impacts of the highly improbably emergency operation on annual mean acid deposition rates are not significant

The maximum modelled PC for nitrogen deposition for a 24 hour emergency outage (0.03 kg/ha/yr) is equivalent to 0.002 keq/ha/yr as N acid deposition, just 0.2% of the average background N acid deposition rate of 1 keq/ha/yr for the Gwent Levels SSSI. The impacts of the highly improbably emergency operation on annual mean acid deposition rates are not significant.

6. Summary and conclusions

An atmospheric dispersion modelling study of emissions from the standby emergency generators at the Vantage CWL13 facility in Newport, has been undertaken. The detailed assessment uses an internationally accepted atmospheric dispersion model, AERMOD, to evaluate the environmental impact on human health and ecological receptors.

The detailed modelling study has considered the planned testing of individual engines and cells of engines ("black building" tests), as well as an emergency outage scenario with all engines running concurrently. Results at the nearest sensitive receptors for human health and vegetation have been compared to air quality criteria.

The 60 diesel/HVO fuelled standby generators will be housed in individual containers and fitted with vertical stacks discharging one metre about the building height. SCR will be fitted to the exhausts and oxides of nitrogen will be reduced to less than 500 mg/Nm^3.

Overall, the routine testing of the individual engines and cells of engines at the CWL13 facility, is found not to be significant. No exceedences of the nitrogen dioxide hourly mean AQS objective were identified at sensitive human health receptors for the individual engine testing (planned or unplanned) and black building test scenarios. The contribution to NO_2 annual mean, when factored for the expected number of hours of testing in a year, is negligible.

The maximum modelled process concentrations of carbon monoxide, PM_{10}, VOCs and sulphur dioxide from CWL13 are less than one percent of relevant short and long air quality objectives at sensitive receptors, both for the testing of individual engines and of engine cells.

No exceedences of the non-statutory daily mean guideline for oxides of nitrogen for the protection of vegetation were identified at the closest designated ecological sites for the planned testing scenarios. The estimated contributions to annual mean critical levels, and critical loads for nitrogen and acid deposition, are very low even under the conservative assessment approach.

Hypothetical full emergency outage scenarios were modelled for CWL13 alone, and in combination with CWL11/12. The modelling shows that for a full outage of CWL13 there could be exceedences of the AQS standard for hourly NO_2 but the AEGL-1 for acute non-disabling health effects is not exceeded. For CWL13 in combination with CWL11/12, exceedances of both the hourly NO_2 AQS standard and the AEGL-1 could occur, were a full outage to coincide with the very least favourable hours of meteorological data for dispersion but the probability of this happening is extremely low. Calculations have shown that, even in the unlikely event of 24 hours of power outage in a year, the probability of an exceedance of the AQS objective for a cumulative outage across all sites is below 5% for sensitive locations. The contribution of the CWL13 facility to the hourly exceedances in a cumulative scenario is minimal when compared to the equivalent modelled results for CWL11/12, with a 0 to 6% modelled increase in the number of hourly NO_2 exceedances in combination.

The assessment demonstrates that there are no significant impacts on air quality due to the operation of the CWL13 facility alone, either during testing or an emergency scenario.

An AQMP is in place for the existing CWL11 facility and this has been updated to reflect the expanded CWL11 and CWL12 facility. This can be further updated, if required and in consultation with NRW, to reflect the low potential for cumulative impacts from CWL13 emissions and to ensure actions to be taken to protect human health in the event of an emergency are appropriate and robust.

Appendices

Appendix A. Meteorological Data

A.1. Windroses for Cardiff Airport 2011 to 2021

The air quality assessment has been undertaken using five years of meteorological data from 2011 to 2015. These years were chosen to retain consistency with the original permit application for CWL11 and the subsequent permit variation for CWL11/12.

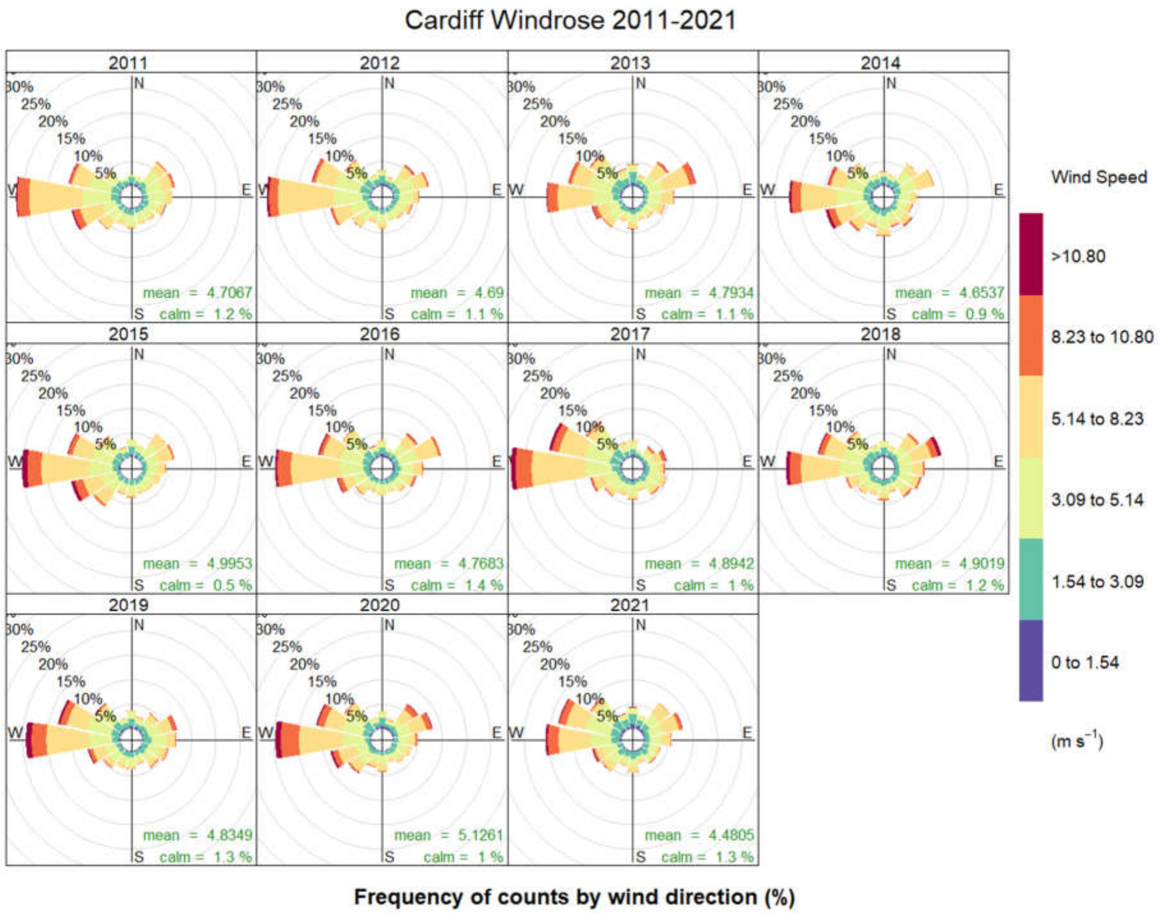
The Government online dispersion modelling guidance for industrial permitting states that a minimum of three years and a recommended five years of meteorological data should be used in a modelling study. It does not specify that these should be the five most recent years. Other important factors to consider when selecting data are the data quality and data capture rates, and how representative the meteorological station is of the site under assessment (based on proximity and the surrounding land use and terrain).

ADMLC guidance (https://admlc.com/model-guidelines) states that "*In general, multiple years of meteorological data should be used to ensure that year to year variations are taken into account. The UK national environmental regulatory bodies advise the use of five years of consecutive meteorological data for environmental impact assessments. In other circumstances and for low risk cases it may be acceptable to use data representing fewer years*".

Consideration has been given to whether a more recent dataset should be used. Figure A-1 shows the individual windroses for Cardiff Airport for the eleven year period from 2011 to 2021. It demonstrates that the prevailing wind directions are fairly consistent year on year, with a similarly high proportion of winds from the west and also the adjoining west north west sector in all cases, with a secondary prevailing wind from the east north east. The west to west north west direction is of particular interest to the study as this will tend to carry emissions towards the nearest sensitive receptors on Pencarn Avenue. The average windspeed is similar for both five year periods: between 4.6 and 5.0 m/s (2011 to 2015) and from 4.5 to 5.1 m/s (2016 to 2021).

The chances of the engine emissions testing or an emergency outage coinciding with the least favourable hours of meteorological data in any five year dataset are low. This remote possibility applies to any set of meteorological data chosen but particularly so for a non-continuous operation such as standby energy generation. On this basis, the use of more recent data is not anticipated to materially change the results presented for this permit application.

Figure A-1 - Windorses for Cardiff Airport, 2011-2021



Appendix B. Additional information

B.1. Engine cells and engine types

Table B-1 - Summary of CWL11/12 and CWL13 engine cells

Unit ID	Manufacturer	Model	Rating, MW_{th}	No. of engines
CWL11 existing				
GF1	Perkins	4006-23TAG3A	1.970	6
GF2	Perkins	4006-23TAG3A	1.970	4
GF14	MTU	12V1600G20F	1.457	5
GF19	MTU	12V1600G20F	1.457	8
GF20	MTU	12V1600G20F	1.457	8
GF21	MTU	12V1600G20F	1.457	8
GF24	Volvo	TWD1642GE	1.311	9
GF29	Volvo	TWD1642GE	1.311	9
TF1	Mitsubishi	S12R-F1PTAW2	3.226	5
TF2	Kohler	KD45V20-5DEP	2.987	5
TF3	Kohler	KD45V20-5DEP	2.987	5
TF4	Kohler	KD45V20-5DEP	2.987	5
CWL11 expansion*				
TF5	Kohler	KD45V20-5DES	2.240	5
MF1	Kohler	KD45V20-5DES	2.240	5
MF2	Kohler	KD45V20-5DES	2.240	5
MF3	Kohler	KD45V20-5DES	2.240	5
MF7	Kohler	KD45V20-5DES	2.240	5
MF8	Kohler	KD45V20-5DES	2.240	5
MF9	Kohler	KD45V20-5DES	2.240	5
TF9	Kohler	KD45V20-5DES	2.240	5
TF10	Kohler	KD45V20-5DES	2.240	5
TF11	Kohler	KD45V20-5DES	2.240	5
TF12	Kohler	KD45V20-5DES	2.240	5
TF13	Kohler	KD45V20-5DES	2.240	5
TF14	Kohler	KD45V20-5DES	2.240	5
CWL12*				
B1-GF	Kohler	KD45V20-5DES	2.240	5
B1-FF	Kohler	KD45V20-5DES	2.240	5
B1-SF	Kohler	KD45V20-5DES	2.240	5
B2-GF	Kohler	KD45V20-5DES	2.240	5
B2-FF	Kohler	KD45V20-5DES	2.240	5
B2-SF	Kohler	KD45V20-5DES	2.240	5
B3-GF	Kohler	KD45V20-5DES	2.240	5
B3-FF	Kohler	KD45V20-5DES	2.240	5

Unit ID	Manufacturer	Model	Rating, MW_{th}	No. of engines
B3-SF	Kohler	KD45V20-5DES	2.240	5
B4-GF	Kohler	KD45V20-5DES	2.240	5
B4-FF	Kohler	KD45V20-5DES	2.240	5
B4-SF	Kohler	KD45V20-5DES	2.240	5
CWL13				
DH1	Kohler	KD45V20-5DEP	2.987	6
DH2	Kohler	KD45V20-5DEP	2.987	6
DH3	Kohler	KD45V20-5DEP	2.987	6
DH4	Kohler	KD45V20-5DEP	2.987	6
DH5	Kohler	KD45V20-5DEP	2.987	6
DH6	Kohler	KD45V20-5DEP	2.987	6
DH7	Kohler	KD45V20-5DEP	2.987	6
DH8	Kohler	KD45V20-5DEP	2.987	6
DH9	Kohler	KD45V20-5DEP	2.987	6
DH10	Kohler	KD45V20-5DEP	2.987	6

* for CWL11 expansion and CWL12, the engine rating is set to 75% load

B.2. Engine locations

Table B-2 - Assigned engine stack locations

Engine	Description	X coordinate	Y coordinate	Permit ID
GF1_1	PERKINS 4006-23TAG3A	328098.5	184602.7	A1
GF1_2	PERKINS 4006-23TAG3A	328094.8	184600.3	A2
GF1_3	PERKINS 4006-23TAG3A	328091.3	184597.5	A3
GF1_4	PERKINS 4006-23TAG3A	328102.4	184597.4	A4
GF1_5	PERKINS 4006-23TAG3A	328098.7	184594.8	A5
GF1_6	PERKINS 4006-23TAG3A	328095.2	184592.3	A6
GF2_1	PERKINS 4006-23TAG3A	328135.4	184469.0	A20
GF2_2	PERKINS 4006-23TAG3A	328140.8	184473.1	A21
GF2_3	PERKINS 4006-23TAG3A	328132.4	184467.0	A22
GF2_4	PERKINS 4006-23TAG3A	328137.8	184470.8	A23
GF14_1	MTU 12V1600G20F	328142.0	184624.4	A7
GF14_2	MTU 12V1600G20F	328134.6	184627.8	A8
GF14_3	MTU 12V1600G20F	328138.5	184622.1	A9
GF14_4	MTU 12V1600G20F	328131.2	184625.6	A10
GF14_5	MTU 12V1600G20F	328135.5	184619.6	A11
GF19_1	MTU 12V1600G20F	328156.4	184640.7	A12
GF19_2	MTU 12V1600G20F	328158.2	184638.3	A13
GF19_5	MTU 12V1600G20F	328163.6	184631.3	A14
GF19_3	MTU 12V1600G20F	328159.8	184635.9	A15
GF19_4	MTU 12V1600G20F	328161.9	184633.6	A16
GF19_6	MTU 12V1600G20F	328164.5	184640.0	A17

Engine	Description	X coordinate	Y coordinate	Permit ID
GF19_7	MTU 12V1600G20F	328166.6	184637.7	A18
GF19_8	MTU 12V1600G20F	328168.3	184635.4	A19
GF20_1	MTU 12V1600G20F	328268.7	184670.7	A42
GF20_2	MTU 12V1600G20F	328272.9	184664.4	A43
GF20_3	MTU 12V1600G20F	328266.0	184668.6	A44
GF20_4	MTU 12V1600G20F	328270.4	184662.6	A45
GF20_5	MTU 12V1600G20F	328263.4	184667.0	A46
GF20_6	MTU 12V1600G20F	328268.1	184660.5	A47
GF20_7	MTU 12V1600G20F	328260.8	184664.9	A48
GF20_8	MTU 12V1600G20F	328265.8	184659.1	A49
GF21_1	MTU 12V1600G20F	328281.9	184652.8	A50
GF21_2	MTU 12V1600G20F	328286.7	184646.4	A51
GF21_3	MTU 12V1600G20F	328279.6	184650.7	A52
GF21_4	MTU 12V1600G20F	328284.2	184644.5	A53
GF21_5	MTU 12V1600G20F	328276.8	184648.8	A54
GF21_6	MTU 12V1600G20F	328281.6	184642.6	A55
GF21_7	MTU 12V1600G20F	328274.2	184646.8	A56
GF21_8	MTU 12V1600G20F	328279.0	184640.4	A57
GF24_1	VOLVO TAD 1642GE	328235.5	184535.9	A33
GF24_2	VOLVO TAD 1642GE	328240.8	184540.0	A34
GF24_3	VOLVO TAD 1642GE	328246.2	184544.0	A35
GF24_4	VOLVO TAD 1642GE	328251.5	184547.9	A36
GF24_5	VOLVO TAD 1642GE	328257.1	184552.0	A37
GF24_6	VOLVO TAD 1642GE	328262.3	184555.7	A38
GF24_7	VOLVO TAD 1642GE	328267.8	184559.9	A39
GF24_8	VOLVO TAD 1642GE	328272.8	184563.8	A40
GF24_9	VOLVO TAD 1642GE	328278.7	184567.7	A41
GF29_1	VOLVO TAD 1642GE	328180.0	184495.1	A24
GF29_2	VOLVO TAD 1642GE	328185.3	184498.8	A25
GF29_3	VOLVO TAD 1642GE	328193.1	184504.9	A26
GF29_4	VOLVO TAD 1642GE	328198.7	184508.9	A27
GF29_5	VOLVO TAD 1642GE	328204.2	184512.8	A28
GF29_6	VOLVO TAD 1642GE	328209.7	184516.8	A29
GF29_7	VOLVO TAD 1642GE	328215.0	184520.8	A30
GF29_8	VOLVO TAD 1642GE	328220.2	184524.6	A31
GF29_9	VOLVO TAD 1642GE	328225.4	184528.7	A32
TF1_1	MITSI S12R-F1PTAW2	328080.8	184616.8	A58
TF1_2	MITSI S12R-F1PTAW2	328075.5	184618.5	A59
TF1_3	MITSI S12R-F1PTAW2	328072.6	184621.7	A60
TF1_4	MITSI S12R-F1PTAW2	328070.0	184625.1	A61
TF1_5	MITSI S12R-F1PTAW2	328070.1	184631.1	A62
TF2_1	Kohler KD45V20	328102.8	184633.0	A63
TF2_2	Kohler KD45V20	328097.8	184634.7	A64

Engine	Description	X coordinate	Y coordinate	Permit ID
TF2_3	Kohler KD45V20	328094.7	184638.0	A65
TF2_4	Kohler KD45V20	328092.6	184641.9	A66
TF2_5	Kohler KD45V20	328092.7	184647.9	A67
TF3_1	Kohler KD45V20	328124.8	184649.2	A68
TF3_2	Kohler KD45V20	328119.8	184650.9	A69
TF3_3	Kohler KD45V20	328116.7	184654.2	A70
TF3_4	Kohler KD45V20	328114.6	184658.1	A71
TF3_5	Kohler KD45V20	328114.7	184664.1	A72
TF4_1	Kohler KD45V20	328055.4	184633.5	A73
TF4_2	Kohler KD45V20	328062.7	184638.9	A74
TF4_3	Kohler KD45V20	328069.8	184644.1	A75
TF4_4	Kohler KD45V20	328076.9	184649.3	A76
TF4_5	Kohler KD45V20	328083.8	184654.5	A77
CWL11 expansion				
TF5_1	Kohler KD45V20 @ 75%	328099.7	184663.9	A78
TF5_2	Kohler KD45V20 @ 75%	328106.9	184669.5	A79
TF5_3	Kohler KD45V20 @ 75%	328114.3	184674.6	A80
TF5_4	Kohler KD45V20 @ 75%	328125.4	184671.7	A81
TF5_5	Kohler KD45V20 @ 75%	328130.8	184664.5	A82
DC1MF1A	Kohler KD45V20 @ 75%	328270.0	184709.9	A83
DC1MF1B	Kohler KD45V20 @ 75%	328272.4	184706.8	A84
DC1MF1C	Kohler KD45V20 @ 75%	328274.7	184703.6	A85
DC1MF1D	Kohler KD45V20 @ 75%	328277.0	184700.4	A86
DC1MF1E	Kohler KD45V20 @ 75%	328279.3	184697.3	A87
DC1MF2A	Kohler KD45V20 @ 75%	328281.6	184694.1	A88
DC1MF2B	Kohler KD45V20 @ 75%	328284.0	184690.9	A89
DC1MF2C	Kohler KD45V20 @ 75%	328286.3	184687.8	A90
DC1MF2D	Kohler KD45V20 @ 75%	328288.6	184684.6	A91
DC1MF2E	Kohler KD45V20 @ 75%	328290.9	184681.5	A92
DC1MF3A	Kohler KD45V20 @ 75%	328293.2	184678.3	A93
DC1MF3B	Kohler KD45V20 @ 75%	328295.6	184675.1	A94
DC1MF3C	Kohler KD45V20 @ 75%	328297.9	184672.0	A95
DC1MF3D	Kohler KD45V20 @ 75%	328300.2	184668.8	A96
DC1MF3E	Kohler KD45V20 @ 75%	328302.5	184665.6	A97
DC1MF7A	Kohler KD45V20 @ 75%	328304.9	184662.5	A98
DC1MF7B	Kohler KD45V20 @ 75%	328307.2	184659.3	A99
DC1MF7C	Kohler KD45V20 @ 75%	328309.5	184656.2	A100
DC1MF7D	Kohler KD45V20 @ 75%	328311.8	184653.0	A101
DC1MF7E	Kohler KD45V20 @ 75%	328314.1	184649.8	A102
DC1MF8A	Kohler KD45V20 @ 75%	328316.5	184646.7	A103
DC1MF8B	Kohler KD45V20 @ 75%	328318.8	184643.5	A104
DC1MF8C	Kohler KD45V20 @ 75%	328321.1	184640.4	A105
DC1MF8D	Kohler KD45V20 @ 75%	328323.4	184637.2	A106

Engine	Description	X coordinate	Y coordinate	Permit ID
DC1MF8E	Kohler KD45V20 @ 75%	328325.7	184634.0	A107
DC1MF9A	Kohler KD45V20 @ 75%	328328.1	184630.9	A108
DC1MF9B	Kohler KD45V20 @ 75%	328330.4	184627.7	A109
DC1MF9C	Kohler KD45V20 @ 75%	328332.7	184624.5	A110
DC1MF9D	Kohler KD45V20 @ 75%	328335.0	184621.4	A111
DC1MF9E	Kohler KD45V20 @ 75%	328337.3	184618.2	A112
DC1TF9A	Kohler KD45V20 @ 75%	328271.3	184710.8	A113
DC1TF9B	Kohler KD45V20 @ 75%	328273.6	184707.6	A114
DC1TF9C	Kohler KD45V20 @ 75%	328275.9	184704.5	A115
DC1TF9D	Kohler KD45V20 @ 75%	328278.3	184701.3	A116
DC1TF9E	Kohler KD45V20 @ 75%	328280.6	184698.2	A117
DC1TF10A	Kohler KD45V20 @ 75%	328282.9	184695.0	A118
DC1TF10B	Kohler KD45V20 @ 75%	328285.2	184691.8	A119
DC1TF10C	Kohler KD45V20 @ 75%	328287.6	184688.7	A120
DC1TF10D	Kohler KD45V20 @ 75%	328289.9	184685.5	A121
DC1TF10E	Kohler KD45V20 @ 75%	328292.2	184682.4	A122
DC1TF11A	Kohler KD45V20 @ 75%	328294.5	184679.2	A123
DC1TF11B	Kohler KD45V20 @ 75%	328296.8	184676.0	A124
DC1TF11C	Kohler KD45V20 @ 75%	328299.2	184672.9	A125
DC1TF11D	Kohler KD45V20 @ 75%	328301.5	184669.7	A126
DC1TF11E	Kohler KD45V20 @ 75%	328303.8	184666.5	A127
DC1TF12A	Kohler KD45V20 @ 75%	328306.1	184663.4	A128
DC1TF12B	Kohler KD45V20 @ 75%	328308.4	184660.2	A129
DC1TF12C	Kohler KD45V20 @ 75%	328310.8	184657.1	A130
DC1TF12D	Kohler KD45V20 @ 75%	328313.1	184653.9	A131
DC1TF12E	Kohler KD45V20 @ 75%	328315.4	184650.7	A132
DC1TF13A	Kohler KD45V20 @ 75%	328317.7	184647.6	A133
DC1TF13B	Kohler KD45V20 @ 75%	328320.0	184644.4	A134
DC1TF13C	Kohler KD45V20 @ 75%	328322.4	184641.2	A135
DC1TF13D	Kohler KD45V20 @ 75%	328324.7	184638.1	A136
DC1TF13E	Kohler KD45V20 @ 75%	328327.0	184634.9	A137
DC1TF14A	Kohler KD45V20 @ 75%	328329.3	184631.8	A138
DC1TF14B	Kohler KD45V20 @ 75%	328331.6	184628.6	A139
DC1TF14C	Kohler KD45V20 @ 75%	328334.0	184625.4	A140
DC1TF14D	Kohler KD45V20 @ 75%	328336.3	184622.3	A141
DC1TF14E	Kohler KD45V20 @ 75%	328338.8	184619.1	A142
CWL12 expansion				
DC2B1GFA	Kohler KD45V20 @ 75%	328300.2	184732.1	A143
DC2B1GFB	Kohler KD45V20 @ 75%	328302.5	184728.9	A144
DC2B1GFC	Kohler KD45V20 @ 75%	328304.8	184725.8	A145
DC2B1GFD	Kohler KD45V20 @ 75%	328307.1	184722.6	A146
DC2B1GFE	Kohler KD45V20 @ 75%	328309.4	184719.4	A147
DC2B1SFA	Kohler KD45V20 @ 75%	328311.8	184716.3	A148

Engine	Description	X coordinate	Y coordinate	Permit ID
DC2B1SFB	Kohler KD45V20 @ 75%	328314.1	184713.1	A149
DC2B1SFC	Kohler KD45V20 @ 75%	328316.4	184710.0	A150
DC2B1SFD	Kohler KD45V20 @ 75%	328318.7	184706.8	A151
DC2B1SFE	Kohler KD45V20 @ 75%	328321.0	184703.6	A152
DC2B2FFA	Kohler KD45V20 @ 75%	328323.4	184700.5	A153
DC2B2FFB	Kohler KD45V20 @ 75%	328325.7	184697.3	A154
DC2B2FFC	Kohler KD45V20 @ 75%	328328.0	184694.1	A155
DC2B2FFD	Kohler KD45V20 @ 75%	328330.3	184691.0	A156
DC2B2FFE	Kohler KD45V20 @ 75%	328332.6	184687.8	A157
DC2B3GFA	Kohler KD45V20 @ 75%	328335.0	184684.7	A158
DC2B3GFB	Kohler KD45V20 @ 75%	328337.3	184681.5	A159
DC2B3GFC	Kohler KD45V20 @ 75%	328339.6	184678.3	A160
DC2B3GFD	Kohler KD45V20 @ 75%	328341.9	184675.2	A161
DC2B3GFE	Kohler KD45V20 @ 75%	328344.2	184672.0	A162
DC2B3SFA	Kohler KD45V20 @ 75%	328346.6	184668.8	A163
DC2B3SFB	Kohler KD45V20 @ 75%	328348.9	184665.7	A164
DC2B3SFC	Kohler KD45V20 @ 75%	328351.2	184662.5	A165
DC2B3SFD	Kohler KD45V20 @ 75%	328353.5	184659.4	A166
DC2B3SFE	Kohler KD45V20 @ 75%	328355.8	184656.2	A167
DC2B4FFA	Kohler KD45V20 @ 75%	328358.2	184653.0	A168
DC2B4FFB	Kohler KD45V20 @ 75%	328360.5	184649.9	A169
DC2B4FFC	Kohler KD45V20 @ 75%	328362.8	184646.7	A170
DC2B4FFD	Kohler KD45V20 @ 75%	328365.1	184643.5	A171
DC2B4FFE	Kohler KD45V20 @ 75%	328367.1	184640.7	A172
DC2B1FFA	Kohler KD45V20 @ 75%	328301.4	184732.9	A173
DC2B1FFB	Kohler KD45V20 @ 75%	328303.7	184729.7	A174
DC2B1FFC	Kohler KD45V20 @ 75%	328306.0	184726.6	A175
DC2B1FFD	Kohler KD45V20 @ 75%	328308.4	184723.4	A176
DC2B1FFE	Kohler KD45V20 @ 75%	328310.7	184720.3	A177
DC2B2GFA	Kohler KD45V20 @ 75%	328313.0	184717.1	A178
DC2B2GFB	Kohler KD45V20 @ 75%	328315.3	184713.9	A179
DC2B2GFC	Kohler KD45V20 @ 75%	328317.7	184710.8	A180
DC2B2GFD	Kohler KD45V20 @ 75%	328320.0	184707.6	A181
DC2B2GFE	Kohler KD45V20 @ 75%	328322.3	184704.5	A182
DC2B2SFA	Kohler KD45V20 @ 75%	328324.6	184701.3	A183
DC2B2SFB	Kohler KD45V20 @ 75%	328326.9	184698.1	A184
DC2B2SFC	Kohler KD45V20 @ 75%	328329.3	184695.0	A185
DC2B2SFD	Kohler KD45V20 @ 75%	328331.6	184691.8	A186
DC2B2SFE	Kohler KD45V20 @ 75%	328333.9	184688.6	A187
DC2B3FFA	Kohler KD45V20 @ 75%	328336.2	184685.5	A188
DC2B3FFB	Kohler KD45V20 @ 75%	328338.5	184682.3	A189
DC2B3FFC	Kohler KD45V20 @ 75%	328340.9	184679.2	A190
DC2B3FFD	Kohler KD45V20 @ 75%	328343.2	184676.0	A191

Engine	Description	X coordinate	Y coordinate	Permit ID
DC2B3FFE	Kohler KD45V20 @ 75%	328345.5	184672.8	A192
DC2B4GFA	Kohler KD45V20 @ 75%	328347.8	184669.7	A193
DC2B4GFB	Kohler KD45V20 @ 75%	328350.1	184666.5	A194
DC2B4GFC	Kohler KD45V20 @ 75%	328352.5	184663.3	A195
DC2B4GFD	Kohler KD45V20 @ 75%	328354.8	184660.2	A196
DC2B4GFE	Kohler KD45V20 @ 75%	328357.1	184657.0	A197
DC2B4SFA	Kohler KD45V20 @ 75%	328359.4	184653.9	A198
DC2B4SFB	Kohler KD45V20 @ 75%	328361.7	184650.7	A199
DC2B4SFC	Kohler KD45V20 @ 75%	328364.1	184647.5	A200
DC2B4SFD	Kohler KD45V20 @ 75%	328366.4	184644.4	A201
DC2B4SFE	Kohler KD45V20 @ 75%	328368.5	184641.5	A202
CWL13				
DC3DH9_1	Kohler KD45V20 100% +SCR	328417.3	184495.3	A1
DC3DH9_2	Kohler KD45V20 100% +SCR	328420.4	184497.9	A2
DC3DH9_3	Kohler KD45V20 100% +SCR	328423.4	184500.3	A3
DC3DH9_4	Kohler KD45V20 100% +SCR	328426.7	184502.7	A4
DC3DH9_5	Kohler KD45V20 100% +SCR	328429.9	184505.0	A5
DC3DH9_6	Kohler KD45V20 100% +SCR	328433.0	184507.4	A6
DC3DH7_1	Kohler KD45V20 100% +SCR	328439.4	184512.4	A7
DC3DH7_2	Kohler KD45V20 100% +SCR	328442.9	184514.7	A8
DC3DH7_3	Kohler KD45V20 100% +SCR	328445.7	184517.3	A9
DC3DH7_4	Kohler KD45V20 100% +SCR	328449.2	184519.8	A10
DC3DH7_5	Kohler KD45V20 100% +SCR	328452.0	184521.8	A11
DC3DH7_6	Kohler KD45V20 100% +SCR	328455.1	184524.5	A12
DC3DH5_1	Kohler KD45V20 100% +SCR	328458.3	184526.8	A13
DC3DH5_2	Kohler KD45V20 100% +SCR	328461.3	184529.3	A14
DC3DH5_3	Kohler KD45V20 100% +SCR	328464.5	184531.8	A15
DC3DH5_4	Kohler KD45V20 100% +SCR	328467.7	184534.3	A16
DC3DH5_5	Kohler KD45V20 100% +SCR	328470.7	184536.6	A17
DC3DH5_6	Kohler KD45V20 100% +SCR	328473.5	184539.2	A18
DC3DH3_1	Kohler KD45V20 100% +SCR	328479.9	184543.9	A19
DC3DH3_2	Kohler KD45V20 100% +SCR	328482.9	184546.2	A20
DC3DH3_3	Kohler KD45V20 100% +SCR	328486.0	184548.8	A21
DC3DH3_4	Kohler KD45V20 100% +SCR	328489.3	184551.2	A22
DC3DH3_5	Kohler KD45V20 100% +SCR	328492.4	184553.4	A23
DC3DH3_6	Kohler KD45V20 100% +SCR	328495.4	184556.1	A24
DC3DH1_1	Kohler KD45V20 100% +SCR	328498.3	184558.3	A25
DC3DH1_2	Kohler KD45V20 100% +SCR	328501.4	184560.9	A26
DC3DH1_3	Kohler KD45V20 100% +SCR	328504.6	184563.5	A27
DC3DH1_4	Kohler KD45V20 100% +SCR	328507.6	184566.1	A28
DC3DH1_5	Kohler KD45V20 100% +SCR	328510.7	184568.5	A29
DC3DH1_6	Kohler KD45V20 100% +SCR	328513.9	184571.1	A30
DC3D10_1	Kohler KD45V20 100% +SCR	328478.9	184416.8	A31

Engine	Description	X coordinate	Y coordinate	Permit ID
DC3D10_2	Kohler KD45V20 100% +SCR	328482.1	184418.9	A32
DC3D10_3	Kohler KD45V20 100% +SCR	328485.5	184421.5	A33
DC3D10_4	Kohler KD45V20 100% +SCR	328488.5	184423.9	A34
DC3D10_5	Kohler KD45V20 100% +SCR	328491.5	184426.6	A35
DC3D10_6	Kohler KD45V20 100% +SCR	328494.6	184428.9	A36
DC3DH8_1	Kohler KD45V20 100% +SCR	328501.3	184434.2	A37
DC3DH8_2	Kohler KD45V20 100% +SCR	328504.7	184436.1	A38
DC3DH8_3	Kohler KD45V20 100% +SCR	328507.5	184438.5	A39
DC3DH8_4	Kohler KD45V20 100% +SCR	328510.9	184441.6	A40
DC3DH8_5	Kohler KD45V20 100% +SCR	328513.6	184443.8	A41
DC3DH8_6	Kohler KD45V20 100% +SCR	328516.7	184446.1	A42
DC3DH6_1	Kohler KD45V20 100% +SCR	328520.0	184448.7	A43
DC3DH6_2	Kohler KD45V20 100% +SCR	328522.9	184450.8	A44
DC3DH6_3	Kohler KD45V20 100% +SCR	328526.4	184453.5	A45
DC3DH6_4	Kohler KD45V20 100% +SCR	328529.3	184455.9	A46
DC3DH6_5	Kohler KD45V20 100% +SCR	328532.5	184458.5	A47
DC3DH6_6	Kohler KD45V20 100% +SCR	328535.5	184460.8	A48
DC3DH4_1	Kohler KD45V20 100% +SCR	328541.6	184465.7	A49
DC3DH4_2	Kohler KD45V20 100% +SCR	328544.6	184468.0	A50
DC3DH4_3	Kohler KD45V20 100% +SCR	328547.4	184470.4	A51
DC3DH4_4	Kohler KD45V20 100% +SCR	328550.9	184472.8	A52
DC3DH4_5	Kohler KD45V20 100% +SCR	328553.8	184475.5	A53
DC3DH4_6	Kohler KD45V20 100% +SCR	328557.2	184477.8	A54
DC3DH2_1	Kohler KD45V20 100% +SCR	328560.2	184480.2	A55
DC3DH2_2	Kohler KD45V20 100% +SCR	328563.0	184482.9	A56
DC3DH2_3	Kohler KD45V20 100% +SCR	328566.2	184485.3	A57
DC3DH2_4	Kohler KD45V20 100% +SCR	328569.4	184487.6	A58
DC3DH2_5	Kohler KD45V20 100% +SCR	328572.5	184490.1	A59
DC3DH2_6	Kohler KD45V20 100% +SCR	328575.4	184492.4	A60

Figure B-1 - Vantage Newport modelled sources

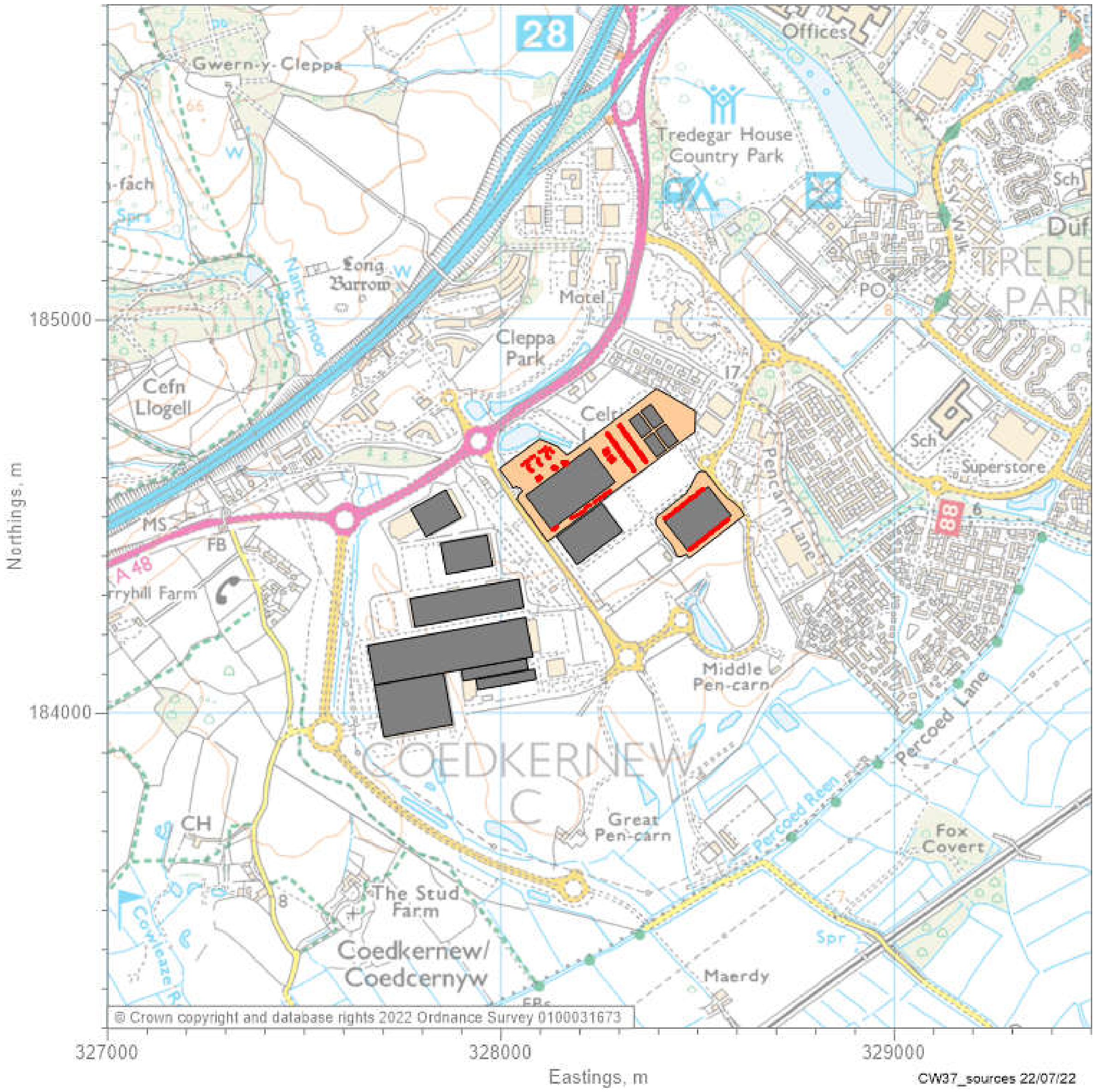
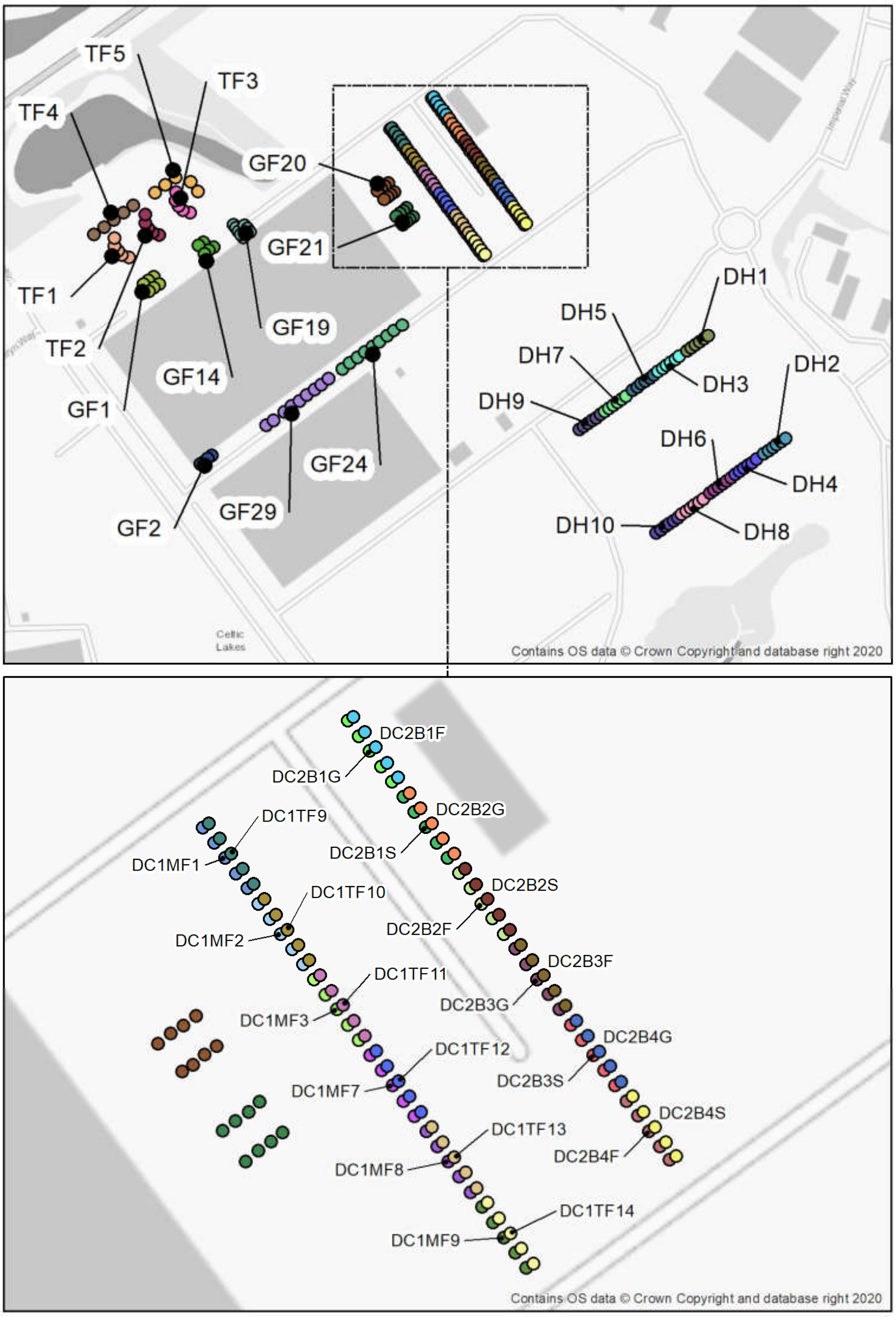


Figure B-2 - Location of engine cells



B.3. CWLL11/12 engine characteristics

Table B-3 - CWL11/12 engine characteristics

Parameter	KD45V20-DEP (CWL11)	KD45V20-DES @75% load (CWL11 expansion, CWL12)	Source
Thermal input, MW	2.987	2.240	Quoted / calculated
Prime power (PRP), kW	1330	1000	Quoted by supplier
Fuel consumption (FSP), g/kWh	-	6.3	Quoted by supplier
Fuel consumption, kg/h	251.9	188.9	Quoted / calculated
Fuel calorific value, MJ/kg	42.8	42.8	Library value
Stack height, m	3.645	12.3	Design value (except TF5 which is as per existing)
Stack diameter, m	0.35	0.35	Design value
Discharge temp., °C	499	499	After turbocharger
Normalised flow rate, Nm^3/s (at reference conditions 273.15K, 101.3 kpa, 5% oxygen, dry basis)	1.065	0.799	Derived from fuel consumption/thermal input specific factors
Oxygen content, % dry	5	5	Not required
Water content, %	10	10	Not required
Actual flow rate, m^3/s	4.583	3.129	Calculated
Efflux velocity, m/s	43.31	32.52	Calculated
NOx emission rate, g/kWh	-	6.3	Quoted
NO_x $conc^n$., mg/Nm^3	2000	1929	Quoted, at 5% O_2
NO_x emission rate, g/s	2.132	1.542	Calculated
CO $conc^n$., mg/Nm^3	667	84	Quoted, at 5% O_2
CO emission rate, g/s	0.711	0.578	Calculated, based on 75% of the original emission rate, as a conservative approach
PM $conc^n$., mg/Nm^3	3	4	Quoted, at 5% O_2
PM emission rate, g/s	0.003	0.003	Calculated
VOCs (intended as HC) $conc^n$., mg/Nm^3	10	11	Quoted, at 5% O_2
VOCs (intended as HC) emission rate, g/s	0.011	0.009	Calculated

Appendix C. Feasibility study of impacts from concurrent testing

C.1. Objectives

In order to complete the annual maintenance and testing regime for all engines on CWL13, there may be a need for testing of CWL13 engines to overlap with hours of testing at the CWL11/12 site. This may arise for either the individual engine tests, or testing cells of engines ("black building tests").

A sensitivity study using dispersion modelling was conducted at design stage for CWL13. It focused on the potential for additional exceedences of the hourly mean standards for nitrogen dioxide (NO_2) to occur if cells are tested on the CWL13 site concurrently with cells within CWL11 or CWL12.

It is proposed to install SCR abatement technology on the CWL13 engines to reduce NOx emissions from 2000 to 500 mg/Nm^3. Furthermore, due to the enhanced plume rise from the high temperatures and flow rates of the generator flue gas, the height of discharge above the CWL13 roof to encourage effective dispersion, and the physical separation of the two facilities, the potential for cumulative impacts from combined testing across the Vantage data centres nearby is expected to be low.

Note that the results presented here are derived from a superseded version of the AERMOD modelling as the work was undertaken at an earlier design stage. However, the core model parameters remain unchanged while any differences in the design are minor and will not materially affect the conclusions of the sensitivity study for the purposes of demonstrating the low potential for cumulative impacts.

C.2. Approach

The US EPA regulatory atmospheric model AERMOD was used to model a range of combinations for the two sites. Model elements included:

- Offsite receptors, including two locations in Imperial Park close to CWL13;
- Existing and proposed buildings and engine containers;
- Terrain and meteorological parameters;
- Source time variable assumptions reflecting operational practice (short duration cell tests and load shedding).

The modelling considered two individual engine tests per day, or two black building tests per day, undertaken concurrently, one on CWL11/12 and one on CWL13. It was not practical nor necessary to model all potential operational combinations of cells. An iterative approach was taken, informed by the previous modelling and proximity of sensitive receptors, to identify a representative set of worst case combinations to provide a robust basis for determining the potential for cumulative impacts of the cells, and a subset for individual engines.

The cells at CWL11/12 that gave rise to the highest ground level concentrations at receptors (as modelled for the variation application for CWL11/12), the cells giving the highest frequency of elevated concentrations and the location of these maxima were combined with selected cells from the CWL13 facility:

- CWL11 combined with CWL13 individual and black building tests at receptors most affected by CWL11 emissions;
- CWL12 combined with CWL13 individual and black building tests at receptors most affected by CWL12 emissions; and
- CWL13 combined with CWL11/12 individual and black building tests at receptors most affected by CWL13 emissions.

In making these selections, local meteorology (wind direction and speed) was considered in the context of the general arrangement of engines and thus the greatest potential for overlapping plumes at receptors. The wind directions that would carry emissions most frequently towards each receptor were identified and those groups of engines upwind of the most frequent directions were prioritised in the selection of groups of cells to model.

The duration of testing considered in the modelling was eight hours a day for the individual engine tests, and for the black building tests, 15 minutes operation of cells within each of those weekday hours.

The results were evaluated to determine the likelihood of exceedences under each of the modelled scenarios, through a comparison with air quality criteria. The criteria used were:

- National Air Quality Standard for hourly mean NO_2 (200 µg/m^3)
- Acute Exposure Guidance Level (AEGL) of 0.5 ppm (equivalent to approximately 950 µg/m^3).

The locations where exceedences would occur and the spatial and temporal extent were identified.

C.2.1. Scenarios

The scenarios considered in the sensitivity study are shown in Table C-1. The relative location of each engine group is presented in Table C-1 .

Table C-1 – Cumulative testing scenarios

Source group	CWL11	CWL12	CWL13
1	GF20	-	DH9
2	DC1TF9	-	DH9
3	TF4	-	DH9
4	-	DC2B1F	DH5
5	GF24	-	DH1
6	-	DC2B4S	DH4
7	DC1TF14	-	DH10
8	GF24	-	DH10
9	GF21	-	DH8
10	-	DC2B2F	DH5

C.3. Results

C.3.1. Black building test

The results provided in Table C-2 for combined black building tests, i.e. cells tested on two different sites, concurrently, are expressed as maximum hourly NO_2 concentrations and are the maxima from a five year meteorological dataset.

Table C-2 – Cumulative testing results for black building tests

Source Group	Maximum hourly NO_2 (µg/m^3)			Change in NO_2 (µg/m^3)			Receptor
	CWL11/12 variation	CWL11/12 + CWL13 building	CWL11/12 + CWL13 engines	Due to new building	Due to concurrent testing	Overall change	
1	119	115	115	-4	0	-4	11 Pencarn Ave
2	39	38	38	-1	0	-1	Imperial Ctyd
3	193	145	155	-48	+10	-38	Imperial Ctyd
4	56	67	67	+11	0	+11	Imperial Way
5	130	126	126	-4	0	-4	11 Pencarn Ave
6	64	68	68	+4	0	+4	11 Pencarn Ave
7	70	68	68	-2	0	-2	18 Pencarn Ave
8	130	126	126	-4	0	-4	11 Pencarn Ave
9	149	141	141	-8	0	-8	11 Pencarn Ave
10	60	64	64	+4	0	+4	18 Pencarn Ave

The results show that the maximum modelled hourly NO_2 concentrations are:

- Below the AQS standard of 200 μg/m^3 at all receptors for all combined testing scenarios;
- Well below the AEGL-1 of 940 μg/m^3 at all receptors for all combined testing scenarios.

Evaluation of the differences in the maximum modelled results at offsite receptors, due to the cumulative impact of CWL13, shows that the changes range from -38 μg/m^3 to +4 μg/m^3. There are just three receptors where there is a small overall increase, and at all three receptors the concentration is less than half the AQS standard.

Changes in the CWL11/12 modelled results compared to the permit variation modelling are also noted. These changes are due to the presence of the CWL13 building in the model. There is a reduction of 48 μg/m^3 at the most affected receptor, compared to the increase of 10 μg/m^3 due to the additional engines. Overall, for source group 3, at this receptor there is a reduction of 38 μg/m^3 due to the combined testing with CWL13.

Note that these results represent when *all* engines within a selected cell are operated concurrently for 15 minutes. On the basis of these findings, hourly concentrations are not anticipated to be a concern when two individual cells are tested concurrently on each site, as is demonstrated in the following section.

Taking the maximum hourly mean result for any of the source groups, 155 μg/m^3 (for source group 3) the non-statutory objective for vegetation of 75 μg/m^3 as a daily mean should also be met, on the basis that no more than one concurrent black building test would be undertaken on a single day.

C.3.2. Individual engine test

The results of the sensitivity study for individual engine tests, i.e. individual engines on two sites tested concurrently, expressed as maximum hourly NO_2 concentrations from a five year meteorological dataset, are provided in Table C-3, for the selected source groups.

Table C-3 - - Cumulative testing results for individual engine tests

Source group	Engines in group	Maximum hourly NO_2 (µg/m^3)		Change	Receptor
		CWL11/12	With CWL13		
1i	GF20_2 + G.01_1 (DH9)	64	64	0	11 Pencarn Ave
2i	DC1TF9_C + G.01_1 (DH9)	32	33	+1	Celtic Springs
3i	TF4_5 + G.01_6 (DH9)	115	123	+8	Imperial Ctyd
4i	DC2B1FFE + G.03_1 (DH5)	56	56	0	18 Pencarn Ave
5i	GF24_9 + GF.05_1 (DH1)	55	63	+8	Imperial Ctyd
6i	DC2B4SF_C + G.09_1 (DH9)	55	55	0	11 Pencarn Ave
7i	DC1TF14_C + G.06_1 (DH10)	61	61	0	18 Pencarn Ave
8i	GF24_9 + GF.06_1 (DH10)	55	56	+1	Imperial Ctyd
9i	GF21_2 + GF.07_1 (DH8)	75	75	0	11 Pencarn Ave
10i	DC2B2FF_C + G.03_1 (DH5)	50	51	+1	18 Pencarn Ave

The results show that the maximum modelled hourly NO_2 concentrations for combined individual engine testing are:

- Below the AQS standard of 200 µg/m^3;
- Below the AEGL criterion of 950 µg/m^3.

The maximum change due to cumulative impact of the CWL13 engines is an increase of 8 µg/m^3 at non-residential property in Imperial Courtyard. The greatest increase at a residential property is 1 µg/m^3.

On the basis of these results for engines within cells that gave the highest black building test results, it is highly unlikely there would be any exceedences of the hourly mean at offsite sensitive human health receptors for any combination of individual testing across CWL11/12 and CWL13.

Taking the maximum hourly mean NO_2 concentration for any of the engine pairings, 123 µg/m^3 the non-statutory objective for vegetation of 75 µg/m^3 as a daily mean is also likely to be achieved at ecological receptors, even were testing to be undertaken across a full working day[31].

[31] In a single day, different engine pairings would be tested therefore each hour of the working day would need to comprise all of the least favourably positioned engines on two sites being tested consecutively, in combination with the least favourable hours of meteorological data in a five year dataset, to approach this value as a daily mean (and assuming no conversion of NO_x to NO_2).

C.4. Summary

This feasibility study provided an assessment of concurrent black building testing and individual testing of standby generators across the two sites, CWL13 and CWL11/12. The findings demonstrate that, with the enhanced pollutant dispersion and emissions abatement at CWL13, and the short duration of black building testing (15 minutes) across all sites, the additional emissions from CWL13 have no material impact on maximum modelled hourly NO_2 concentrations for CWL11/12, which are below the AQS hourly standard.

The results indicate that in specific instances there may be a small increase in ground level of NO_2 but in other cases, there is enhanced dispersion of CWL11/12 engine emissions post-expansion, due to increased mixing with the presence of the new CWL13 building.

On the basis of this study, it is concluded that the operational testing regime for CWL13 can be managed independently of that of CWL11/12 and that should tests be undertaken concurrently, there is an extremely low likelihood of cumulative impacts.

Appendix D. Emergency operation contour plots

Figure D-1 - Maximum modelled hourly mean NO_2 concentrations (µg/m^3), CWL13

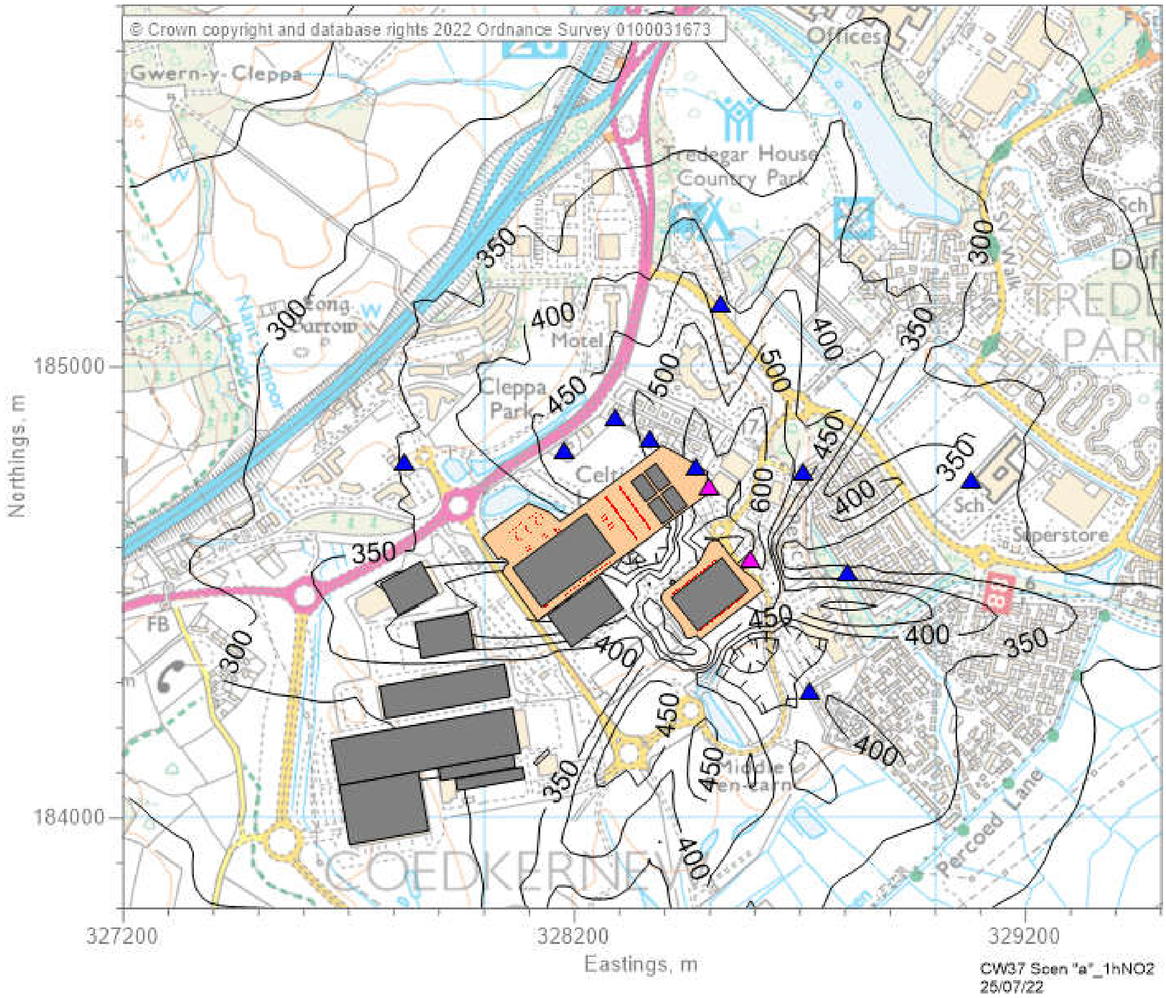


Figure D-2 - Modelled exceedances of the hourly mean NO_2 standard, CWL13

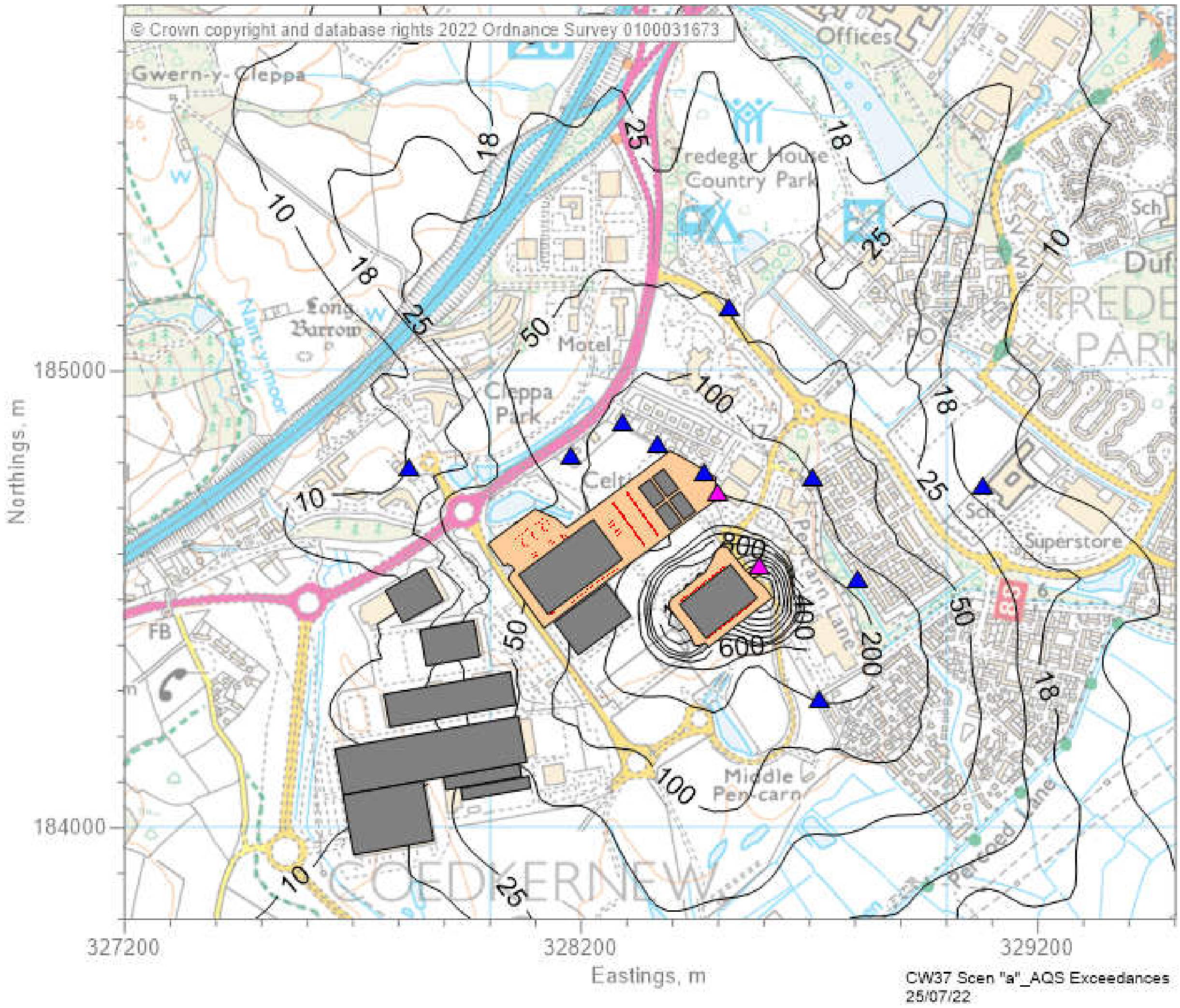


Figure D-3 - Maximum modelled hourly mean NO_2 concentrations (µg/m^3), CWL11/12

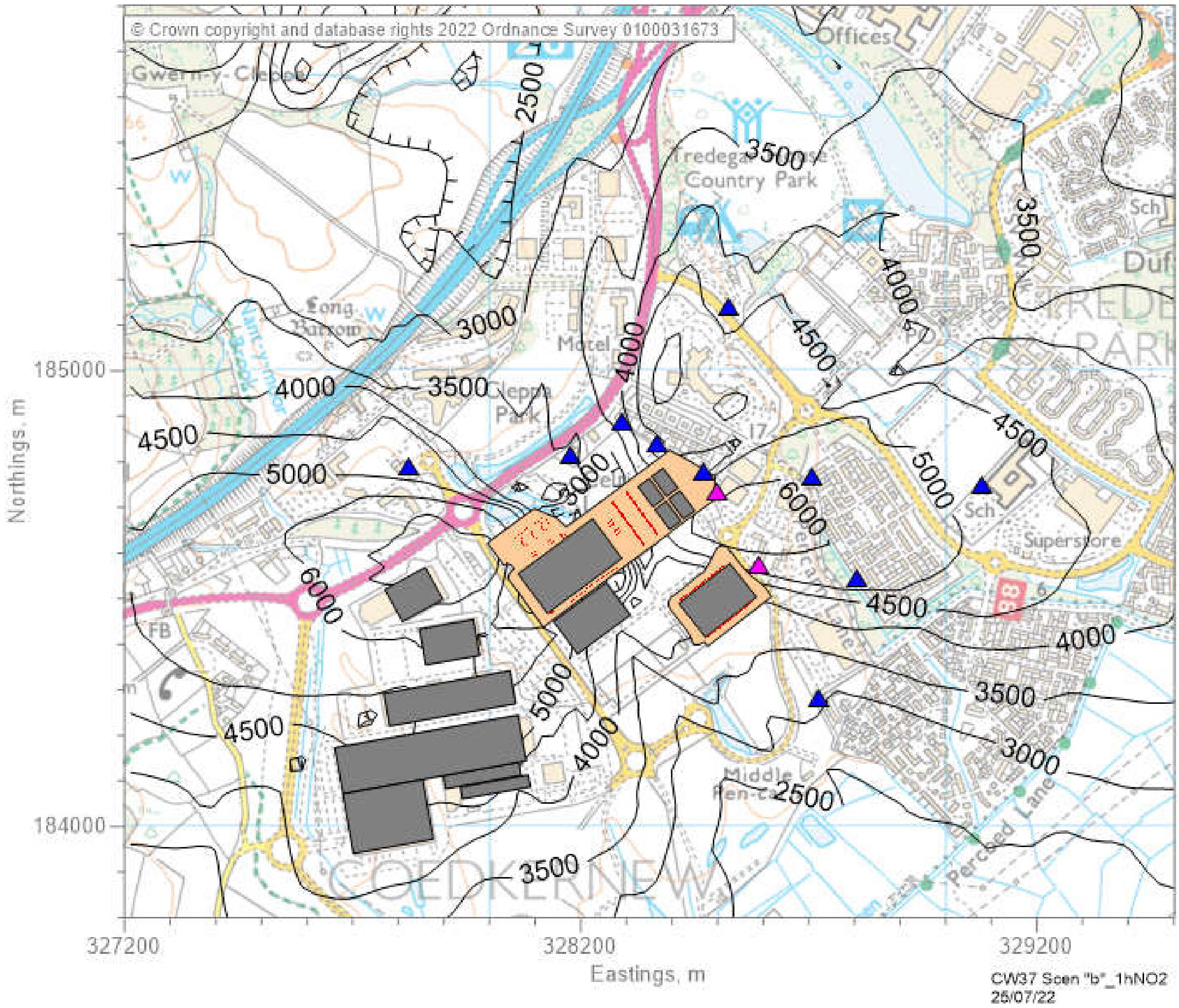


Figure D-4 - Exceedances of the hourly mean NO_2 AQS standard, CWL11/12

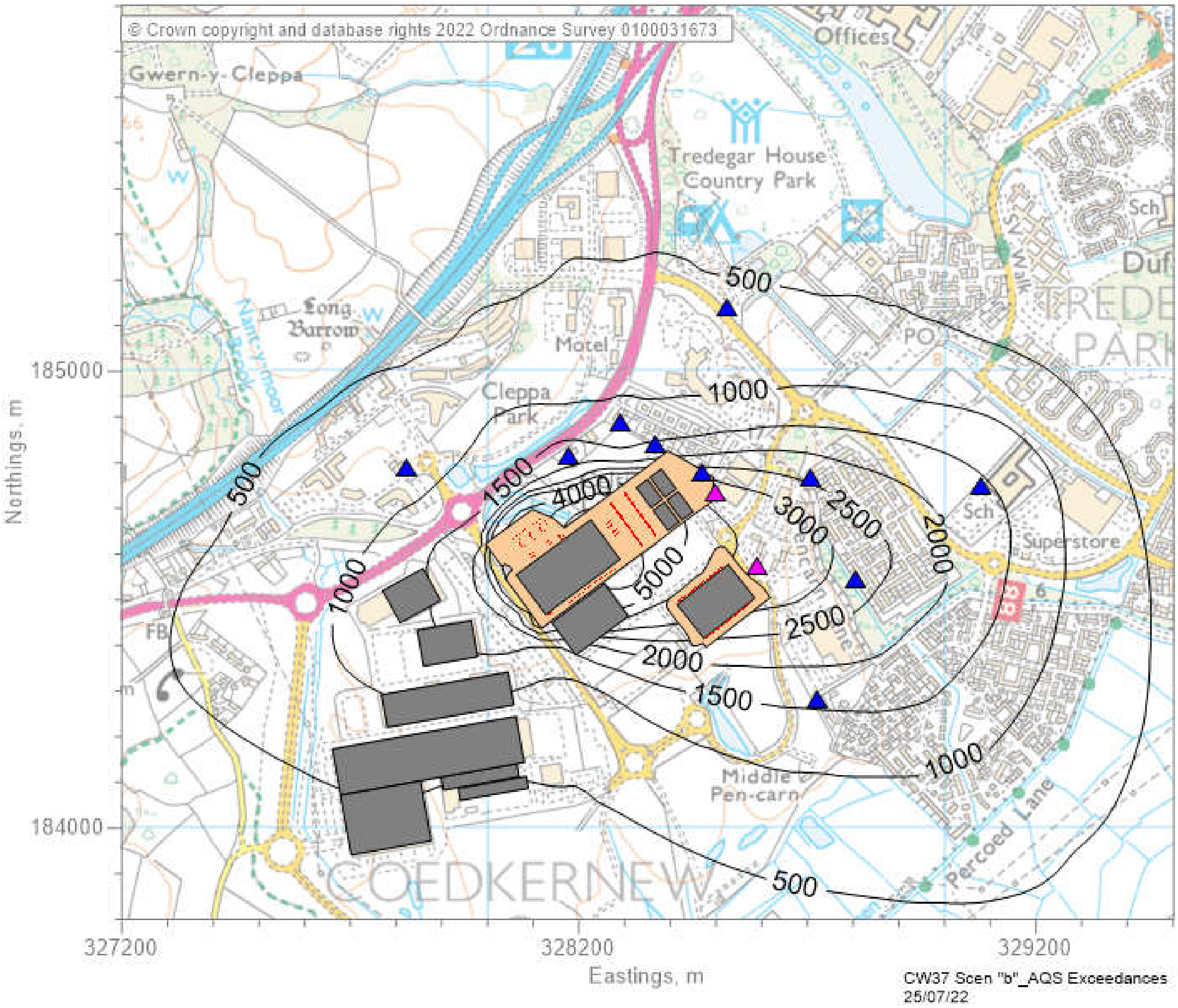


Figure D-5 - Maximum modelled hourly mean NO_2 concentrations (µg/m^3), CWL11/12+13

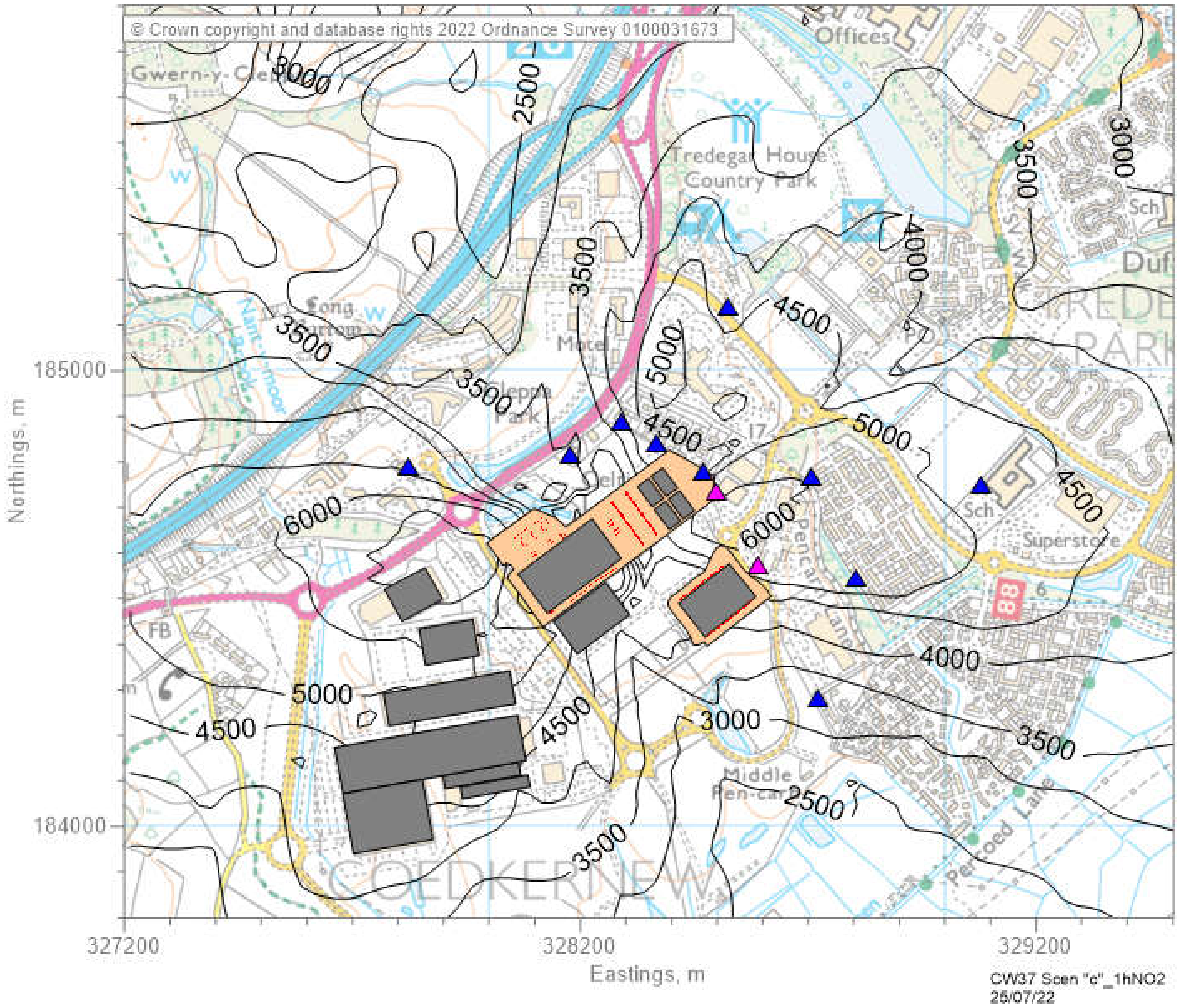
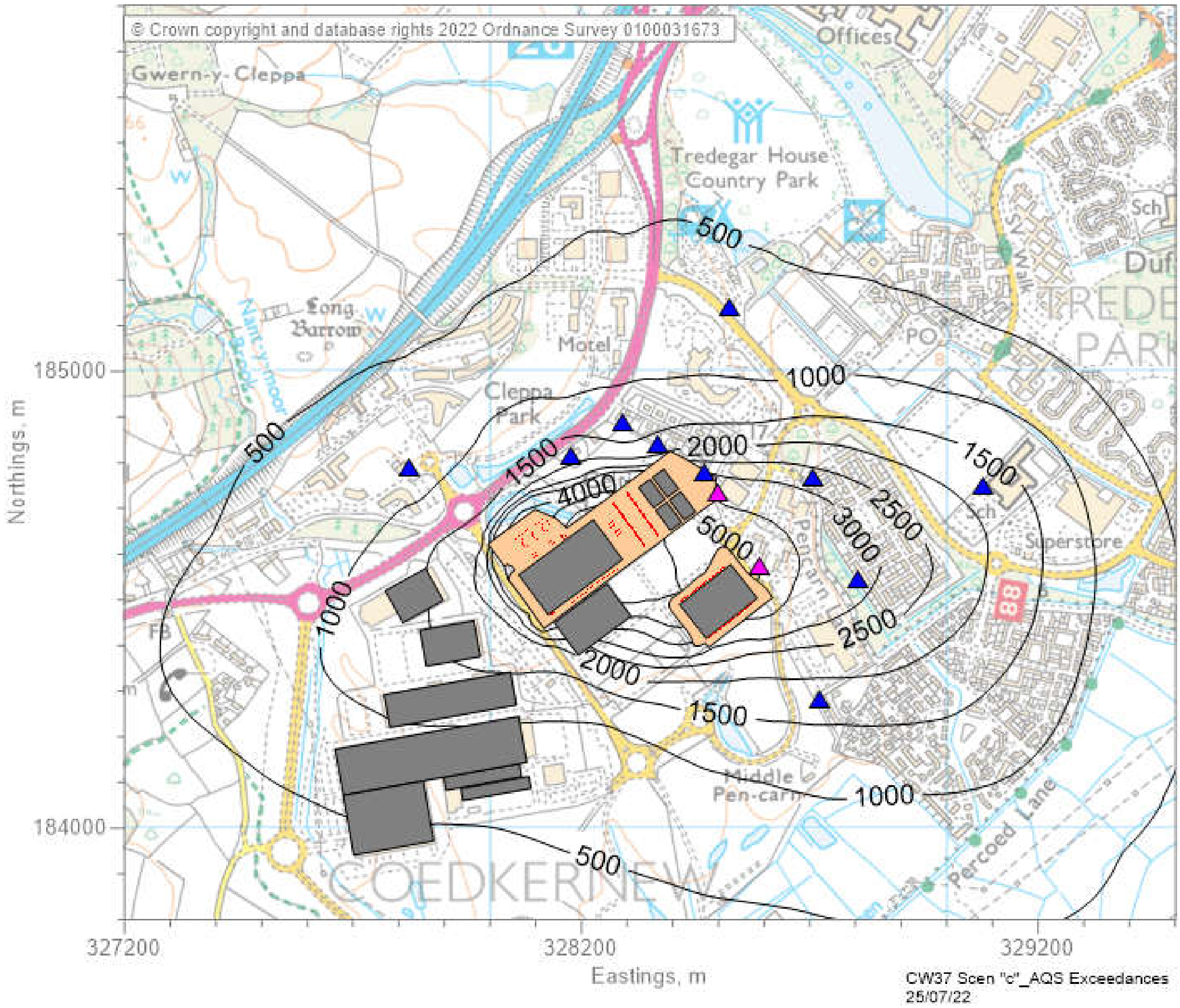


Figure D-6 - Exceedances of the hourly mean NO_2 AQS standard, CWL11/12+13



Appendix E. Emergency operation and statistical analysis

E.1. Cumulative emergency results

The maximum modelled hourly mean nitrogen dioxide concentrations (as the PEC) and annual counts of exceedences of the AQS standard for the emergency scenarios (full outages of CWL11/12 and in combination with CWL13) are presented in this section.

Table E-1 - Emergency operation scenario - CWL11/12 engines only

I.D.	Receptor	Max hourly NO_2 PEC, µg/m³	Number of modelled hours above 200 µg/m³				
			2011	2012	2013	2014	2015
1	47 Powis Close	3080	1261	1583	1619	1284	1364
2	18 Pencarn Ave	4438	1652	1578	1441	1885	1678
3	Celtic Springs	3735	2045	1791	1769	2255	1907
4	Teddies Nursery	4727	1025	843	903	861	834
5	11 Pencarn Ave	4392	2968	2726	2110	2686	2939
6	24 Pencarn Ave	3766	1280	1173	1118	1521	1245
7	2 Sir Briggs Ave	**5987**	2601	2419	1817	2194	2504
8	127 Edmundsbury	5335	2511	2700	2155	2188	2389
9	Tredegar House	4411	621	568	551	703	635
10	St Joseph's	4733	1606	1577	1133	1274	1440
11	Imperial Way	5725	3618	3482	2682	3168	3521
12	Imperial Courtyard	5472	3382	3722	3100	3007	3326

Table E-2 - Emergency operation scenario - CWL11/12 engines with CWL13 engines

I.D.	Receptor	Max hourly NO_2 PEC, µg/m³	Number of modelled hours above 200 µg/m³				
			2011	2012	2013	2014	2015
1	47 Powis Close	3268	1351	1723	1770	1406	1498
2	18 Pencarn Ave	4439	1834	1722	1572	2074	1840
3	Celtic Springs	3735	2122	1835	1806	2318	1963
4	Teddies Nursery	4988	1034	848	918	869	840
5	11 Pencarn Ave	4392	3241	2963	2335	2994	3165
6	24 Pencarn Ave	3881	1387	1246	1211	1641	1342
7	2 Sir Briggs Ave	**5987**	2996	2724	2100	2555	2882
8	127 Edmundsbury	5445	3001	3183	2465	2561	2834
9	Tredegar House	4417	731	656	647	828	726
10	St Joseph's	4750	1789	1771	1261	1444	1666
11	Imperial Way	5725	3915	3740	2930	3515	3787
12	Imperial Courtyard	5547	4957	5036	4296	4630	4972

E.2. Hypergeometric mean calculations

Table E-3 - Hypergeometric mean calculation for CWL13 and in combination with CWL11/12

ID	Description	CWL13 alone		CWL11/12 +CWL13		Comment
		Residential	Non-residential	Residential	Non-residential	
x	No. successes in the sample	5	5	5	5	Operational hours minus number of “allowed” exceedances
n	Sample size	24	24	24	24	No. emergency operational hours
M	No. successes in the population	8451	6046	5519	3724	Non-exceedance hours per year
N	Population size	8760	8760	8760	8760	Potential operating envelope per year
		309	2714	3241	5036	No. hours modelled to exceed per year
		19	19	19	19	No. exceedances allowed by the objective
Result	Cumulative hypergeometric distribution	<0.0001%	0.0002%	0.003%	2.3%	Probability of less than 5% indicates exceedances are unlikely as long as the generator plant operational lifetime is no more than 20 years
		<0.0001%	0.0004%	0.007%	5.72%	Factor of 2.5 applied for consecutive hours of emergency operation

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Appendix E. Noise Assessment

Vantage - Site CWL13

Noise Impact Assessment

Vantage

August 2022

Notice

This document and its contents have been prepared and are intended solely as information for Vantage and use in relation to the noise assessment for Vantage's CWL13 environmental permit application.

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This document has 58 pages including the cover.

Document history

Document title: Noise Impact Assessment

Document reference: 5214555/2022/August/1.0

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
Rev 0.1	First Issue	LM	AL	IE	IE	July 2022
Rev 0.2	For client comment	LM	AL	IE	IE	August 2022
Rev 1.0	Final for issue	LM	AL	IE	IE	August 2022

Contents

Tables

Figures

1. Introduction

Vantage Data Centers UK Ltd ('the Operator', or 'Vantage') currently operates a data centre facility at Imperial Park, Newport. Natural Resources Wales (NRW) is the regulator for the existing installation. The existing facility has an Environmental Permit to operate 77 standby generator sets in an area called CWL11. An application to vary the permit to operate a further 125 standby generator sets (65 sets at CWL11 and 60 sets at the adjoining CWL12 site was submitted to NRW in September 2021. The permit variation application for the combined CWL11/12 site was 'duly made' in February 2022 and is in the process of being determined.

Due to the success of the existing Vantage facility and the significant demand for data facilities, the business has an ongoing requirement for additional capacity. A new data centre is proposed by Vantage at a site known as CWL13. The CWL13 facility will be located to the south east of the existing data centre. The new site is accessed via North Lake Drive and Celtic Way, from the junction with the A48 to the north west.

The facility is a Tier 3 data centre. Due to the sensitive and significant nature of the information held at the site, a secure and reliable electricity supply is business-critical. The first level of power security will be two independent grid connections so that power supply can be maintained in the event of a localised power outage. However, an additional level of protection is required in case of grid failure and this will be achieved though the installation of standby emergency generators. The proposed development comprises a two storey data centre building containing ten Data Halls and the installation of 60 new standby generators.

Planning consent has been granted for the development, subject to the close-out of a number of pre-operational planning conditions. No Environmental Statement was prepared for the facility; however a noise assessment was prepared to support the planning application.

An acoustic impact assessment has been undertaken for CWL13 to support a permit application. The assessment considers the sound emissions from CWL13 as a single development but also considers the potential cumulative impact of CWL13 and other existing Vantage facility (CWL11/12). This assessment uses the highest sound levels for each type of plant to be installed and completes a BS 4142 assessment of the potential impact at nearby sensitive receptors from these sound sources when in operation.

A glossary of technical terms is provided in Appendix A.

2. Regulations, Planning and Context

2.1. Natural Resources Wales

In a previous assessment of generators at the existing CWL11/12 site, it was agreed with Natural Resources Wales (NRW) that assessments should focus on engine testing scenarios (i.e. not all engines operating at the same time as they may in an emergency scenario); however, emergency operation is also considered. Following this, assessments of the following scenarios have been undertaken:

- Quarterly servicing
- Black building test
- Emergency operation

2.2. BS 4142:2014+A1:2019

British Standard 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound (BS 4142) describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods described in the standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

The standard is used to determine the rating levels for sources of sound of an industrial and/or commercial nature and the ambient, background and residual sound levels at outdoor locations. These levels could be used for the purposes of investigating complaints; assessing sound from proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and assessing sound at proposed new dwellings or premises used for residential purposes. However, the determination of sound amounting to a nuisance is beyond the scope of the standard.

The procedure contained in BS 4142 assesses the significance of sound which depends upon the margin by which the rating level of the specific sound sources exceeds the background sound level ($L_{A90,T}$) and the context in which the sound occurs.

The reference time interval for the specific sound source 'Tr' is 60 minutes during the daytime and 15 minutes during the night. The reduced reference time at night reflects the increased sensitivity to sound during this period. The relevant time periods for daytime and night-time are as follows:

- Daytime – 07:00 to 23:00 hours; and
- Night-time – 23:00 to 07:00 hours.

The assessment method considers the characteristics of the sound, such as tonality, impulsivity and intermittency. Corrections are applied to the specific sound source to account for these characteristics in order to obtain the rating level; the corrections account for acoustic features which have the potential to increase disturbances.

An initial estimate of the impact of the sound source is obtained by subtracting the measured background sound level from the rating level and considering the following:

- Typically, the greater this difference, the greater the magnitude of the impact.
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, the standard adds a character correction to the specific sound level to obtain the rating level. Character corrections can be included for tonality, impulsivity, other sound characteristics that make it "readily distinctive", and intermittency.

For this assessment the following impact scale has been adopted:

Table 2-1 – Impact assessment scale

Rating level of industrial/commercial sound	Impact	Significance
Up to 1dB above the background sound level	Negligible	Not significant
1 to 5 dB greater than the background sound level	Minor adverse	Not significant
More than 5 dB greater than the background sound level	Moderate adverse	Significant depending on context
More than 10 dB greater than the background sound level	Major adverse	Significant depending on context

3. Site Description

3.1. Sensitive receptors

The site is in a largely industrialised area in the eastern part of Imperial Park, approximately 830m from the M4. Imperial Park houses several industrial, distribution and administration facilities which are located to the north and west of the proposed development. The proposed installation is approximately 125 m to the south east of the existing CWL11 facility's main building and 100 m to the south of CWL12. CWL13 is also bordered by IQE's Newport Semiconductor Facility to the west, Imperial Way to the north-east and G24 Power to the south-east. The business units in proximity to the site are industrial or commercial nature and therefore not considered to be sensitive to sound.

There is some residential land-use near to the site, and the closest noise sensitive receptors (NSRs) are as follows:

Table 3-1 – Residential Noise Sensitive Receptors

ID	Address	Receptor Type	Location (relative to the site)
1	14 Church Crescent	Residential	Approximately 950m to the west
2	1 Nant-Y-Moor Cottages, Blacksmiths Way	Residential	Approximately 890m to the west
3	Teddies Nursery	Non-residential	Approximately 660m to the north west
4	1-4 Cardiff Road	Residential	Approximately 390m to the north west
5	19 Pencarn Avenue	Residential	Approximately 310m to the north
6	11 Pencarn Avenue	Residential	Approximately 210m to the north
7	61-65 Edmundsbury Rd	Residential	Approximately 220m to the east
8	89-95 Edmundsbury Rd	Residential	Approximately 220m to the east
9	117-119 Edmundsbury Rd	Residential	Approximately 250m to the east
10	50-62 Edmundsbury Rd	Residential	Approximately 260m to the east
11	14-16 Powis Close	Residential	Approximately 260m to the south east
12	49 Powis Close	Residential	Approximately 260m to the south east

Residential dwellings are considered to be noise sensitive at all times of day and night.

Non-residential receptors are considered to be noise sensitive in daytime hours only as they would not be occupied at night.

The nearest NSR locations are shown on the satellite image in Figure 3-1 with the CWL13 main building shown in red.

Figure 3-1 – Nearest noise sensitive properties to the site

The ground conditions are considered to be mixed hard and soft ground between the source and the NSRs.

3.2. Location and operation of plant

3.2.1. Generator engines

The proposed diesel engines at the site are required to operate as a backup source of power generation. The engines are grouped into cells; one for each data hall. Each cell contains six engines (termed “generator sets” or “sets”).

The proposed development comprises a two storey data centre building containing ten data halls and the installation of 60 new emergency standby generators. The sole purpose of the generators is to provide power under emergency conditions. The engines will also be maintained and tested on a regular basis to ensure they are operational and to conform with manufacturer’s recommendations.

The generator sets will be Kohler units, which incorporate the KD45V20-DES engine. The engines are grouped into ‘cells’, and there will be 10 cells, each with 6 generator sets. There will be 30 generators located along the north western side of the main building and 30 along the south eastern side. The generators have been labelled as shown on Figure 3-2 for the purpose of this assessment.

3.2.2. Operation

As the standby generators are for back-up emergency power generation there is no ‘routine operation’. However, there are two testing scenarios for the engines that take place during routine servicing and maintenance activities:

- testing of individual engines; and
- testing the cells (known as a black building test).

In addition to routine testing, there may also be unplanned events. These are:

- testing of the engines after an unplanned repair (called a ‘break-fix’ event) - where possible these are tied into the planned testing that takes place during servicing and maintenance; and
- emergency scenario (i.e. operation in the event of a grid failure).

In order to complete the annual maintenance and testing regimes for all engines at CWL13 there may be a need for the routine testing of the CWL13 engines to overlap with similar routine testing at the CWL11/12 facility. This may arise for either the individual engine tests, or for the black building tests. Studies have been undertaken to assess the feasibility of concurrent testing at CWL13 and CWL11/12 (see Section 7.1) in relation to potential noise impacts.

3.2.2.1. Emergency Scenario

The emergency scenario is a theoretical scenario to simulate what could happen in the event of a major grid outage. The purpose of the engines is to provide electrical backup to the site's National Grid connection. This is an integral part of Vantage's service offering and a contractual obligation to its clients.

In an emergency scenario, all engines would start up simultaneously, a process which takes up to 21 seconds. During this time, a battery uninterruptible power supply (UPS) would meet the data centre power demand. Once all the engines are synchronised, automated load shedding down to the required output would occurring within 10 minutes. However, for the purposes of the noise assessment for CWL13, a conservative approach has been taken and load shedding is not accounted for - consequently it has been assumed that all 60 engines at the site run concurrently for the full duration of this scenario. This scenario could occur at any time of day or night.

The probability of an emergency scenario occurring is very low (the Office of Nuclear Regulation (ONR) identifies a conservative value for an outage of up to 2 hours as a 1 in 20 year event; longer events have a lower probability); this probability is reduced further by the dual connections to the grid, either of which could be used in isolation if the other were to fail. As the facility has a direct connection to the National Grid, an emergency scenario would only occur in the event of a regional outage. The duration of this type of event would be outside the operator's control, however it would be addressed by National Grid as a high priority. The existing CWL11 Vantage facility has not experienced a full emergency since operation commenced in 2009.

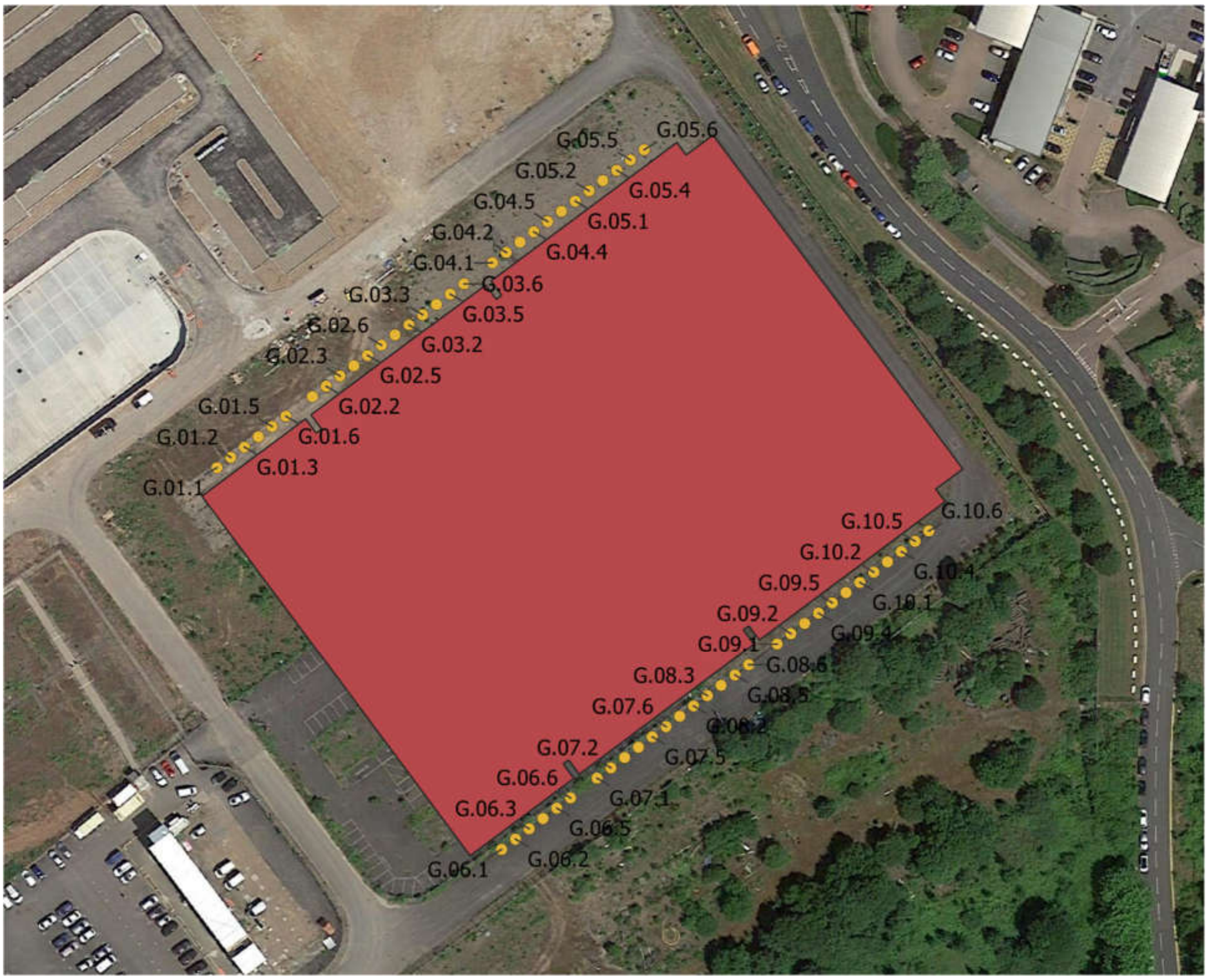

Figure 3-2 – CWL13 Site layout

Figure 3-2 shows the generators grouped in sixes (i.e. six engines per cell). Information on the final numbering of the data halls and engines is now available, and this information is shown in the following table to allow cross-referencing with other project information.

Table 3-2 – Data halls and generator numbers

Data Hall	Engine Stack Number	Figure 3-2 cell number	Figure 3-2 engine numbers
1	A25 to A30	G.05	G.05.01 to G.05.06
2	A55 to A60	G.10	G.10.01 to G.10.06
3	A19 to A24	G.04	G.04.01 to G.04.06
4	A49 to A54	G.09	G.09.01 to G.09.06
5	A13 to A18	G.03	G.03.01 to G.03.06
6	A43 to A48	G.08	G.08.01 to G.08.06
7	A7 to A12	G.02	G.02.01 to G.02.06
8	A37 to A42	G.07	G.07.01 to G.07.06
9	A1 to A6	G.01	G.01.01 to G.01.06
10	A31 to A36	G.06	G.06.01 to G.06.06

3.2.2.2. Planned Operation

The engines will also be active during regular testing and maintenance operations that can take place on weekday daytimes (excluding bank holidays) between 09:00 and 17:00. There are two key modes of testing as described below:

1. **Quarterly servicing** – the supplier of the generator engines, WB Power Services Ltd (WBPS), services the generator engines on a quarterly basis. The engines and fuel tanks will be supplied and maintained by WBPS:
   - two of the services require a 2-hour test to be completed after the service (each engine is run for 2 hours individually); and
   - two of the services require the generator engines to be tested individually for up to 15 minutes.

   The 2-hour individual generator engine tests and the 15-minute test runs are carried out in alternating quarters. This testing will not be carried out at the same time or overlapping with any other testing mode at CWL13. For both durations of testing, the noise modelling looks at a one-hour period with continuous operation of each generator engine, identifying those generator engines with the highest and lowest noise levels in each cell.
2. **Black building Test –**Twice per year per cell (a total of 20 times per year), a controlled mains failure is simulated to prove the system's response. In this test, a single cell is selected, power is isolated, and the system responds as it would in an emergency scenario. All engines in the cell fire up during this test. The overall test takes some 10-15 minutes to carry out for each cell.

   This testing mode will not be carried out at the same time or overlapping with any other testing mode at CWL13. Only one black building test would be carried out on any weekday. No testing will take place at weekends or bank holidays.

Even though the engines are regularly serviced and well maintained, occasionally an engine fault requiring repair (known as a break-fix) may occur outside of the planned servicing and maintenance periods. Part of the repair requires running the engine for a period of time to establish that the repair has been successful. Where feasible the repair activities are coordinated with planned maintenance activities; however, this is not always possible.

There is not a set time for a break-fix test run - some repairs will require longer testing than others, as this is dependent on the actual works and the engineer's findings etc. It is anticipated that a minimum of 15 minutes is required to confirm generator operation following a repair, however this can be longer. On this basis it is considered that the sound impacts from break-fix testing would be similar to that for the 15-minute quarterly testing. Consequently, this scenario has not been specifically assessed as it is bounded by the assessment of the routine individual engine tests.

The total operational time during testing and maintenance is summarised in Table 3-3, which shows that testing would take place for a total duration of 11 weeks per year noting that quarterly testing could take place continuously and that there would only be one black building test per day.

Table 3-3 – Testing Duration

Test	Duration	Frequency	Total
Quarterly testing (15 min runs)	~2 days	Every 6 months	Equivalent to 1 week per year total running time
Quarterly testing (2 hour runs)	3 weeks	Every 6 months	Equivalent to 6 weeks per year total running time
Black building testing	15 minutes per cell	20 times a year	4 weeks per year at 15min/day
Total			**11 weeks per year**

3.2.3. Air handling units

In addition to the diesel engines, rooftop Air Handling Units (AHUs) are proposed to cool internal equipment. A total of 100 AHUs are proposed for the site. To reflect that residents nearby would hear noise from CWL13 as a whole the noise from the operation of the AHUs is considered in this assessment, but the AHUs are outside the scope of the permit[1].

[1] Noise from the AHUs was not considered in the noise assessments reported for the previous permit application and variation for CWL11/12; this is partly because the AHUs are not part of the permitted activity and partly because for CWL11/12 the generator noise is higher and inclusion of the AHUs was negligible. Because the noise from the CWL13 generators is lower than most CWL11/12 generators, the contribution from AHUs has less potential to be negligible and they are included in the assessment.

4. Acoustic Survey

4.1. Locations

Acoustic surveys were carried out on Tuesday 15th May 2018 and between 27th June and 8th July 2019, and on 7th December 2020, to establish the existing conditions at representative sensitive receptors in proximity to CWL11/12, as identified in Figure 3-1. These receptors are also relevant to CWL13. Measurements were taken under free-field conditions, unless otherwise stated, during the daytime and night-time periods and additional soundscape observations were made.

The four locations visited were:

- Position 1 – 11 Pencarn Avenue (co-ordinates: 328421, 184808) in 2018. This location was moved to 19 Pencarn Avenue in 2019 due to the sound of a garden water feature close to number 11. Logging data was recorded on the boundary fence with Vantage at the rear of the properties, sample measurements were taken in front of the properties.
- Position 2 – 43 Powis Close (co-ordinates: 328726, 184268). Logging data was recorded in the rear garden of this property with façade reflections from the garden fence. Sample measurements were taken in front of the property in free-field conditions.
- Position 3 – 1 Nant-Y-Moor Cottages, Blacksmith Way near (co-ordinates: 327544, 184602). 2019 logging data was recorded in the rear garden of this property. Additional sample measurements were made in the layby on Blacksmith Way. The 2018 sample measurements were taken on the opposite side of the road at the junction of Blacksmith Way and Nant-Y-Moor Close.
- Position 4 – Buchanan Way (co-ordinates: 327847, 184808). Sample measurements taken on the pavement outside of Teddies Nursery.

In addition to the baseline sound surveys, acoustic measurements were taken at Vantage in 2018 and 2020 during engine testing operations to determine the sound emissions of the existing engines at CWL11. In 2018 the measurements focussed around generator engines in CWL11 cells GF24 and GF29, and in 2020 the measurements were taken at each type of generator engine on site, including Kohler engines of the same noise specification as the CWL13 engines. This data is used to derive a sound spectrum of the plant to apply to the manufacturers' single figure sound power level values in the 3D acoustic model. Further calculations were undertaken to verify the manufacturers single figure sound power level values, based on measured levels on site.

4.2. Methodology

4.2.1. Noise survey during 2018

The acoustic survey consisted of attended short-term measurements at each of the four survey positions. At least two measurements of 15-minute duration were recorded at each receptor position using an integrating sound level meter, that was tripod-mounted with a microphone height of approximately 1.4 m above ground level.

A full range of acoustical parameters were recorded, including the ambient sound level ($L_{Aeq,T}$), background sound level ($L_{A90,T}$) and maximum sound level (L_{AFmax}). Details of the main sound sources affecting the measured sound levels and the weather conditions were recorded in site notes.

4.2.2. Noise survey during 2019

A further acoustic survey was conducted in 2019. This survey consisted of unattended long-term logging over a period of several days at the three residential locations which are considered to be noise sensitive at night. Measurements were made using integrating sound level meters, that were tripod-mounted with a microphone height of approximately 1.3 m to 1.4 m above ground level. Additional attended night-time sample measurements were also made close to each logger location.

A full range of acoustical parameters were recorded, including the ambient sound level ($L_{Aeq,T}$), background sound level ($L_{A90,T}$) and maximum sound level (L_{AFmax}). Details of the main sound sources affecting the measured sound levels and the weather conditions were recorded in site notes.

4.2.3. Noise survey during 2020

The acoustic survey was undertaken on Monday 7th December 2020 at the Vantage site at Imperial Way, Newport, Wales. The measurements covered both individual engines, being representative of both durations of quarterly tests, and a single black building test for CWL11 (cell GF14-17).

The survey consisted of nearfield measurements of on-site generator engines and, where possible, were taken at a number of positions around the engine. Measurements were undertaken for one engine in each cell[2].

4.3. Instrumentation

4.3.1. Noise survey during 2018

The acoustic monitoring equipment that was used for both surveys is compliant with precision class 1 or type 1 as defined in IEC 61672-1:2013 or BS EN IEC 60651/804. All equipment was calibrated on site before and after each measurement period with no noticeable drift in calibration. All equipment has been laboratory calibrated within the required period and calibration certificates are available upon request. A summary of the equipment details can be found below.

Table 4-1 – Instrumentation details – 2018 survey

Item	Model	Serial number	Date of most recent laboratory calibration before survey
Sound level meter	Norsonic 140	1403242	26/05/2017
Preamplifier	Norsonic 1209	12198	26/05/2017
Microphone	Norsonic 1225	79574	26/05/2017
Calibrator	Norsonic 1251	1859044	26/05/2017

4.3.2. Noise survey during 2019

The acoustic monitoring equipment that was used for both surveys is compliant with precision class 1 or type 1 as defined in IEC 61672-1:2013 or BS EN IEC 60651/804. All equipment was calibrated on site before and after each measurement period with no noticeable drift in calibration. All equipment has been laboratory calibrated within the required period and calibration certificates are available upon request. A summary of the equipment details can be found below.

Initially all three logger locations were monitored simultaneously but two of the loggers suffered from power supply failures and lost the bulk of their data. Logging at these locations was therefore repeated later using different equipment.

Table 4-2 – Instrumentation details – 2019 survey

Location	Item	Model	Serial number	Date of most recent laboratory calibration before survey
L1	Sound level meter	01dB Fusion	11200	31/10/2018
	Preamplifier	01dB Pre No22	1605098	31/10/2018
	Microphone	GRAS 40CE	226400	31/10/2018
	Calibrator	Brüel & Kjær 4231	2385276	30/10/2018
L2	Sound level meter	01dB Fusion	12076	13/05/2019
	Preamplifier	01dB Pre No22	1805399	13/05/2019
	Microphone	GRAS 40CD	331856	13/05/2019

[2] Atkins Acoustics report 2021/JAN/02

Location	Item	Model	Serial number	Date of most recent laboratory calibration before survey
	Calibrator	01dB Cal 21	35183004	16/04/2019
L3	Sound level meter	01dB Fusion	12078	13/05/2019
	Preamplifier	01dB Pre No22	1805324	13/05/2019
	Microphone	GRAS 40CD	331906	13/05/2019
	Calibrator	Rion NC-74	35125802	08/04/2019
Sample measurements	Sound level meter	Rion NL-52	00620854	13/09/2018
	Preamplifier	Rion NH-25	20914	13/09/2018
	Microphone	Rion UC-59	03690	13/09/2018
	Calibrator	Rion NC-74	35125802	08/04/2019

4.3.3. Noise survey during 2020

Table 4-3 details the equipment was used during the survey.

Table 4-3 - Instrumentation Details – 2020 Survey

Equipment	Model	Serial Number	Date of last laboratory calibration before survey
Frequency Meter	Rion NL-52	00620855	26/03/2020
Microphone	Rion UC-59	03691	26/03/2020
Pre-amplifier	Rion NH-25	20915	26/03/2020
Calibrator	Rion NC-74	35125803	24/03/2020

The equipment was mounted on a tripod at a height of approximately 1.5m above local ground level. Equipment was calibrated on site before and after measurements and no significant drift was noted. Laboratory calibration certificates for the equipment used during the survey are available on request.

4.4. Measured sound levels

4.4.1. Noise survey during 2018

The measured sound levels at each of the monitoring locations are summarised in Table 4-4, with the complete dataset provided in Appendix B. The $L_{Aeq,T}$ shown is the logarithmic average of the individual 15-minute readings. The L_{AFmax} is the maximum sound pressure level that was recorded during any of the measurement periods. The L_{A90} and L_{A10} levels shown in Table 4-4 have been approximated by the arithmetic means of the individual L_{A10} and L_{A90} during each sample measurement.

Table 4-4 – Summary of measured sound levels

Measurement ID	Address	Measured sound levels, dB				Main sound sources
		$L_{Aeq,T}$	$L_{AF10,T}$	$L_{AF90,T}$	$L_{AFmax,T}$	
1	11/19 Pencarn Avenue	52.0	54.7	44.7	76.4	Construction sounds from IQE, birds, local water feature
2	Powis Close	44.9	46.6	36.4	67.7	Birds, distant road traffic, distant construction works at

Measurement ID	Address	Measured sound levels, dB				Main sound sources
		$L_{Aeq,T}$	$L_{AF10,T}$	$L_{AF90,T}$	$L_{AFmax,T}$	
						IQE, plant operating at the adjacent IQE site
3	Blacksmith Way	59.1	57.3	51.3	82.0	Distant road traffic, birds, engine/generator (possibly from Vantage), possible construction
4	Buchanan Way	59.8	62.9	50.7	75.5	Local and distant road traffic, people (nursery), water, engines/ generator (possibly from Vantage)

Throughout the attended measurements, observations were made on the existing acoustic environment at each location. The main sound sources were identified as local and distant roads, including the A48 and M4, birdsong, water, construction works at IQE, and equipment operating at IQE, with engine sound from the existing Vantage site only occasionally being audible.

The weather conditions during the acoustic survey were dry with an air temperature of approximately 20°C. The wind conditions were still. The weather conditions are considered appropriate for acoustic surveys.

4.4.2. Noise survey during 2019

The measured sound levels at each of the monitoring locations are summarised in Table 4-5, Table 4-6 and Table 4-7, with the complete dataset provided in Appendix B. The $L_{Aeq,T}$ shown is the logarithmic average of the individual 15-minute readings. The L_{AFmax} is the maximum sound pressure level that was recorded during any of the measurement periods. The L_{A90} and L_{A10} levels shown in Table 4-5, Table 4-6 and Table 4-7 have been approximated by the arithmetic means of the individual L_{A90} and L_{A10} during each sample measurement.

Table 4-5 – Summary of attended measured daytime sound levels

Measurement ID	Address	Measured sound levels, dB				Main sound sources
		$L_{Aeq,T}$	$L_{AF10,T}$	$L_{AF90,T}$	$L_{AFmax,T}$	
1	11/19 Pencarn Avenue	47.7	43.0	39.5	73.6	Distant road traffic noise, faint hum from plant
2	Powis Close	45.2	37.7	35.6	62.7	Plant noise (500Hz hum), some local road traffic noise, local residents in gardens
3	Blacksmith Way	54.1	51.8	49.6	68.7	Road Traffic Noise from M4, some local road traffic noise, pedestrians talking
4	Buchanan Way	57.1	54.7	48.6	84.4	Road Traffic Noise, some movement of cars in nursery car park

Table 4-6 – Summary of attended measured night-time sound levels

Measurement ID	Address	Measured sound levels, dB				Main sound sources
		$L_{Aeq,T}$	$L_{AF10,T}$	$L_{AF90,T}$	$L_{AFmax,T}$	
1	11/19 Pencarn Avenue	39.8	38.9	36.9	49.7	Distant Road Traffic Noise, faint hum from plant
2	Powis Close	40.3	38.0	36.2	58.5	Plant Noise (500Hz hum), Freight Train
3	Blacksmith Way	50.1	49.1	45.8	62.7	Road Traffic Noise from M4. Intermittent clicking from nearby animal deterrent, some local road traffic noise

Table 4-7 – Summary of unattended measured sound levels

Measurement ID	Address	Measured sound levels, dB							
		Daytime				Night-time			
		$L_{Aeq,16h,16h}$	$L_{AF10,16h}$	$L_{AF90,16h}$	L_{AFmax}	$L_{Aeq,8h}$	$L_{AF10,8h}$	$L_{AF90,8h}$	L_{AFmax}
1	Vantage site, near Pencarn Avenue	52.8	51.6	45.2	96.9	48.7	45.7	40.8	75.8
2	Powis Close*	62.3	60.9	49.8	89.6	58.2	52.6	44.0	96.4
3	1 Nant-Y-Moor	56.3	54.8	51.0	85.3	49.2	49.7	45.4	74.6

*It is noted that there were high noise levels in the evening and early morning at this location, as shown in Appendix B. These high noise level conditions were not observed during the attended measurements. It is therefore considered that the unattended measurements are not representative of typical conditions and the attended measurements have been used to define the background noise climate.

Throughout the attended measurements, observations were made on the existing acoustic environment at each location.

The weather conditions during the 2019 acoustic surveys were dry with an air temperature of between 18 and 27 °C. The wind conditions were still. The weather conditions are considered appropriate for acoustic surveys.

4.4.3. Noise survey during 2020

The measured sound levels at each type of generator in CWL11 were used to calculate the sound power for each type of generator engine. The calculated sound power was compared against data provided in manufacturers data. In all cases, measurements correlated well with stated values and were within a tolerance expected when measuring source data in situ rather than under laboratory conditions.

During the acoustic survey, observations were made on the presence of distinct tonal components emanating from the generator engines. Tones from the generator engines were not perceptible at receptor locations.

Data from the survey has been used to identify potential tones using the objective method described in BS4142. An initial analysis shows potential tones from some engine types in CWL11. The Kohler generators that are the same as those for CWL13 did not have any tones.

5. Baseline Noise Levels

5.1. Summary of measured sound levels

In 2018, the main sound sources were identified as local and distant roads, including the A48 and M4, birdsong, water, construction works at IQE, and equipment operating at IQE, with equipment sound from Vantage only occasionally being audible.

In 2019, the main sound sources were identified as local and distant roads, including the A48 and M4, birdsong, plant sound from various sites including Vantage and G24 Power (especially at Powis Close), occasional aircraft, and one night-time occurrence of a freight train approximately 800m to the south-east. Construction sound from IQE was no longer present in 2019 although some light construction works were present on the Vantage site. These were intermittent and are judged to have had no consequence on the measured background sound levels.

The background sound levels used in the BS 4142 assessment are:

Table 5-1 – Background Noise Levels – Receptors with Noise Measurements

Receptor ID	Address	Background sound levels, dB		Basis
		Daytime L_{A90}	Night-time L_{A90}	
2	Blacksmith Way	51	45	Unattended measurements, 2019
3	Buchanan Way	50	-	Attended measurements, 2019
5 & 6	Pencarn Avenue	45	41	Unattended measurements, 2019
11 & 12	Powis Close	36	36	Attended measurements, 2019

5.2. Estimates of sound levels at other receptors

In addition to those locations where sound measurements have been taken, there are three additional noise sensitive locations which are included in the assessment. The background sound levels at these receptors have been estimated from the results in Table 5-1, taking into consideration the main baseline sound sources is road traffic noise.

Table 5-2 – Background Noise Levels – Additional Receptors

Receptor ID	Address	Background sound levels, dB		Basis
		Daytime L_{A90}	Night-time L_{AF90}	
1	Church Crescent	49	43	2 dB lower than Blacksmiths Way[3].
4	Cardiff Road	47	43	2 dB higher than Pencarn Avenue[4]
7-10	Edmundsbury Road	40	38	Between Pencarn avenue and Powis Close

[3] 2 dB lower than measurements on Blacksmiths Way to account for being further from main road sources.

[4] Measurements at Pencarn Avenue and Buchanan Way are both approximately 150 m from A48, which will be the main noise source for the receptor at Cardiff Road. Therefore, a case could be made to use the average of the measurements on Pencarn Avenue and Buchanan Way. However, the noise levels at Buchanan Way are influenced to a greater level by traffic on M4. Therefore, it is our professional judgement that a baseline noise level 2 dB greater than Pencarn Avenue is suitable as it accounts for greater contributions from A48 whilst also noting levels would be lower than Buchanan Way due to being further from M4.

6. Assessment

6.1. Methodology

A BS 4142 assessment has been undertaken for the operation of the complete CWL13 site. This requires the specific sound level to be predicted for a typical one-hour period when the generator engines are in operation during the daytime, or a 15-minute period at night-time. Based on the types of generator engine testing that take place at Vantage, the following operating scenarios have been considered:

1. Quarterly testing, where individual engines are each tested sequentially for 15 minutes. As the sequential testing of individual engines could last for more than one hour, a single one-hour period is used. The noise levels from the four engines with the highest levels at each receptor are used as a worst case. This type of testing is also considered to be representative of sound levels expected from break-fixes.
2. Quarterly testing, where individual generator engines are tested sequentially for 2 hours. As the testing lasts for more than one hour, a single one-hour period is used.
3. Black building test, where all generator engines in a cell are operating simultaneously, for 15 minutes. No load shedding has been assumed for the assessment of the black building test.
4. Cumulative testing scenario, where engines on CWL13 may be tested at the same time as engines on either CWL11 or, CWL12.
5. Emergency scenario, where all 60 of the CWL13 engines are activated and operate simultaneously.
6. Cumulative emergency scenario, where all engines on the CWL11, CWL12 and CWL13 sites are activated and operate simultaneously.

A 3D noise model has been constructed using SoundPlan Version 8.2 software to predict the specific sound levels at the identified sensitive receptors for a number of operational scenarios. The noise model calculates sound propagation in accordance with ISO 9613-2 and considers ground topography, the absorption of the intervening ground type, dimensions of nearby buildings or structures that may provide screening, and on-time of the generator engines and AHUs.

The specific sound levels outputted from the noise model have been used to undertake a BS 4142 assessment taking into account the measured background sound levels obtained from the acoustic survey. Acoustic penalties have been applied to calculate the rating level for the daytime and the night-time assessment periods in line with the BS 4142 methodology. These are required to consider acoustic features that may cause annoyance to sensitive receptors. The BS 4142 acoustic penalties applied are described in Section 6.5.1.

To provide a conservative assessment, the higher of manufacturer or measured sound power (calculated using EMMUA140[5] where appropriate) is used for each generator engine type. A frequency profile for each generator engine type has been derived from measured data during the 2018 and 2020 acoustic surveys, and then applied to the sound power levels used in the model. Information about the sound power levels is provided in Section 6.3 and Appendix B.

6.2. Noise modelling assumptions and impact limits

6.2.1. Base mapping

The ground topography was modelled using open-source LiDAR data accompanied with ground height information shown on scheme drawings at Vantage. The ground type was modelled as mixed ground using an absorption coefficient of 0.6 throughout the study area, with large areas of soft ground (e.g. fields) having an absorption coefficient of 1.

The locations of buildings in proximity to Vantage were modelled using OS Open Data and their heights were set to 6 m above ground level. Site observations and online mapping resources such as Google Streetview were used to identify taller buildings and estimate appropriate heights, which included industrial buildings at Imperial Park.

[5] The Engineering Equipment and Materials Users Association – Noise Procedure Specification, Publication 140: 1985

Receivers were modelled at heights of 1.5 m and 4 m above ground level at sensitive receptors of interest, with additional receivers added for taller buildings as required. The worst-case predictions are reported.

6.2.2. Site features

Due to the distance between the engines and nearest sensitive receptors, the engines were modelled as point sources radiating sound omnidirectionally. The point sources were positioned at the top of the engines (approximately 2.5 m-2.8 m above ground level) in order to predict the worst-case sound emissions. The positions of the engines were modelled in accordance with scheme drawings.

The CWL13 building includes a 6 m high acoustic louvred parapet to minimise impacts from the AHUs. For the purpose of this assessment the acoustic louvred parapet has been modelled with an acoustic performance of R_w 25dB.

6.2.3. Existing Site features

The CWL11/12 site has a permit to operate 77 engines at CWL11 and has a permit variation application to include further 65 engines on CWL11 and 60 new engines on CWL12. For the purpose of this assessment, it has been assumed that CWL11/12 will be built and fully operational when CWL13 is fully operational. The assessment of noise for CWL13 is provided in this Section. Interaction of noise from CWL13 with CWL11/12 is considered in the cumulative assessment (Section 7).

6.2.4. Quarterly testing

During Quarterly testing, engines are run individually, either for 15 minutes or 2 hours. The noise modelling looks at a one-hour period with continuous operation of engines, identifying the range of sound levels from all engines, with the highest sound level used to assess the impacts in a worst case scenario.

6.2.5. Black building testing

For each cell in the black building test assessment all six of the engines in the cell are assumed to start up and run for the duration of the test (15 minutes).

6.2.6. Emergency scenario

All 60 engines are assumed to run at during the theoretical emergency scenario.

6.3. Source sound levels

The engines for CWL13 are the same as one of the types in use at CWL11/12. This type of engine has been modelled using the measured data which was slightly higher than that given in the engine data sheet, shown in Table 6-1. The conversion to sound power from measurements uses the size of the generator engine and the calculation method for large sources from EEMUA140.

Table 6-1 – Modelled Sound Power Levels for CWL13 generators

Engine type	Engine Datasheet	Model / Sound attenuation	Sound pressure level from manufacturer, dB(A)	Engine size, m	Sound power level, dB(A)
Kohler	KD1650E	KD45V20-5DES with WB Power Services Acoustic Enclosure	65 at 1m	2.4x6x2.6	88*

*Measured data used due to being higher than manufacturer data

Although frequency data was not provided in product sheets, a frequency profile has been used based on measurements undertaken during 2020. This approach accounts for the performance of the acoustic treatment of the engines more accurately. The assessment has assumed that the CWL13 AHUs have a maximum sound power level of 77.5dB.

6.4. Specific sound levels

6.4.1. AHUs

The predicted free-field specific sound levels for the AHUs are provided in Table 6-2. The sound level is given for the one-hour assessment period during the daytime, and the 15 minute assessment period at night-time.

Table 6-2 – Predicted specific sound levels - AHUs

ID	Address	Floor	Specific Sound Level ($L_{Aeq,T}$ dB)
1	14 Church Crescent	Ground	18.6
		First	19.1
2	1 Nant-Y-Moor Cottages, Blacksmiths Way	Ground	20.6
		First	20.6
3	Teddies Nursery	Ground	22.5
		First	23.1
4	1-4 Cardiff Road	Ground	27.6
		First	27.9
5	19 Pencarn Avenue	Ground	17.1
		First	17.8
6	11 Pencarn Avenue	Ground	31.1
		First	32.1
7	61-65 Edmundsbury Rd	Ground	24.1
		First	25.6
8	89-95 Edmundsbury Rd	Ground	31.3
		First	32.0
9	117-119 Edmundsbury Rd	Ground	29.7
		First	30.9
10	50-62 Edmundsbury Rd	Ground	24.8
		First	28.6
11	14-16 Powis Close	Ground	30.9
		First	32.0
12	49 Powis Close	Ground	31.5
		First	32.1

6.4.2. Quarterly testing

The predicted free-field specific sound levels for the quarterly testing scenario described above are provided in Table 6-3. A range of sound levels is given which identifies the highest and lowest sound levels of each duration of testing. The specific sound level is for the full one hour daytime assessment period, and for 15 minute tests it is assumed that four different engines are tested within a one hour period. The cells with the single highest engine sound level are indicated.

Table 6-3 – Predicted specific sound levels during routine testing

ID	Address	Floor	Cell with highest engine sound level	Specific Sound Level ($L_{Aeq,1hr}$ dB)		
				Range of sound levels – 15 min tests	Worst case 1 hour (from 15 min or 2h tests)	Worst case 1 hour + AHUs
1	14 Church Crescent	Ground	G.01	0.0 to 10.4	10.4	19.2
		First	G.01	0.0 to 11.1	11.1	19.7
2	1 Nant-Y-Moor Cottages, Blacksmiths Way	Ground	G.01	0.0 to 13.9	13.9	21.4
		First	G.01	0.0 to 13.8	13.8	21.4
3	Teddies Nursery	Ground	G.04	0.0 to 14.6	14.6	23.2
		First	G.04	0.0 to 15.2	15.2	23.8
4	1-4 Cardiff Road	Ground	G.01	0.0 to 24.7	24.7	29.4
		First	G.01	0.0 to 28.0	28.0	31.0
5	19 Pencarn Avenue	Ground	G.05	0.0 to 10.2	10.2	17.9
		First	G.05	0.0 to 11.5	11.5	18.7
6	11 Pencarn Avenue	Ground	G.04	0.0 to 30.4	30.4	33.8
		First	G.05	0.0 to 31.7	31.7	34.9
7	61-65 Edmundsbury Rd	Ground	G.05	0.0 to 10.2	10.2	24.1
		First	G.05	0.3 to 11.2	11.2	25.6
8	89-95 Edmundsbury Rd	Ground	G.10	1.5 to 28.9	28.9	33.3
		First	G.10	1.7 to 29.1	29.1	33.8
9	117-119 Edmundsbury Rd	Ground	G.10	0.0 to 24.8	24.8	30.9
		First	G.10	0.0 to 26.6	26.6	32.3
10	50-62 Edmundsbury Rd	Ground	G.10	0.0 to 24.7	24.7	27.8
		First	G.10	0.4 to 26.7	26.7	30.8
11	14-16 Powis Close	Ground	G.07	0.0 to 28.2	28.2	32.8
		First	G.07	0.0 to 30.5	30.5	34.3
12	49 Powis Close	Ground	G.10	0.0 to 31.1	31.1	34.3
		First	G.10	0.0 to 31.7	31.7	34.9

6.4.3. Black building test

The predicted free-field specific sound levels for the black building test scenario described above are provided in Table 6-4. A range of sound levels is given which identifies the highest and lowest sound levels of the cells.

In each case, the range of sound level given is for the full one-hour daytime assessment period. The assessment assumes that the engines run for 15 minutes. The total time is 25% of the one-hour assessment period and the specific level is 6 dB lower than the output from the sound model to take the 25% on-time into account.

Only one black building test would take place per day, during daytime hours. No testing would take place at weekends or on bank holidays.

Table 6-4 – Predicted specific sound levels during black building tests

ID	Address	Floor	Cell with highest engine sound level	Specific Sound Level ($L_{Aeq,1hr}$ dB)		
				Range of sound levels	Worst case 1 hour (on-time corrected)	Worst case 1 hour + AHUs
1	14 Church Crescent	Ground	G.01	7.8 to 18.2	12.2	19.5
		First	G.01	7.8 to 18.9	12.9	20.0
2	1 Nant-Y-Moor Cottages, Blacksmiths Way	Ground	G.01	7.8 to 21.6	15.6	21.8
		First	G.01	7.8 to 21.5	15.5	21.8
3	Teddies Nursery	Ground	G.04	7.8 to 22.4	16.4	23.5
		First	G.01	7.8 to 22.9	16.9	24.0
4	1-4 Cardiff Road	Ground	G.01	7.8 to 32.3	26.3	30.0
		First	G.01	7.8 to 35.7	29.7	31.9
5	19 Pencarn Avenue	Ground	G.05	6.4 to 16.5	10.5	18.0
		First	G.05	7.3 to 17.7	11.7	18.8
6	11 Pencarn Avenue	Ground	G.04	7.8 to 38.0	32.0	34.6
		First	G.05	7.8 to 39.3	33.3	35.8
7	61-65 Edmundsbury Rd	Ground	G.05	2.0 to 15.3	9.3	24.2
		First	G.05	2.3 to 16.0	10.0	25.7
8	89-95 Edmundsbury Rd	Ground	G.10	4.7 to 35.9	29.9	33.7
		First	G.10	4.8 to 36.1	30.1	34.2
9	117-119 Edmundsbury Rd	Ground	G.10	1.8 to 32.3	26.3	31.3
		First	G.10	1.8 to 34.1	28.1	32.7
10	50-62 Edmundsbury Rd	Ground	G.10	1.8 to 31.9	25.9	28.4
		First	G.10	1.8 to 34.1	28.1	31.4
11	14-16 Powis Close	Ground	G.10	2.1 to 35.8	29.8	33.4
		First	G.07	2.4 to 38.0	32.0	35.0
12	49 Powis Close	Ground	G.10	1.8 to 38.6	32.6	35.1
		First	G.10	1.8 to 39.4	33.4	35.8

6.4.4. Emergency scenario

The predicted free-field specific sound levels for the emergency operational scenario for CWL13 plant described above are provided in Table 6-5. The sound level is given applies to both the one-hour assessment period during the daytime, and the 15 minute assessment period at night-time. As a worst case, load shedding is not accounted for in this assessment.

Table 6-5 – Predicted specific sound levels during emergency conditions

ID	Address	Floor	Specific sound Level ($L_{Aeq,T}$ dB)	Specific Sound Level including AHUs ($L_{Aeq,T}$ dB)
1	14 Church Crescent	Ground	24.8	25.7
		First	25.5	26.4
2	1 Nant-Y-Moor Cottages, Blacksmiths Way	Ground	28.1	28.8
		First	28.0	28.7
3	Teddies Nursery	Ground	29.2	30.0
		First	29.9	30.7
4	1-4 Cardiff Road	Ground	37.7	38.1
		First	40.8	41.0
5	19 Pencarn Avenue	Ground	21.7	23.0
		First	22.6	23.8
6	11 Pencarn Avenue	Ground	44.4	44.6
		First	45.3	45.5
7	61-65 Edmundsbury Rd	Ground	21.5	26.0
		First	22.2	27.2
8	89-95 Edmundsbury Rd	Ground	40.4	40.9
		First	40.6	41.2
9	117-119 Edmundsbury Rd	Ground	37.9	38.5
		First	39.7	40.2
10	50-62 Edmundsbury Rd	Ground	36.1	36.4
		First	39.0	39.4
11	14-16 Powis Close	Ground	42.3	42.6
		First	44.4	44.6
12	49 Powis Close	Ground	43.7	44.0
		First	44.5	44.7

6.5. BS 4142 assessment

It is important that this assessment is read in conjunction with the context provided in Section 10. This section provides additional information that should be considered when drawing conclusions from the impacts and sound levels presented.

Results tables are presented in Appendix D.

6.5.1. Rating level corrections

A BS 4142:2014 + A1:2019 assessment has been undertaken based on the specific sound levels calculated above. An intermittency correction has been included for the 15 minute quarterly servicing scenario to allow for small time gaps between the testing of individual engines. Rating level corrections have been applied that are consistent with assessments and applications for the existing Vantage data centre.

The ratings levels include the following acoustic penalties:

- Quarterly servicing:

- + 3 dB for intermittency during the 15-minute tests as individual engines could be switched on and off within the 1-hour reference time period.
    - No acoustic penalties during the 2-hour tests as the sound source would be steady without any intermittent or impulsive features.
- Black building test and emergency conditions:
    - No acoustic penalties have been applied as the sound source would be steady without any intermittent or impulsive features.

Although the sound of the AHUs would be neither tonal, impulsive or intermittent they have potential to be readily distinctive against the residual acoustic environment, and a + 3 dB correction has been applied.

The acoustic penalties were arithmetically added to the specific sound levels as set out in Section 6.3 for each source to give an overall rating level. A worked example of these calculations is shown in Appendix C. The rating levels and the level of impact according to BS 4142 for each operational scenario are presented in the following subsections.

It should be noted that the 77 permitted engines on the existing CWL11/12 site have been routinely tested since 2009. To avoid background creep in the assessment, these testing periods are not included in the background noise data, and the impact of the 60 proposed engines for CWL13 is assessed without accounting for contributions from CWL11/12 engines.

6.5.2. AHUs

Although the AHUs are not included within the permit, the assessment shows that most impacts from their operation are predicted to be negligible during the day and at night. There are minor adverse impacts at some properties on Powis Close. These impacts are not considered to be significant.

6.5.3. Quarterly testing (CWL13)

The rating levels and resultant impacts from both types of quarterly testing are provided in Table D-1 in Appendix D.

The impacts when considering the quarterly testing in combination with the AHUs were predicted to negligible at all locations for the 2-hour quarterly tests. Negligible impacts were also predicted at the majority of sensitive receptors for the 15-minute tests, with minor adverse impacts at some locations on Powis Close. Although first floor impact levels at 49 Powis Close are predicted to be +1.9dB, this impact would only be during testing of the engines with highest sound levels at the receptor (for cell G.10) if four engines were to be tested sequentially within the one hour assessment period. During the testing of the engines for all of the other cells, or if fewer engines were tested per hour, impacts would be lower. Therefore, this impact, and all other impacts from quarterly testing, are not considered to be significant.

6.5.4. Black building testing (CWL13)

The rating levels and resultant impacts from the black building testing are provided in Table D-2 in Appendix D. Only one black building test would take place per day, during daytime hours. No testing would take place at weekends or bank holidays. The assessment shown in Appendix D is worst case as it assumes that the test lasts for 15 minutes.

During the black building testing negligible impacts were predicted at the majority of sensitive receptors, with minor adverse impacts at some locations on Powis Close. These impacts are not considered to be significant.

6.5.5. Emergency scenario (CWL13)

The impacts arising during emergency conditions, where all CWL13 generators are operational, are provided in Table D-3 and Table D-4 in Appendix D for daytime and night-time respectively. Load shedding has not been considered for the assessment of the emergency scenario.

Impacts at most receptors would be negligible or minor adverse during the emergency scenario for both daytime and night-time, and these impacts are not considered to be significant. There would be a moderate adverse impact at Powis Close (for day and night time periods). These moderate impacts are potentially significant; however, the likelihood of a power failure is very low, due to Vantage's dual linkage direct to the National Grid and the reliability of the grid. During the operation of the existing site since 2009 there has not been a total power failure on site that would have caused the emergency scenario to occur. Therefore, it is considered that the moderate adverse impacts at Powis Close are not significant in this context.

7. Cumulative Assessment

The section looks at the cumulative impact of sound from the CWL11/12 facility and the proposed CWL13 facility at sensitive receptors.

7.1. Generator testing

For the routine testing (quarterly and black building) the bounding case for the assessment of testing at CWL13 coinciding with testing at CWL11/12 is the 15 minute quarterly test. This is because this test applies a 3dB correction for intermittency (i.e. the effects of stopping and starting engines within a 1 hour period where individual engines are tested sequentially). For the black building tests, where higher numbers of engines in a cell tun together, there is no intermittency correction and the test lasts for 15 minutes out of the one hour assessment period. Similarly no corrections are applied for the 2 hour quarterly tests. The calculations show that impacts from 15 minute quarterly testing are higher than black building testing or from 2 hour quarterly testing.

The generators at CWL11 and CWL12 will not be tested simultaneously, so the cumulative assessment has considered the worst case impacts from CWL11/12 as a whole combined with the worst case impacts from CWL13. Table 7-1 shows the worst case cumulative sound impacts of generator testing noise across the two facilities, irrespective of the type of testing. At each receptor the highest noise levels from the CWL11/12 assessment have been combined with the highest levels from the CWL13 assessment to give a worst case assessment. The rating level and BS 4142 assessment leading to the assignment of an impact level is provided in Appendix D.5.

The free-field specific sound levels shown in Table 7-1 include sound emissions from AHUs. Although the AHUs are not part of the permit, the assessment shows that impacts at receptors are from a combination of sound from both the engine testing and the air handling units.

Table 7-1 – Cumulative sound impacts from generator testing

ID	Address	Floor	Specific Sound Level from CWL11/12 ($L_{Aeq,T}$ dB)	Specific Sound Level from CWL13 ($L_{Aeq,T}$ dB)	Total Specific Sound Level from all sites ($L_{Aeq,T}$ dB)	BS 4142 level of impact
1	14 Church Crescent	Ground	37.0	19.2	37.0	Negligible
		First	37.6	19.7	37.6	Negligible
2	1 Nant-Y-Moor Cottages, Blacksmiths Way	Ground	40.7	21.4	40.7	Negligible
		First	41.2	21.4	41.2	Negligible
3	Teddies Nursery	Ground	44.5	23.2	44.6	Negligible
		First	45.8	23.8	45.9	Negligible
4	1-4 Cardiff Road	Ground	49.5	29.4	49.6	Moderate Adverse
		First	52.0	31.0	52.0	Moderate Adverse
5	19 Pencarn Avenue	Ground	47.0	17.9	47.0	Moderate Adverse
		First	48.2	18.7	48.2	Moderate Adverse
6	11 Pencarn Avenue	Ground	45.4	33.8	45.7	Minor Adverse
		First	46.7	34.9	47.0	Moderate Adverse

ID	Address	Floor	Specific Sound Level from CWL11/12 ($L_{Aeq,T}$ dB)	Specific Sound Level from CWL13 ($L_{Aeq,T}$ dB)	Total Specific Sound Level from all sites ($L_{Aeq,T}$ dB)	BS 4142 level of impact
7	61-65 Edmundsbury Rd	Ground	37.9	24.1	38.1	Minor Adverse
		First	39.9	25.6	40.0	Minor Adverse
8	89-95 Edmundsbury Rd	Ground	38.6	33.3	39.7	Minor Adverse
		First	39.5	33.8	40.5	Minor Adverse
9	117-119 Edmundsbury Rd	Ground	38.2	30.9	39.0	Minor Adverse
		First	40.3	32.3	41.0	Minor Adverse
10	50-62 Edmundsbury Rd	Ground	33.7	27.8	34.7	Negligible
		First	35.4	30.8	36.7	Negligible
11	14-16 Powis Close	Ground	37.0	32.8	38.4	Moderate Adverse
		First	38.5	34.3	39.9	Moderate Adverse
12	49 Powis Close	Ground	35.0	34.3	37.7	Minor Adverse
		First	37.2	34.9	39.2	Moderate Adverse

Table 7-1 shows that no major adverse impacts would occur from the cumulative testing, although moderate adverse impacts were predicted for 1-4 Cardiff Road, 11 Pencarn Avenue, 19 Pencarn Avenue, 14-16 Powis Close and 49 Powis Close.

At the sensitive receptors at Powis Close, the highest noise levels from testing at CWL11/12 and at CWL13 are similar, and the cumulative worst case testing increased the overall specific sound level by 1.4-2.7 dB compared with testing at CWL11/12 alone. However the overall impact magnitude identified for CWL11/12 does not change with simultaneous generator testing at CWL13.

At Cardiff Road and Pencarn Avenue, the worst case the sound contributions from CWL13 are lower than those from CWL11/12 and had a negligible influence on the cumulative specific sound level.

Negligible or minor adverse impacts were predicted at all other sensitive receptors, and other cell / engine combinations of simultaneous testing would give rise to lower impacts than those shown above.

For simultaneous black building testing, impacts would be lower than shown as these do not incur the 3dB correction for intermittency. Given that one black building test would be permitted per day per site and they are each only 15 minutes long, the likelihood of two of these occurring at the same time is also lower.

As the predicted specific sound levels and resulting impact magnitudes from cumulative generator testing were dominated by the sound emissions from CWL11/12, it can be concluded that the cumulative effect of simultaneous CWL13 generator testing would not be significant and that the operational testing regime for CWL13 can be managed independently of that of CWL11/12.

7.2. Emergency scenario (CWL11/12 and CWL13)

Table 7-2 shows the cumulative impacts of generator noise across the two facilities during an emergency scenario, where power is lost to all sites at the same time. These calculations include contributions from all generators and AHUs. The simultaneous loss of power to both facilities would be very unlikely and would represent worst case conditions.

Table 7-2 – Cumulative Assessment - Specific Sound Levels

ID	Address	Floor	Specific Sound Level from CWL11 and CWL12 ($L_{Aeq,T}$ dB)	Specific Sound Level from CWL13 ($L_{Aeq,T}$ dB)	Total Specific Sound Level from all sites ($L_{Aeq,T}$ dB)
1	14 Church Crescent	Ground	47.9	25.7	47.9
		First	48.6	26.4	48.7
2	1 Nant-Y-Moor Cottages, Blacksmiths Way	Ground	51.7	28.8	51.7
		First	51.7	28.7	51.8
3	Teddies Nursery	Ground	56.6	30.0	56.6
		First	57.3	30.7	57.4
4	1-4 Cardiff Road	Ground	62.3	38.1	62.4
		First	63.5	41.0	63.5
5	19 Pencarn Avenue	Ground	58.0	23.0	58.0
		First	59.3	23.8	59.3
6	11 Pencarn	Ground	49.4	44.6	50.6
		First	50.4	45.5	51.6
7	61-65 Edmundsbury Rd	Ground	42.0	26.0	42.1
		First	44.6	27.2	44.6
8	89-95 Edmundsbury Rd	Ground	42.3	40.9	44.6
		First	43.7	41.2	45.6
9	117-119 Edmundsbury Rd	Ground	43.7	38.5	44.9
		First	46.3	40.2	47.3
10	50-62 Edmundsbury Rd	Ground	39.1	36.4	41.0
		First	40.7	39.4	43.1
11	14-16 Powis Close	Ground	41.1	42.6	45.0
		First	42.5	44.6	46.7
12	49 Powis Close	Ground	40.4	44.0	45.6
		First	41.9	44.7	46.6

As shown in the table above, the total specific sound level is dominated by CWL11/12 at most receptors and the CWL13 site would generate sound levels up to 35dB lower than CWL11/12. At some receptors in Edmundsbury Road and Powis Close the noise levels from CWL11/12 and CWL13 would be similar.

Table D-5 and Table D-6 (see Appendix D) show the impact assessment for the cumulative emergency scenario for day and night time. The assessment predicts moderate or major adverse impacts at most receptors. The largest contribution to the impacts is, in general, from the engines on CWL11/12.

During an emergency in the daytime, the effect of the CWL13 engines does not adversely affect the magnitude of the impacts predicted for CWL11/12, with the exception of one receptor on Edmundsbury Road and receptors on Powis Close. In Edmundsbury Road the contribution from CWL11/12 is negligible and that from CWL13 is minor; in combination this results in a moderate cumulative impact. For receptors in Powis Close the assessment shows moderate impacts from CWL13, and these would cause the impact to increase from moderate (for CWL11/12) to major cumulatively. However, the CWL13 main building provides screening of noise from CWL11/12, and numerically the cumulative major impact is smaller than the equivalent major impact from CWL11/12 without the screening effect of the CWL13 building.

During an emergency in the night-time, the effect of the CWL13 engines is similar to the effects in the daytime. In Edmundsbury Road the operation of CWL13 engines (a minor impact) causes a moderate impact with CWL11/12 to become a major cumulative impact. The effect of CWL13 at receptors in Powis Close is the same as that during the day.

All moderate and major impacts in this cumulative scenario are potentially significant, however, the likelihood of a power failure is very low, due to Vantage's dual linkage direct to the National Grid and the reliability of the grid. During the operation of the existing site since 2009 there has not been a total power failure on site that would have caused the emergency scenario to occur. Therefore, it is considered that the moderate and major adverse impacts are not significant in this context.

The assessment shows that the impacts from the emergency scenario are higher in the cumulative emergency assessment compared to those for the proposed CWL13 facility, and sound from the CWL11/12 would be dominant during the emergency operation scenario, except at Powis Close where noise levels from CWL11/12 would be similar to those from CWL13. At Powis Close noise levels from CWL11/12 are reduced due to screening from the CWL13 building.

8. Uncertainty

In accordance with BS 4142, this section summarises sources of uncertainty that can influence the assessment. Uncertainty can arise from the use of measured sound levels in calculations, assumptions about the sound sources, the calculation method, and simplification of data or site conditions.

Sources of uncertainty have been minimised as far as possible by undertaking the baseline acoustic survey and predicting the specific sound levels from the site using validated calculation methods. Nevertheless, the following aspects for the assessment have introduced uncertainty:

- The baseline acoustic survey was relatively short term, based on measurements over a few days. Longer measurements would give a more reliable assessment of baseline conditions.
- The frequency data from the acoustic survey has been used to estimate the spectrum of the generator engines with an acoustic enclosure.
- Detailed LiDAR has been used to provide a more accurate ground model, and therefore better reflects the real-world situation and sound propagation between the proposed development and the nearest sensitive receptors assessed in this study.
- The specific sound levels were calculated assuming that sound is propagating over mixed hard and soft ground to the receptors and that there is no other localised screening which may reduce sound levels at receptors.
- Additional receptors from those used in the assessments of CWL11 and CWL12 have been added on Edmundsbury Road as the proposed site is closer to these receptors than the existing data centre (CWL11/12). This has resulted in greater accuracy in the reported receptor names, and additional screening from buildings has been put into the model for previously reported receptors.
- Rating corrections have been applied to the specific sound level for each type of source rather than the total specific sound level for all sound sources combined. These corrected levels were then logarithmically summed to give an overall rating level.
- The effect of load shedding has not been included in this assessment.

9. Mitigation

Provided that the selected plant for the development does not exceed the sound levels specified in Section 6 no further mitigation measures will be required.

The cumulative testing assessment has taken into account all noise mitigation measures that were included in the designs of the CWL11/12 facility. No further mitigation measures are proposed as impacts from all CWL13 engines are not significant in any testing scenario.

10. Context

To fully assess impacts, BS 4142 requires context to be considered. Contextual factors affecting the impact significance are discussed in the subsections below.

10.1. Site and locality

The CWL13 site is located in an already industrialised area, including an existing data centre. The background sound levels at nearby receptors already contain some sound from the existing industrial and commercial units adjacent to the CWL13 site. There is a permitted data centre (CWL11/12) in the vicinity of the CWL13, part of which has not yet been built. Therefore, the proposed CWL13 is in character with the existing and planned noise sources in the area.

10.2. Context with existing facility (CWL11/12)

There are engines on the existing site (CWL11/12) that have been operational since 2009 and that are subject to the same routine testing regime as set out for CWL13.

Sound levels from the testing of the permitted generators on the existing CWL11/12 site have previously been assessed to be up to +13.4dB above background levels at receptors during Quarterly testing (15-minute tests) and +10.4dB during black building testing. To date, no complaints have been received from local residents in relation to the sound from these tests. For comparison, the proposed site has been assessed as having only up to +1.9dB above background during Quarterly testing and up to +1.3dB above background during black building testing.

Assessment of the emergency scenario for existing CWL11/12 site has previously showed potential impact from generators of +17.9dB above background at receptors on Powis Close. For comparison, the CWL13 site has been assessed as having up to +9dB above background during daytime and night-time.

The total testing period for the proposed CWL13 site would cover approximately 11 weeks out of the year. No testing would take place during night-time hours or at weekends (or bank holidays), which are particularly sensitive time periods in terms of sleep and rest.

10.3. Interpretation of BS 4142

BS 4142 notes that an increase of 5dB above background noise levels is an indication of an ‘adverse’ impact and an increase of 10dB is an indication of a ‘significant adverse’ impact. This assessment has taken the conservative approach of assessing a 5dB increase over background noise as potentially being significant.

10.4. Internal noise levels

BS 8233 ‘*Guidance on sound insulation and noise reduction for buildings*’ provides recommendations for overall noise levels inside of buildings. For daytime, the recommended level for suitable resting inside living rooms and bedrooms is 35dB $L_{Aeq,16h}$. The standard also explains that sound insulations from a partially open window can be assumed to be 15dB. This would mean that noise levels at the façade of a building would need to be 50dB $L_{Aeq,16h}$ for internal levels to exceed the recommended 35dB $L_{Aeq,16h}$ limit. Rating sound levels at receptor facades do not exceed 50dB $L_{Ar,1h}$ during routine testing or the emergency scenario for CWL13. Therefore, it can be demonstrated that noise levels from the CWL13 site will not exceed the recommended internal noise levels during the day to achieve suitable resting conditions, and the resulting impacts are not significant.

10.5. Temporary impacts

The cumulative emergency scenario (all engines and AHUs from CWL11/12 and CWL13 operating simultaneously) is an extremely unlikely scenario. Under this scenario, the assessment showed that there is potential for significant impacts and sound levels could exceed 50dB at some receptor facades. However, the potential impacts and sound levels would be temporary whilst the operator works to resolve the power outage. Temporary elevated levels would not affect health and well-being of people and are not considered to be significant. The cumulative emergency scenario shows that the largest contribution to impacts would come from the existing CWL11/12 site. In the 13 years that CWL11 has been operating, a full emergency scenario has never occurred.

11. Conclusion

Vantage provides wholesale out-of-town data centre space for some of the world's largest companies at its existing facility (CWL11/12) at Imperial Park in Newport. Due to the success of the existing Vantage facility and the significant demand for data facilities, the business has an ongoing requirement for additional capacity. A new data centre is proposed by Vantage at a site known as CWL13. The new facility will be located to the south east of the existing data centre. The CWL13 data centre will have ten new data halls within a single structure, with 60 associated emergency standby generators.

A BS 4142 worst case assessment of the impact of sound from CWL13 has been undertaken with reference to baseline conditions and manufacturer sound data. To fully assess impacts, BS 4142 requires context to be considered. This is discussed in Chapter 10 of the this report. An assessment has also been undertaken to look at the potential for cumulative impacts for operation CWL13 along with CWL11/12.

11.1. CWL13 site

The total routine engine testing time over the course of a year would be approximately the equivalent of 11 weeks.

It should be noted that there have been engines on the existing CWL11 site since 2009 that already undergo routine testing without complaints, and these existing engines have previously been assessed to have a higher sound level above background at the nearest receptors than the proposed CWL13 generators. These existing testing periods are not included in the background sound level measurements, demonstrating that this assessment is a worst-case assessment.

11.1.1. Generator sound levels

The new engines have been selected with sound levels to limit potentially significant impacts at receptors during routine testing. The assessment assumes the sound power level for the generators is 88dBA L_w.

11.1.2. Quarterly testing

No quarterly testing would take place at night, at weekends or on bank holidays. Predicted impacts from the 15 minute and 2 hour quarterly testing are generally negligible. Receptors on Powis Close are predicted to receive a minor adverse impact during the 15 minute quarterly testing. These impacts would only occur during the testing of engines closest to the receptor and impacts would therefore be lower during the testing of other engines on the site. In all cases, façade sound levels would not exceed 50dB and therefore internal sound levels would not exceed 35dB as recommended in BS8233. The impacts from quarterly testing at CWL13 are not considered to be significant.

11.1.3. Black Building testing

No black building testing would take place at night, at weekends or on bank holidays. There is only one black building test undertaken at CWL13 on any one day.

The impacts from black building testing would be negligible at all receptors except Powis Close where minor impacts are predicted. The impacts from black building tests at CWL13 are not considered to be significant.

11.1.4. Emergency scenario

The emergency scenario for CWL13 in isolation shows that most impacts at sensitive receptors would be negligible or minor adverse, which are not considered to be significant.

Moderate adverse impacts at Powis Close were predicted during the daytime and night time. The likelihood of this impact being realised is very low as the site will have dual national grid linkage. In addition to this, at the existing CWL11 site (which also has a dual connection to the national grid), an emergency scenario has not occurred since that site commenced operations in 2009. Therefore, it is considered that impacts from the emergency scenario for CWL13 are not significant.

11.2. Cumulative testing and emergency conditions (CWL11/12 and (CWL13)

The potential for cumulative impacts from generator testing and an emergency scenario across CWL11/12 and CWL13 has been examined. An assessment of concurrent generator testing across the two facilities demonstrates that the predicted specific sound levels and resulting impact magnitudes would be dominated by the sound emissions from CWL11/12, with CWL13 only notably influencing the overall cumulative sound levels at Powis Close by up to 2dB, which would not affect the overall impact magnitudes identified from CWL11/12. Therefore, testing generators at CWL13 at the same time as CWL11/12 would not be significant.

On this basis, it is considered that the operational testing regime for CWL13 can be managed independently of that of CWL11/12.

The cumulative emergency scenario, where all engines on CWL11/12 and CWL13 would be active simultaneously, shows that several moderate or major adverse impacts would occur. Given that this scenario is very unlikely to occur (as described above for CWL13 alone), these impacts are not considered to be significant.

Appendices

Appendix A. Glossary

Decibel (dB)

The unit of measurement used for sound pressure levels. The scale is logarithmic rather than linear. The threshold of hearing is 0 dB and the threshold of pain is 120 dB. In practical terms these limits are seldom experienced and typical levels lie within the range 30 dB (a quiet night-time level in a bedroom) to 90 dB (at the kerbside of a busy city street).

A-weighting:

An electrical frequency weighting used to represent the response of the human hearing mechanism to sound. A-weighted sound level is indicated either by placing the capital letter A after the letters dB to get dB(A) or it may be added as a subscript to the sound level parameter as in $L_{Aeq,T}$.

Percentile Level (Statistical Sound Level Indices, L_{AN}, L_{A10}, L_{A90})

L_{AN} is the dB(A) level exceeded N% of the time measured on a sound level meter with Fast(F) time weighting, e.g. L_{A90} the dB(A) level exceeded for 90% of the time, is commonly used to estimate background sound level. L_{A10}, the level exceeded for 10% of the time, is commonly used in the assessment of road traffic noise.

Research has shown that the arithmetic average of the 18, 1-hour L_{A10} levels (depicted as $L_{A10,18h}$) between 0600 and 2400 hours shows a reasonably good correlation with community responses to traffic noise. This unit is used in the UK for the assessment of road traffic noise.

Equivalent Continuous A-Weighted Sound Pressure Level ($L_{Aeq,T}$):

Equivalent continuous A-weighted sound pressure level is the steady sound level that has the same sound energy as the fluctuating A-weighted sound pressure level occurring over the same time period and at the same location.

Ambient Sound Level ($L_{Aeq,T}$):

Totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far.

Background Sound level ($L_{AF90,T}$):

The A-weighted sound pressure level of the existing ambient sound level that is exceed for 90% of a given time period, T, measured using time weighting 'Fast'.

Free-Field (acoustical):

Free-field means a position far away from any reflecting surfaces other than the ground. Several standards and guidelines recommend that to achieve free-field conditions the microphone should be positioned at least 3.5 metres from any reflecting surfaces.

Facade position:

A façade position is located one metre from a building façade or large vertical structure.

Appendix B. Acoustic survey data

B.1. Attended Measurements

Table B-1 – Measured sound levels at 11 Pencarn Avenue

Date	Time	Duration (minutes)	Measured sound levels, dB				Main sound sources
			$L_{Aeq,T}$	L_{AF10}	L_{AF90}	L_{AFmax}	
15/05/2018	07:35	15	51.2	52.8	45.2	70.0	Water from water feature, aircraft, construction works at IQE, birds
15/05/2018	09:39	15	53.3	56.7	43.5	76.4	As above, repositioned to top of bund
15/05/2018	12:52	15	51.3	54.5	45.5	71.2	Same position as previous measurement. Birds, train horn? NDG generators just audible
04/07/2019	23:21	15	40.7	39.4	37.4	49.7	Distant traffic, hum from plant
05/07/2019	00:32	15	38.5	38.3	36.3	43.7	Distant traffic, hum from plant
08/07/2019	14:01	15	49.4	42.7	39.1	73.6	Faint hum from plant, aircraft, birds
08/07/2019	15:39	15	44.9	43.3	39.9	58.4	Faint hum from plant, birds, some construction noise

Table B-2 – Measured sound levels at Powis Close

Date	Time	Duration (minutes)	Measured sound levels, dB				Main sound sources
			$L_{Aeq,T}$	L_{AF10}	L_{AF90}	L_{AFmax}	
15/05/2018	08:03	15	46.6	50.2	37.6	62.1	Birds, hum, road traffic
15/05/2018	13:15	15	42.2	43.0	35.2	67.7	Birds, distant roads, distant construction
05/07/2019	00:09	15	40.2	38.6	36.4	46.5	500Hz tone from plant
05/07/2019	01:21	15	40.5	37.4	36.0	58.5	500Hz tone from plant, freight train at 01:30
08/07/2019	13:10	14*	47.4	38.5	36.2	62.7	500Hz tone from plant, traffic (local), birds
08/07/2019	14:50	15	40.8	36.8	35.0	60.1	500Hz tone from plant, birds, local residents talking

*measurement cut short due to local workers revving their lorry's engine

Table B-3 – Measured sound levels at Blacksmith Way

Date	Time	Duration (minutes)	Measured sound levels, dB				Main sound sources
			$L_{Aeq,T}$	L_{AF10}	L_{AF90}	L_{AFmax}	
15/05/2018	08:37	15	59.2	57.8	51.7	78.7	Traffic, dog, birds, possible lawn mower
15/05/2018	13:44	15	59.0	56.8	50.8	82.0	Distant roads, DIY, birds, possible generator
04/07/2019	23:45	15	49.0	48.2	45.4	62.7	Traffic (M4), traffic (local), intermittent clicks from animal deterrent
05/07/2019	00:58	15	50.9	50.0	46.2	57.7	Traffic (M4), intermittent clicks from animal deterrent
08/07/2019	13:34	15	54.8	52.4	49.7	68.3	M4 Traffic is dominant, some local traffic, distant construction noise, birds, trees
08/07/2019	15:13	15	53.4	51.2	49.5	68.7	M4 Traffic is dominant, some local traffic, birds, trees

Table B-4 – Measured sound levels at Buchanan Way

Date	Time	Duration (minutes)	Measured sound levels, dB				Main sound sources
			$L_{Aeq,T}$	L_{AF10}	L_{AF90}	L_{AFmax}	
15/05/2018	09:05	15	60.6	64.9	50.3	75.5	Traffic, engines, water, nursery
15/05/2018	14:05	15	58.7	60.8	51.0	74.6	Local roads, distant roads, people, water
08/07/2019	14:27	15	57.1	54.7	48.6	84.4	Traffic, vehicles in nursery carpark, people, water

Figure B-1 – Measurement Locations

B.2. Unattended measurements:

Table B-5 – Unattended Measurements at Vantage site boundary, near Pencarn Avenue

Date	Time	Measured sound levels, dB			
		$L_{Aeq,T}$	L_{AF10}	L_{AF90}	L_{AFmax}
27/06/2019	12:00:00	50.1	51.4	44.2	71.1
27/06/2019	13:00:00	51.9	54.2	45.0	72.0
27/06/2019	14:00:00	49.6	51.9	43.9	71.1
27/06/2019	15:00:00	50.4	53.0	44.3	77.1
27/06/2019	16:00:00	48.7	51.2	45.1	66.3
27/06/2019	17:00:00	50.8	53.3	45.1	68.9
27/06/2019	18:00:00	49.3	51.7	44.9	67.7
27/06/2019	19:00:00	50.3	53.1	44.1	71.5
27/06/2019	20:00:00	46.0	45.9	41.9	69.1
27/06/2019	21:00:00	43.4	44.7	41.3	58.9
27/06/2019	22:00:00	43.3	44.5	40.7	59.7
27/06/2019	23:00:00	40.9	41.9	39.4	51.7
27/06/2019	00:00:00	39.8	40.8	38.3	50.9
27/06/2019	01:00:00	40.1	41.2	38.6	51.3
27/06/2019	02:00:00	40.3	41.6	38.7	52.9
27/06/2019	03:00:00	40.7	41.8	39.3	48.9
27/06/2019	04:00:00	52.6	48.5	41.1	73.1
27/06/2019	05:00:00	53.8	57.4	45.6	71.1
27/06/2019	06:00:00	50.6	52.7	45.3	75.8
01/07/2019	07:00:00	59.2	54.9	48.8	96.9
01/07/2019	08:00:00	52.3	54.1	49.7	70.0
01/07/2019	09:00:00	53.0	54.3	50.6	78.2
01/07/2019	10:00:00	51.8	53.3	49.4	72.0
01/07/2019	11:00:00	59.0	53.5	43.8	96.9

Table B-6 – Unattended Measurements at Powis Close

Date	Time	Measured sound levels, dB			
		$L_{Aeq,T}$	L_{AF10}	L_{AF90}	L_{AFmax}
05/07/2019	16:00	62.7	66.3	47.6	82.7
05/07/2019	17:00	59.2	56.1	43.0	84.3
05/07/2019	18:00	48.4	49.9	44.5	74.3
05/07/2019	19:00	52.5	53.6	46.6	78.4
05/07/2019	20:00	62.5	64.3	53.0	85.6
05/07/2019	21:00	65.3	67.8	57.2	89.5
05/07/2019	22:00	65.8	68.2	57.0	89.6
05/07/2019	23:00	63.7	66.3	53.2	87.1
06/07/2019	00:00	64.3	65.0	50.9	96.4
06/07/2019	01:00	49.6	52.0	42.2	75.5
06/07/2019	02:00	48.1	50.2	42.0	74.9
06/07/2019	03:00	44.2	46.3	40.4	64.9
06/07/2019	04:00	43.7	46.0	39.1	63.3
06/07/2019	05:00	45.5	47.2	42.5	64.7
06/07/2019	06:00	47.0	47.6	42.1	78.2

Due to equipment failure, only 10 hours of data has been measured. From evening to early morning noise levels are high. These conditions were not noted during attended measurements.

Table B-7 – Unattended Measurements at Blacksmiths Way

Date	Time	Measured sound levels, dB			
		$L_{Aeq,T}$	L_{AF10}	L_{AF90}	L_{AFmax}
05/07/2019	17:00	54.1	55.1	52.6	65.6
05/07/2019	18:00	55.2	56.2	53.7	62.4
05/07/2019	19:00	55.8	56.7	54.2	69.8
05/07/2019	20:00	53.7	54.8	51.3	65.6
05/07/2019	21:00	52.5	53.8	50.4	62.6
05/07/2019	22:00	51.7	52.9	49.4	69.0
05/07/2019	23:00	49.9	51.4	47.5	62.6
06/07/2019	00:00	49.9	51.4	47.0	60.7
06/07/2019	01:00	48.4	50.3	44.6	56.1
06/07/2019	02:00	47.0	49.0	43.8	53.6
06/07/2019	03:00	47.6	49.5	44.0	61.0
06/07/2019	04:00	47.3	48.9	44.4	58.9
06/07/2019	05:00	52.7	54.3	49.2	69.0
06/07/2019	06:00	50.0	51.5	47.2	70.8
08/07/2019	07:00	54.6	55.6	52.7	70.0
08/07/2019	08:00	63.5	64.0	54.6	85.3

Date	Time	Measured sound levels, dB			
		$L_{Aeq,T}$	L_{AF10}	L_{AF90}	L_{AFmax}
08/07/2019	09:00	61.5	58.1	50.2	84.2
08/07/2019	10:00	51.5	52.7	49.2	66.9
08/07/2019	11:00	52.5	52.8	49.0	75.1
08/07/2019	12:00	51.1	52.1	49.1	66.6
08/07/2019	13:00	51.5	52.6	49.6	63.7
08/07/2019	14:00	51.5	52.9	49.5	62.0
08/07/2019	15:00	51.6	52.3	49.1	68.7

B.3. Sound Power Measurements (2020)

Table B-8 – Measured sound levels of existing generators

Engine type	Engine Datasheet	Model / Sound attenuation	Manufacturer Sound power level, dB(A)	Measured Sound power level, dB(A)
Perkins	-	-	106	105
MTU	X715C2	soundproofed	108	107
Volvo	V715C2	soundproofed	105	106
Mitsubishi	T1650C	soundproofed	109	107
Kohler	KD1650E	KD45V20-5DES super sound proofed	103	102
Kohler	KD1650E	KD45V20-5DES with WB Power Services Acoustic Enclosure	86	88

Appendix C. Worked example

The rating levels shown in Table C-1 include the following acoustic penalties to the specific sound levels for each source type as described in Section 6.5.1.

- +3dB for generator sound
- +3dB for AHU sound

Table C-1 – Worked Example

Address	Floor	Daytime Background sound level (L_{A90} dB)	AHU		Generators			Total		Impact (Total $L_{Ar,1h}$- L_{A90} dB)
			Specific Sound Level ($L_{Aeq,1h}$ dB)	Rating level ($L_{Ar,1h}$ dB)	Generator Cell	Specific Sound Level ($L_{Aeq,1h}$ dB)	Rating level ($L_{Ar,1h}$ dB)	Specific Sound Level ($L_{Aeq,1h}$ dB)	Rating level ($L_{Ar,1h}$ dB)	
49 Powis Close	First	36.0	32.0	35.0	G.01	0.0	3.0	32.0	35.0	-1.0
			32.0	35.0	G.02	1.1	4.1	32.0	35.0	-1.0
			32.0	35.0	G.03	1.2	4.2	32.0	35.0	-1.0
			32.0	35.0	G.04	1.0	4.0	32.0	35.0	-1.0
			32.0	35.0	G.05	1.5	4.5	32.0	35.0	-1.0
			32.0	35.0	G.06	27.7	30.7	33.4	36.4	0.4
			32.0	35.0	G.07	29.2	32.2	33.8	36.8	0.8
			32.0	35.0	G.08	29.2	32.2	33.8	36.8	0.8
			32.0	35.0	G.09	31.6	34.6	34.8	37.8	1.8
			32.0	35.0	G.10	31.7	34.7	34.9	37.9	1.9

Appendix D. BS 4142 Assessment Tables

D.1. Quarterly Testing (CWL13)

The rating levels shown in Table D-1 include the following acoustic penalties to the specific sound levels for each source type as described in Section 6.5.1.

- +3dB for intermittent generator sound for the 15 minute tests
- +3dB for AHU sound

Table D-1 – BS 4142 Assessment - Quarterly Testing

ID	Address	Floor	Daytime Background sound level (L_{A90} dB)	Worst case Specific sound level ($L_{Aeq,1h}$ dB)	Rating level ($L_{Ar,1h}$ dB)		Difference ($L_{Ar,1h}$-L_{A90} dB)		Level of impact
					15 minute tests	2 hour test	15 minute tests	2 hour test	
1	14 Church Crescent	Ground	49	19.2	22.2	21.9	-26.8	-27.1	Negligible
		First	49	19.7	22.7	22.4	-26.3	-26.6	Negligible
2	1 Nant-Y-Moor Cottages, Blacksmiths Way	Ground	51	21.4	24.4	24.0	-26.6	-27.0	Negligible
		First	51	21.4	24.4	24.0	-26.6	-27.0	Negligible
3	Teddies Nursery	Ground	50	23.2	26.2	25.8	-23.8	-24.2	Negligible
		First	50	23.8	26.8	26.4	-23.2	-23.6	Negligible
4	1-4 Cardiff Road	Ground	47	29.4	32.4	31.6	-14.6	-15.4	Negligible
		First	47	31.0	34.0	32.7	-13.0	-14.3	Negligible
5	19 Pencarn Avenue	Ground	45	17.9	20.9	20.5	-24.1	-24.5	Negligible
		First	45	18.7	21.7	21.3	-23.3	-23.7	Negligible
6	11 Pencarn Avenue	Ground	45	33.8	36.8	35.6	-8.2	-9.4	Negligible
		First	45	34.9	37.9	36.7	-7.1	-8.3	Negligible

ID	Address	Floor	Daytime Background sound level (L_{A90} dB)	Worst case Specific sound level ($L_{Aeq,1h}$ dB)	Rating level ($L_{Ar,1h}$ dB)		Difference ($L_{Ar,1h}$-L_{A90} dB)		Level of impact
					15 minute tests	2 hour test	15 minute tests	2 hour test	
7	61-65 Edmundsbury Rd	Ground	40	24.1	27.1	27.1	-12.9	-12.9	Negligible
		First	40	25.6	28.6	28.6	-11.4	-11.4	Negligible
8	89-95 Edmundsbury Rd	Ground	40	33.3	36.3	35.4	-3.7	-4.6	Negligible
		First	40	33.8	36.8	36.0	-3.2	-4.0	Negligible
9	117-119 Edmundsbury Rd	Ground	40	30.9	33.9	33.4	-6.1	-6.6	Negligible
		First	40	32.3	35.3	36.4	-4.7	-5.4	Negligible
10	50-62 Edmundsbury Rd	Ground	40	27.8	30.8	29.5	-9.2	-10.5	Negligible
		First	40	30.8	33.8	32.8	-6.2	-7.2	Negligible
11	14-16 Powis Close	Ground	36	32.8	35.8	34.9	-0.2	-1.1	Negligible
		First	36	34.3	37.3	36.3	1.3	0.3	Minor adverse (15 minute), Negligible (2 hour)
12	49 Powis Close	Ground	36	34.3	37.3	36.1	1.3	0.1	Minor adverse (15 minute), Negligible (2 hour)
		First	36	34.9	37.9	36.7	1.9	0.7	Minor adverse (15 minute), Negligible (2 hour)

D.2. Black building testing (CWL13)

The rating levels shown in Table D-2 include the following acoustic penalties to the specific sound levels for each source type as described in Section 6.5.1.

- +3dB for AHU sound

It should be noted that a -6dB correction for the test lasting 15 minutes out of the one hour assessment period has also been applied to the generators.

Table D-2 – BS 4142 Assessment – black building test

ID	Address	Floor	Worst case Specific sound level ($L_{Aeq,1h}$ dB)	Rating level ($L_{Ar,1h}$ dB)	Daytime Background sound level (L_{A90} dB)	Difference ($L_{Ar,1h}$-L_{A90} dB)	Level of impact
1	14 Church Crescent	Ground	19.5	22.1	49	-26.9	Negligible
		First	20.0	22.6	49	-26.4	Negligible
2	1 Nant-Y-Moor Cottages, Blacksmiths Way	Ground	21.8	24.2	51	-26.8	Negligible
		First	21.8	24.2	51	-26.8	Negligible
3	Teddies Nursery	Ground	23.5	26.0	50	-24.0	Negligible
		First	24.0	26.6	50	-23.4	Negligible
4	1-4 Cardiff Road	Ground	30.0	32.0	47	-15.0	Negligible
		First	31.9	33.4	47	-13.6	Negligible
5	19 Pencarn Avenue	Ground	18.0	20.6	45	-24.4	Negligible
		First	18.8	21.3	45	-23.7	Negligible
6	11 Pencarn Avenue	Ground	34.6	36.2	45	-8.8	Negligible
		First	35.8	37.3	45	-7.7	Negligible
7	61-65 Edmundsbury Rd	Ground	24.2	27.2	40	-12.8	Negligible
		First	25.7	28.7	40	-11.3	Negligible
8	89-95 Edmundsbury Rd	Ground	33.7	35.6	40	-4.4	Negligible
		First	34.2	36.2	40	-3.8	Negligible
9	117-119 Edmundsbury Rd	Ground	31.3	33.6	40	-6.4	Negligible

ID	Address	Floor	Worst case Specific sound level ($L_{Aeq,1h}$ dB)	Rating level ($L_{Ar,1h}$ dB)	Daytime Background sound level (L_{A90} dB)	Difference ($L_{Ar,1h}$-L_{A90} dB)	Level of impact
		First	32.7	34.9	40	-5.1	Negligible
10	50-62 Edmundsbury Rd	Ground	28.4	30.0	40	-10.0	Negligible
		First	31.4	33.2	40	-6.8	Negligible
11	14-16 Powis Close	Ground	33.4	35.3	36	-0.7	Negligible
		First	35.0	36.8	36	0.8	Negligible
12	49 Powis Close	Ground	35.1	36.7	36	0.7	Negligible
		First	35.8	37.3	36	1.3	Minor Adverse

D.3. Emergency Scenario (CWL13)

The rating levels shown in Table D-3 and Table D-4 include the following acoustic penalties to the specific sound levels for each source type as described in Section 6.5.1.

- +3dB to AHU sound

Table D-3 – BS 4142 Assessment – Emergency scenario (daytime)

ID	Address	Floor	Worst case Specific sound level ($L_{Aeq,1h}$ dB)	Rating level ($L_{Ar,1h}$ dB)	Daytime Background sound level (L_{A90} dB)	Difference ($L_{Ar,1h}$-L_{A90} dB)	Level of impact
1	14 Church Crescent	Ground	25.7	26.5	49	-22.5	Negligible
		First	26.4	27.1	49	-21.9	Negligible
2	1 Nant-Y-Moor Cottages, Blacksmiths Way	Ground	28.8	29.4	51	-21.6	Negligible
		First	28.7	29.3	51	-21.7	Negligible
3	Teddies Nursery	Ground	30.0	30.7	50	-19.3	Negligible
		First	30.7	31.4	50	-18.6	Negligible
4	1-4 Cardiff Road	Ground	38.1	38.5	47	-8.5	Negligible
		First	41.0	41.2	47	-4.5	Negligible
5	19 Pencarn Avenue	Ground	23.0	24.0	45	-21.0	Negligible
		First	23.8	24.8	45	-17.0	Negligible
6	11 Pencarn Avenue	Ground	44.6	44.8	45	-0.2	Negligible
		First	45.5	45.7	45	0.7	Negligible
7	61-65 Edmundsbury Rd	Ground	26.0	28.2	40	-11.8	Negligible
		First	27.2	29.5	40	-10.5	Negligible
8	89-95 Edmundsbury Rd	Ground	40.9	41.4	40	1.4	Minor Adverse
		First	41.2	41.7	40	1.7	Minor Adverse
9	117-119 Edmundsbury Rd	Ground	38.5	39.0	40	-1.0	Negligible

ID	Address	Floor	Worst case Specific sound level ($L_{Aeq,1h}$ dB)	Rating level ($L_{Ar,1h}$ dB)	Daytime Background sound level (L_{A90} dB)	Difference ($L_{Ar,1h}$-L_{A90} dB)	Level of impact
		First	40.2	40.7	40	0.7	Negligible
10	50-62 Edmundsbury Rd	Ground	36.4	36.7	40	-3.3	Negligible
		First	39.4	39.7	40	-0.3	Negligible
11	14-16 Powis Close	Ground	42.6	42.9	36	6.9	Moderate Adverse
		First	44.6	44.9	36	8.9	Moderate Adverse
12	49 Powis Close	Ground	44.0	44.2	36	8.2	Moderate Adverse
		First	44.7	45.0	36	9.0	Moderate Adverse

Table D-4 – BS 4142 Assessment – Emergency scenario (night-time) (CWL13)

ID	Address	Floor	Worst case Specific sound level ($L_{Aeq,15min}$ dB)	Rating level ($L_{Ar,15min}$ dB)	Night time Background sound level (L_{A90} dB)	Difference ($L_{Ar,15min}$-L_{A90} dB)	Level of impact
1	14 Church Crescent	Ground	25.7	26.5	43	-16.5	Negligible
		First	26.4	27.1	43	-15.9	Negligible
2	1 Nant-Y-Moor Cottages, Blacksmiths Way	Ground	28.8	29.4	45	-15.6	Negligible
		First	28.7	29.3	45	-15.7	Negligible
3	Teddies Nursery	Ground	30.0	30.7	N/A	N/A	N/A
		First	30.7	31.4	N/A	N/A	N/A
4	1-4 Cardiff Road	Ground	38.1	38.5	43	-5.8	Negligible
		First	41.0	41.2	43	-1.8	Negligible
5	19 Pencarn Avenue	Ground	23.0	24.0	41	-20.2	Negligible
		First	23.8	24.8	41	-16.2	Negligible
6	11 Pencarn Avenue	Ground	44.6	44.8	41	3.8	Minor Adverse
		First	45.5	45.7	41	4.7	Minor Adverse
7	61-65 Edmundsbury Rd	Ground	26.0	28.2	38	-9.8	Negligible
		First	27.2	29.5	38	-8.5	Negligible
8	89-95 Edmundsbury Rd	Ground	40.9	41.4	38	3.4	Minor Adverse
		First	41.2	41.7	38	3.7	Minor Adverse
9	117-119 Edmundsbury Rd	Ground	38.5	39.0	38	1.0	Minor Adverse
		First	40.2	40.7	38	2.7	Minor Adverse
10	50-62 Edmundsbury Rd	Ground	36.4	36.7	38	-1.3	Negligible
		First	39.4	39.7	38	1.7	Minor Adverse

ID	Address	Floor	Worst case Specific sound level ($L_{Aeq,15min}$ dB)	Rating level ($L_{Ar,15min}$ dB)	Night time Background sound level (L_{A90} dB)	Difference ($L_{Ar,15min}$-L_{A90} dB)	Level of impact
11	14-16 Powis Close	Ground	42.6	42.9	36	6.9	Moderate Adverse
		First	44.6	44.9	36	8.9	Moderate Adverse
12	49 Powis Close	Ground	44.0	44.2	36	8.2	Moderate Adverse
		First	44.7	45.0	36	9.0	Moderate Adverse

D.4. Cumulative Emergency Scenario

The acoustic penalties applied to the specific sound levels for the cumulative emergency scenario are:

- +3dB for AHU sound

Table D-5 – BS 4142 Cumulative Assessment – Emergency scenario (daytime) (CWL13 and CWL11/12)

ID	Address	Floor	Worst case Specific sound level ($L_{Aeq,1h}$ dB)	Rating level ($L_{Ar,1h}$ dB)	Daytime Background sound level (L_{A90} dB)	Difference ($L_{Ar,1h}$- L_{A90} dB)	Level of impact
1	14 Church Crescent	Ground	47.9	48.4	49	-0.6	Negligible
		First	48.6	49.1	49	0.1	Negligible
2	1 Nant-Y-Moor Cottages, Blacksmiths Way	Ground	51.7	52.0	51	1.0	Minor Adverse
		First	51.8	52.0	51	1.0	Minor Adverse
3	Teddies Nursery	Ground	56.6	56.7	50	6.7	Moderate Adverse
		First	57.4	57.5	50	7.5	Moderate Adverse
4	1-4 Cardiff Road	Ground	62.4	62.5	47	15.5	Major Adverse
		First	63.5	63.7	47	16.7	Major Adverse
5	19 Pencarn Avenue	Ground	58.0	58.3	36	13.3	Major Adverse
		First	59.3	59.6	40	14.6	Major Adverse
6	11 Pencarn	Ground	50.6	52.7	45	7.7	Moderate Adverse
		First	51.6	53.8	45	8.8	Moderate Adverse
7	61-65 Edmundsbury Rd	Ground	42.1	45.0	40	5.0	Moderate Adverse
		First	44.6	47.0	40	7.0	Moderate Adverse
8	89-95 Edmundsbury Rd	Ground	44.6	47.1	40	7.1	Moderate Adverse
		First	45.6	48.0	40	8.0	Moderate Adverse
9	117-119 Edmundsbury Rd	Ground	44.9	46.7	40	6.7	Moderate Adverse
		First	47.3	48.8	40	8.8	Moderate Adverse

ID	Address	Floor	Worst case Specific sound level ($L_{Aeq,1h}$ dB)	Rating level ($L_{Ar,1h}$ dB)	Daytime Background sound level (L_{A90} dB)	Difference ($L_{Ar,1h}$-L_{A90} dB)	Level of impact
10	50-62 Edmundsbury Rd	Ground	41.0	42.8	40	2.8	Minor Adverse
		First	43.1	44.8	40	4.8	Minor Adverse
11	14-16 Powis Close	Ground	45.0	46.6	36	10.6	Major Adverse
		First	46.7	48.4	36	12.4	Major Adverse
12	49 Powis Close	Ground	45.6	46.5	40	10.5	Major Adverse
		First	46.6	47.8	40	11.8	Major Adverse

Table D-6 – BS 4142 Cumulative Assessment – Emergency scenario (night-time) (CWL13 and CWL11/12)

ID	Address	Floor	Worst case Specific sound level ($L_{Aeq,15min}$ dB)	Rating level ($L_{Ar,15min}$ dB)	Night time Background sound level (L_{A90} dB)	Difference ($L_{Ar,15min}$-L_{A90} dB)	Level of impact
1	14 Church Crescent	Ground	47.9	48.4	43	5.4	Moderate Adverse
		First	48.6	49.1	43	5.6	Moderate Adverse
2	1 Nant-Y-Moor Cottages, Blacksmiths Way	Ground	51.7	52.0	45	7.0	Moderate Adverse
		First	51.8	52.0	45	7.0	Moderate Adverse
3	Teddies Nursery	Ground	56.6	56.7	N/A	N/A	N/A
		First	57.4	57.5	N/A	N/A	N/A
4	1-4 Cardiff Road	Ground	62.4	62.5	43	19.5	Major Adverse
		First	63.5	63.7	43	20.7	Major Adverse
5	19 Pencarn Avenue	Ground	58.0	58.3	41	17.3	Major Adverse
		First	59.3	59.6	41	18.6	Major Adverse
6	11 Pencarn Avenue	Ground	50.6	52.7	41	11.7	Major Adverse

ID	Address	Floor	Worst case Specific sound level ($L_{Aeq,15min}$ dB)	Rating level ($L_{Ar,15min}$ dB)	Night time Background sound level (L_{A90} dB)	Difference ($L_{Ar,15min}$-L_{A90} dB)	Level of impact
		First	51.6	53.8	41	12.8	Major Adverse
7	61-65 Edmundsbury Rd	Ground	42.1	45.0	38	7.0	Moderate Adverse
		First	44.6	47.0	38	9.0	Moderate Adverse
8	89-95 Edmundsbury Rd	Ground	44.6	47.1	38	9.1	Moderate Adverse
		First	45.6	48.0	38	10.0	Major Adverse
9	117-119 Edmundsbury Rd	Ground	44.9	46.7	38	8.7	Moderate Adverse
		First	47.3	48.8	38	10.8	Major Adverse
10	50-62 Edmundsbury Rd	Ground	41.0	42.8	38	4.8	Minor Adverse
		First	43.1	44.8	38	6.8	Moderate Adverse
11	14-16 Powis Close	Ground	45.0	46.6	36	10.6	Major Adverse
		First	46.7	48.4	36	12.4	Major Adverse
12	49 Powis Close	Ground	45.6	46.5	36	10.5	Major Adverse
		First	46.6	47.8	36	11.8	Major Adverse

D.5. Cumulative Testing

The acoustic penalties applied to the specific sound levels for the cumulative testing scenario are:

- +3dB for AHU sound
- +3dB for intermittent generator sound for the 15 minute tests

Table D-7 – BS 4142 Cumulative Testing from CWL13 and CWL11/12

ID	Address	Floor	Worst case Specific sound level ($L_{Aeq,1h}$ dB)	Rating level ($L_{Ar,1h}$ dB)	Daytime Background sound level (L_{A90} dB)	Difference ($L_{Ar,1h}$-L_{A90} dB)	Level of impact
1	14 Church Crescent	Ground	37.0	40.0	49	-9.0	Negligible
		First	37.6	40.6	49	-8.4	Negligible
2	1 Nant-Y-Moor Cottages, Blacksmiths Way	Ground	40.7	43.7	51	-7.3	Negligible
		First	41.2	44.2	51	-6.8	Negligible
3	Teddies Nursery	Ground	44.6	47.6	50	-2.4	Negligible
		First	45.9	48.9	50	-1.1	Negligible
4	1-4 Cardiff Road	Ground	49.6	52.6	47	5.6	Moderate Adverse
		First	52.0	55.0	47	8.0	Moderate Adverse
5	19 Pencarn Avenue	Ground	47.0	50.0	36	5.0	Moderate Adverse
		First	48.2	51.2	40	6.2	Moderate Adverse
6	11 Pencarn	Ground	45.7	48.7	45	3.7	Minor Adverse
		First	47.0	50.0	45	5.0	Moderate Adverse
7	61-65 Edmundsbury Rd	Ground	38.1	41.1	40	1.1	Minor Adverse
		First	40.0	43.0	40	3.0	Minor Adverse
8	89-95 Edmundsbury Rd	Ground	39.7	42.7	40	2.7	Minor Adverse
		First	40.5	43.5	40	3.5	Minor Adverse
9	117-119 Edmundsbury Rd	Ground	39.0	42.0	40	2.0	Minor Adverse

ID	Address	Floor	Worst case Specific sound level ($L_{Aeq,1h}$ dB)	Rating level ($L_{Ar,1h}$ dB)	Daytime Background sound level (L_{A90} dB)	Difference ($L_{Ar,1h}$- L_{A90} dB)	Level of impact
		First	41.0	44.0	40	4.0	Minor Adverse
10	50-62 Edmundsbury Rd	Ground	34.7	37.7	40	-2.3	Negligible
		First	36.7	39.7	40	-0.3	Negligible
11	14-16 Powis Close	Ground	38.4	41.4	36	5.4	Moderate Adverse
		First	39.9	42.9	36	6.9	Moderate Adverse
12	49 Powis Close	Ground	37.7	40.7	40	4.7	Minor Adverse
		First	39.2	42.2	40	6.2	Moderate Adverse

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Appendix F. Accident Management

CWL13 Environmental Permit Application

Accident Management Plan

Vantage Data Centers UK Limited

August 2022

Notice

This document and its contents have been prepared and are intended solely as information for Vantage Data Centers UK Limited and use in relation to the Environmental Permit application for CWL13.

Atkins Limited assumes no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

This document has 24 pages including the cover.

Document history

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
Rev 0.1	Draft for client comment	LH/ES	AE	CC	-	Aug 2022
Rev 1.0	Final for Issue	LH/ES	AE	CC	SR	Aug 2022

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1. Introduction

1.1. Background

Vantage Data Centers UK Limited ('Vantage', or 'the Operator') provides wholesale out-of-town data centre space for some of the world's largest companies, including blue-chip company and government data. Due to the sensitive and significant nature of the information held at the site, a secure and reliable electricity supply is business-critical; without a continuous supply of electricity, Vantage cannot guarantee their contractual customer obligations. The first level of security of supply will be two independent connections to the National Grid, so that power supply can be maintained in the event of a localised power outage. However, an additional level of protection is required in case of grid failure and this will be achieved through the installation of 60 new standby generators with an aggregated thermal input of 179 MW_{th}.

This Accident Management Plan (AMP) has been produced to support the Environmental Permit Application for a new data centre at CWL13, Imperial Park, Newport by the owner and operator Vantage Data Centers UK Ltd ('Vantage', or 'the Operator').

The scope of this Accident Management Plan is operations within the proposed Installation boundary - please refer to the application supporting information document for more details.

The AMP is to be used as a reference document for operational staff; it shows what actions should be taken to minimise a given incident and who is responsible for authorising and taking action.

This AMP for CWL13 has been based on the AMP for Vantage's existing data centre facility at CWL11/12. Once CWL13 is fully operational this AMP should be reviewed and updated (if required) to ensure it is fully aligned with the operation, management and control systems for CWL13.

1.2. Structure of the AMP

The AMP is structured as follows:

Table 1-1 - Accident Management Plan Structure

Section	Heading	Content
1	Introduction	Describes the need for the AMP, provides an overview of Vantage and identifies local receptors.
2	Methodology	Describes how incidents / accidents have been assessed in the AMP.
3	Potential Accident Scenarios	Describes possible incidents / accidents that could occur at CWL13, outlines mitigative measures in place and describes actions to be taken in the event of one occurring.
4	Recording / Reporting an Accident	Describes the anticipated recording and reporting requirements of CWL13 in the event of an incident / accident.
Appendices	Appendices	Appendices include a full accident control matrix table and site plan.

1.3. Relevant Documentation

This AMP has been prepared with reference to the following key documents:

- Natural Resources Wales - How to comply with your environmental permit (Last updated October 2014); and
- Environment Agency - Develop a management system: environmental permits (Published 1 February 2016, last updated 4 August 2021).

1.4. Regulated Activities

The data centre will fall under Chapter 1 of Schedule 1 of the Environmental Permitting (England and Wales) Regulations 2016 (EPR16):

Schedule 1, Section 1.1 Combustion Activities:

Part A (1) (a) Burning any fuel in an appliance with a rated thermal input of 50 or more megawatts.

The sole purpose of the generators is to provide power under emergency conditions. The engines will be maintained and tested on a regular basis to ensure they are operational and to conform with manufacturer's recommendations.

The generator sets will be Kohler units, which incorporate the KD45V20-DES engine with a thermal input of just under 3 MWth, and an aggregated total thermal input capacity of 179 MWth. The engines are grouped into 'cells', and there will be 10 cells, each with 6 generator sets. The generators will be housed in individual containers on a concrete base.

The engines will burn hydrotreated vegetable oil (HVO), although diesel will be used as an alternative fuel in the event of supply issues. The two fuels can be used interchangeably.

The limits of the combustion activity associated with the operation of the standby generators for emergency use and testing / maintenance are from receipt of raw materials to combustion of fuel, release of exhaust gases to atmosphere and distribution of emergency power to the data centre. As part of maintenance and testing small quantities of wastes will be generated (these will not be stored onsite).

In addition, the following directly associated activities will be carried out at the Installation:

- fuel storage - from receipt of fuel to dispatch for use in the standby generators; and
- surface water drainage system servicing the area in which the Schedule 1 activity takes place - the limits of which are input to the site drainage system until discharge to the wider business park drainage system.

There will be no sub-surface bulk storage tanks or process pipework. The only below ground pipework is for the mains water supply and surface water drainage.

Hours of operation for testing are strictly limited to:

- 09.00 to 17.00 (8 hours per day); and
- Monday to Friday, excluding bank holidays.

The engines at the facility each typically operate for five hours per year for testing and maintenance purposes.

1.5. Site Location

The CWL13 facility is located at: Bouges, Vantage Data Centre, North Lake Drive, Newport, NP10 8UL.

1.6. Site Description

CWL13 will be located on a brownfield site in the south eastern corner of Imperial Park approximately three miles south west of from Newport city centre. Imperial Park is located off the A48 near Junction 28 of the M4. The CWL13 site is accessed via North Lake Drive and Celtic Way, from the junction with the A48. Imperial Park houses a number of industrial, distribution and administration facilities. The immediate surrounding land use can be summarised as follows

- north: undeveloped open land, and car park associated with the IQE's Newport Semiconductor Facility;
- east: South Lake Drive with Imperial Courtyard Business Park beyond;
- south: vegetated scrub, shrubs and trees with landscaped parkland beyond; and,
- west: undeveloped open land and IQE Building.

1.7. Receptors

Local / sensitive receptors are normally considered to be places where members of the public / off-site workers may be exposed to unacceptable releases from the facility for prolonged periods. As well as human receptors, environmental receptors are also considered including; terrestrial and hydrological environments.

1.7.1. Human Receptors

The nearest residential properties are on Pencarn Avenue, approximately 210 metres to the north. There are also residential properties on Edmundsbury Road approximately 220 m to the north east and on Powis Close approximately 260 m to the south east. The nearest discrete human receptor to CWL13 is a non-residential property in Imperial Courtyard, approximately 50 metres to the east of the CWL13 data centre building. A children's nursery is 650 metres to the north west near the Holiday Inn, between the A48 and the M4 motorway.

There are no air quality management areas (AQMA) within close proximity of the site, the nearest is located in excess of 2.5 km, to the north, at the M4 at Junction 27.

1.7.2. Ecological Receptors

All European and International ecologically designated sites and nationally designated sites have been considered within 10 km[1] of the proposed Installation boundary, as well as national and local non-statutory local wildlife sites within 2 km. The site is not subject to any environmentally sensitive designations.

The nearest internationally designated site (the Severn Estuary Ramsar site / Special Protection Area (SPA) / Special Area of Conservation (SAC)) is over 2.5 km to the south east at its closest point. The River Usk SAC is approximately 4 km to the north east. There are no other European sites within 10 km.

The nearest nationally designated site is Gwent Levels Site of Special Scientific Interest (SSSI) which is located approximately 260 m south east of the site at its closest point. The features of interest that are common to all of the SSSIs within the Gwent Levels are the reen (drainage ditch) habitats, which support a varied assemblage of aquatic flora and fauna. There are no other nationally designated sites within 2 km.

The nearest non-statutory designated ecological site is LG Duffryn Site 1 Site of Interest for Nature Conservation (SINC) - 60 m to the south of the site boudary, designated for its pond / reedbed habitat. There are 3 other SINCs within 1 km (LG Duffryn Site 2, Duffryn Ponds and Celtic Springs).

There are a number of areas of semi-natural and restored ancient woodland, the nearest area is 640 m to the north of CWL13.

1.7.3. Geological, Hydrogeological, Hydrological Receptors and Flooding

The superficial deposits beneath the site are River Terrace Deposits, typically comprising sand and gravel with lenses of silt, clay or peat. The bedrock is the Mercia Mudstone Group. The River Terrace Deposits are classified as a secondary A aquifer. The Mercia Mudstone Group is classified as a secondary B aquifer.

There are no surface water features located on or directly adjacent to the site. The nearest surface water feature to the site is an unnamed man-made lake, located 70 m south of the site, between South Lake Drive and North Lake Drive. There are a further three lakes within 500 m. All of the lakes are hydraulically isolated from the site.

The closest surface watercourse to the site is Blackwall Reen, 130 m to the east, flowing in a southerly direction. Percoed Reen water course is down hydraulic gradient, 700 m to the south east, on the Gwent Levels. Nant y Moor Reen water course is 900 m to the south west.

There are no licensed groundwater abstractions on the site; there is one groundwater abstraction within 1 km of the site, located 150 m to the south, which is for "amenity use: make up or top-up water" for an adjacent lake. There are no licenced surface water abstractions within 1 km of the site.

[1] Although searches for combustion plant >50 MWth in aggregate are often carried out up to 15 km, 10 km is the distance in permitting guidance and that accepted by NRW for the CWL11 permit application. This is because the facility, despite having a combined thermal input of over 50 MW, is a combination of intermittently operated engines with relatively low stacks. The maximum impacts occur in the near field, which is not the case for some large combustion plant with very tall stacks where the concentrations can be higher further from the source

The site is not within a Source Protection Zone (SPZ) - the nearest SPZ is 18 km to the south east on the other side of the Bristol Channel.

The Natural Resources Wales (NRW) online flood risk map and online development advice map indicate that the site is not located in a flood risk zone and is on that is at little or no risk of flooding (less than 0.1% chance per year).

The above information has been based on the Geo-Environmental Desk Study that was undertaken for CWL13 in October 2020[2].

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2 Next Generation Data DC3, Newport, Geo-Environmental Desk Study, Atkins, October 2020

2. Methodology

2.1. General Approach

Identification of the potential accidents that could occur at CWL13 has been based on those identified for CWL11/12. This is a reasonable premise at this time since the two facilities share common receptors and the activities at the two sites are largely the same.

The likelihood and severity of an accident occurring has been assessed using professional judgement and expertise, as per the CWL11/12 AMP. The risk matrix was then used to combine the likelihood and severity to determine the level of risk. (Note that mitigative measures are not considered at this stage.)

The mitigative measures that will be in place are described and a revised risk level produced accordingly. Actions to be taken in the event of an accident and / or failure of control measures have been outlined.

2.2. Risk Assessment Process

Each potential accident is assessed and evaluated in relation to the level of environmental impact. This process quantifies the environmental risk, which is then used to assess the significance of that risk. The following risk ratings are developed by combining the likelihood and severity scores for each potential accident, as shown in Risk Rating Matrix below.

Table 2-1 **- Risk Rating Matrix**

Risk Matrix		Severity		
Likelihood		High	Medium	Low
	High	High	High	Medium
	Medium	High	Medium	Low
	Low	Medium	Low	Low

The principles of applying a certain likelihood or severity rating to an incident / accident are described below.

Likelihood:

- Low - an incident that is highly unlikely to occur.
- Medium - a reasonably likely incident.
- High - an incident that is highly likely to occur.

Severity:

- Low - an incident that would cause a negligible impact on receptors.
- Medium - an incident that would cause a slight impact on receptors.
- High - an incident that would cause a serious threat to human health or the environment.

3. Potential Accident Scenarios

3.1. Spills - (Fuel, engine oil, anti-freeze / coolant and AdBlue)

Possible scenarios in which a spill could occur include:

- a spill of fuel from delivery vehicle / pipework;
- a spill while re-filling AdBlue;
- a catastrophic fuel tank failure; or
- a catastrophic AdBlue tank failure.

In addition spills associated with refilling lubrication oil and coolant in the engines could occur. However, spills of these substances are not expected to result in large scale accidents as these materials are not stored on site, and are brought in for maintenance purposes. Further, refilling of the engines is undertaken in the engine containers and drip trays are used. Any spills would be small and would be contained in the engine container. Similarly wastes are not stored on site, they are generated in the engine containers in small quantities and removed from site.

A spill could pose a contamination risk to land, groundwater and surface water. These areas can become contaminated and can cause serious harm to the environment.

Key documents which support this section of the AMP will include the following procedures that are in place for CWL11/12, or their equivalent for CWL13 (as relevant):

- PM03-01 Emergency Management;
- PM04-13 Corrective Action Procedure; and
- PM05 Incident Management Procedure.

Vantage will have a number of mitigation measures in place to prevent spills and associated impacts, these include:

- all storage tanks have secondary containment capabilities with at least 110% capacity;
- the two sets of fuel delivery bays are fitted with oil interceptors;
- the fill cabinets for fuel and AdBlue are fitted with drip trays;
- as the engines sit above the fuel tanks, the ‘external’ fuel pipework for the engines is limited to a very short length between the tank and the engine, the rest of the pipework is internal and is effectively bunded by the engine container (similarly the AdBlue tanks sit on top of the fuel tanks, beneath the discharge attenuator);
- all storage tanks, engines and pipework are routinely inspected by trained operatives; and
- maintenance / repairs of site infrastructure are carried out in accordance with manufacturer recommendations.

Vantage will have the following mitigative measures and actions to be taken in the event of a spill:

- spill kits will be strategically placed across the site;
- site staff are trained to supervise deliveries;
- site staff are trained on the contents of a spill kit and how to use them; and
- the drainage system has an isolation control value which should contain spills, in addition there are further interceptors off-site in the wider business park’s drainage system.

Specific mitigative measures according to each scenario are described in Table 4-1.

After a spill has occurred and it is under control, it will trigger an incident review as specified in section 4.

3.2. Fire

Possible scenarios in which a fire could occur include:

- maintenance activities / hot works; and
- an external fire igniting fuels.

In addition, security breaches and adverse weather could cause a fire - these are discussed in Sections 3.4 and 3.5.

Fires can cause harm to environmental receptors via air and water pathways. Noxious smoke and gases can be released into the atmosphere and contaminated fire water can enter the groundwater and surface water. Whilst extremely unlikely, should a fire develop, there could also be a risk of harm to site personnel and visitors. In the case of a significant fire, nearby residents and workplaces may also be impacted.

Key documents which support this section of the AMP will include the following documents for CWL11/12, or their equivalent for CWL13 (as relevant):

- PM02-01 Fire and Evacuation Procedure;
- PM04-13 Corrective Action Procedure; and
- PM05 Incident Management Procedure.

Vantage will have a number of mitigative measures in place to prevent fires occurring, these include:

- all plant, pipework and equipment will be regularly inspected;
- plant, pipework and equipment will be maintained as per the manufacturer's recommendations; and
- housekeeping measures will be in place to ensure small leaks / spills of flammable materials are cleaned up at their source and (where relevant) repairs are carried out as soon as practically possible.

Vantage will have following mitigative measures and actions to be taken in the event of a fire:

- fire extinguishers will be available on site; and
- the isolation system for the surface water drainage system at CWL13 (and interceptors within the wider business park drainage system) will prevent the spread and distribution of contaminated fire water.

Specific mitigative measures according to each scenario are described in Table 4-1.

After a fire has occurred and it is under control, an incident review will be triggered, as specified in section 4.

3.3. Vehicle Collisions

Possible scenarios in which a vehicle collision incident could occur include:

- a vehicle colliding with a storage tank or engine container; and
- a vehicle colliding with a fuel / materials delivery vehicle.

Vehicles involved in collisions could include staff, visitor, contractor, construction or delivery vehicles. Depending on the location and the extent of damage, vehicle collisions have the potential to result in a spill of a hazardous substance.

Vantage will have a number of mitigative measures in place to prevent vehicle collisions occurring and actions to be taken in the event of a collision, these include:

- the site will be fully fenced and guarded by security 24 hours a day to prevent unauthorised vehicle entry;
- all fuel storage tanks are double skinned and are located away from site traffic, beneath the engine containers - vehicle crash / deflection barriers will be provided if / where necessary;
- AdBlue tanks will be located away from traffic, on top of the fuel tank;
- there will be no external pipework between fill points and tanks;
- there will be no storage of lubrication oil or coolant, these are only present in the engines which are in containers, there will be no storage of waste;
- there will be designated parking spaces provided for staff and visitors; and
- Vantage staff will be trained to direct and guide delivery vehicles and visitors to appropriate areas away from hazards.

Specific mitigative measures according to each scenario are described in Table 4-1.

After a collision has occurred, the person / persons involved are made safe and the situation is under control, it will trigger an incident review specified in section 4.

3.4. Security Breach

A security breach can lead onto other incidents including; spills and fires (as described above). Therefore, it is important to ensure that adequate security procedures are in place to prevent a security breach.

Vantage will have a number of mitigative measures in place to prevent security breaches and as a result, other incidents occurring, these include:

- the site being surrounded and secured by a large perimeter fence with one designated entrance and exit;
- barriers / fences will be provided at the site entrance before a vehicle can gain full access to the site;
- the site gates / vehicle barriers will be controlled and monitored by security 24 hours a day;
- the site will have a 24-hour CCTV monitoring system with multiple cameras in strategic locations across the site; and
- storage tanks will be surrounded by additional security fencing and / or vehicle crash / deflection barriers (as / if necessary).

Specific mitigative measures according to each scenario are described in Table 4-1.

After a security breach has occurred and the situation is under control, an incident review would be triggered, as outlined in section 4.

3.5. Adverse Weather

Extreme adverse weather, although generally unlikely, could become a more common occurrence with the effects of climate change.

Adverse weather could include the following; flooding, lightning strikes, high wind speeds, extremely low temperatures and extremely high temperatures. In the event of adverse weather, a major spill incident or a fire could occur (as described above).

The NRW online flood risk map and online development advice map indicate that the site is not located in a flood risk zone and that is at little or no risk of flooding (less than 0.1% chance per year).

Vantage will have a number of mitigative measures in place to prevent adverse weather incidents, these include:

- lightning protection is in place;
- all generators, fuel storage tanks and AdBlue tanks are raised above regular ground level;
- all generators are contained within sealed systems (the engine containers);
- all oil storage tanks are double skinned and located beneath the engine containers; and
- all site infrastructure and equipment is inspected on a regular basis.

Specific mitigative measures according to each scenario are described in Table 4-1.

If adverse weather effects occur that result in an incident and once the situation it is under control, an incident review would be triggered, as outlined in section 4.

4. Recording / Reporting an Incident / Accident

4.1. Incident / Accident Review

Whenever an incident / accident occurs it will be recorded and reported in accordance with PM04-13 Corrective Action Procedure.

In addition, the Vantage PM05 Incident Management Procedure (or CWL13 equivalent) will be followed according to the scale of the incident.

All incident report forms will be submitted to senior management for review and action who will then:

- check to see if a similar incident / accident has occurred previously;
- if applicable, assess previous occurrences of the same / similar incident;
- establish the root cause of the incident;
- assesses whether the incident is minor / major and the problem resolved;
- gather previous reports of incidents and note if systems and procedures have been followed by staff correctly;
- review the procedures in place and if required alter the procedure according to prevent re-occurrence;
- review staff training to assess if there is a gap in the staff training programme; and
- communicate any changes made to staff by methods including but not limited to; tool box talks and specific training to ensure good practice upheld.

A formal review of all systems will be undertaken by Vantage in the event of a major incident or accident, in line with the PM05 Incident Management Procedure (or equivalent for CWL13). Any adjustments made will be communicated as above.

4.2. Notifying NRW

Following a major incident / accident Vantage will notify Natural Resources Wales (NRW) as soon as practicable.

The NRW Incident Number is: 0300 065 3000

Vantage will also notify the Regulatory Officer if any complaints are received. This will also include details on any actions have been taken to address the complaint. Copies of any material complaints received will be made available to NRW for review.

4.3. Accident Management Plan Review

The AMP will be reviewed by Vantage senior management every four years or immediately following any major accident / incident.

Any technical or managerial changes which impact on the site will also initiate a review of the AMP to ensure that the control techniques remain appropriate for the site.

Appendices

Appendix A. Accident Control Matrix

Table 4-1 - Accident Control Matrix

Event	Likelihood	Severity	Risk	Mitigation Measures	Mitigated Risk	Actions in event of incident
Spill						
Spill from fuel delivery vehicle / pipework	Low	Medium for diesel, Low if HVO: contamination of land and pollution of local groundwater and surface watercourses.	Low	Fuel tank fill cabinets have drip trays. Fuelling of tanks is conducted by a trained contractor and supervised by trained Vantage staff. Pipework is minimal and deployed away from site traffic. Pipework is regularly inspected and maintained. Permeable paving has a geotextile liner which forms a barrier and traps fuel to prevent it from entering soil or groundwater. There will be an onsite isolation control valve within the downstream drainage system which would be closed in the event of a spill. Outside the proposed Installation boundary, within the wider business park drainage system, there are a number of interceptors which provide further protection measures. Spill kits will be distributed at key locations across the site in the event of a spill. All activities occur on hardstanding.	Low	In the event of a spill, the spill procedure should be followed. In the event of a major spill the drainage isolation system will be utilised. Spill kits are replaced / replenished accordingly after a spill incident.
Spill from AdBlue delivery vehicle / pipework	Low	Low: contamination of land and pollution of local groundwater and surface watercourses.	Low	AdBlue tank fill cabinets will be fitted with drip trays.	Low	In the event of a spill, the spill procedure should be followed. In the event of a major spill the

Event	Likelihood	Severity	Risk	Mitigation Measures	Mitigated Risk	Actions in event of incident
				Filling of tanks is conducted by a trained contractor and supervised by trained Vantage staff. Pipes are minimal and deployed away from site traffic. Pipework is regularly inspected and maintained. Relatively small volumes of AdBlue are stored. There will be an onsite isolation control valve within the downstream drainage system which would be closed in the event of a spill. Outside the proposed Installation boundary, within the wider business park drainage system, there are a number of interceptors which provide further protection measures. Spill kits will be distributed at key locations across the site in the event of a spill. All activities will occur on hardstanding.		drainage isolation system will be utilised. Spill kits are replaced / replenished accordingly after a spill incident.
Spill while re-filling antifreeze / lubrication oil in engines	Low	Low-Medium: contamination of land and pollution of local groundwater and surface watercourses.	Low	Anti-freeze and lubrication oil levels in engines checked prior to filling. Drip trays are used during refilling. Refilling of the engines will occur in the engine containers - any spills would be small and would be contained in the engine container.	Low	As above.
Catastrophic fuel tank failure	Low	High: contamination of land and pollution of local groundwater and surface watercourses with significant quantities of diesel fuels / oils.	Medium	Fuel tanks are double skinned with 110% capacity and alarmed. Tanks are inspected regularly for leaks and infrastructural damage. Spill kits distributed at key locations across the site in the event of a spill. All activities occur on hardstanding.	Low	As above.

Event	Likelihood	Severity	Risk	Mitigation Measures	Mitigated Risk	Actions in event of incident
				Permeable paving has a geotextile liner, which forms a barrier and traps fuel to prevent it from entering soil or groundwater. There will be an onsite isolation control valve within the downstream drainage system, which would be closed in the event of loss of containment. Outside the proposed Installation boundary, within the wider business park drainage system, there are a number of interceptors which act as further protection measures.		
Catastrophic AdBlue Tank Failure	Low	Low: contamination of land and pollution of local groundwater and surface watercourses with significant quantities of diesel fuels / oils.	Low	AdBlue tanks are bunded with 110 % capacity. Tanks are inspected regularly for leaks and infrastructural damage. Spill kits distributed at key locations across the site in the event of a spill. All activities occur on hardstanding.	Low	As above.
Fire						
Maintenance Activities / Hot Works	Low	High: smoke emissions to air and pollution of local groundwater and surface watercourses. Risk to health and safety of staff and neighbouring receptors.	Medium	Any construction or maintenance procedures are conducted away from area where flammable materials are stored, as far as practicable. Applicable hot works being conducted on site require a permit to work.	Low	Follow the fire and evacuation procedure. In the event of any firewater runoff, the drainage system isolation control valve will be utilised.
External fire igniting fuels	Low	High: smoke emissions to air and pollution of local groundwater and surface watercourses. Risk to health and safety of staff and neighbouring receptors.	Medium	Fuel storage tanks are contained within steel plating. The main Vantage building has integrated fire suppression systems.	Low	Follow the fire and evacuation procedure. In the event of any firewater runoff the drainage system

Event	Likelihood	Severity	Risk	Mitigation Measures	Mitigated Risk	Actions in event of incident
						isolation control valve will be utilised.
Vehicle Collision						
Vehicle colliding with storage tank or engine	Low	Medium: contamination of land and pollution of local groundwater and surface watercourses.	Low	Site is fully fenced and guarded by 24 hour security to prevent unauthorised vehicle entry. All storage tanks and engines are located away from site traffic. All fuel storage tanks are double skinned and alarmed. AdBlue tanks are bunded. Vantage staff trained to direct and guide delivery vehicles and visitors to appropriate areas away from hazards. All activities occur on hardstanding. Fuel delivery bays have interceptors. There will be an onsite isolation control valve within the downstream drainage system which would be closed in the event of loss of containment. Outside the proposed Installation boundary, within the wider business park drainage system, there are a number of interceptors which act as further protection measures.	Low	Follow the spill management procedure accordingly. In the event of a major spill the drainage isolation system will be utilised. Fix barriers, containers and replace damaged equipment as required.
Security Breach						
Vandalism including damage to equipment / infrastructure	Low	High: has the potential to cause significant damage to site infrastructure and cause multiple catastrophic tank failures.	Medium	The site is secured by a large perimeter fence, with one designated entrance and exit. Site gates / vehicle barriers will be controlled and monitored by security 24 hours a day The site also has a 24 hour CCTV monitoring system with multiple cameras in strategic locations across the site.	Low	Call Vantage Service Desk who will direct to appropriate personnel. Call police if necessary.

Event	Likelihood	Severity	Risk	Mitigation Measures	Mitigated Risk	Actions in event of incident
Arson	Low	High: has the potential to cause fires across the site, on both sites of the data centre building.	Medium	Also refer to fire mitigation measures. The site is secured by a large perimeter fence with one designated entrance and exit. Site gates / vehicle barriers will be controlled and monitored by security 24 hours a day. The site also has a 24 hour CCTV monitoring system with multiple cameras in strategic locations across the site.	Low	Call Vantage Service Desk who will direct to appropriate personnel. Call police if necessary.
Adverse Weather						
Flood	Low	Medium: flood waters could infiltrate the waste oil storage container on site. Oil residues etc may be picked up by flood waters.	Low	The site is at low risk of flooding. Containers of potentially polluting materials are secured to ground, where required, to prevent release during flood conditions. All generators and storage tanks will be raised above regular ground level and will be contained within sealed systems (fuel storage tanks will be double skinned and alarmed). The site subscribes to NRW's flood warning system.	Low	Follow spill procedure as appropriate. Any repairs to infrastructure and / or equipment are made as soon as practicable.
Lightning Strike	Low	Medium: lightening could ignite fuel residues and lead to a larger fire.	Low	All generators and storage tanks will be contained within sealed systems. Any spills are cleared as soon as practicable, in accordance with the spill procedure.	Low	Follow fire procedure as appropriate. Any repairs to infrastructure and / or equipment are made as soon as practicable.
High Winds	Low	Medium: winds could cause damage to fuel stores if object was blown.	Low	All infrastructure is secured and it is unlikely to be affected by high wind speeds.	Low	Any repairs to infrastructure and / or equipment are made as soon as practicable.

Event	Likelihood	Severity	Risk	Mitigation Measures	Mitigated Risk	Actions in event of incident
Extremely Low Temperatures	Low	Low: unlikely to cause a spill or fire as a result of low temperatures.	Low	All generators contain anti-freezing mechanism to prevent freezing of essential equipment. Site infrastructure and equipment are inspected regularly.	Low	As above.
Extremely High Temperatures	Low	Low: unlikely to cause a spill or fire as a result of high temperatures.	Low	All generators contain cooling mechanisms to prevent overheating of equipment. All diesel fuel storage tanks are double skinned to prevent heat transfer to the diesel. Site infrastructure and equipment are inspected regularly.	Low	As above.

Appendix B. List of Substances at Site

Table 4-2 - List of Substances on Site

Name	Description	Location and Storage
Engine Oil	Lubricating oil for engines	In engines Not stored on site
Antifreeze / Coolant	Antifreeze for engines	In engines Not stored on site
Fuel (HVO / diesel)	Fuel for engines	Double skinned tanks, 110% capacity
AdBlue	Reagent for selective catalytic reduction	Integrally bunded tanks, 110% capacity

Appendix C. Emergency Contact Details

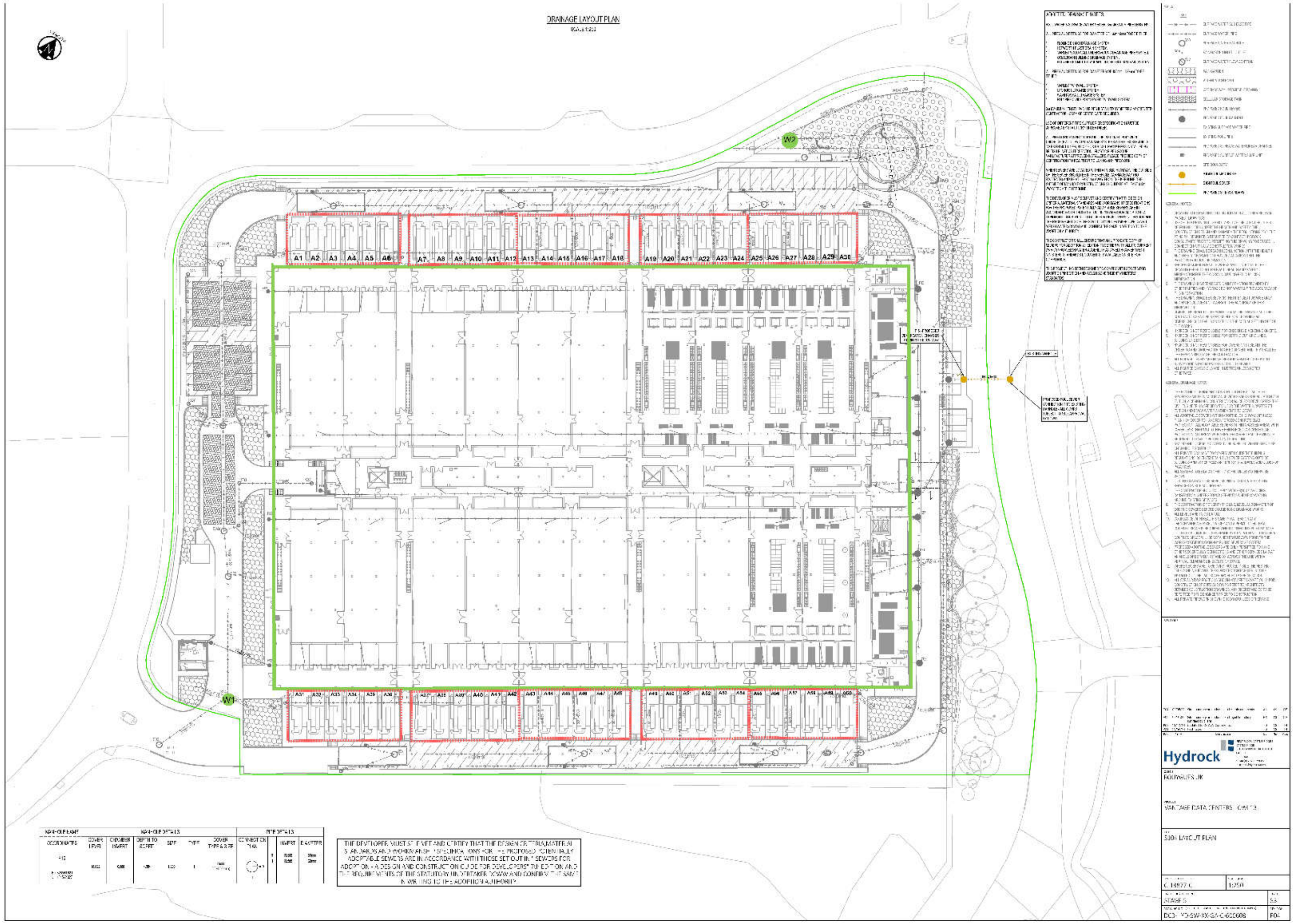
Name	Role	Contact Number
Vantage Service Desk	24-hour call centre - this team will know which team members are on-site at any one time and will pass on the correct details	01633 674500

Appendix D. Reference Documents

In the event of an incident Vantage procedures and documentation will be followed, based on the IMS for CWL11, these are expected to include the following (or equivalents thereof):

Document Title	Date	Version Number
PM02-01	Fire & Evacuation Procedure	20/05/2022
PM03-01	Emergency Management	20/05/2022
PM04	Monitoring, Measurement, Analysis and Evaluation Procedure	12/05/2021
PM04-13	Corrective Action Procedure	16/07/2021
PM05	Incident Management Procedure	22/02/2022

Appendix E. Site Plan



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CWL13

Site Condition Report

Vantage Data Centers UK Ltd

04 August 2022

Notice

This document and its contents have been prepared and are intended solely as information for Vantage Data Centers UK Ltd (VDC) and use in relation to providing supporting information for VDC's environmental permit application.

Atkins Limited assumes no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

This document has 15 pages, including the cover, plus Appendices.

Document history

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
Rev 1.0	Final for issue	HL	AA	SW	JA	04/08/22

Table of Contents

1. Site Details

Name of the applicant	Vantage Data Centers UK Ltd
Activity address	Bouges, Vantage Data Centre, North Lake Drive, Newport, NP10 8UL.
National Grid Reference	ST 2848 8449 (NGR 328489, 184490)
Document reference and dates for Site Condition Report at permit application and surrender	5214555_CWL13_Site Condition Report_V1.0.August 2022.
Document references for site plans (including location and boundaries)	Figures relevant to the site, including a site location plan and installation boundary / layout drawing, are provided within Appendix A of the main application. An exploratory hole location plan is included within the ground investigation factual report, which is provided in Appendix B of this Site Condition Report. The site location (including the area covered by the Site Condition Report) and the location and nature of the activities, locations of receptors, sources of emissions/releases, monitoring points, site drainage and site surfacing are shown within the drawings listed above and within the drawings provided within Part A of the Permit Application.

2. Condition of the Land at Permit Issue

Environ-mental setting	**Location and Current Land Use** The site is located in the south eastern corner of Imperial Park, which is on the south western edge of Newport, off the A48 near Junction 28 of the M4. For the purposes of this report, the site is defined as the land within the permit application site boundary, which is an irregular rectangular shape, and which excludes the Data Hall building in the centre of the site. The overall site area, including the Data Hall building is 2.6 hectares (ha). The site is accessed via North Lake Drive and Celtic Way, from the junction with the A48. The site is owned by Vantage Data Centers UK Limited (hereafter VDC or 'the operator') which provides wholesale out-of-town data centre space and holds government and blue-chip company data for some of the world's largest companies at its state-of-the-art facility at Imperial Park in Newport. The wider facility, comprising light industrial buildings, was established in 2009. A site walkover was undertaken in September 2020 prior to the development of the site as a data centre. At this time, the site was vacant land comprising a mixture of hardstanding and gravel surfacing. The site was secure, with no obvious signs of fly tipping or illegal entry. No obvious visual or olfactory evidence of ground contamination was noted on site. A stockpile of reddish-brown sandy gravel, assumed to be left over engineering fill, was present in the central north of the site. Planning consent for the development was granted in March 2021, subject to the close-out of a number of pre-operational planning conditions. Following planning consent, development of the Data Centre has commenced. The development comprises a two-storey data centre building containing 10 individual data halls with support space for plant rooms, staff welfare facilities and offices. This building is excluded from the permit application site boundary and therefore is

2. Condition of the Land at Permit Issue

not part of the Installation. External space comprises an internal perimeter circular road, parking and a Sustainable Drainage System, with a 4 m high security fence on the boundaries of the site.

There are 60 standby generators sets arranged as 10 cells (each engine is <3MWth), 30 generators / 5 cells are located along the north-western side of the building and 30 generators / 5 cells along the south-eastern side. These are in place to provide back-up power generation to the data centre in the event of a grid power failure.

Topography

The elevation of the site is generally flat, approximately 14.5 m above ordnance datum (AOD), with limited gradient changes.

Surrounding Land Use

- North: undeveloped open land, and car park associated with the IQE building;
- East: South Lake Drive and Imperial Courtyard Business Park beyond;
- South: vegetated scrub, shrubs and trees with landscaped parkland beyond; and,
- West: undeveloped open land and IQE building.

Geology

An intrusive ground investigation (GI) was completed at the wider site (including the land underlying the proposed data centre building) in January and February 2021 by Geotechnical Engineering Ltd. [2]. The factual report is provided in Appendix B. The GI compromised the following:

Table 2-1 - Summary of Site Investigation

Date	Works Undertaken
18/01/2021 – 22/01/2021	Dynamic Cone Penetrometer tests (DCP) and Dynamic Probeholes (DPSH) - 17 locations, DCP01 to DCP12 (plus alternative locations 1A, 3A, 9A, 11A, 12A) - 12 locations, DC3_DPSH01 to DC3_DPSH12
25/01/2021 – 29/01/2021	Boreholes (BH) and trial pits (TP) - 3 BH locations, DC3_BH03, DC3_BH04B, DC3_BH05 - 12 TP locations, DC3_TP01 to DC3_TP12
01/02/2021 – 5/2/2021	Boreholes - 5 locations DC3_BH01, DC3_BH02, DC3_BH04B (continued), DC3_BH06, DC3_BH07
12/02/2021	Ground gas and groundwater monitoring – round 1
17/02/2021	Ground gas and groundwater monitoring and sampling – round 2
03/03/2021	Ground gas and groundwater monitoring and sampling – round 3

The exploratory hole locations relevant to the site (i.e. the permit application site) and covered within this Site Condition Report are as follows: DC3_TP 01, DC3_DCP 01, DC3_BH01, DC3_DPSH01, DC3_BH02, DC3_TP 02, DC3_DCP 02, DC3_DPSH02, DC3_BH03, DC3_TP 03, DC3_DCP 03, DC3_DPSH03, DC3_TP 04, DC3_DCP 04, DC3_DPSH07, DC3_BH05, DC3_TP 10, DC3_DCP 10, DC3_TP 11, DC3_DCP 11, DC3_TP 12, and DC3_DCP 12.

Made Ground

Made Ground was identified as part of the 2021 GI [2] to a maximum depth of between 0.2 m and 1.3 m bgl. The area with the greatest thickness of Made Ground was recorded in the centre and north-east of the site, in the area of a former water treatment plant.

Typically, Made Ground comprised gravelly silt and sandy gravel. Gravel comprised fine to coarse angular sandstone, quartzite, brick and concrete. Rare slag and clinker were recorded in DC3_BH02, BH05, TP01, TP02, TP10, TP11 and TP12. Additional anthropogenic materials were recorded in DC3_TP02 (rubber and clay pipe fragments). Details of visual and olfactory evidence of contamination are provided in Table 2-3 below.

A plastic membrane was present at the base of the Made Ground, directly on top of natural strata, at 0.3 m in DC3_BH01, 0.20 m bgl in DC3_TP01, and 0.25 m bgl in DC3_TP04.

Superficial Geology

River Terrace Deposits (RTD) were located directly underlying the Made Ground across the site to proven depths of between 6.6 and 7.85 m bgl and recorded thicknesses of between 5.75 and 6.95 m. Typically, the stratum comprised silty sandy gravel and cobbles of sandstone. The base of the stratum was not encountered within the trial pit locations.

Bedrock Geology

In all four boreholes, mudstone of the Mercia Mudstone Group was encountered underlying the River Terrace Deposits.

Weathered mudstone was present in DC3_BH01 at 6.7 m bgl (1 m thickness) typically comprising sandy gravelly silt with gravel of mudstone lithorelicts.

Competent mudstone was recorded from 6.6 m bgl in DC3_BH05 to 7.85 m bgl in DC3_BH03 and comprised weak reddish-brown mudstone with closely space fracturing. The base of the stratum was not proven past the maximum depth of investigation at 14.43 m bgl (DC3_BH03) [2]. St Maughans Formation is mapped underlying the Mercia Mudstone Group.

Hydrogeology

Groundwater Levels

During the 2021 GI [2] groundwater levels were monitored on three occasions within the standpipes and are summarised in Table 2-2.

Table 2-2 - Summary of Water Monitoring

Location	Stratum	Ground Level (m AOD)	Monitoring Round 1 Water Level (12/02/21)		Monitoring Round 2 Water Level (17/02/21)		Monitoring Round 3 Water Level (03/03/21)	
			m bgl	m AOD	m bgl	m AOD	m bgl	m AOD
DC3_BH01	River Terrace Deposits	TBC	2.80	TBC	2.37	TBC	2.95	TBC
DC3_BH03		14.43	3.42	11.01	3.38	11.05	3.60	10.83
DC3_BH05		14.60	2.16	12.44	2.20	12.40	2.75	11.85

The depth to groundwater increases to the south-east of the site and the groundwater flow direction is interpreted to be in this direction towards the Bristol Channel.

Aquifer Designation

2. Condition of the Land at Permit Issue

Natural Resources Wales (NRW) classifies the River Terrace Deposits as a secondary A aquifer [5]. The Mercia Mudstone Group is classified as a secondary B aquifer and the underlying St Maughans Formation is classified as a secondary A aquifer.

Groundwater Source Protection Zones

Data obtained from the NRW geo-portal online environmental database [5] indicates that the site is not located on or within 1 km of a groundwater source protection zone (SPZ).

Groundwater Vulnerability

The Envirocheck Report [6] shows that the site is located within a high vulnerability, productive superficial aquifer within the superficial deposits.

Groundwater Abstractions

Data from the Envirocheck Report [6] indicates that there are no licensed groundwater abstractions on the site.

In the surrounding area there is one groundwater abstraction within 1 km of the site, located 150 m south of the site, which is licenced to Hynix Semiconductors for “amenity use: make up or top-up water” for an adjacent lake.

Hydrology

Hydrological Features

There are no surface water features located on the site. The nearest surface water feature to the site is an unnamed man-made lake, located 70 m south of the site, between South-Lake Drive and North-Lake Drive.

Within 500 m of the site there are a number of other surface water features comprising:

- Blackwall Reen, flowing south, 130 m east of the site;
- an unnamed lake 430 m south of the site;
- two unnamed lakes located on either side of the A43 carriageway 450 m and 470 m north-west of the site;
- Percoed Reen, 700 m south-east of the site; and,
- Nant Y Moor Reen, 900 m to the south-west of the site.

All of the lakes are isolated and do not appear to be fed by or connected to drains or watercourses.

Blackwall Reen is the closest surface watercourse to the site, which flows south parallel to the site before turning to flow south-east. Percoed Reen watercourse is down hydraulic gradient of the site, situated 700 m south-east of the site on the Gwent Levels. The Gwent Levels includes several unnamed watercourses and comprises low-lying estuarine alluvial wetland areas with intertidal mudflats along the Welsh bank of the River Severn.

Discharge Consents and Abstraction Licences

Data from the Envirocheck Report [6] indicates that there are no licensed discharge consents related to the site. There are six active discharge consents located within 1 km of the site as summarised below:

- 500 m south: storm sewage overflow discharge to an unnamed Reen for Newport City Council;
- 530 m south: trade effluent discharge to Percoed Reen for Jeff Perren
- 605 m south: trade effluent discharge to Percoed Reen for Jeff Perren
- 715m west: sewage discharge to Nant Y Moor Brook for Dwr Cymru Cyfyngedig

2. Condition of the Land at Permit Issue

- 770 m south: site drainage discharge to Percoed Reen for Manweb Services Ltd and,
- 785 m west: domestic treated effluent discharge to Nant Y Moor Brook.

Data from the Envirocheck Report [6] indicates that there are no licensed surface water abstractions on or within 1 km of the site.

Flood Risk

The NRW online flood risk map [5] indicates that the site is not located in a flood risk zone and has a risk <0.1% annual of flooding from rivers.

The NRW online development advice map [5], indicates that the site is located within Zone A, which, in accordance with Planning Policy Wales TAN15, relates to land that is at little or no risk of flooding and no further flood risk assessment is required.

Sensitive Land-Uses

The Defra MAGIC online database [7] indicates that there are no environmentally sensitive land uses located on the site or adjacent to the site. There are four Sites of Importance for Nature Conservation (SINCs) within 1 km of the site, the closest being the LG Duffryn Site 1 SINC located c. 60 m to the south. The Gwent Levels Site of Special Scientific Interest (SSSI) is located 260 m south-east of the site at its closest point, related to flora and fauna species which are rare or absent in other marsh level systems.

Pollution History

Site History

A review of the historical maps provided within the Envirocheck Report [6] has been undertaken. A summary of the site's history is provided below.

The first available map dated 1883 shows the site was occupied by open fields with a footpath crossing the southern half of the site, orientated in a north-east to south-west direction. Historical mapping shows no significant change to site use until c. 1992/1993 when an oval shaped feature partially covered the northern section of the site (potentially a pond or landscaped feature). By publication of the 2000 map, development had taken place on site comprising a rectangular compound of structures (Water Treatment Works). In the south-east of the site, a car park was shown as being present. The former oval shaped feature was no longer present. By publication of the 2016 map, the Water Treatment Works in the north-east of the site had been removed.

In the surrounding areas within 500 m of the site, potentially contaminative mapped land-uses between 1883 and 1992 were limited to industrial estates, a works of undefined use and gravel pits. The Cleppa Park Industrial Estate 480 m north-east of the site boundary was identified on historical plans from 1992. A gravel pit was noted on plans dated from 1883 until 1970, approximately 250 m north east of the site. A further gravel pit was noted on plans dated from 1901/1902 until 1920/1922, approximately 400 m south of the site. A pumping station was located 500 m south of the site from 1999 until the present day and in 2000 an electricity sub-station was located 60 m to the north of the site and a sewage treatment plant 100 m north of the site.

A Mott McDonald demolition report [8], produced for the Welsh Government, indicates that the site was originally developed in 2000 by the Welsh Assembly Government for the electronics company LG and comprised a complex of warehouse and support buildings. It is understood the site was never fully occupied. The Welsh Government retained control of the Imperial Park industrial estate and in 2013 made the decision to demolish a number of the buildings and facilities in order to remove health and safety and security issues surrounding the site [8] [9]. The utility and support buildings were demolished in 2013. This included a waste water treatment plant on the site and an underground storage tank farm, central utilities building (CUB) and electricity sub-station off-site to the north. Overhead gantries, originally supporting pipework, and utility connections between the buildings, were also removed as part of the demolition.

2. Condition of the Land at Permit Issue

The on-site water treatment plant was reported to comprise a control room, blower house, tank farm comprising 26 tanks and silos. The demolition report stated that the tanks were "as-new" and empty when demolished. This suggests that the plant was unlikely to have been brought into use or was used for a short period of time.

Aerial photographs dated 2011, viewed on Google Earth Pro, show the water treatment works in the north-east corner of the site comprising five above ground water tanks, four above ground storage tanks, four below ground tanks and seven separate rectangular buildings. A gantry was located on the northern boundary of the site, connecting services to the wider business park. The aerial photograph also shows areas of hardstanding for car parking in the south west of the site. A later aerial photograph, dated 2013, shows the water treatment works in the process of demolition. In 2015, a photograph shows the former location of the works had been covered with a gravel layer.

Pollution Incidents

Data from the Envirocheck Report [6] indicates that there are no pollution incidents recorded on the site. There are two recorded pollution incidents to controlled waters within 1 km of the site as summarised below:

- 275 m north: a category 3 minor incident involving diesel oil spillage in December 1996; and
- 600 m west: a category 3 minor incident involving release of crude sewage in December 1996.

The Envirocheck Report [6] indicates that there is one recorded substantiated pollution incident within 1 km of the site, located 880 m south related to a Category 2 significant incident to land from deposition of household waste.

Control of Major Accident Hazards (COMAH) and Planning Hazardous Substances Consents

According to the Envirocheck Report [6], there is one COMAH site recorded within 500 m of the site. This relates to an active Lower Tier control registered to LG Electronics Wales Ltd which is located 356 m south of the site.

Integrated Pollution Control

According to the Envirocheck Report [6], seven Integrated Pollution Control registered activities were recorded within 500 m (between 153 m and 467 m from the site). These all relate to activities at LG Philips Displays Wales Ltd and LG Electronics Wales Ltd although the permits have now been superseded or revoked. These related to processes involving the use of halogens and inorganic chemicals within the chemical industry.

Integrated Pollution Prevention and Control

According to the Envirocheck Report [6], eight Integrated Pollution Prevention and Control registered activities were recorded within 500 m relating to three separate operations. The first concerned two separate permits relating to SPP Process Technology Systems UK Limited located approximately 139 m east of the site. This related to processes involving the use of halogens and inorganic chemicals within the chemical industry although both permits have now either been surrendered or superseded. The second activity concerned five separate permits that have now been superseded or surrendered, for operations by SPP Process Technology Systems UK Limited (former location of Surface Technologies Systems Plc) also located approximately 139 m east of the site. The third activity concerned one permit relating to Newport Semiconductor Facility located approximately 163 m west of the site. This related to processes involving the use of halogens and inorganic chemicals within the chemical industry and is still effective.

2. Condition of the Land at Permit Issue

According to the Envirocheck Report [6], one additional Local Authority Pollution Prevention and Control activity is located within 500 m of the site. This relates to Quinn Radiators Ltd located 441 m south-west of the site. The permit is currently active and relate to powder coating processes.

It is noted that the Vantage CWL11 site c.100 m to the north-west of the CWL13 site also holds an Environmental Permit for operation of standby generation engines.

Landfill and Waste

The Envirocheck Report [6] shows no currently active landfill sites within 1 km of the site.

There are two recorded historical landfill sites within 1 km of the site as summarised below:

- 630 m north: Graig-Y-Saeson Farm received inert, industrial and household waste between August and October 1988; and
- 840 m north-west: Cefn Llogell Farm received inert waste between 1993 and 1996.

According to the Envirocheck Report [6] a historical metal recycling site was located 215 m east of the site. This site reportedly closed in 2005.

Mineral Extraction and Mining

There are three BGS recorded mineral sites within 1 km of the site as summarised below [1]:

- 215 m east: Tredegar Park opencast quarry for extraction of sand and gravel (closed);
- 500 m south: Pont-Estyll opencast quarry for extraction of sand and gravel (closed); and,
- 970 m north-west: Cleppa Park opencast quarry for extraction of sandstone (closed).

Review of available Ordnance Survey plans and aerial photographs suggests that Tredegar Park and Cleppa Park have been infilled and currently occupied by commercial units. There are three lakes situated at Pont-Estyll, which suggest that this site may not have been completely infilled.

The Coal Authority interactive map [11] shows that the site does not lie in a coal mining area.

Radon

Public Health England information [12] indicates that the site is in an area of intermediate probability radon where 5 to 10% of homes are estimated to be at or above the Action Level.

Unexploded Ordnance (UXO) Risk

The Zetica Regional Unexploded Bomb (UXB) Risk Map [13]which relates to air dropped World War II Ordnance only, indicates that the site is within an area of low risk with less than 15 bombs per 1000 acre or less.

Considering the classification of UXB above and post war historical development of the site, the risk of encountering unexploded ordnance (UXO) is low but cannot be completely discounted.

A site specific pre desk study assessment report was obtained from Zetica [13] which identified that there were strategic targets in vicinity of the site and a recorded 366 High Explosive (HE) bombs fell within the region. No available records are available to suggest the site was bombed. Zetica considered that a detailed desk study was not considered essential in this instance.

Contemporary Trade Directory Information

Contemporary trade directory information provided within the Envirocheck Report **[6]** indicates the presence of several current and former activities within Imperial Park and within 500 m of

2. Condition of the Land at Permit Issue

	the site. Those that are located within 150 m have been summarised here to comprise of three companies: Silvertel (Electric Component Manufacturers) located approximately 68 m north-east (active); Identigen (Laboratories) located approximately 79 m north-east; and Vansdirect (Commercial Van Dealers) located approximately 114 m north-east. **Other Environmental Information** The Envirocheck Report [6], did not identify any of the following environmental issues or current sources of contamination within 500 m of the site: • Enforcement or prohibition notices; • Contaminated Land register entries or notices; • Prosecutions relating to Controlled Waters; • Explosive sites; • Notification of Installations Handling Hazardous Substances (NIHHS); • Planning hazardous substances consents and enforcements; and, • Fuel stations. **Summary of Pollution Potential** It is considered that there is a potential for contamination to be present on-site associated with the Made Ground underlying the site and associated with surrounding former and existing potentially contaminative land uses (detailed above) which may have impacted on the site.
Evidence of Historic Contamination	A site walkover carried out at the site in September 2020 did not identify any visual or olfactory evidence of contamination. During the 2021 GI, Made Ground was identified across the site as were visual and olfactory indicators of potential contamination, summarised in Table 2-3.

Table 2-3 - Summary of Visual and Olfactory Observations

Location	Strata	Depth (m bgl)	Visual / Olfactory Observation
DC3_TP03	Made Ground	0.20 – 0.30	Faint hydrocarbon odour
DC3_TP10	Made Ground	0.40 – 0.60	Faint organic odour
DC3_TP12	Made Ground	0.16 – 0.35	Blueish grey colouration
	River Terrace Deposits	3.90 – 4.05	Black stained residue on sandstone gravel Slight hydrocarbon odour

Baseline Soil and Ground-water Reference Data	To support the planning application for the development of the data centre, a ground investigation was undertaken at the site in 2021, including chemical testing of soil and groundwater samples (factual report provided in Appendix B). The scope of this GI was extended to also include collection of baseline data in relation to the proposed permitted activities. It should be noted that, based on the site-specific assessment of substances to be used, stored and handled in relation to permitted activities at the site (see Section 3 below), no substances have been identified which represent a significant potential pollution risk. Therefore, the collection of baseline data is considered to be a precautionary approach. The relevant baseline GI within the site boundary comprised: • 3 No. cable percussive boreholes to 14.43 m below ground level (m bgl) installed with a groundwater monitoring well (response zone targeting the River Terrace Deposits);

2. Condition of the Land at Permit Issue

- 1 No. cable percussive borehole to 8.54 m bgl –no installation; and
- 6 No. machine excavated trial pits to a maximum 1.20 mbgl.

An additional trial pit (DC3_TP01), seven DCPs and four DPSHs were also progressed within the site (as summarised in the geology section above), however no baseline soil or groundwater samples were collected from these locations.

Eight soil samples were taken from the Made Ground and two from the superficial deposits during the GI at DC3_TP03, DC3_TP11, DC3_BH03, DC3_TP02, DC3_TP10 (superficial deposits), DC3_TP12, DC3_BH05 (superficial deposits), DC3_BH02, DC3_TP04, and DC3_BH01 and were tested for the following contaminants / parameters:

- Arsenic, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium & zinc;
- Complex cyanide, free cyanide, total cyanide, sulphide, water soluble sulphate (as SO_4), ammoniacal nitrogen as N and NH_3 & pH;
- Speciated polycyclic aromatic hydrocarbons (PAHs) (USEPA 16);
- Total Petroleum Hydrocarbons (TPHs), speciated Criteria Working Group;
- BTEX (benzene, toluene, ethylbenzene, p & m-xylene and o-xylene) & MTBE (methyl tertiary butyl ether);
- Asbestos screen;
- Total organic carbon (TOC) & organic matter; and
- Total phenols;

Six of the samples (DC3_TP03, DC3_TP11, DC3_BH03, DC3_TP02, DC3_TP10, DC3_TP12) were also tested for the following:

- Speciated and total Polychlorinated Biphenyls (PCBs); and
- Speciated glycols.

Nine of the samples (DC3_TP03, DC3_TP11, DC3_BH03, DC3_TP02, DC3_TP10, DC3_TP12, DC3_BH05, DC3_BH02 & DC3_TP04) were also tested for the following:

- Thiourea.

Groundwater monitoring wells DC3_BH01, DC3_BH03, and DC3_BH05 (with installations within the River Terrace Deposits) were sampled on 17/02/21 and 03/03/21. The groundwater samples were scheduled for testing of the following contaminants / parameters:

- Arsenic, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium & zinc;
- Free cyanide, total cyanide, sulphate as SO_4, sulphide, chloride, ammoniacal nitrogen as N and NH_3;
- Dissolved organic carbon, TOC & pH;
- Speciated PAHs (USEPA 16);
- TPHs, speciated Criteria Working Group;
- BTEX & MTBE;
- Total phenols;

2. Condition of the Land at Permit Issue

	• Speciated & total PCBs; • Speciated glycols; and • Thiourea. Minimum and maximum concentrations of each contaminant / parameter recorded within the soil and groundwater are provided in Appendix C.
Supporting information	The following references were used in the production of this Site Condition Report: [1] British Geological Society , “Onshore index,” [Online]. Available: http://mapapps2.bgs.ac.uk/geoindex/home.html. [Accessed June 2022]. [2] Atkins, “Vantage CLW13 Geo-Environmental Ground Investigation Report 5197938/DC3/SI/R1/V1,” 2021. [3] British Geological Society, “Geological Survey of England and Wales, Newport. Sheet 249. Solid and Drift edition, 1:5000 Series,” 1997. [4] British Geological Society, “Lexicon of Named Rock Units Database,” [Online]. Available: http://www.bgs.ac.uk/lexicon/home.. [Accessed June 2022]. [5] Natural resources Wales, “Flood Risk Map,” [Online]. Available: https://naturalresources.wales/our-evidence-and-reports/maps/flood-risk-map/?lang=en.. [Accessed June 2022]. [6] Landmark Information Group, “Envirocheck Report 256105007. Available within the Geo-environmental Desk Study submitted under planning application 20/1176, available via Newport City Council’s online planning portal’,” 2020. [7] DEFRA, “Magic Maps,” [Online]. Available: https://magic.defra.gov.uk/magicmap.aspx. [Accessed June 2022]. [8] Mott MacDonald, “Demolition of CUB and Related Structures at Former LG Factory Site - Draft Demolition Management Plan,” 2013. [9] The National Assembly for Wales, Audit Comittee, “Protecting Public Money in the LG Projects Committee Report (3).,” 2007. [10] Hughes and Salvidge, “LG HYNIX Newport Demolition Health and Safety File,” 2013. [11] Coal Authority, “Coal Authority Interactive Map,” [Online]. Available: https://naturalresources.wales/our-evidence-and-reports/maps/flood-risk-map/?lang=en.. [Accessed June 2022]. [12] Public Health England, “UK Maps of Radon,” [Online]. Available: http://www.ukradon.org/information/ukmaps.. [Accessed June 2022]. [13] Zetica, “UXB Risk Maps,” [Online]. Available: http://www.zetica.com/uxb_downloads.htm.. [Accessed June 2022]. [14] Atkins, “Phase 1 Desk Study. Imperial Park, Newport. 170420_Phase 1 DS V1,” April 2017. [15] Newport City Council, “My Newport - My Maps,” [Online]. Available: http://my.newport.gov.uk/iShare/mynewport.aspx. [Accessed June 2022].

3. Permitted Activities

Permitted activities	**Current Development** The installation will comprise 60 new standby generators. The generator sets will be Kohler type, which incorporate the KD45V20-DES engine with a thermal input of just under 3 MWth. The engines are grouped into 'cells', and there will be 10 cells, each with 6 generator sets. The engines will burn hydrotreated vegetable oil (HVO), although diesel may be used as an alternative fuel in the event of supply issues. The two fuels can be used interchangeably. Each engine will have an individual flue that exhausts at one metre above the parapet of the building. Selective catalytic reduction abatement technology will be installed on the CWL13 engines to reduce emissions of nitrogen oxides. This process involves the injection of a urea solution (AdBlue) into the engine exhaust gases. The only point source emission to water will be uncontaminated surface water runoff, which will ultimately be discharged into the business park drainage system via two discharge points. There will be no process effluent produced. There will be no discharges to sewer. There will be no planned emissions to groundwater. It is considered unlikely that offsite nuisance as a consequence of dust or odour will occur as a result of the operation of the installation. Release of fugitive emissions to land and water will be prevented through appropriate infrastructure and management controls. Further information on emissions is provided in the main permit application documentation. **Identification of the Substances Used at the Installation** As part of the proposed operations the following substances are to be handled within the installation boundary. Further details are provided in Table A1 in Appendix A of this document: • Hydrotreated vegetable oil (HVO); • Diesel; • Antifreeze / coolant; • Engine oil; and • AdBlue (urea solution). In addition to the materials listed above, there is an ammonia slip catalyst (ASC) present in the SCR catalyst housing (mounted on top of the generator). The catalyst is a metal (platinum) oxide and as it forms an integral part of the SCR reactor it is not considered as a 'raw material'. No ASC will be stored on site and is unlikely to be brought onto site as it should not need replacing within the life span of the engines (as it is only requires changing after 6,000-8,000 hours of use, and the engine will only be used for approximately 5 hours per year for routine testing / maintenance). The following wastes will be generated at the installation: • Engine oil; • Filter oil / fuel; and • Antifreeze / coolant. Other wastes will be generated but these are not considered to have significant pollution potential and therefore have not been included as part of this assessment. No waste will be stored on site; wastes are removed by the external maintenance

3. Permitted Activities

team. Further details on all wastes are provided in the main permit application documentation.

Identification of those Substances which are Relevant Hazardous Substances or which Represent a Theoretical Pollution Risk

The substances listed above have been further considered to determine whether each substance is considered to be a relevant hazardous substance and / or whether it represents a theoretical pollution risk. Details of this process for each substance are provided in the table in Appendix A.

Assessment of Site Specific Pollution Risk

Those substances that were identified as relevant hazardous substances and / or a theoretical pollution risk have been further considered to determine whether circumstances will exist on-site which may result in the release of the substance in sufficient quantities to represent a pollution risk. Details of this assessment, including details of storage, use and quantities of the substances, as well as any relevant containment measures, practices or procedures, for each substance are provided in Table A1 in Appendix A.

In addition to the details provided in Appendix A, the following general practices, procedures and measures, in accordance with Best Available Techniques (BAT), will be adopted in relation to the storage, handling and use of chemicals / oils / fuels / potentially hazardous substances at the site. Further details are provided in the main permit application documentation.

Subsurface Structures

There will be no subsurface bulk storage tanks or process pipework. The only below ground pipework is for the mains water supply and surface water drainage.

Surfacing

The site will comprise a mix of hardstanding and soft landscaping. To the immediate north-west and south-east of the building, the generators will be located on concrete bases, with permeable paving for vehicular areas and pedestrian areas located beyond these (north-west of the north-western generators and south-east of the south-eastern generators). Within the permeable paving vehicular areas will be hardstanding tanker bays for refuelling; there will be three on each side of the building. To the south west, west, north east and east of the building, acting as a ring around the building, will be areas of vehicular tarmac. Car parks, made of permeable paving and recycled rubber paving kerbs will be located to the south-west and north of the buildings. Soft landscaped areas will be largely present to the north, east, and south west of the building and comprise a mix of grassland, shrubs, trees and rain garden. Further details are provided on the Landscape Softworks and Hardworks plans provided in Appendix D.

Storage Areas

Each generator set will be in its own container which sits on top of an individual fuel tank. Each 16 m^3 tank will be an above ground, double skinned, integrally bunded (with 110% capacity) ‘belly tank’ which is complete with alarm and integral fill point. A drip tray will be present beneath the fill point. The AdBlue tanks will sit underneath the discharge attenuator and on top of the fuel tank. The 1 m^3 tanks will be integrally bunded (with 110% capacity) with bunded fill point cabinets.

Antifreeze / coolant and engine oil will be present in the engines but will not be stored on the site. These materials will be brought on to site by an external

3. Permitted Activities

	maintenance team as required for maintenance / testing of the engines. Drip trays will be used when topping up engine oil and antifreeze / coolant within the engines. Any spills / leaks will be contained within the engine container, which effectively acts as a bund. Spill kits will be provided in the areas of the tanks / generators. Tanks / generators will be regularly inspected and procedures to cover spills, leaks or damaged tanks will be incorporated into the site Environmental Management System. **Transport and Handling of Materials** Raw materials will be delivered to the site by road, using authorised carriers. Materials will be delivered within plastic containers, bowser or tanker by LGV / HGV. There are six hardstanding tanker bays for refuelling activities, which are spilt into two sets of three bays, one set on each side of the site. Transfer from tanker to the engine tanks will be via a flexible hose which conforms to British Standards. Material unloading, storage, handling and use of raw materials will be undertaken in accordance with local site procedures. Offloading activities will be supervised at all times (in accordance with site procedures). **Drainage** The site will have a SUDS drainage system. The refuelling bays will be connected to oil interceptors which will be alarmed and regularly inspected / maintained. In the event of a large-scale accidental release during refuelling (for example as a result of hose connection failure), the spill could run onto the permeable paving outside of the refuelling bay areas. The paving will have a geotextile liner which forms a barrier to prevent the fuel from entering soil or groundwater. The fuel would be ‘trapped’ above the liner in the crushed stone drainage layer, from which it could be removed and the pavement remediated. There is also an onsite isolation control value within the downstream drainage system which would be closed in the event of a spill. The oil that collected in the drainage system could then be removed. As part of the commissioning / handover, a spillage risk assessment will be undertaken to determine if any additional measures, e.g. use of larger portable drip tray or spill pads/mats, are required to protect the permeable paving in the vicinity of the fill point during refuelling. Given that all substances are stored in dedicated storage areas with appropriate containment measures, all substances are stored, transported and used above ground and substances in liquid form are stored, transported and used within bunded storage containers, there is considered to be limited potential for leaks / spills to impact underlying ground / groundwater. Therefore, none of the substances to be used or handled at the site as part of the permitted activities are considered to represent a significant site specific potential pollution risk.
Non-permitted activities undertaken	N/A
Document references	Figures relevant to the site, including a site location plan and installation boundary / layout drawing are provided within Appendix A of the main application. The site location (including the area covered by the Site Condition Report), sources of emissions/releases and site drainage are shown within the drawings provided within the main permit application supporting information documentation.

4. Changes to the Activity

Have there been any changes to the activity boundary?	Not applicable for permit application.
Have there been any changes to the permitted activities?	Not applicable for permit application.
Have any 'dangerous substances' not identified in the Application Site Condition Report been used or produced as a result of the permitted activities?	Not applicable for permit application.
Checklist of supporting information	Not applicable for permit application.

5. Measures Taken To Protect Land

Not applicable for permit application.

Checklist of supporting information	Not applicable for permit application.

6. Pollution Incidents That May Have Had an Impact on Land, And Their Remediation

Not applicable for permit application.

Checklist of supporting information	Not applicable for permit application.

7. Soil Gas and Water Quality Monitoring (Where Undertaken)

Not applicable for permit application

Checklist of supporting information	Not applicable for permit application.

8. Decommissioning and Removal of Pollution Risk

Not applicable for permit application

Checklist of supporting information	Not applicable for permit application.

9. Reference Data and Remediation (Where Relevant)

Not applicable for permit application

Checklist of supporting information	Not applicable for permit application.

10. Statement of Site Condition

Not applicable for permit application.

Appendices

Appendix A. Pollution Risk Evaluation

Table A1 - Determining relevant hazardous substances / substances which may represent a pollution risk

Substance	State S – Solid L – Liquid G - Gas	Use	Fate	Hazardous Properties	Annual Quantity	Storage and Transport Arrangements	Comments
Diesel	L	Secondary fuel for engines	Consumed during combustion in engines and combustion gases emitted to atmosphere.	Toxic to aquatic life with long lasting effects. Harmful to health: may be fatal if swallowed and enters airways, causes skin irritation, harmful if inhaled, may cause cancer, may cause damage to organs through prolonged or repeated exposure.	98,000 litres[(a)]	Stored in alarmed, double skinned, internally bunded above ground metal tanks. All associated pipework above ground. Diesel is delivered via a tanker and transferred to the engines via a flexible hose which conforms to British Standards. Drip tray present beneath the refuelling point.	The use of an alternative fuel source would be propane gas which would pose an explosive risk. The safety risks of this outweigh any environmental benefit of using natural gas. Storage of diesel, or transport, is not considered likely to impact soil or groundwater on site given measures in place. Negligible environmental impact.

Substance	State S – Solid L – Liquid G - Gas	Use	Fate	Hazardous Properties	Annual Quantity	Storage and Transport Arrangements	Comments
HVO (hydrotreated vegetable oil)	L	Fuel for engines	Consumed during combustion in engines and combustion gases emitted to atmosphere.	Health Hazard: may be fatal if swallowed and enters airways. Repeated exposure may cause skin dryness or cracking.	104,000 litres[(b)]	Stored in alarmed, double skinned, internally bunded above ground metal tanks. All associated pipework above ground. HVO is delivered via a tanker and transferred to the engines via a flexible hose which conforms to British Standards. Drip tray present beneath the refuelling point.	The use of an alternative fuel source would be propane gas which would pose an explosive risk. The safety risks of this outweigh any environmental benefit of using natural gas. Storage of HVO, or transport, is not considered likely to impact soil or groundwater on site given measures in place. Low environmental impact.
Antifreeze / coolant	L	Anti-Freeze / coolant for engines	Removed every 2-3 years during maintenance (recycled).	Harmful to health: harmful if swallowed, may cause damage to organs through prolonged or repeated exposure.	5,000 kg[(c)]	Not stored on site. Delivered in plastic containers and used within the engines. Drip trays used when topping up engine. Engine within container	No alternatives, essential to process. It is not stored on site and is brought onto site and removed, as required by a

Substance	State S – Solid L – Liquid G - Gas	Use	Fate	Hazardous Properties	Annual Quantity	Storage and Transport Arrangements	Comments
						which acts as a bund.	specialist contractor. Low environmental impact.
Engine oil	L	Lubricating oil for engines	Waste oil removed during oil changes (recycled).	Toxic to aquatic life with long lasting effects. Harmful to health: irritating to skin, risk of serious eye irritation.	12,000 kg	Not stored on site. Delivered in plastic containers and used within the engines. Drip trays used when topping up engine. Engine within container which acts as a bund.	No alternatives, essential to process. It is not stored on site and is brought onto site and removed, as required by a specialist contractor. Low environmental impact.
AdBlue	L	SCR reagent - used as a catalyst to reduce emissions of nitrogen oxides	Used in the conversion oxides of nitrogen in engine exhaust into nitrogen and water vapour.	Not classified	5,600 kg	Stored in integrally bunded above ground tanks above diesel / HVO tanks. All associated pipework above ground. Delivered to site in bowser. Refuelling via bunded fill point cabinets.	No alternatives, essential to process. It is stored appropriately. converts oxides of nitrogen in engine exhaust into nitrogen and water vapour.

Substance	State S – Solid L – Liquid G - Gas	Use	Fate	Hazardous Properties	Annual Quantity	Storage and Transport Arrangements	Comments
							Low environmental impact.
Filter oil / fuel (waste)	L	Maintenance	Disposed and recycled of via authorised waste contractor	As per diesel and HVO.	800 kg	Used within engine until replacement is needed, then disposed of (recycled) via waste contractor.	Not stored on site. Not likely to impact soil or groundwater on site as is generated and transported in small quantities above ground. Low environmental impact.
Antifreeze / coolant (waste)	L	Anti-Freeze / coolant for engines	Removed every 2-3 years during maintenance (recycled).	Harmful to health: harmful if swallowed, may cause damage to organs through prolonged or repeated exposure.	2,500 kg	Used within engine until replacement is needed, then recycled via waste contractor. Engine within container which acts as a bund.	No alternatives, essential to process. It is not stored on site and is brought onto site and removed, as required by a specialist contractor. Low environmental impact.

Substance	State S – Solid L – Liquid G - Gas	Use	Fate	Hazardous Properties	Annual Quantity	Storage and Transport Arrangements	Comments
Engine oil (waste)	L	Lubricating oil for engines	Waste oil removed during oil changes (recycled).	Toxic to aquatic life with long lasting effects. Harmful to health: irritating to skin, risk of serious eye irritation.	4,000 kg	Used within engine until replacement is needed, then recycled via waste contractor. Engine within container which acts as a bund.	Not stored on site. Not likely to impact soil or groundwater on site as is generated and transported in small quantities above ground. Low environmental impact.

Table Notes:

(a) Diesel is typically only to be used as a fuel in the event of supply issues with HVO. The diesel usage given is the theoretical annual use if all of the engines were run on diesel (based on 5 hours testing per engine per year); however in reality diesel use should be negligible or very low.

(b) HVO usage assumes no diesel use (i.e. this is the maximum usage, based burning HVO during the 5 hours testing per engine per year).

(c) Antifreeze is typically only changed every 2.5 to 3 years, this is the maximum usage in the year that antifreeze is changed.

Other wastes will be generated but these are not considered to have significant pollution potential and therefore have not been included within this assessment. Further details on all wastes are provided in the main permit application documentation.

Appendix B. Factual Ground Investigation Report

IMPERIAL PARK DC3

FACTUAL REPORT ON
GROUND INVESTIGATION

Prepared for VANTAGE DATA CENTRES UK

Report Ref: 36253

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IMPERIAL PARK DC3

FACTUAL REPORT ON GROUND INVESTIGATION

Prepared for VANTAGE DATA CENTRES UK

Report Ref: 36253

PROJECT: Construction of new 2-storey building, road and car park.

CONSULTANT: Atkins

VOLUME - VERSION	STATUS	ORIGINATOR	CHECKER	APPROVED	DATE
1 of 1 – A	INTERIM	IS	CT	-	08/03/2021
1 of 1 – B	DRAFT	SP	-	-	06/04/2021
1 of 1 – B	FINAL	SP	JH	JH	04/05/2021

ORIGINATOR	APPROVER
S PHELPSTEAD Senior Engineering Geologist	C THOMAS Geotechnical Consultant

The report is not to be used for contractual or engineering purposes unless this sheet is signed and the report designated “Final”.

The report has been prepared for the sole use and reliance by Vantage Data Centres UK. GEL accepts no liability as a result of the use or reliance of this report by any other parties.

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APPENDICES

1. INTRODUCTION

It is proposed to construct a new 2-storey building with associated road and car park at North Lake Drive, Coedkernew, Newport. Geotechnical Engineering Limited (GEL) was instructed by Atkins (Consultant) acting on behalf of Vantage Data Centres UK (Client) to carry out an investigation to determine the ground conditions.

The scope of works and terms and conditions of appointment were specified by the Consultant and GEL correspondence reference T31628 dated 18th September 2020. The investigation was carried out under direction and part time supervision of the Consultant.

This report describes the investigation and presents the findings.

2. SITE LOCATION AND GEOLOGY

The site comprises vacant brownfield land situated east of Imperial Park Estate off North Lake Drive, Coedkernew, Newport and may be located by its National Grid co-ordinates ST 284 844.

British Geological Survey (BGS) England and Wales (Sheet No. 249, 1:50 000, 1975) and the BGS online geology (1:50,000) indicate the site is underlain by River Terrace deposits comprising sands and gravels overlying the Mercia Mudstone Group. Made ground is also anticipated on site due to previous site use.

3. GROUND INVESTIGATION

3.1 Fieldwork

The fieldwork was carried out in general accordance with BS5930:2015 during the period 18th January to 3rd February 2021 and comprised seven boreholes, twelve trial pits, thirteen dynamic probes and seventeen dynamic cone penetrometer (DCP) tests.

The exploratory hole locations were selected by the Consultant and set out by this Company and are shown on Figure 1. The ground level and co-ordinates at each exploratory hole, (excluding DCPs which were undertaken at each trial pit location) were established by this Company using GPS techniques.

The boreholes, referenced DC3_BH01, DC3_BH02, DC3_BH03, DC3_BH04B and DC3_BH05, DC3_BH06 and DC3_BH07 (Appendix A), were formed using a track-mounted Massenza M14 or Comacchio 405 rig. Initially, an inspection pit was hand excavated at each borehole location to a maximum depth of 1.20m to check for buried services. Boreholes DC3_BH04 and DC3_BH04A were terminated at a depth of 0.40m due rapid inflow of water during excavation. Disturbed samples were taken and retained in a combination of plastic tubs, bags and glass jars. Heavy duty dynamic sampling techniques were employed in DC3_BH04B and DC3_BH05 to produce a continuous disturbed sample of 112mm nominal diameter. The samples were recovered in semi-rigid plastic liner.

On refusal to dynamic sampling or from the base of the inspection pit, the boreholes were continued by rotary core drilling techniques utilising a water or air mist flush. A double-tube swivel core barrel with semi-rigid plastic liner was utilised to recover a continuous sample of 108mm diameter (90mm in DC_BH02).

The dynamic samples and rotary core were extracted horizontally from the sampler and core barrel respectively, the semi-rigid liner was cut to length and caps placed at each end to retain moisture content. All samples and core were retained in sequence in labelled, wooden coreboxes.

Standard penetration tests (SPT) were carried out in general accordance with BS EN ISO 22476-3:2005+A1:2011. A split barrel or a solid cone was used depending upon the materials encountered and the split barrel samples retained in airtight jars. The SPT N value was taken as the number of blows to penetrate the 300mm test drive following a 150mm seating drive. Where low penetration was recorded the seating drive was terminated at 25 blows and the test drive completed after a further 50 blows. Detailed SPT results, together with the energy ratio (E_r), are presented in Appendix A and summarised as uncorrected N values on the borehole logs.

Boreholes were monitored for groundwater ingress as dynamic sampling and coring (with air mist) proceeded. Upon encountering water in boreholes DC3_BH02 and DC3_BH07, sampling was temporarily stopped to allow the level to stabilise. Water levels were also recorded at the start and finish of each day's work, on completion of the borehole and are presented on the relevant log.

On completion gas/water monitoring standpipes were installed in DC3_BH01, DC3_BH03, DC3_BH05 and DC3_BH07. Each installation consisted of a 50mm ID HDPE slotted tube set in a filter response zone of non-calcareous pea gravel. The installation was sealed above and below with a bentonite plug and accessed via a valve assembly. The installations were protected at the surface by a lockable stopcock or raised cover set in concrete. Installation details are given on the relevant borehole log.

On completion, DC3_BH02, DC3_BH04 to DC3_BH04B and DC3_BH06 were backfilled with bentonite pellets and the surface reinstated.

The trial pits, referenced DC3_TP01 to DC3_TP12 (Appendix A), were formed by a tracked excavator with a 0.60m wide backactor bucket. Trial pit DC3_TP03A was excavated adjacent to DC3_TP03 to undertake additional soakaway testing, logging was not undertaken on request of the Consultant.

Representative disturbed samples were taken and retained in sealed plastic bags, glass jars and airtight containers to retain moisture content.

Soakaway tests were carried out in trial pits DC3_TP01, DC3_TP03, DC3_TP03A, DC3_TP10 and DC3_TP12 in general accordance with BRE DG 365 (2016). The excavation sides were squared using the excavator bucket and the dimensions recorded within the test section. The trial pit was partially filled with clean water using a dedicated bowser with a 75mm diameter outlet and the fall in level recorded against time. The test was repeated up to 3 times. The results are presented in Appendix A.

On completion all trial pits were backfilled with arisings compacted in suitable layers by the excavator bucket. The ground surface was left slightly proud to accommodate the future inevitable settlement of the backfill.

Dynamic Cone Penetrometer tests (DCP), referenced DC3_DCP01, DC3_DCP01A, DC3_DCP02, DC3_DCP03, DC3_DCP03A, DC3_DCP04 to DC3_DCP09A, DC3_DCP10 to DC3_DCP11A, DC3_DCP12 and DC3_DCP12A (Appendix A), were carried out at each trial pit location using a CNS Farnell A2465 dynamic cone penetrometer. Probe depths were measured with respect to ground level and the number of blows for the penetration of the probe was recorded. Equivalent CBR values have been calculated and presented with the results in Appendix A.

Dynamic probeholes, referenced DC3_DPSH01 to DC3_DPSH02A, DC3_DPSH03 to DC3_DPSH05, DC3_DPSH06A and DC3_DPSH07 to DC3_DPSH12 (Appendix A), were carried out using a Terrier 2000 rig and operated in general accordance with the DPSH(B) specification given in BS EN ISO 22476-2:2005+A1:2011. Sacrificial cones were used along with 32mm diameter x 1.00m long driving rods.

Probe depths were measured with respect to ground level and the number of blows, n_{10} , recorded for each 100mm penetration of the probe. At the end of each 1m penetration the maximum torque acting on the rods was measured.

Samples for chemical analyses were dispatched daily from site directly to i2 Analytical Ltd under a Chain of Custody. The remaining samples were brought to this Company's laboratory for testing and storage.

3.2 Logging

The logging of soils and rocks was carried out by an Engineering Geologist in general accordance with BS5930:2015. A key to the exploratory hole logs is presented in Appendix A. Detailed descriptions of the core and samples are given in the borehole logs, Appendix A, along with details of sampling, in situ testing, groundwater ingress, installations and relevant comments on drilling techniques.

Suitable core subsamples were selected by the logging engineer. The core was carefully logged and prepared prior to preserving the subsample by wrapping in clingfilm, tinfoil and coating with at least three layers of wax. The sample was further protected by a covering of waxed cheesecloth, labelled and transported horizontally in padded, wooden coreboxes.

Prior to logging, photographs of the core and trial pits were taken and are presented separately.

The trial pits were logged in situ to a depth of approximately 1.20m and thereafter from the surface. Detailed descriptions are given in the trial pit logs, Appendix A, along with details of sampling and in situ testing, groundwater ingress and relevant comments on stability and excavatability.

3.3 Monitoring

The installations were monitored for gas flow and then tested for methane, carbon dioxide, oxygen, hydrogen sulphide, and carbon monoxide using a Gas Data GFM 435 gas analyser. The installations were also monitored for Volatile Organic Compounds (VOC's) using a MiniRAE 2000 Portable Photo-Ionisation Detector (PID) with a 10.6eV gas discharge lamp. The detector uses an ultra violet light source to break down the chemicals into positive and negative ions (ionisation). The detector measures the charge of the ionised gas and converts the signal into current. The current is then amplified and displayed as "ppm"; after measurement the ions reform the original gas or vapour allowing it to be sampled. Subsequent readings, along with water level records, are tabulated in Appendix B.

Prior to water sampling, the water monitoring standpipes were developed by pumping and then purged until at least three well volumes of water had been removed.

3.4 Laboratory Testing

Multiple schedules of laboratory tests were prepared by the Consultant, the following tests being carried out in accordance with BS1377:1990, unless stated otherwise. The number in brackets refers to the test number given in that standard. The results are presented in Appendix C.

The natural water content was determined on sixteen selected samples in accordance with BS EN ISO 17892-1:2014.

Liquid limit, plastic limit and plasticity index tests [Part 2:4.3, 5.3 and 5.4] were carried out on fourteen selected samples. Atterberg line plots have also been presented.

Particle size distributions were determined in accordance with BS EN ISO 17892-4:2016 for twenty-two samples by wet sieving [5.2]. The results are presented as grading curves.

Particle densities were determined for three samples using the fluid pycnometer method in accordance with BS EN ISO 17892-3:2015.

The sulphate content of 2:1 water soluble extracts were determined for four soil samples and organic matter content was determined for seven selected samples by Chemtest Ltd.

The BRE SD1 Suite C (2005) suite of tests was carried out on six samples by Chemtest Ltd using in-house methods.

Selected samples were despatched to i2 Analytical Ltd, where chemical analyses were carried out to in-house methods for a suite of contaminants. The results are presented in Appendix D.

GEOTECHNICAL ENGINEERING LIMITED

4. REFERENCES

British Standards Institution (2015): Code of practice for ground investigations. BS 5930:2015.

British Standards Institution (2016): Methods of test for soils for civil engineering purposes – Part 1: General requirements and sample preparation. BS1377-1:2016.

British Standards Institution (1990): Methods of tests for soils for civil engineering purposes. BS 1377 Parts 2-9.

British Standards Institution (2014): Geotechnical investigation and testing – Laboratory testing of soil. Part 1: Determination of water content. BS EN ISO 17892-1:2014.

British Standards Institution (2016): Geotechnical investigation and testing – Laboratory testing of soil. Part 3: Determination of particle density. BS EN ISO 17892-3:2015.

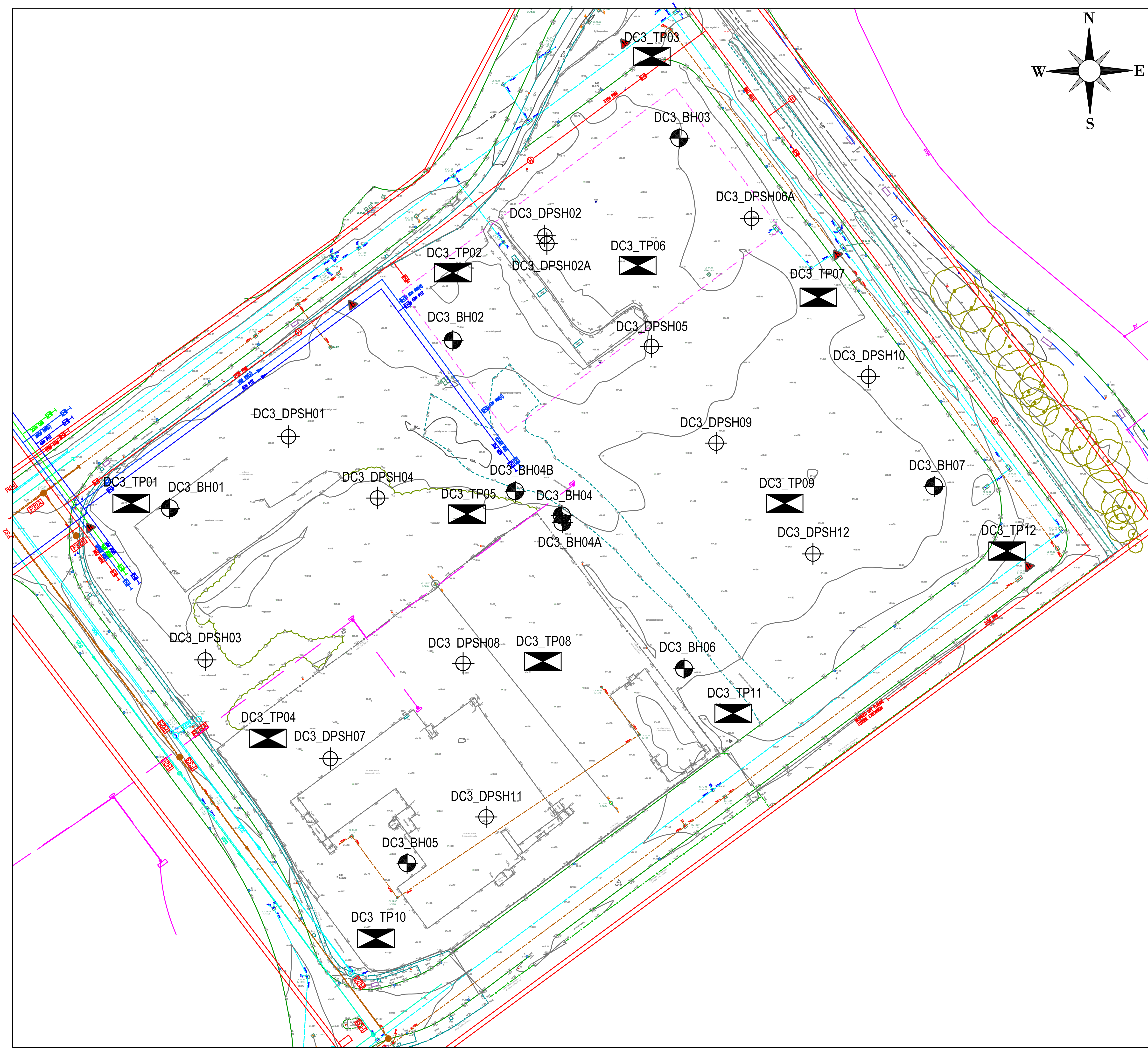
British Standards Institution (2016): Geotechnical investigation and testing – Laboratory testing of soil. Part 4: Determination of particle size distribution. BS EN ISO 17892-4:2016.

British Standards Institution (2012): Geotechnical investigation and testing. Field testing. Standard penetration test. BS EN ISO 22476-3:2005+A1:2011.

British Standards Institution (2012): Geotechnical investigation and testing. Field testing. Dynamic probing. BS EN ISO 22476-2:2005+A1:2011.

Building Research Establishment (2005): Concrete in aggressive ground. BRE Special Digest 1. Third Edition.

Building Research Establishment (2016): Soakaway Design. Digest DG 365.



Key.

Borehole Location.

Dynamic Probe Location.

Trial Pit Location (with adjacent DCP).

Notes:

Based on drawing provided by the Consultant.

geotechnical

Geotechnical Engineering Ltd

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Client: VANTAGE DATA CENTRES UK

Site: IMPERIAL PARK DC3

Title: EXPLORATORY HOLE LOCATION PLAN

Drawn By:	SP	Checked By:	CT	Paper Size:	A3
Scale:	1:750	Date:	18/03/2021		
Contract:	36253	Figure:	01		

APPENDIX A

FIELDWORK DATA

Geotechnical Engineering Limited

KEY TO EXPLORATORY HOLE LOGS

Sample type

D Small disturbed	U Undisturbed	L Dynamic	ES Environmental - soil	Cs Core subsample (prepared)
B Bulk disturbed	UT Undisturbed thin wall	C Core	EW Environmental - water	Ls Dynamic subsample (prepared)
LB Large bulk disturbed	P Piston	W Water		

Test type

S SPT - Split spoon sampler followed by uncorrected SPT 'N' Value
C SPT - Solid cone followed by uncorrected SPT 'N' Value
(*250 - Where full test drive not completed, linearly extrapolated 'N' value reported, ** - Denotes no effective penetration)
H Hand vane - direct reading in kPa - not corrected for BS1377 (1990). Re* denotes refusal
M Mackintosh probe - number of blows to achieve 100mm penetration
Mx Mexe cone - average reading of equivalent CBR value in %
PP Pocket penetrometer - direct reading in kg/sq.cm
Vo Headspace vapour reading, uncorrected peak values in ppm, using a PID (calibrated with Isobutylene, using a 10.6eV bulb)

Sample/core range/I_f

Dynamic sample

Undisturbed sample - open drive including thin wall. Symbol length reflects recovery

x x = Total Core Recovery (TCR) as percentage of core run

y y = Solid Core Recovery (SCR) as percentage of core run. Assessment of core is based on full diameter.

z z = Rock Quality Designation (RQD). The amount of solid core greater than 100mm expressed as percentage of core run.

Where SPT has been carried out at beginning of core run, disturbed section of core excluded from SCR and RQD assessment.

I_f - fracture spacing - the modal fracture spacing (mm) over the indicated length of core. Where spacing varies significantly, the minimum, mode and maximum values are given. NI = non-intact core NA = not applicable

Instrumentation

Porous tip | Perforated standpipe | Granular response zone | Bentonite seal | Cement/ bentonite grout | Soil Backfill | Concrete

Stratum boundaries

Estimated boundary

Grading boundary

Logging

The logging of soils and rocks has been carried out in general accordance with BS 5930:2015.

Chalk is logged in general accordance with Lord et al (2002) CIRIA C574. Where possible, dynamic samples in chalk have been logged in accordance with CIRIA C574; descriptions and gradings (if presented) should be treated with caution given the potential for sample disturbance.

For rocks the term fracture has been used to identify a mechanical break within the core. Where possible incipient and drilling induced fractures have been excluded from the assessment of fracture state. Where doubt exists, a note has been made in the descriptions. All fractures are considered to be continuous unless otherwise reported.

Made Ground is readily identifiable when, within the material make up, man made constituents are evident. Where Made Ground appears to be reworked natural material the differentiation between in situ natural deposits and Made Ground is much more difficult to ascertain. The interpretation of Made Ground within the logs should therefore be treated with caution.

The descriptors "topsoil" and "tarmacadam" are used as generic terms and do not imply conformation to any particular standard or composition.

Rootlets are defined as being less than 2mm in diameter, roots are defined as in excess of 2mm diameter.

General Comments

The process of drilling and sampling will inevitably lead to disturbance, mixing or loss of material in some soil and rocks.

Indicated water levels are those recorded during the process of drilling or excavating exploratory holes and may not represent standing water levels.

All depths are measured along the axis of the borehole and are related to ground level at the point of entry. All inclinations are measured normal to the axis of the core.

Where provided, the stratigraphic names/geological rock units are for guidance only and may not be wholly accurate.

Geotechnical Engineering Limited

BOREHOLE LOG

DC3_BH01

CLIENT	VANTAGE DATA CENTRES UK	Sheet	1 of 2
SITE	IMPERIAL PARK DC3		
Start Date	03 February 2021	Easting 328408	Scale 1:50
End Date	03 February 2021	Northing 184496, Ground Level 14.94mOD	Depth 11.35 m

sample no & type	sample depth (m) from - to	casing depth (m)	samp. /core range	If	water record depth (m)	instru -ment	test type & value
1D	0.10 - 0.30						
1ES	0.10 - 0.30						
2B	0.10 - 0.30						
2ES	0.60 - 0.80						
3D	0.60 - 0.80						
4B	0.60 - 0.80						
3ES	1.00 - 1.20						
5D	1.00 - 1.20						
6B	1.00 - 1.20	Nil	100	NA			S *88
7D	1.20 - 1.65						
8C	1.20 - 2.20						
9D	1.80 - 1.90						
10C	2.20 - 3.20	Nil	100				C *77
11C	3.20 - 4.20	3.00	95				C *61
12D	3.80 - 3.90						
13C	4.20 - 5.20	4.00	100				C *167
14C	5.20 - 6.70	5.00	100				C *65
15D	6.10 - 6.20						
16C	6.70 - 8.20	6.00	97	NA			S *65
4ES	7.15 - 7.25						
17D	7.25 - 7.35						
				NI			

description	depth (m)	reduced level (m)
Dark brown slightly sandy slightly gravelly SILT. Gravel is subangular fine to coarse concrete and sandstone. (MADE GROUND)	0.03	14.91
MADE GROUND comprising greyish brown CONCRETE. (MADE GROUND)	0.10	14.84
Orangish brown slightly sandy slightly silty angular fine to coarse sandstone GRAVEL. (MADE GROUND) 0.30m: Clear plastic membrane and seepage.	0.30	14.64
Brown slightly silty sandy subrounded and rounded fine to coarse sandstone and quartzite GRAVEL. (MADE GROUND)	0.90	14.04
Yellowish brown silty very sandy subrounded sandstone and quartzite GRAVEL with a low subrounded sandstone cobble content. 0.90 - 1.05m: Rounded sandstone cobble (150 x 140 x 100mm).	1.20	13.74
Drilling disturbed recovered as very dense yellow and reddish brown slightly sandy subangular to rounded fine to coarse sandstone and quartzite GRAVEL with a medium subangular sandstone cobble content. Some fines probably washed away. 2.80 - 3.05m: Sandy gravel.	6.70	8.24
Very stiff reddish brown slightly gravelly sandy clayey SILT with rare grey reduction spots (up to 15mm). Gravel is angular and subangular fine to coarse extremely weak mudstone lithorelicts occasionally stained black (up to 20mm).	7.70	7.24
Extremely weak reddish brown silty sandy MUDSTONE with rare grey reduction spots (up to 25mm). Fractures are randomly orientated extremely closely spaced planar smooth occasionally stained black (up to 40mm).		

Continued Next Page

HOLE CONSTRUCTION

TOP (m)	BASE (m)	TYPE	PLANT USED
0.00	1.20	Inspection Pit	Hand tools
1.20	11.20	Rotary Core	Massenza M14

WATER STRIKE Groundwater not encountered prior to use of flush

DEPTH (m)	CASING (m)	ROSE TO (m)	AFTER (min)	REMARKS

CASING DEPTH

DIAM (mm)	BASE (m)
168	7.50

BACKFILL

TOP (m)	BASE (m)	MATERIAL
0.00	0.20	Concrete
0.20	2.00	Bentonite
2.00	6.00	Gravel
6.00	11.35	Bentonite

INSTRUMENTATION

DEPTH (m)	TYPE
6.00	Standpipe

BARREL DIAMETER

DIAM (mm)	BASE (m)
131	11.20

HOLE PROGRESS

DATE TIME	DEPTH (m)	CASING (m)	WATER (m)
03-02-2021 08:30	0.00	Nil	Dry
03-02-2021 17:30	11.28	7.50	Dry

REMARKS

AGS

CONTRACT **36253**

CHECKED **JH**

Geotechnical Engineering Limited

BOREHOLE LOG

DC3_BH01

CLIENT	VANTAGE DATA CENTRES UK	Sheet	2 of 2
SITE	IMPERIAL PARK DC3		
Start Date	03 February 2021	Easting	328408
Scale	1:50		
End Date	03 February 2021	Northing	184496
Ground Level	14.94mOD	Depth	11.35 m

sample no & type	sample depth (m) from to	casing depth (m)	samp. /core range	If	water record depth (m)	instru -ment	test type & value	description	depth (m)	reduced level (m)	legend
									8.15	6.79	
18D 19C 20D 5ES 6ES	8.20 - 8.35 8.20 - 9.70 8.70 - 8.80 8.70 - 8.80 8.80 - 8.90	7.50	97 7 0	NI			S *143	Extremely weak reddish brown silty sandy MUDSTONE with rare grey reduction spots (up to 20mm). Fractures are randomly orientated extremely closely and very closely spaced planar smooth rarely stained black (up to 35mm).			
				NI 20 55				Extremely weak reddish brown slightly sandy MUDSTONE locally disintegrated to clayey gravelly sand. Fractures are 70° to 80° extremely closely and very closely spaced planar smooth stained black. 9.50m: Band of bluish grey reduction spots (15mm thick).	9.20	5.74	
21D 22C 7ES 23D	9.70 - 9.85 9.70 - 11.20 10.00 - 10.10 10.10 - 10.20	7.50	97	NI 20 40			S *300	Extremely weak reddish brown MUDSTONE with occasional bluish grey reduction spots (up to 70mm). Fractures are randomly orientated extremely closely and very closely spaced planar smooth locally stained black and infilled with clay (up to 5mm). 10.20 - 10.40m: Tending to sandy clay along 45° zone of weakness (remnant fracture) with bluish grey reduction spots. 10.45 - 11.00m: 70° to subvertical undulating rough fracture stained black preserved in gravel. 11.05 - 11.07m: Band of extremely weak mudstone (20mm thick).	9.70	5.24	
24D	11.20 - 11.35	7.50					S *231		11.35	3.59	

Borehole Completed at 11.35m

HOLE CONSTRUCTION

TOP (m) BASE (m) TYPE PLANT USED

WATER STRIKE Groundwater not encountered prior to use of flush

DEPTH (m) CASING (m) ROSE TO (m) AFTER (min) REMARKS

CASING DEPTH

DIAM (mm) BASE (m)

BACKFILL

TOP (m) BASE (m) MATERIAL

INSTRUMENTATION

DEPTH (m) TYPE

AGS

BARREL DIAMETER

DIAM (mm) BASE (m)

HOLE PROGRESS

DATE TIME DEPTH (m) CASING (m) WATER (m)

REMARKS

CONTRACT

36253

CHECKED

JH

Geotechnical Engineering Limited

BOREHOLE LOG

DC3_BH02

CLIENT	VANTAGE DATA CENTRES UK	Sheet	1 of 2
SITE	IMPERIAL PARK DC3		
Start Date	01 February 2021	Easting	328466
Scale	1:50		
End Date	01 February 2021	Northing	184531
Ground Level	14.56mOD	Depth	8.54 m

sample no & type	sample depth (m) from to	casing depth (m)	samp. /core range	If	water record depth (m)	instru -ment	test type & value
1ES	0.00 - 0.20						
					0.30		
1B	0.40 - 0.60						
2D	0.40 - 0.60						
2ES	0.40 - 0.60						
3B	1.10 - 1.20						
3ES	1.10 - 1.20	Nil	50	NA			C *59
4D	1.10 - 1.20						
5C	1.20 - 2.20						
6D	2.10 - 2.20						
7C	2.20 - 3.20	2.20	50				C *75
					3.00		
8D	3.10 - 3.20						
9C	3.20 - 4.20	3.20	10				C *120
10C	4.20 - 5.20	4.20	40				C *150
11D	5.10 - 5.20						
12C	5.20 - 6.70	5.20	42				C *88
13D	6.50 - 6.60						
14C	6.70 - 7.40	6.70	80				C *70
15C	7.40 - 8.40	7.40	90 9 0	NI			
16D	7.50 - 7.60						
4ES	7.60 - 7.70						

description	depth (m)	reduced level (m)	legend
Reddish brown silty SAND and GRAVEL. Sand is fine to coarse. Gravel is angular and subangular fine to coarse sandstone. (MADE GROUND)	0.20	14.36	
Greyish brown slightly silty sandy angular and subangular fine to coarse sandstone, clinker and concrete GRAVEL with a low subangular brick and concrete cobble content. (MADE GROUND)	1.10	13.46	
Greyish brown slightly silty sandy subangular to well rounded fine to coarse sandstone GRAVEL with a low subrounded to well rounded sandstone cobble content.	1.20	13.36	
Limited recovery: Recovered as very dense subangular to well rounded medium and coarse rarely fine sandstone GRAVEL. Rare sandy clay veneer on gravels. Fines washed away.	7.30	7.26	
Very stiff fissured reddish brown silty CLAY. Fissures are randomly oriented extremely closely and very closely spaced planar smooth occasionally stained black. 7.35m: 30x30mm light bluish grey reduction spot	7.40	7.16	
Extremely weak highly fractured reddish brown MUDSTONE recovered as very clayey angular to subrounded fine to coarse gravel. Gravels occasionally stained black. 7.57 - 7.77m: Light bluish grey reduction spot.			

Continued Next Page

HOLE CONSTRUCTION

TOP (m)	BASE (m)	TYPE	PLANT USED
0.00	1.20	Inspection Pit	Hand tools
1.20	8.20	Rotary Core	Commachio 405

WATER STRIKE

DEPTH (m)	CASING (m)	ROSE TO (m)	AFTER (min)	REMARKS
0.30	Nil	0.30	20	
3.00	2.20	3.00	20	

CASING DEPTH

DIAM (mm)	BASE (m)
168	7.40

BACKFILL

TOP (m)	BASE (m)	MATERIAL
0.00	8.54	Bentonite

INSTRUMENTATION

DEPTH (m)	TYPE

AGS

BARREL DIAMETER

DIAM (mm)	BASE (m)
116	8.40

HOLE PROGRESS

DATE TIME	DEPTH (m)	CASING (m)	WATER (m)
01-02-2021 09:30	0.00	Nil	Dry
01-02-2021 17:00	8.54	8.40	3.00

REMARKS

CONTRACT **36253**

CHECKED **JH**

Geotechnical Engineering Limited

BOREHOLE LOG

DC3_BH02

CLIENT	VANTAGE DATA CENTRES UK			Sheet	2 of 2
SITE	IMPERIAL PARK DC3				
Start Date	01 February 2021	Easting	328466	Scale	1:50
End Date	01 February 2021	Northing	184531	Ground Level 14.56mOD	Depth 8.54 m

sample no & type	sample depth (m) from to	casing depth (m)	samp. /core range	If	water record depth (m)	instru -ment	test type & value	description	depth (m)	reduced level (m)	legend
17D	8.40 - 8.54	7.40					S *333	Extremely weak highly fractured reddish brown MUDSTONE recovered as very clayey angular to subrounded fine to coarse gravel. Gravels occasionally stained black. 8.17 - 8.30m: Light bluish grey reduction spot.	8.54	6.02	
								Borehole Completed at 8.54m			

HOLE CONSTRUCTION
TOP (m) BASE (m) TYPE PLANT USED

WATER STRIKE
DEPTH (m) CASING (m) ROSE TO (m) AFTER (min) REMARKS

CASING DEPTH
DIAM (mm) BASE (m)

BACKFILL
TOP (m) BASE (m) MATERIAL

INSTRUMENTATION
DEPTH (m) TYPE

AGS

CONTRACT
36253

BARREL DIAMETER
DIAM (mm) BASE (m)

HOLE PROGRESS
DATE TIME DEPTH (m) CASING (m) WATER (m)

REMARKS

CHECKED
JH

Geotechnical Engineering Limited

BOREHOLE LOG

DC3_BH03

CLIENT	VANTAGE DATA CENTRES UK	Sheet	1 of 2
SITE	IMPERIAL PARK DC3	Scale	1:50
Start Date	25 January 2021	Easting	328513
End Date	26 January 2021	Northing	184572
Ground Level	14.69mOD	Depth	14.43 m

sample no & type	sample depth (m) from - to	casing depth (m)	samp. /core range	If	water record depth (m)	instru -ment	test type & value
1D	0.50 - 0.70						
1ES	0.50 - 0.70						
2B	0.50 - 0.70						
2ES	0.90 - 1.10						
3D	0.90 - 1.10						
4B	0.90 - 1.10						
5C	1.20 - 2.20	Nil	80	NA			C *91
6C	1.20 - 2.20						
7D	1.50 - 1.60						
3ES	1.60 - 1.70						
8C	2.20 - 3.20	1.50	100				C *64
9D	2.60 - 2.70						
10C	3.20 - 4.20	3.00	100				C 46
11C	4.20 - 5.20	3.00	60				C 50
12C	5.20 - 6.70	4.50	77				C 49
13C	6.70 - 8.20	6.00	100				C *81
14D	7.90 - 8.00						

description	depth (m)	reduced level (m)	legend
Brown sandy angular and subangular fine to coarse concrete, sandstone, quartzite and rare brick GRAVEL. (MADE GROUND)	0.50	14.19	
Orangish brown slightly silty sandy angular to subrounded fine to coarse sandstone and quartzite GRAVEL. (MADE GROUND)	0.90	13.79	
Very dense orangish brown locally slightly clayey sandy subangular to rounded fine to coarse sandstone and quartzite GRAVEL with a low subangular sandstone cobble content. 1.20 - 1.50m: Yellowish brown slightly silty very sandy gravel.	1.75	12.94	
Greyish brown and reddish brown slightly clayey sandy subrounded and rounded fine to coarse sandstone and quartzite GRAVEL with a medium subangular sandstone cobble content.	2.00	12.69	
Drilling disturbed recovered as very dense to dense brown, orangish brown, yellowish brown and greyish brown subangular to rounded fine to coarse sandstone and quartzite GRAVEL. 3.20 - 3.65m: Slightly sandy.	4.20	10.49	
Drilling disturbed recovered as very dense to dense brown slightly gravelly fine to coarse SAND. Gravel is subrounded and rounded fine to coarse sandstone. 4.70 - 4.80m: Sandstone cobble (125 x 100 x 90mm).	5.20	9.49	
Drilling disturbed recovered as very dense to dense grey, brown and greyish brown subrounded and rounded fine to coarse GRAVEL. 6.20 - 6.35m: Greyish brown fine to coarse sand. 6.35 - 6.70m: No recovery.	7.85	6.84	
Stiff reddish brown slightly sandy gravelly CLAY with frequent bluish grey reduction spots (up to 20mm diam). Gravel is subangular and subrounded fine to coarse lithorelicts of extremely weak mudstone (up to 30mm).			

Continued Next Page

HOLE CONSTRUCTION

TOP (m)	BASE (m)	TYPE	PLANT USED
0.00	1.20	Inspection Pit	Hand tools
1.20	14.43	Rotary Core	Massenza M14 Rig

WATER STRIKE Groundwater not encountered prior to use of flush

DEPTH (m)	CASING (m)	ROSE TO (m)	AFTER (min)	REMARKS

CASING DEPTH

DIAM (mm)	BASE (m)
168	7.50

BACKFILL

TOP (m)	BASE (m)	MATERIAL
0.00	0.20	Concrete
0.20	3.50	Bentonite
0.50	3.50	Bentonite
3.50	7.50	Gravel

INSTRUMENTATION

DEPTH (m)	TYPE
7.50	Standpipe

BARREL DIAMETER

DIAM (mm)	BASE (m)
131	14.20

HOLE PROGRESS

DATE TIME	DEPTH (m)	CASING (m)	WATER (m)
25-01-2021 11:00	0.00	Nil	Dry
25-01-2021 16:30	5.20	4.50	0.50
26-01-2021 08:00	5.20	4.50	1.20
26-01-2021 17:00	14.43	7.50	1.00

REMARKS

AGS

CONTRACT **36253**

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BOREHOLE LOG

DC3_BH03

CLIENT	VANTAGE DATA CENTRES UK			Sheet	2 of 2
SITE	IMPERIAL PARK DC3				
Start Date	25 January 2021	Easting	328513	Scale	1:50
End Date	26 January 2021	Northing	184572	Ground Level 14.69mOD	Depth 14.43 m

sample no & type	sample depth (m) from to	casing depth (m)	samp. /core range	If	water record depth (m)	instru -ment	test type & value	description	depth (m)	reduced level (m)	legend
15C	8.20 - 9.70	7.50	95				C 50				
16D	8.70 - 8.80			NA				Very stiff reddish brown sandy gravelly CLAY with frequent bluish grey reduction spots (up to 150mm). Gravel is subangular and subrounded fine to coarse lithorelicts of extremely and very weak mudstone (up to 50mm).	8.55	6.14	
				NI				Extremely weak locally very weak reddish brown sandy MUDSTONE with occasional bands of very stiff clay and rare bluish grey reduction spots (up to 30mm). Fractures are randomly orientated extremely closely and very closely spaced planar smooth frequently infilled (up to 3mm) with reddish brown clay. 9.25 - 9.50m: Recovered as angular and subangular fine to coarse mudstone gravel.	9.15	5.54	
17D 18C	9.70 - 9.84 9.70 - 11.20	7.50	85 42 12	NI 80 170			S *395	Extremely weak locally very weak reddish brown MUDSTONE locally tending to very stiff clay with frequent mudstone lithorelicts and frequent bluish grey reduction spots (up to 50mm). Fractures and incipient fractures are 30° to 50° and 80° to 90° extremely closely to closely spaced planar smooth frequently stained black. 11.50 - 11.65m: Zone of weakness, tending to soft clay along 50° fracture, infilled with white calcite crystals (up to 5mm). 11.65 - 11.70m: Zone of weakness, tending to clay along 30° fractures.	9.70	4.99	
19D 20C	11.20 - 11.41 11.20 - 12.70	7.50	99 56 19				S *150				
21D 22C	12.70 - 12.85 12.70 - 14.20	7.50	100 62 27				S *395				
23D	14.20 - 14.43	7.50					S *200		14.43	0.26	
								Borehole Completed at 14.43m			

HOLE CONSTRUCTION
TOP (m) BASE (m) TYPE PLANT USED

WATER STRIKE Groundwater not encountered prior to use of flush
DEPTH (m) CASING (m) ROSE TO (m) AFTER (min) REMARKS

CASING DEPTH
DIAM (mm) BASE (m)

BACKFILL

TOP (m)	BASE (m)	MATERIAL
7.50	14.43	Bentonite

INSTRUMENTATION
DEPTH (m) TYPE

AGS

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BARREL DIAMETER
DIAM (mm) BASE (m)

HOLE PROGRESS
DATE TIME DEPTH (m) CASING (m) WATER (m)

REMARKS

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TRIAL PIT LOG

CLIENT	VANTAGE DATA CENTRES UK				**DC3_BH04**
SITE	IMPERIAL PARK DC3			Sheet	1 of 1
Start Date	27 January 2021	Easting	328488.9	Scale	1:25
End Date	27 January 2021	Northing	184494.7 Ground Level 14.62mOD	Depth	0.40 m

sample no & type	sample depth (m) from to	test type & value	water record	description	depth (m)	reduced level (m)	legend
1ES	0.10 - 0.20			Brown slightly clayey sandy angular and subangular fine to coarse sandstone and quartzite GRAVEL. (MADE GROUND)	0.20	14.42	
2D 3B	0.20 - 0.35 0.20 - 0.35			Orangish brown slightly sandy GRAVEL with a medium high cobble content. Gravel is angular and subangular fine to coarse sandstone. (MADE GROUND) 0.35m: Hole terminated at 0.40m due to rapid inflow of water obscuring excavation.	0.40	14.22	
				Trial pit Completed at 0.40m			

Equipment: Hand Tools.

Pit width x length: 0.50m x 0.50m

Sidewall stability:

Groundwater:

Depth Strike (m)	Rose to (m)	Time to rise (min)	Remarks
0.35	0.10	5	

Backfill details:

Depth Top (m)	Depth Base (m)	Material	Remarks
0.00	0.40	Arisings	

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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Geotechnical Engineering Limited

TRIAL PIT LOG

DC3_BH04A

CLIENT	VANTAGE DATA CENTRES UK			Sheet	1 of 1
SITE	IMPERIAL PARK DC3				
Start Date	27 January 2021	Easting	328489.0	Scale	1:25
End Date	27 January 2021	Northing	184493.4 Ground Level 14.64mOD	Depth	0.40 m

sample no & type	sample depth (m) from to	test type & value	water record	description	depth (m)	reduced level (m)	legend
				Brown slightly clayey sandy angular and subangular fine to coarse sandstone and quartzite GRAVEL. (MADE GROUND)	0.30	14.34	
				Orangish brown slightly sandy GRAVEL with a medium high cobble content. Gravel is angular and subangular fine to coarse sandstone. (MADE GROUND) 0.35m: Hole terminated at 0.40m due to rapid inflow of water obscuring excavation.	0.40	14.24	

Trial pit Completed at 0.40m

Equipment: Hand Tools.

Pit width x length: 0.50m x 0.50m

Sidewall stability:

Groundwater:

Depth Strike (m)	Rose to (m)	Time to rise (min)	Remarks
0.35	0.10	5	

Backfill details:

Depth Top (m)	Depth Base (m)	Material	Remarks
0.00	0.40	Arisings	

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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BOREHOLE LOG

DC3_BH04B

CLIENT	VANTAGE DATA CENTRES UK			Sheet	1 of 2
SITE	IMPERIAL PARK DC3				
Start Date	29 January 2021	Easting	328479	Scale	1:50
End Date	01 February 2021	Northing	184500	Ground Level 14.87mOD	Depth 14.21 m

sample no & type	sample depth (m) from - to	casing depth (m)	samp. /core range	If	water record depth (m)	instru -ment	test type & value	description	depth (m)	reduced level (m)
1D 1ES 2B	0.20 - 0.40 0.20 - 0.40 0.20 - 0.40							Brown slightly gravelly sandy SILT. Gravel is subangular and subrounded fine to coarse sandstone, quartzite and rare tarmac. (MADE GROUND)	0.20	14.67
2ES 3D 4B	0.60 - 0.80 0.60 - 0.80 0.60 - 0.80							Brown very silty very sandy subangular and subrounded fine to coarse sandstone, quartzite and rare granite GRAVEL with rare rootlets. (MADE GROUND) 0.20 - 0.35m: Pockets of grey clayey silt.	0.60	14.27
5D 6L	1.20 - 1.65 1.20 - 2.00	Nil					S 23	Brown and orangish brown slightly gravelly SILT. Gravel is subangular and subrounded fine to coarse quartzite and sandstone. (MADE GROUND) 1.05 - 1.15m: Sandstone cobble (180x130x100mm).	1.10	13.77
3ES 7D	1.70 - 1.80 1.80 - 1.90							Firm orangish brown slightly gravelly sandy clayey SILT. Gravel is subangular and subrounded fine to coarse sandstone. (MADE GROUND)	1.45	13.42
8D 9C	2.00 - 2.45 2.00 - 3.00	Nil	80	NA			S 21	Medium dense reddish brown and greyish brown slightly gravelly clayey fine to coarse SAND. Gravel is subangular and surrounded fine to coarse sandstone with a medium cobble content.	2.00	12.87
10C	3.00 - 4.00	3.00	83				C *100	Drilling disturbed recovered as medium dense becoming very dense orangish brown subangular and subrounded fine to coarse sandstone and quartzite GRAVEL with a high subangualr sandstone cobble content. Fines washed away. 2.25 - 2.45m: Sandy clayey gravel. 3.45 - 3.60m: Sandy silty gravel. 3.60 - 3.85m: Sandy gravel.		
11D	3.50 - 3.60									
12C	4.00 - 5.00	4.00	100				C *103			
13D	4.50 - 4.60									
14C	5.00 - 6.00	4.00	100				C *115			
15C	6.50 - 8.00	5.50	100 20 20				C 47	Dense reddish brown locally bluish grey slightly clayey sandy GRAVEL. Gravel is subangular fine and medium mudstone lithorelicts. 7.00 - 7.15m: Gravelly fine to coarse SAND.	6.50	8.37
16CS	7.70 - 7.90			NI				Extremely weak reddish brown slightly sandy MUDSTONE with rare bluish grey reduction spots (up to 25mm). 7.90 - 8.00m: Subvertical undulating rough fracture stained black.	7.70	7.17
17C	8.00 - 9.50	7.00					S *130		8.00	6.87

Continued Next Page

HOLE CONSTRUCTION

TOP (m)	BASE (m)	TYPE	PLANT USED
0.00	1.20	Inspection Pit	Hand Tools.
1.20	2.00	Windowless Sampler	Massenza M14 Rig
2.00	14.00	Rotary Core	Massenza M14 Rig

WATER STRIKE Groundwater not encountered prior to use of flush

DEPTH (m)	CASING (m)	ROSE TO (m)	AFTER (min)	REMARKS

CASING DEPTH

DIAM (mm)	BASE (m)
168	7.00

BACKFILL

TOP (m)	BASE (m)	MATERIAL
0.00	14.21	Bentonite

INSTRUMENTATION

DEPTH (m)	TYPE

BARREL DIAMETER

DIAM (mm)	BASE (m)
128	2.00
131	14.00

HOLE PROGRESS

DATE TIME	DEPTH (m)	CASING (m)	WATER (m)
29-01-2021 10:00	0.00	Nil	Dry
29-01-2021 17:00	4.00	4.00	1.00
01-02-2021 08:00	4.00	4.00	2.03
01-02-2021 17:00	14.00	7.00	0.00

REMARKS

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BOREHOLE LOG

DC3_BH04B

CLIENT	VANTAGE DATA CENTRES UK			Sheet	2 of 2
SITE	IMPERIAL PARK DC3				
Start Date	29 January 2021	Easting	328479	Scale	1:50
End Date	01 February 2021	Northing	184500	Ground Level 14.87mOD	Depth 14.21 m

sample no & type	sample depth (m) from to	casing depth (m)	samp. /core range	If	water record depth (m)	instru -ment	test type & value	description	depth (m)	reduced level (m)	legend
			100 0 0	NI				Extremely weak reddish brown slightly sandy MUDSTONE. Fractures are randomly orientated extremely closely spaced planar smooth frequently infilled with clay (up to 2mm) rarely stained black (up to 70mm) from fracture surface.			
18D	8.50 - 8.60										
4ES	8.60 - 8.70										
								9.00 - 9.05m: Band of very weak mudstone with intersecting subvertical and 70° planar smooth fractures.	9.30	5.57	
				NI 15 50				Extremely weak locally very weak reddish brown slightly sandy MUDSTONE locally tending to gravelly sandy clay with frequent grey and bluish grey reductions spots (up to 70mm). Fracture are intersecting subhorizontal to 20° and 70° to subvertical extremely closely to very closely spaced planar smooth and undulating rough frequently stained black and occasional infilled with calcite crystals (up to 3mm).			
19C	9.50 - 11.00	7.00	100 45 0				S *136				
20D	10.00 - 10.10										
21C	11.00 - 12.50	7.00	100 34 0				S *158				
									12.40	2.47	
22C	12.50 - 14.00	7.00	93 53 23	NI 50 110			S *120	Extremely weak reddish brown MUDSTONE locally tending to clayey gravelly sand with occasional bluish grey reduction spots (up to 35mm). Fractures are subhorizontal very closely to closely spaced planar smooth occasionally infilled with calcite crystals (up to 5mm). 12.50 - 12.70m: Limited recovery.			
23CS	13.10 - 13.28										
24D	14.00 - 14.21	7.00					S *145		14.21	0.66	
								Borehole Completed at 14.21m			

HOLE CONSTRUCTION
TOP (m) BASE (m) TYPE PLANT USED

WATER STRIKE Groundwater not encountered prior to use of flush
DEPTH (m) CASING (m) ROSE TO (m) AFTER (min) REMARKS

CASING DEPTH
DIAM (mm) BASE (m)

BACKFILL
TOP (m) BASE (m) MATERIAL

INSTRUMENTATION
DEPTH (m) TYPE

AGS

BARREL DIAMETER
DIAM (mm) BASE (m)

HOLE PROGRESS
DATE TIME DEPTH (m) CASING (m) WATER (m)

REMARKS

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BOREHOLE LOG

DC3_BH05

CLIENT	VANTAGE DATA CENTRES UK			Sheet	1 of 2
SITE	IMPERIAL PARK DC3				
Start Date	27 January 2021	Easting	328457	Scale	1:50
End Date	27 January 2021	Northing	184423 Ground Level 14.60mOD	Depth	14.00 m

sample no & type	sample depth (m) from - to	casing depth (m)	samp. /core range	If	water record depth (m)	test type & value
1D	0.10 - 0.30					
1ES	0.10 - 0.30					
2B	0.10 - 0.30					
2ES	0.60 - 0.80					
3D	0.60 - 0.80					
4B	0.60 - 0.80					
5D	1.20 - 1.65	Nil				S 21
6L	1.20 - 1.50					
3ES	1.30 - 1.40	1.50	55	NA		
7D	1.40 - 1.50					
8C	1.50 - 2.50					
10C	2.50 - 3.50	1.50	90			C *100
9D	2.50 - 2.65					
11C	3.50 - 4.50	3.00	90			C *156
12C	4.50 - 5.50	4.50	100			C *161
13C	5.50 - 7.00	4.50	100			C 50
4ES	6.70 - 6.80			NA		
14D	6.80 - 6.90					
15D	7.00 - 7.15	6.00	89	NI		S *81
16C	7.00 - 8.50		57	NA		
17D	7.30 - 7.40		38			
				160		
				170		
				190		

description	depth (m)	reduced level (m)
MADE GROUND comprising black TARMACADAM. (MADE GROUND)	0.05	14.55
Grey locally red GRAVEL AND SAND. Gravel is angular and subangular fine to coarse sandstone, mudstone, quartzite and rare slag. Sand is fine to coarse. (MADE GROUND)	0.30	14.30
Firm orange sandy clayey SILT. (MADE GROUND)	0.35	14.25
Firm becoming stiff brown and orangish brown slightly sandy slightly gravelly silty CLAY. Gravel is subangular and subrounded fine to coarse quartzite and sandstone. 0.35 - 0.45m: Greyish brown. 0.35m: Fabric membrane.	1.65	12.95
Drilling disturbed recovered as very dense brown, greyish brown, orangish brown and grey subangular to rounded fine to coarse GRAVEL with a medium to high subangular sandstone cobble content. Fines probably washed away.	6.60	8.00
Extremely weak reddish brown frequently stained black slightly sandy clayey MUDSTONE with occasional bluish grey reduction spots (up to 8mm). Recovered non-intact.	7.00	7.60
Extremely weak reddish brown MUDSTONE with frequent reduction spots (up to 80mm). Fractures are 30° to 50° and 80° very closely spaced planar smooth frequently stained black.	7.10	7.50
Orangish brown sandy slightly gravelly SILT. Gravel is subangular fine to coarse extremely weak and very weak mudstone lithorelicts occasionally stained grey. 7.40 - 7.50m: Bluish grey reduction spot (120 x 70mm).	7.55	7.05
Extremely weak reddish brown sandy MUDSTONE locally tending to sandy silt with rare blueish grey reduction spots (up to 30mm). Fractures are 10° to 20° closely spaced planar rough.		

Continued Next Page

HOLE CONSTRUCTION

TOP (m)	BASE (m)	TYPE	PLANT USED
0.00	1.20	Inspection Pit	Hand tools
1.20	1.50	Windowless Sampler	Massenza M14 Rig
1.50	14.00	Rotary Core	Massenza M14 Rig.

WATER STRIKE Groundwater not encountered prior to use of flush

DEPTH (m)	CASING (m)	ROSE TO (m)	AFTER (min)	REMARKS

CASING DEPTH

DIAM (mm)	BASE (m)
168	7.50

BACKFILL

TOP (m)	BASE (m)	MATERIAL
0.00	0.20	Concrete
0.20	2.50	Bentonite
2.50	6.50	Gravel
6.50	14.00	Bentonite

INSTRUMENTATION

DEPTH (m)	TYPE
6.50	Standpipe

AGS

BARREL DIAMETER

DIAM (mm)	BASE (m)
128	1.50
131	14.00

HOLE PROGRESS

DATE TIME	DEPTH (m)	CASING (m)	WATER (m)
27-01-2021 13:30	0.00	Nil	Dry
27-01-2021 17:00	7.00	4.50	1.00
28-01-2021 09:00	7.00	4.50	2.50
28-01-2021 16:30	14.00	7.50	1.00

REMARKS

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BOREHOLE LOG

DC3_BH05

CLIENT	VANTAGE DATA CENTRES UK			Sheet	2 of 2
SITE	IMPERIAL PARK DC3				
Start Date	27 January 2021	Easting	328457	Scale	1:50
End Date	27 January 2021	Northing	184423	Ground Level 14.60mOD	Depth 14.00 m

sample no & type	sample depth (m) from to	casing depth (m)	samp. /core range	If	water record depth (m)	instru -ment	test type & value	description	depth (m)	reduced level (m)	legend
18D 19C	8.50 - 8.75 8.50 - 10.00	6.00	67				S *100				
									8.85	5.75	
20D	9.00 - 9.10			NA				Stiff reddish brown slightly sandy slightly gravelly silty CLAY with frequent bluish grey reduction spots (up to 20mm), with occasional bands of extremely weak mudstone (up to 50mm) and rare pockets of calcite crystals (up to 50mm). Gravel is angular and subangular fine to coarse extremely weak mudstone lithorelicts.			
				NA					9.35	5.25	
21D 22C	10.00 - 10.15 10.00 - 11.50	7.50	100				S *115	Very stiff reddish brown slightly gravelly sandy locally clayey SILT with frequent bluish grey reduction spots (up to 70mm). Gravel is subangular fine to coarse extremely weak mudstone lithorelicts.			
23D	11.30 - 11.40							11.20 - 11.50m: Gravelly.			
									11.50	3.10	
24D 25C	11.50 - 11.75 11.50 - 13.00	7.50	100 49 15	NI 80 200			S *100	Extremely weak locally very weak indistinctly structured reddish brown slightly sandy MUDSTONE locally tending to very stiff gravelly silty clay with occasional bluish grey reduction spots (up to 10mm). Fractures are possibly 20° to 30° extremely closely to closely spaced planar smooth occasionally infilled with calcite crystals (up to 5mm) and occasionally stained black and grey.			
26D	12.60 - 12.70							12.30 - 12.50m: Tending to silty clay along a remnant fracture, oriented 60° and infilled with calcite crystals.			
27D 28C	13.00 - 13.25 13.00 - 14.00	7.50	100 65 18				S *106				
									13.35	1.25	
				NI 90 160				Extremely weak reddish brown and orangish brown slightly sandy MUDSTONE with frequent bluish grey reduction spots (up to 30mm). Fractures are intersecting subhorizontal to 20° and 80° to subvertical extremely closely to closely spaced planar smooth and undulating rough frequently stained black.			
		7.50					S *75	13.90 - 13.95m: Sand and fine gravel sized mudstone and calcite crystals.	14.00	0.60	
								Borehole Completed at 14.00m			

HOLE CONSTRUCTION
TOP (m) BASE (m) TYPE PLANT USED

WATER STRIKE Groundwater not encountered prior to use of flush
DEPTH (m) CASING (m) ROSE TO (m) AFTER (min) REMARKS

CASING DEPTH
DIAM (mm) BASE (m)

BACKFILL
TOP (m) BASE (m) MATERIAL

INSTRUMENTATION
DEPTH (m) TYPE

BARREL DIAMETER
DIAM (mm) BASE (m)

HOLE PROGRESS
DATE TIME DEPTH (m) CASING (m) WATER (m)

REMARKS

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BOREHOLE LOG

DC3_BH06

CLIENT	VANTAGE DATA CENTRES UK	Sheet	1 of 2
SITE	IMPERIAL PARK DC3		
Start Date	02 February 2021	Easting 328514	Scale 1:50
End Date	02 February 2021	Northing 184463 Ground Level 14.62mOD	Depth 8.37 m

sample no & type	sample depth (m) from - to	casing depth (m)	samp. /core range	If	water record depth (m)	instru -ment	test type & value	description	depth (m)	reduced level (m)
1B	0.20 - 0.40							Brownish grey fine to coarse SAND and GRAVEL. Gravel is angular and subangular fine to coarse sandstone, quartzite, rare slag and rare granite. (MADE GROUND)	0.20	14.42
1ES	0.20 - 0.40									
2D	0.20 - 0.40									
2ES	0.60 - 0.80							Brown and reddish brown slightly silty sandy angular and subangular fine to coarse sandstone, quartzite and rare slag GRAVEL. (MADE GROUND)	0.60	14.02
3B	0.60 - 0.80									
4D	0.60 - 0.80							Firm dark orangish brown slightly sandy slightly gravelly silty CLAY with a low to medium subrounded sandstone cobble content. Gravel is subangular and subrounded fine to coarse sandstone and quartzite.		
5D	1.20 - 1.65	Nil	75	NA			S 49			
6C	1.20 - 2.20							Drilling disturbed recovered as dense becoming very dense orangish brown locally sandy locally silty subrounded and rounded fine to coarse sandstone and quartzite GRAVEL. Fines washed away.	1.45	13.17
7C	2.20 - 3.20	Nil	95				C *158	1.80 - 1.95m: Rounded sandstone cobble (140 x 100 x 90mm).		
8D	2.75 - 2.85									
3ES	2.85 - 2.95									
9C	3.20 - 4.20	3.00	100				C *167			
10C	4.20 - 5.20	4.30	100				C *176			
11C	5.20 - 6.70	6.00	100 0 0	NI			C *97	5.35 - 5.50m: Reddish brown clayey gravel.		
								Extremely weak reddish brown sandy locally very sandy MUDSTONE locally tending to very stiff clay with occasional subhorizontal to 20° and 70-80° calcite veins, occasional bluish grey reduction spots (up to 30mm) and rare orangish brown claystone clasts (up to 20mm). Fractures are randomly orientated extremely closely spaced planar smooth frequently infilled with clay (up to 7mm).	5.50	9.12
4ES	6.00 - 6.10									
12D	6.10 - 6.20									
13D	6.70 - 6.94	6.00	95 0 0				S *176			
14C	6.70 - 8.20									
15D	7.00 - 7.10									

Continued Next Page

HOLE CONSTRUCTION

TOP (m)	BASE (m)	TYPE	PLANT USED
0.00	1.20	Inspection Pit	Hand tools
1.20	8.20	Rotary Core	Massenza M14 Rig

WATER STRIKE Groundwater not encountered prior to use of flush

DEPTH (m)	CASING (m)	ROSE TO (m)	AFTER (min)	REMARKS

CASING DEPTH

DIAM (mm)	BASE (m)
168	6.00

BACKFILL

TOP (m)	BASE (m)	MATERIAL
0.00	8.37	Bentonite

INSTRUMENTATION

DEPTH (m)	TYPE

BARREL DIAMETER

DIAM (mm)	BASE (m)
131	8.20

HOLE PROGRESS

DATE TIME	DEPTH (m)	CASING (m)	WATER (m)
02-02-2021 09:00	0.00	Nil	Dry
02-02-2021 16:30	8.20	6.00	0.00

REMARKS

AGS

CONTRACT **36253**

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BOREHOLE LOG

CLIENT	VANTAGE DATA CENTRES UK								DC3_BH06
SITE	IMPERIAL PARK DC3							Sheet	2 of 2
Start Date	02 February 2021	Easting	328514					Scale	1:50
End Date	02 February 2021	Northing	184463	Ground Level	14.62mOD			Depth	8.37 m

sample no & type	sample depth (m) from to	casing depth (m)	samp. /core range	If	water record depth (m)	instru -ment	test type & value	description	depth (m)	reduced level (m)	legend
16D	8.20 - 8.37	6.00					S *750	Extremely weak reddish brown sandy locally very sandy MUDSTONE locally tending to very stiff clay with occasional subhorizontal to 20° and 70-80° calcite veins, occasional bluish grey reduction spots (up to 30mm) and rare orangish brown claystone clasts (up to 20mm). Fractures are randomly orientated extremely closely spaced planar smooth frequently infilled with clay (up to 7mm). 8.10 - 8.13m: Band of very weak mudstone (30mm thick) with intersecting 80°-subvertical fractures stained black. Borehole Completed at 8.37m	8.37	6.25	

HOLE CONSTRUCTION
TOP (m) BASE (m) TYPE PLANT USED

WATER STRIKE Groundwater not encountered prior to use of flush
DEPTH (m) CASING (m) ROSE TO (m) AFTER (min) REMARKS

CASING DEPTH
DIAM (mm) BASE (m)

BACKFILL
TOP (m) BASE (m) MATERIAL

INSTRUMENTATION
DEPTH (m) TYPE

BARREL DIAMETER
DIAM (mm) BASE (m)

HOLE PROGRESS
DATE TIME DEPTH (m) CASING (m) WATER (m)

REMARKS

AGS

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Geotechnical Engineering Limited

BOREHOLE LOG

DC3_BH07

CLIENT	VANTAGE DATA CENTRES UK		
SITE	IMPERIAL PARK DC3		
Start Date	02 February 2021	Easting	328565
End Date	03 February 2021	Northing	184501

Ground Level 14.57mOD

Sheet 1 of 2
Scale 1:50
Depth 11.42 m

sample no & type	sample depth (m) from to	casing depth (m)	samp. /core range	If	water record depth (m)	test type & value	description	depth (m)	reduced level (m)
1B 1ES 2D 2ES 3B 4D	0.00 - 0.30 0.00 - 0.30 0.00 - 0.30 0.30 - 0.50 0.30 - 0.50 0.30 - 0.50						Moss over reddish brown silty sandy angular and subangular fine to coarse sandstone and crystalline GRAVEL. (MADE GROUND)	0.30	14.27
							Firm greyish brown slightly sandy becoming sandy gravelly clayey SILT with occasional pockets (up to 60x70mm) of sandy clay. Gravel is subangular to rounded fine to coarse sandstone. (MADE GROUND)	1.10	13.47
3ES 5B 6D 7D 8C	1.10 - 1.20 1.10 - 1.20 1.10 - 1.20 1.20 - 1.53 1.20 - 2.20	Nil	43	NA	1.40	S *81	Dark orangish brown clayey sandy subangular to well rounded fine to coarse sandstone GRAVEL with a low subrounded and rounded sandstone cobble content.	1.20	13.37
							Limited recovery: Recovered as very dense greyish brown very clayey very sandy subangular to well rounded medium and coarse rarely fine sandstone and quartzite GRAVEL. Fines washed away.		
9D 10C	2.10 - 2.20 2.20 - 3.20	2.20	40			C *68			
11C	3.20 - 4.20	2.20	38		3.20	C *103			
12D 13C	4.10 - 4.20 4.20 - 5.20	3.20	49			C *231	4.15m: Occasional black residue on gravels, no odour.		
14C	5.20 - 6.70	5.20	29			C *200			
15D 16C	6.60 - 6.70 6.70 - 7.30	5.20	60			C *136	7.25 - 7.30m: Firm silty clay.	7.30	7.27
17D	7.30 - 7.75	6.70				S 45	Firm purplish brown slightly sandy silty CLAY.	7.75	6.82
18C 19D 4ES 20C	7.50 - 7.90 7.67 - 7.77 7.77 - 7.87 7.90 - 8.90	7.50 7.50	100	NI			Extremely weak becoming very weak purplish brown locally mottled greenish grey MUDSTONE. Fractures are randomly orientated extremely closely spaced intersecting planar smooth rarely undulating smooth frequently stained black.		

Continued Next Page

HOLE CONSTRUCTION

TOP (m)	BASE (m)	TYPE	PLANT USED
0.00	1.20	Inspection Pit	Hand tools
1.20	11.42	Rotary Core	MC 405

WATER STRIKE

DEPTH (m)	CASING (m)	ROSE TO (m)	AFTER (min)	REMARKS
1.40	Nil	1.40	0	
3.20	3.20	3.20	0	

CASING DEPTH

DIAM (mm)	BASE (m)
168	7.50

BACKFILL

TOP (m)	BASE (m)	MATERIAL
0.00	0.20	Concrete
0.20	2.00	Bentonite
2.00	7.00	Gravel
7.00	11.42	Bentonite

INSTRUMENTATION

DEPTH (m)	TYPE
7.00	Standpipe

BARREL DIAMETER

DIAM (mm)	BASE (m)
131	11.30

HOLE PROGRESS

DATE TIME	DEPTH (m)	CASING (m)	WATER (m)
02-02-2021 09:30	0.00	Nil	Dry
02-02-2021 16:45	8.90	7.50	7.00
03-02-2021 08:30	8.90	7.50	7.00
03-02-2021 12:00	11.42	7.50	8.40

REMARKS

AGS

CONTRACT **36253**

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Geotechnical Engineering Limited

BOREHOLE LOG

DC3_BH07

CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

Sheet 2 of 2

Start Date 02 February 2021 Easting 328565 Scale 1:50

End Date 03 February 2021 Northing 184501 Ground Level 14.57mOD Depth 11.42 m

sample no & type	sample depth (m) from to	casing depth (m)	samp. /core range	If	water record depth (m)	instru -ment	test type & value
21D	8.05 - 8.15		75 32 0				
22D	8.30 - 8.40			NI 15 30			
23D	8.90 - 9.35	7.50	92 3 0				S 23
24C	8.90 - 10.30						
25D	9.50 - 9.60						
5ES	9.60 - 9.70						
				NI 40			
				NA			
26D	10.20 - 10.30						
27C	10.30 - 11.30	7.50	80 0 0				S *130
28D	10.70 - 10.80						
6ES	11.00 - 11.10						
29D	11.30 - 11.42	7.50					S *300

description	depth (m)	reduced level (m)	legend
Extremely weak becoming very weak purplish brown locally mottled greenish grey MUDSTONE. Fractures are randomly orientated extremely closely spaced intersecting planar smooth rarely undulating smooth frequently stained black. 8.05 - 8.20m: Very weak light greenish grey.	8.30	6.27	
Very weak reddish brown MUDSTONE. Fractures are randomly orientated extremely closely and very closely spaced planar smooth rarely undulating smooth frequently stained black. 9.10 - 9.75m: Recovered non-intact.	9.75	4.82	
Weak light greenish grey locally greenish white SILTSTONE. Fractures are subhorizontal to10° and 80° to subvertical extremely closely to very closely spaced planar smooth frequently stained black. 10.00 - 10.06m: Stiff slightly sandy silty clay.	10.05	4.52	
Very stiff indistinctly fissured reddish brown slightly sandy silty CLAY locally tending to extremely weak fractured mudstone. 10.06 - 10.20m: Frequent translucent white crystals (up to 1x2mm) 10.30 - 10.56m: Extremely weak mudstone. 10.30 - 10.70m: Fissures are subhorizontal to10° extremely closely and very closely spaced planar smooth. 11.00 - 11.10m: Stiff reddish brown slightly sandy silty clay. 11.30 - 11.42m: Extremely weak friable reddish brown mudstone.	11.42	3.15	

Borehole Completed at 11.42m

HOLE CONSTRUCTION
TOP (m) BASE (m) TYPE PLANT USED

WATER STRIKE
DEPTH (m) CASING (m) ROSE TO (m) AFTER (min) REMARKS

CASING DEPTH
DIAM (mm) BASE (m)

BACKFILL
TOP (m) BASE (m) MATERIAL

INSTRUMENTATION
DEPTH (m) TYPE

BARREL DIAMETER
DIAM (mm) BASE (m)

HOLE PROGRESS
DATE TIME DEPTH (m) CASING (m) WATER (m)

REMARKS

CONTRACT
36253

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JH

Geotechnical Engineering Limited

STANDARD PENETRATION TEST

CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

borehole no.	borehole depth (m)	s.w.p (mm)	bottom depth (m)	casing depth (m)	water level (m)	seating drive				test drive								test type	N	energy ratio (%)
						blows		pen (mm)		blows				pen (mm)						
DC3_BH01	1.20		1.52	Nil	Dry	5	12	75	75	15	18	17		75	75	20		S	88	76
DC3_BH01	2.20		2.55	Nil	0.00	7	11	75	75	16	21	13		75	75	45		C	77	76
DC3_BH01	3.20		3.60	3.00	0.00	5	8	75	75	10	10	14	16	75	75	75	20	C	61	76
DC3_BH01	4.20		4.44	4.00	0.00	11	14	75	75	26	24			75	15			C	167	76
DC3_BH01	5.20		5.58	5.00	0.00	8	10	75	75	14	15	18	3	75	75	75	5	C	65	76
DC3_BH01	6.70		7.08	6.00	0.00	4	5	75	75	7	13	26	4	75	75	75	5	S	65	76
DC3_BH01	8.20		8.46	7.50	0.00	8	14	75	75	26	24			75	30			S	143	76
DC3_BH01	9.70		9.77	7.50	0.00	25		20		50				50				S	300	76
DC3_BH01	11.20		11.28	7.50	0.00	25		15		50				65				S	231	76
DC3_BH02	1.20		1.61	Nil	0.90	6	13	75	75	15	14	16	5	75	75	75	30	C	59	66
DC3_BH02	2.20		2.55	2.20	2.00	8	17	75	75	15	21	14		75	75	50		C	75	66
DC3_BH02	3.20		3.46	3.20	2.20	8	17	75	55	25	25			75	50			C	120	66
DC3_BH02	4.20		4.45	4.20	3.20	10	13	75	75	30	20			75	25			C	150	66
DC3_BH02	5.20		5.52	5.20	3.00	4	8	75	75	14	27	9		75	75	20		C	88	66
DC3_BH02	6.70		7.07	6.70	3.10	2	3	75	75	9	18	23		75	75	65		C	70	66
DC3_BH02	8.40		8.54	7.40	3.00	17	8	75	15	50				45				S	333	66
DC3_BH03	1.20		1.51	Nil	Dry	8	14	75	75	16	28	6		75	75	14		C	91	76
DC3_BH03	2.20		2.61	1.50	1.00	4	11	75	75	14	17	18	6	75	75	75	31	C	64	76
DC3_BH03	3.20		3.65	3.00	0.50	8	9	75	75	9	11	12	14	75	75	75	75	C	46	76
DC3_BH03	4.20		4.65	3.00	0.50	8	11	75	75	11	14	12	13	75	75	75	75	C	50	76
DC3_BH03	5.20		5.65	4.50	0.50	4	6	75	75	11	11	13	14	75	75	75	75	C	49	76
DC3_BH03	6.70		7.04	6.00	1.20	6	14	75	75	18	24	8		75	75	35		C	81	76
DC3_BH03	8.20		8.65	7.50	1.00	4	8	75	75	11	12	14	13	75	75	75	75	C	50	76
DC3_BH03	9.70		9.76	7.50	1.00	25		22		50				38				S	395	76
DC3_BH03	11.20		11.45	7.50	1.00	8	13	75	75	42	8			75	25			S	150	76

notes:
1. Test carried out in general accordance with BS EN ISO 22476-3:2005 + A1:2011
2. s.w.p = self weight penetration.
3. N values have not been subjected to any correction.
4. Test carried out using split spoon S, solid cone C.
5. Where full test drive not completed, linearly extrapolated N value reported.
6. ** Denotes no effective penetration.

CONTRACT	CHECKED
36253	**JH**

Geotechnical Engineering Limited

STANDARD PENETRATION TEST

CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

borehole no.	borehole depth (m)	s.w.p (mm)	bottom depth (m)	casing depth (m)	water level (m)	seating drive				test drive								test type	N	energy ratio (%)
						blows		pen (mm)		blows				pen (mm)						
DC3_BH03	12.70		12.77	7.50	1.00	25		35		50				38				S	395	76
DC3_BH03	14.20		14.43	7.50	2.53	8	17	75	75	50				75				S	200	76
DC3_BH04B	1.20		1.65	Nil	Dry	3	3	75	75	4	6	6	7	75	75	75	75	S	23	76
DC3_BH04B	2.00		2.45	Nil	Dry	14	11	75	75	5	5	5	6	75	75	75	75	S	21	76
DC3_BH04B	3.00		3.30	3.00	0.00	8	14	75	75	22	28			75	75			C	100	76
DC3_BH04B	4.00		4.30	4.00	0.00	8	11	75	75	39	11			75	70			C	103	76
DC3_BH04B	5.00		5.28	4.00	2.03	6	19	75	75	25	25			75	55			C	115	76
DC3_BH04B	6.50		6.95	5.50	0.00	7	7	75	75	9	21	10	7	75	75	75	75	C	47	76
DC3_BH04B	8.00		8.27	7.00	0.00	17	8	75	75	32	18			75	40			S	130	76
DC3_BH04B	9.50		9.76	7.00	0.00	16	9	75	75	40	10			75	35			S	136	76
DC3_BH04B	11.00		11.17	7.00	0.00	25		75		28	22			75	20			S	158	76
DC3_BH04B	12.50		12.78	7.00	0.00	15	10	75	75	28	22			75	50			S	120	76
DC3_BH04B	14.00		14.25	7.00	0.00	3	12	75	75	20	26			75	20			S	145	76
DC3_BH05	1.20		1.65	Nil	Dry	3	3	75	75	4	5	6	6	75	75	75	75	S	21	76
DC3_BH05	2.50		2.80	1.50	1.00	8	13	75	75	18	32			75	75			C	100	76
DC3_BH05	3.50		3.75	3.00	1.00	4	21	75	75	42	8			75	21			C	156	76
DC3_BH05	4.50		4.74	4.50	1.00	11	14	75	75	38	12			75	18			C	161	76
DC3_BH05	5.50		5.95	4.50	1.00	4	8	75	75	9	11	13	17	75	75	75	75	C	50	76
DC3_BH05	7.00		7.34	6.00	2.50	6	13	75	75	14	21	15		75	75	35		S	81	76
DC3_BH05	8.50		8.80	6.00	0.00	16	9	75	75	24	26			75	75			S	100	76
DC3_BH05	10.00		10.28	7.50	0.00	11	14	75	75	28	22			75	55			S	115	76
DC3_BH05	11.50		11.80	7.50	0.00	16	9	75	75	22	28			75	75			S	100	76
DC3_BH05	13.00		13.30	7.50	0.00	16	9	75	75	26	27			75	75			S	106	76
DC3_BH05	14.00		14.35	7.50	0.00	6	16	75	75	17	18	15		75	75	50		S	75	76
DC3_BH06	1.20		1.65	Nil	Dry	7	9	75	75	7	12	14	16	75	75	75	75	S	49	76

notes:
1. Test carried out in general accordance with BS EN ISO 22476-3:2005 + A1:2011
2. s.w.p = self weight penetration.
3. N values have not been subjected to any correction.
4. Test carried out using split spoon S, solid cone C.
5. Where full test drive not completed, linearly extrapolated N value reported.
6. ** Denotes no effective penetration.

CONTRACT	CHECKED
36253	**JH**

Geotechnical Engineering Limited

STANDARD PENETRATION TEST

CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

borehole no.	borehole depth (m)	s.w.p (mm)	bottom depth (m)	casing depth (m)	water level (m)	seating drive				test drive								test type	N	energy ratio (%)
						blows		pen (mm)		blows				pen (mm)						
DC3_BH06	2.20		2.45	Nil	0.00	11	14	75	75	34	16			75	20			C	158	76
DC3_BH06	3.20		3.44	3.00	0.00	5	11	75	75	28	22			75	15			C	167	76
DC3_BH06	4.20		4.44	4.30	0.00	8	16	75	75	32	18			75	10			C	176	76
DC3_BH06	5.20		5.51	6.00	0.00	10	14	75	75	19	28	3		75	75	5		C	97	76
DC3_BH06	6.70		6.94	6.00	0.00	19	6	75	75	32	18			75	10			S	176	76
DC3_BH06	8.20		8.37	6.00	0.00	8	17	75	75	50				20				S	750	76
DC3_BH07	1.20		1.54	Nil	Dry	5	9	75	75	12	21	17		75	75	35		S	81	66
DC3_BH07	2.20		2.57	2.20	2.00	8	15	75	75	16	20	14		75	75	70		C	68	66
DC3_BH07	3.20		3.46	2.20	3.11	14	11	75	40	25	25			75	70			C	103	66
DC3_BH07	4.20		4.37	3.20	3.10	14	11	75	30	50				65				C	231	66
DC3_BH07	5.20		5.35	5.20	3.00	25		70		50				75				C	200	66
DC3_BH07	6.70		6.96	5.20	4.80	4	12	75	75	32	18			75	35			C	136	66
DC3_BH07	7.30		7.75	6.70	4.40	3	5	75	75	5	6	9	25	75	75	75	75	S	45	66
DC3_BH07	8.90		9.35	7.50	7.00	4	10	75	75	9	4	4	6	75	75	75	75	S	23	66
DC3_BH07	10.30		10.57	7.50	8.10	8	17	75	75	28	22			75	40			S	130	66
DC3_BH07	11.30		11.42	7.50	8.40	25		70		50				50				S	300	66

notes:
1. Test carried out in general accordance with BS EN ISO 22476-3:2005 + A1:2011
2. s.w.p = self weight penetration.
3. N values have not been subjected to any correction.
4. Test carried out using split spoon S, solid cone C.
5. Where full test drive not completed, linearly extrapolated N value reported.
6. ** Denotes no effective penetration.

CONTRACT	CHECKED
36253	**JH**

Geotechnical Engineering Limited

DYNAMIC PROBE RESULTS

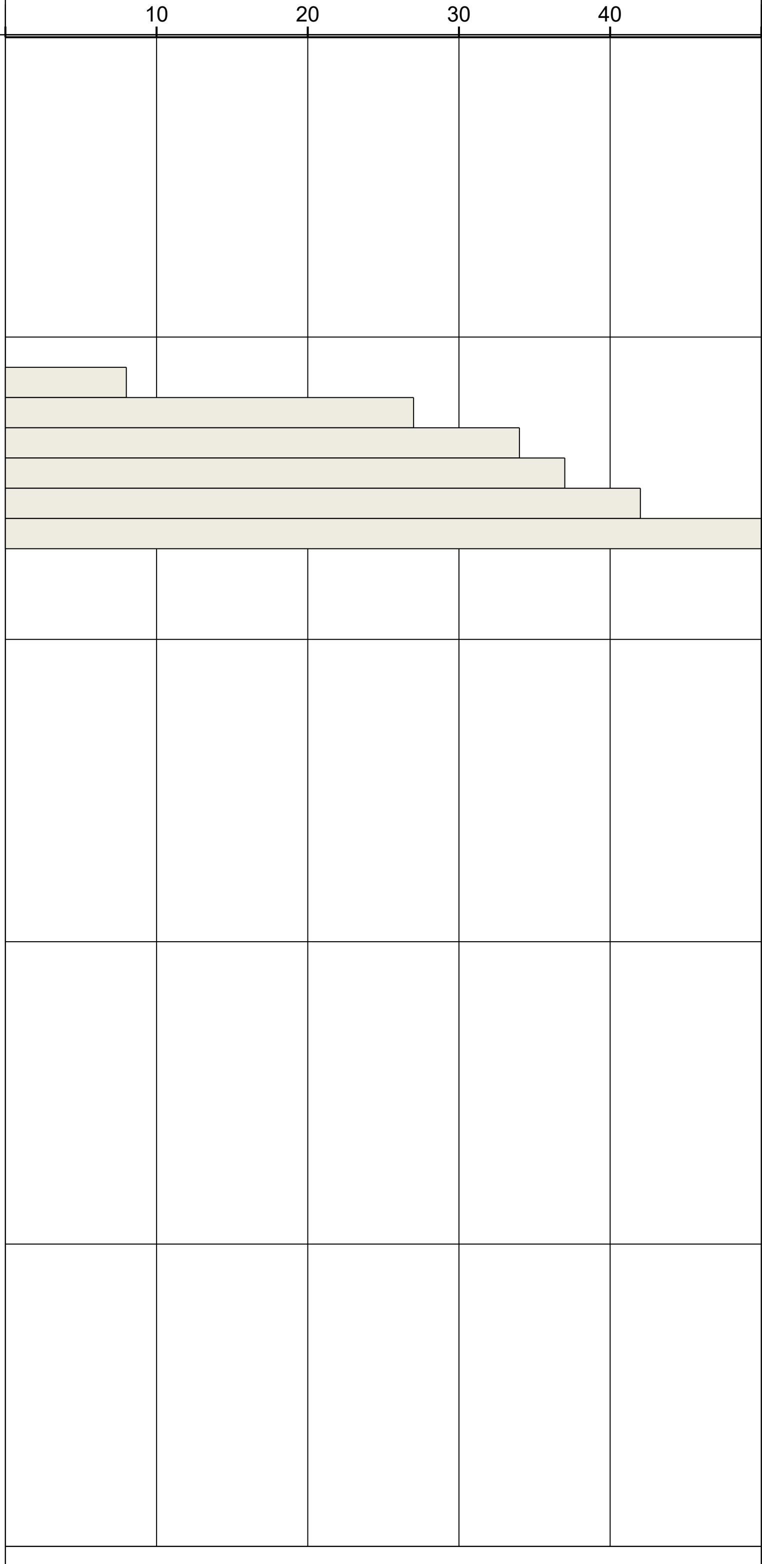
DC3_DPSH01

CLIENT	VANTAGE DATA CENTRES UK		
SITE	IMPERIAL PARK DC3		
Date	20/01/2021	Easting	328432.7
Ground Level	14.94mOD	Northing	184510.9

Sheet 1 of 1
Scale 1:25
Depth (m) 1.69

Depth (m)	Blowcount / penetration (mm)	Remarks
		Reddish brown slightly sandy angular and subangular fine to coarse sandstone GRAVEL with a medium subangular sandstone cobbles. MADE GROUND
		Grey slightly silty fine to coarse SAND. MADE GROUND
		Greyish brown and brown slightly silty slightly sandy angular to subrounded fine to coarse sandstone and quartzite GRAVEL with rare coal (up to 15mm). MADE GROUND 0.40m: Dark grey plastic membrane.
1.00		
	8 / 100	Inspection pit completed at 1.10m
	27 / 100	
	34 / 100	
	37 / 100	
	42 / 100	
	50 / 90	
		Completed at 1.69m
2.00		
3.00		
4.00		
5.00		

Blows / 100mm



Torque (Nm)

Method: BS EN ISO 22476-2:2005+A1:2011. Sacrificial cone used.

Probe type: Superheavy (63.5kg hammer mass/750mm drop)

Remarks: Dynamic Probe undertaken from base of inspection pit.

CONTRACT	CHECKED
36253	JH

AGS

Geotechnical Engineering Limited

DYNAMIC PROBE RESULTS

DC3_DPSH02

CLIENT	VANTAGE DATA CENTRES UK		
SITE	IMPERIAL PARK DC3		
Date	20/01/2021	Easting	328485.4
Ground Level	14.73mOD	Northing	184552.2

Sheet	1 of 1
Scale	1:25
Depth (m)	0.40

Depth (m)	Blowcount / penetration (mm)	Blows / 100mm (10, 20, 30, 40)	Torque (Nm)	Remarks
				Brown and greyish brown sandy angular and subangular fine to coarse sandstone, quartzite, rare clinker and rare fibreglass GRAVEL.
				0.40m: Fragment of possible ACM. Pit terminated at 0.40m.
				Completed at 0.40m
1.00				
2.00				
3.00				
4.00				
5.00				

CONTRACT	CHECKED
36253	JH

AGS

Geotechnical Engineering Limited

DYNAMIC PROBE RESULTS

DC3_DPSH02A

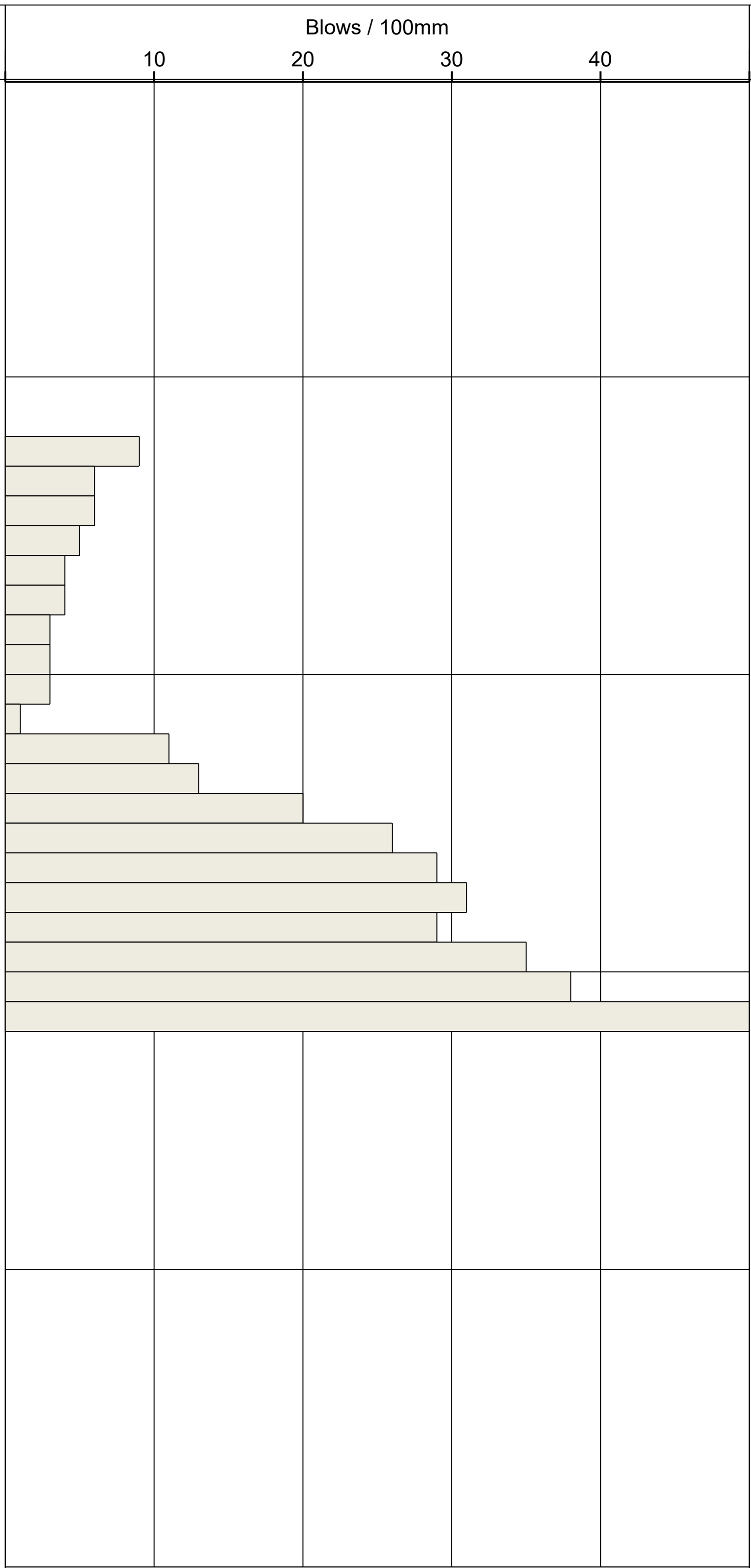
CLIENT	VANTAGE DATA CENTRES UK		
SITE	IMPERIAL PARK DC3		
Date	21/01/2021	Easting	328485.8
Ground Level	14.77mOD	Northing	184550.6

Sheet 1 of 1

Scale 1:25

Depth (m) 3.16

Blowcount / penetration (mm)	Torque (Nm)
9 / 100	
6 / 100	
6 / 100	
5 / 100	
4 / 100	
4 / 100	
3 / 100	
3 / 100	
3 / 100	0
1 / 100	
11 / 100	
13 / 100	
20 / 100	
26 / 100	
29 / 100	
31 / 100	
29 / 100	
35 / 100	
38 / 100	41
50 / 60	20



Remarks:

Brown and greyish brown slightly sandy angular and subangular fine to coarse concrete, sandstone, rare plastic and rare rubber tubing GRAVEL.
MADE GROUND

Reddish brown slightly silty slightly sandy subangular fine to coarse sandstone GRAVEL.
MADE GROUND

Inspection pit completed at 1.20m

Completed at 3.16m

Method: BS EN ISO 22476-2:2005+A1:2011. Sacrificial cone used.

Probe type: Superheavy (63.5kg hammer mass/750mm drop)

Remarks: Dynamic Probe undertaken from base of inspection pit.

CONTRACT	CHECKED
36253	JH

AGS

Geotechnical Engineering Limited

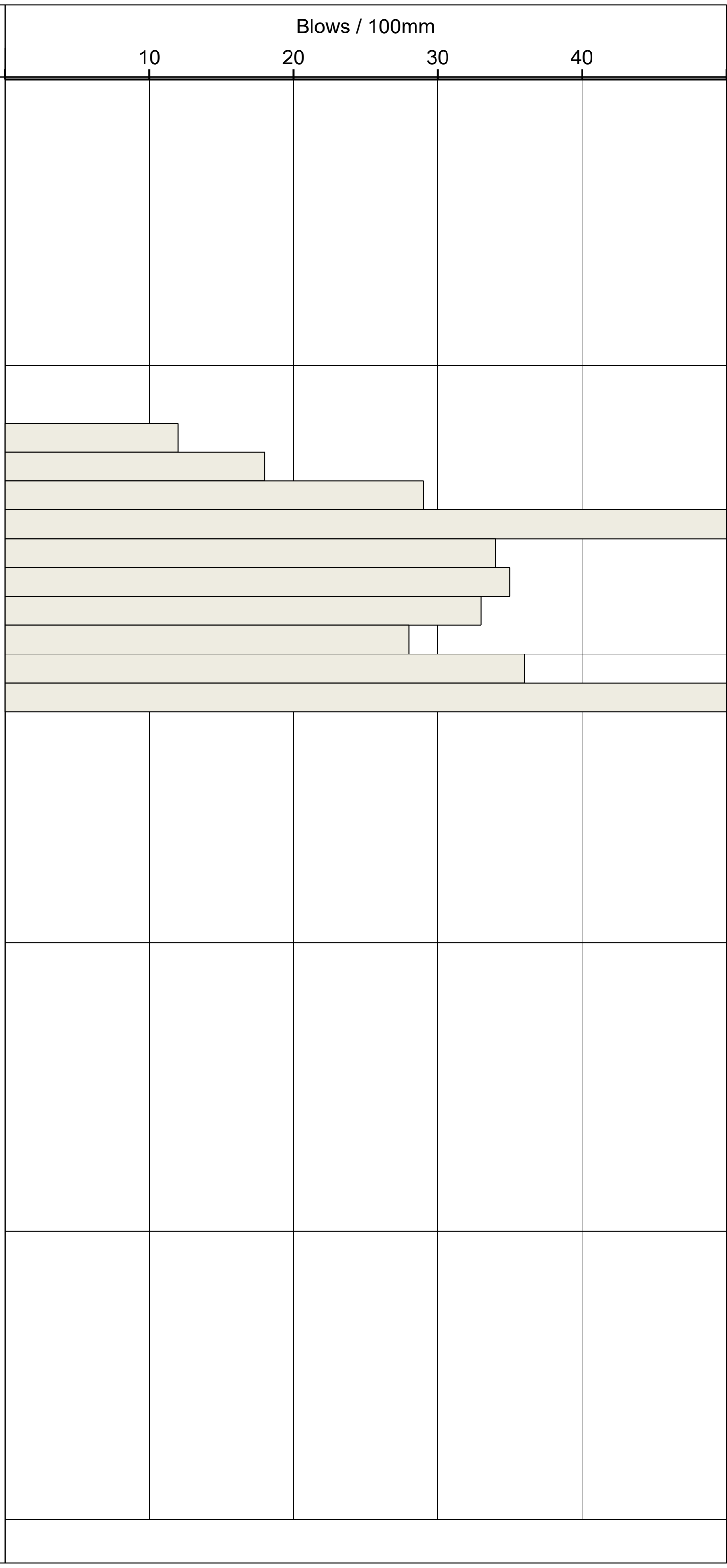
DYNAMIC PROBE RESULTS

DC3_DPSH03

CLIENT	VANTAGE DATA CENTRES UK		
SITE	IMPERIAL PARK DC3		
Date	20/01/2021	Easting	328415.6
Ground Level	14.67mOD	Northing	184465.0

Sheet	1 of 1
Scale	1:25
Depth (m)	2.19

Depth (m)	Blowcount / penetration (mm)	Torque (Nm)	Remarks
0.00			Brown slightly sandy clayey angular to subrounded fine to coarse sandstone, quartzite and rare slag GRAVEL with rare subrounded sandstone cobbles. MADE GROUND
			Firm orangish brown slightly gravelly sandy silty CLAY with a low subrounded sandstone cobble content. Gravel is subangular and subrounded fine to coarse sandstone and quartzite.
1.00			Orangish brown clayey sandy subangular and subrounded fine to coarse sandstone and quartzite GRAVEL with a low subrounded sandstone cobble content.
			Inspection pit completed at 1.20m
	12 / 100		
	18 / 100		
	29 / 100		
	50 / 100		
	34 / 100		
	35 / 100		
	33 / 100		
	28 / 100		
2.00	36 / 100	38	
	50 / 90	27	
			Completed at 2.19m
3.00			
4.00			
5.00			



Method: BS EN ISO 22476-2:2005+A1:2011. Sacrificial cone used.

Probe type: Superheavy (63.5kg hammer mass/750mm drop)

Remarks: Dynamic Probe undertaken from base of inspection pit.

CONTRACT	CHECKED
36253	JH

Geotechnical Engineering Limited

DYNAMIC PROBE RESULTS

DC3_DPSH04

CLIENT	VANTAGE DATA CENTRES UK		
SITE	IMPERIAL PARK DC3		
Date	20/01/2021	Easting	328451.0
Ground Level	14.64mOD	Northing	184498.3

Sheet	1 of 1
Scale	1:25
Depth (m)	2.69

Depth (m)	Blowcount / penetration (mm)	Torque (Nm)
1.00		
	15 / 100	
	23 / 100	
	23 / 100	
	22 / 100	
	16 / 100	
	15 / 100	
	16 / 100	
	17 / 100	
2.00	15 / 100	0
	18 / 100	
	20 / 100	
	33 / 100	
	33 / 100	
	39 / 100	
	50 / 90	7
3.00		
4.00		
5.00		

Blows / 100mm: 10, 20, 30, 40

Remarks

Orangish brown clayey sandy angular to subrounded fine to coarse sandstone and quartzite GRAVEL with a low subangular sandstone cobble content. Occasional rootlets.
MADE GROUND

Orangish brown slightly clayey sandy subangular and subrounded fine to coarse sandstone and quartzite GRAVEL with a low to medium subrounded sandstone cobble content.

Brown slightly clayey slightly sandy subrounded and rounded fine to coarse sandstone and quartzite GRAVEL with a low subrounded sandstone cobble content.

Inspection pit completed at 1.20m

Completed at 2.69m

Method: BS EN ISO 22476-2:2005+A1:2011. Sacrificial cone used.

Probe type: Superheavy (63.5kg hammer mass/750mm drop)

Remarks: Dynamic Probe undertaken from base of inspection pit.

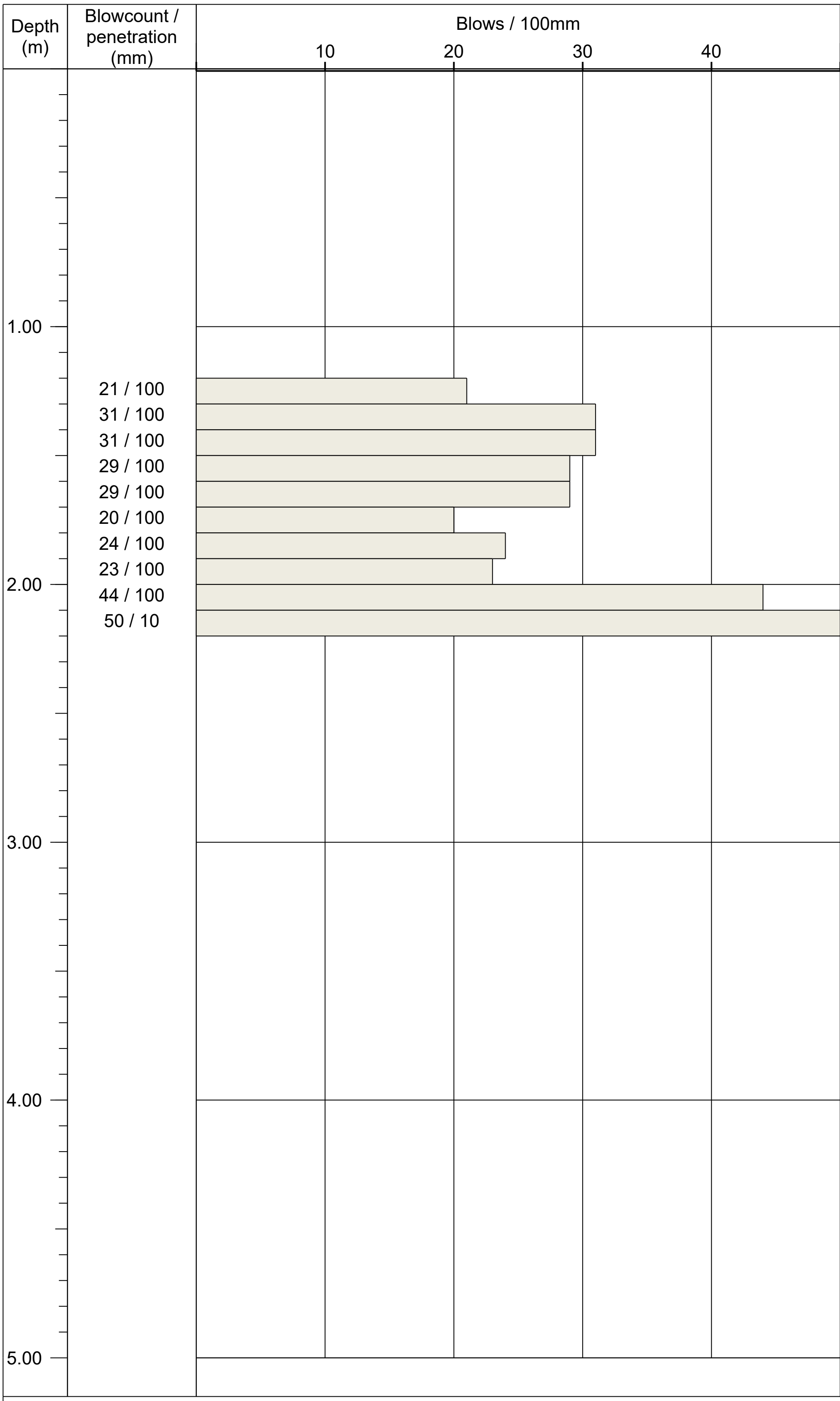
CONTRACT	CHECKED
36253	JH

Geotechnical Engineering Limited

DYNAMIC PROBE RESULTS

DC3_DPSH05

CLIENT	VANTAGE DATA CENTRES UK	Sheet	1 of 1
SITE	IMPERIAL PARK DC3	Scale	1:25
Date	19/01/2021 Easting 328507.3	Depth (m)	2.11
Ground Level	14.84mOD Northing 184529.5		



Depth (m)	Blowcount / penetration (mm)	Torque (Nm)
	21 / 100	
	31 / 100	
	31 / 100	
	29 / 100	
	29 / 100	
	20 / 100	
	24 / 100	
	23 / 100	
2.00	44 / 100	14
	50 / 10	

Remarks

Reddish brown sandy angular and subangular fine to coarse sandstone, quartzite and rare slag GRAVEL. MADE GROUND

Brown locally mottled greyish brown slightly sandy slightly gravelly SILT with rare pockets of grey ash (up to 20mm). Gravel is angular and subangular fine to coarse sandstone, quartzite and rare slag. MADE GROUND

Brown slightly sandy slightly clayey subangular and subrounded fine to coarse sandstone and quartzite GRAVEL.

Inspection pit completed at 1.20m

Completed at 2.11m

Method: BS EN ISO 22476-2:2005+A1:2011. Sacrificial cone used.

Probe type: Superheavy (63.5kg hammer mass/750mm drop)

Remarks: Dynamic Probe undertaken from base of inspection pit.

CONTRACT	CHECKED
36253	JH

Geotechnical Engineering Limited

DYNAMIC PROBE RESULTS

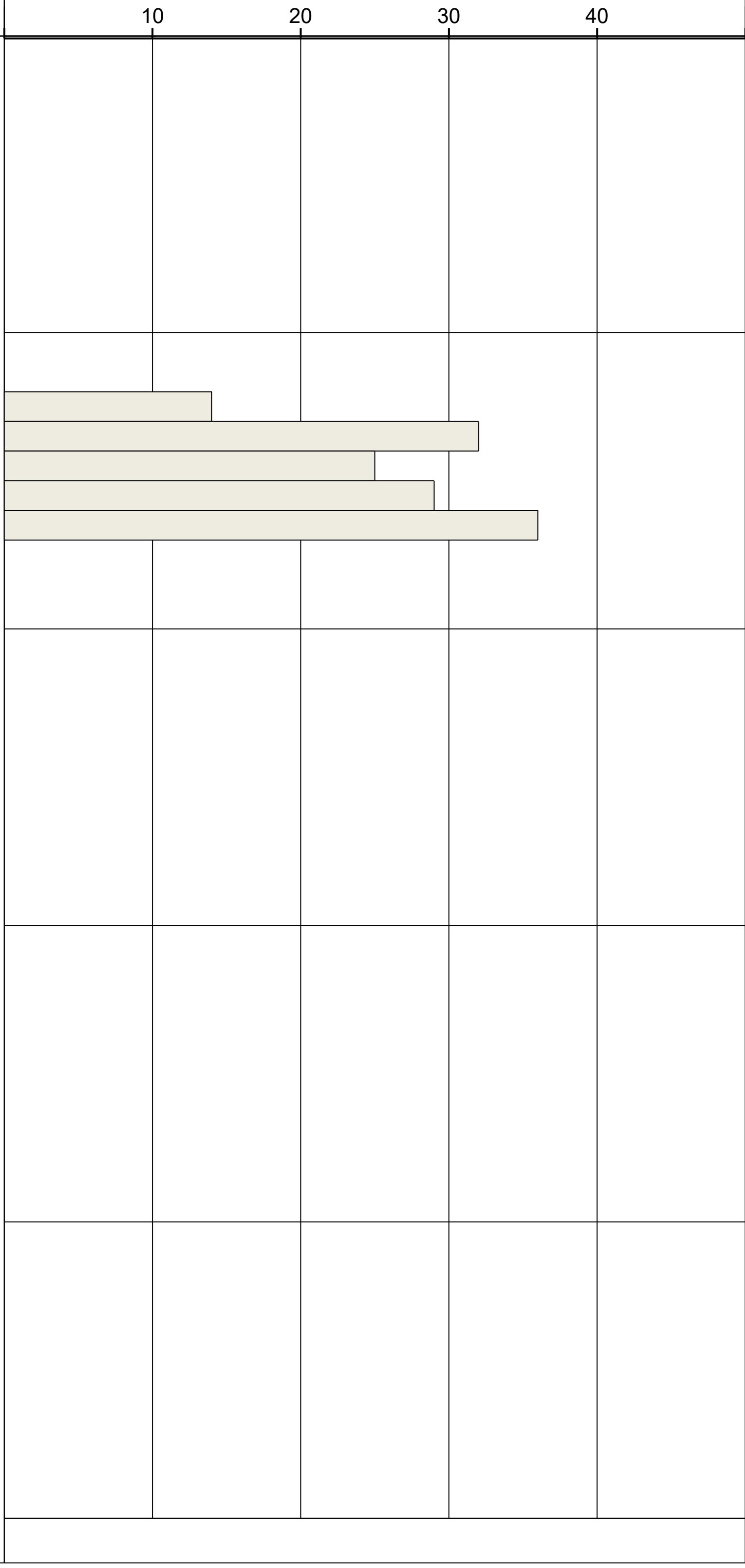
DC3_DPSH06A

CLIENT	VANTAGE DATA CENTRES UK		
SITE	IMPERIAL PARK DC3		
Date	22/01/2021	Easting	328527.9
Ground Level	14.56mOD	Northing	184555.8

Sheet	1 of 1
Scale	1:25
Depth (m)	1.70

Depth (m)	Blowcount / penetration (mm)
1.00	
	14 / 100
	32 / 100
	25 / 100
	29 / 100
	36 / 100
2.00	
3.00	
4.00	
5.00	

Blows / 100mm



Torque (Nm)

Remarks

Brown sandy angular and subangular fine to coarse concrete, sandstone, quartzite and rare slag GRAVEL.
MADE GROUND

Orangish brown slightly silty sandy subangular and subrounded fine to coarse sandstone, quartzite and concrete GRAVEL with occasional sandstone cobbles.
MADE GROUND

Orangish brown slightly silty sandy subangular and subrounded fine to coarse sandstone and quartzite GRAVEL with frequent sandstone cobbles.

Inspection pit completed at 1.20m

Completed at 1.70m

Method: BS EN ISO 22476-2:2005+A1:2011. Sacrificial cone used.

Probe type: Superheavy (63.5kg hammer mass/750mm drop)

Remarks: Dynamic Probe undertaken from base of inspection pit.

CONTRACT	CHECKED
36253	JH

Geotechnical Engineering Limited

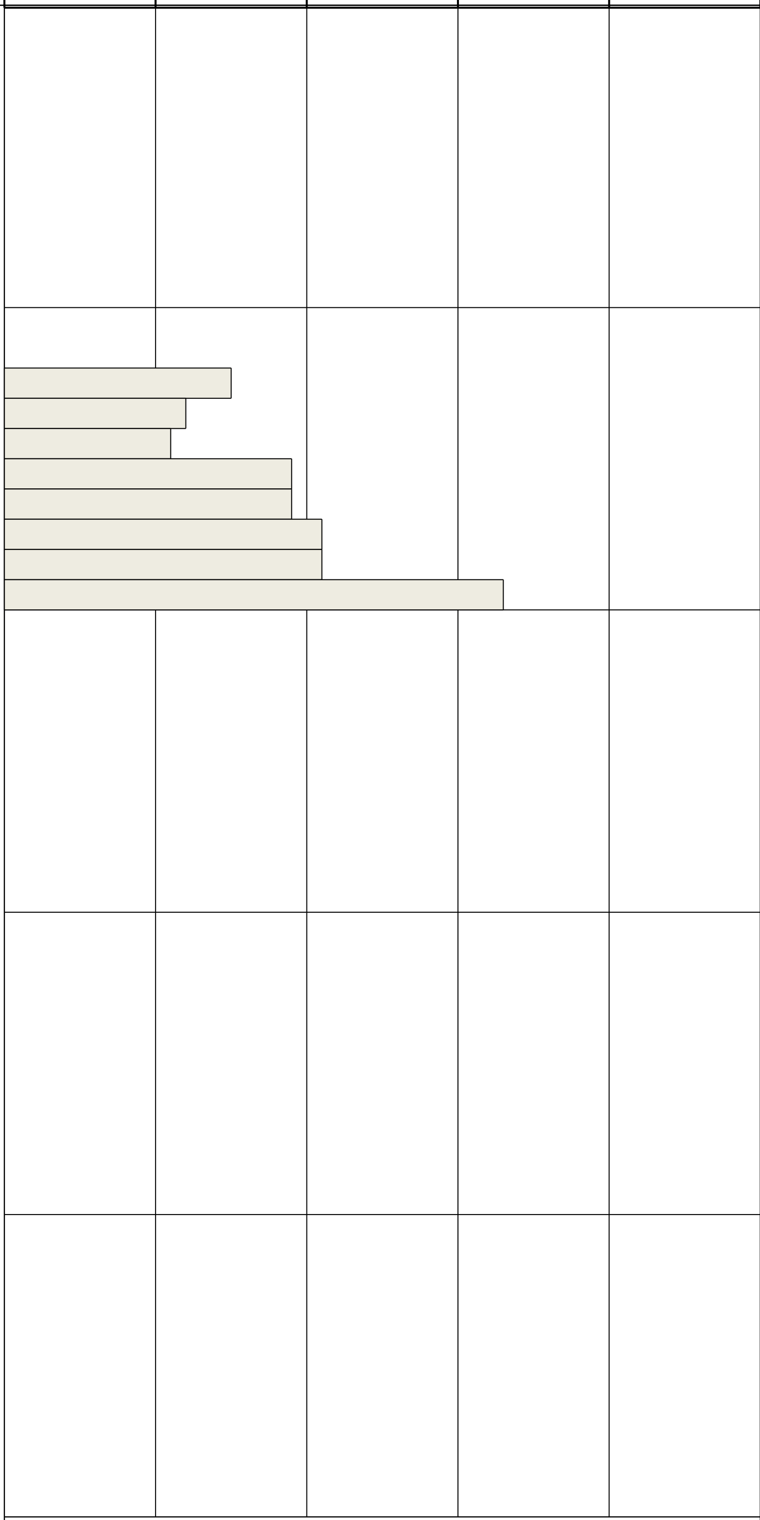
DYNAMIC PROBE RESULTS

DC3_DPSH07

CLIENT	VANTAGE DATA CENTRES UK		
SITE	IMPERIAL PARK DC3		
Date	27/01/2021	Easting	328441.3
Ground Level	14.57mOD	Northing	184444.7

Sheet 1 of 1
Scale 1:25
Depth (m) 2.00

Depth (m)	Blowcount / penetration (mm)	Torque (Nm)	Remarks
			MADE GROUND comprising black TARMACADAM.
			Reddish brown becoming grey silty very sandy angular and subangular fine to coarse sandstone rarely crystalline GRAVEL.
			Stiff brownish grey slightly sandy slightly gravelly silty CLAY. Gravel is angular and subangular fine and medium sandstone.
			0.20m: White translucent polymer sheet
			Orangish brown sandy gravelly SILT. Gravel is angular to subrounded fine to coarse sandstone.
			Orangish brown silty very sandy angular to subrounded fine to coarse sandstone GRAVEL.
1.00			
	15 / 100		Inspection pit completed at 1.20m
	12 / 100		
	11 / 100		
	19 / 100		
	19 / 100		
	21 / 100		
	21 / 100		
	33 / 100		
2.00			Completed at 2.00m
3.00			
4.00			
5.00			



Method: BS EN ISO 22476-2:2005+A1:2011. Sacrificial cone used.

Probe type: Superheavy (63.5kg hammer mass/750mm drop)

Remarks: Dynamic Probe undertaken from base of inspection pit.

AGS

CONTRACT	CHECKED
36253	JH

Geotechnical Engineering Limited

DYNAMIC PROBE RESULTS

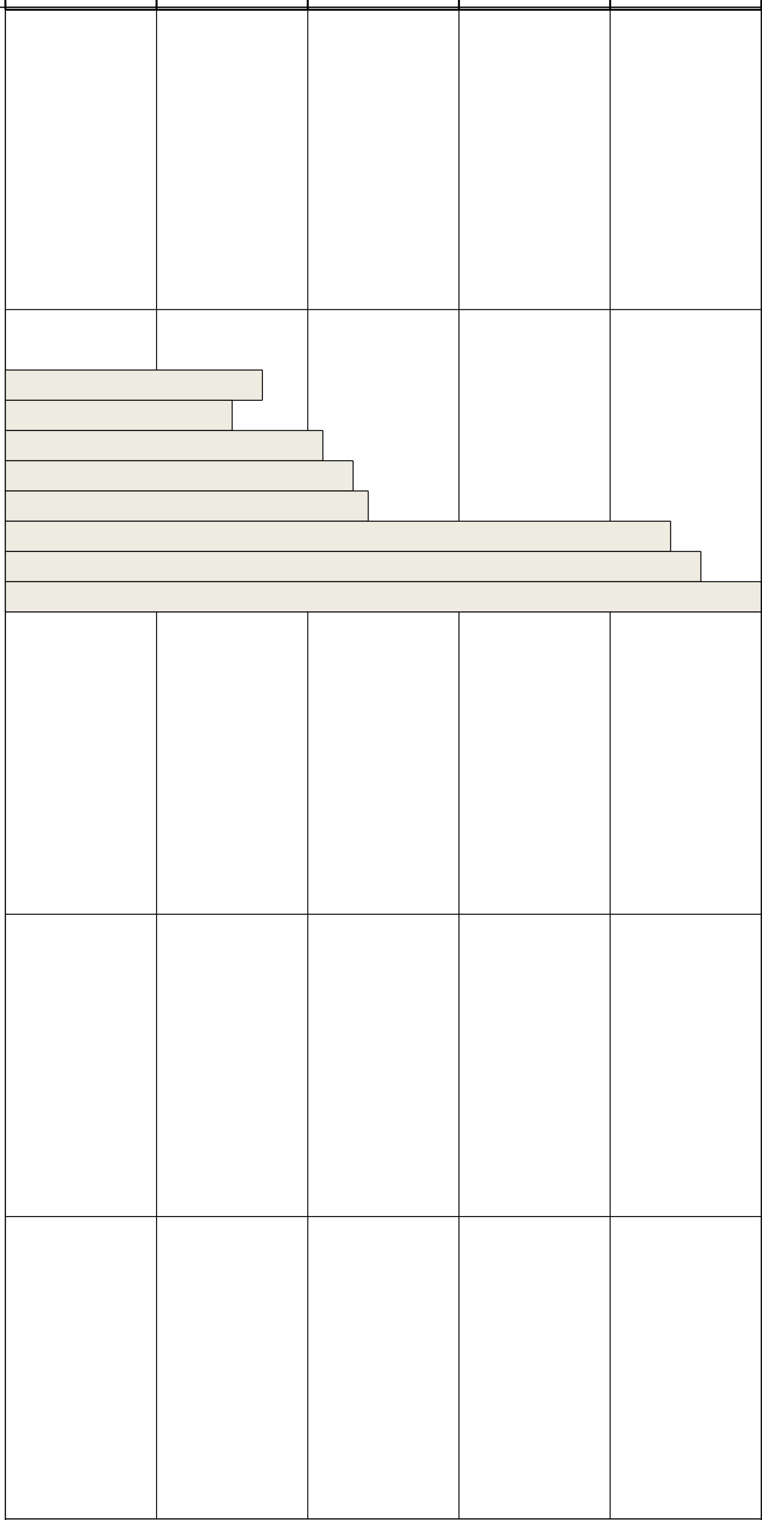
DC3_DPSH08

CLIENT	VANTAGE DATA CENTRES UK		
SITE	IMPERIAL PARK DC3		
Date	22/01/2021	Easting	328468.6
Ground Level	14.59mOD	Northing	184464.3

Sheet 1 of 1
Scale 1:25
Depth (m) 2.00

Depth (m)	Blowcount / penetration (mm)	Torque (Nm)
1.00		
	17 / 100	
	15 / 100	
	21 / 100	
	23 / 100	
	24 / 100	
	44 / 100	
	46 / 100	
	50 / 100	41
2.00		
3.00		
4.00		
5.00		

Blows / 100mm



Remarks

MADE GROUND comprising black TARMACADAM.

MADE GROUND
Greyish brown and grey sandy angular and subangular fine to coarse sandstone, concrete and quartzite GRAVEL.

MADE GROUND
Orangish brown slightly silty sandy angular to subrounded fine to coarse sandstone and quartzite GRAVEL.

MADE GROUND
Firm greyish brown becoming orangish brown slightly gravelly slightly sandy clayey SILT with a low subangular sandstone cobble content. Gravel is subrounded fine to coarse sandstone and quartzite.

MADE GROUND
0.40m: Fabric membrane.
Orangish brown locally yellowish brown clayey gravelly fine to coarse SAND with occasional pockets of firm sandy clayey silt (up to 30mm) and a low subangular sandstone cobble content. Gravel is subangular and subrounded fine to coarse sandstone and quartzite.

Inspection pit completed at 1.20m

Completed at 2.00m

Method: BS EN ISO 22476-2:2005+A1:2011. Sacrificial cone used.

Probe type: Superheavy (63.5kg hammer mass/750mm drop)

Remarks: Dynamic Probe undertaken from base of inspection pit.

CONTRACT	CHECKED
36253	JH

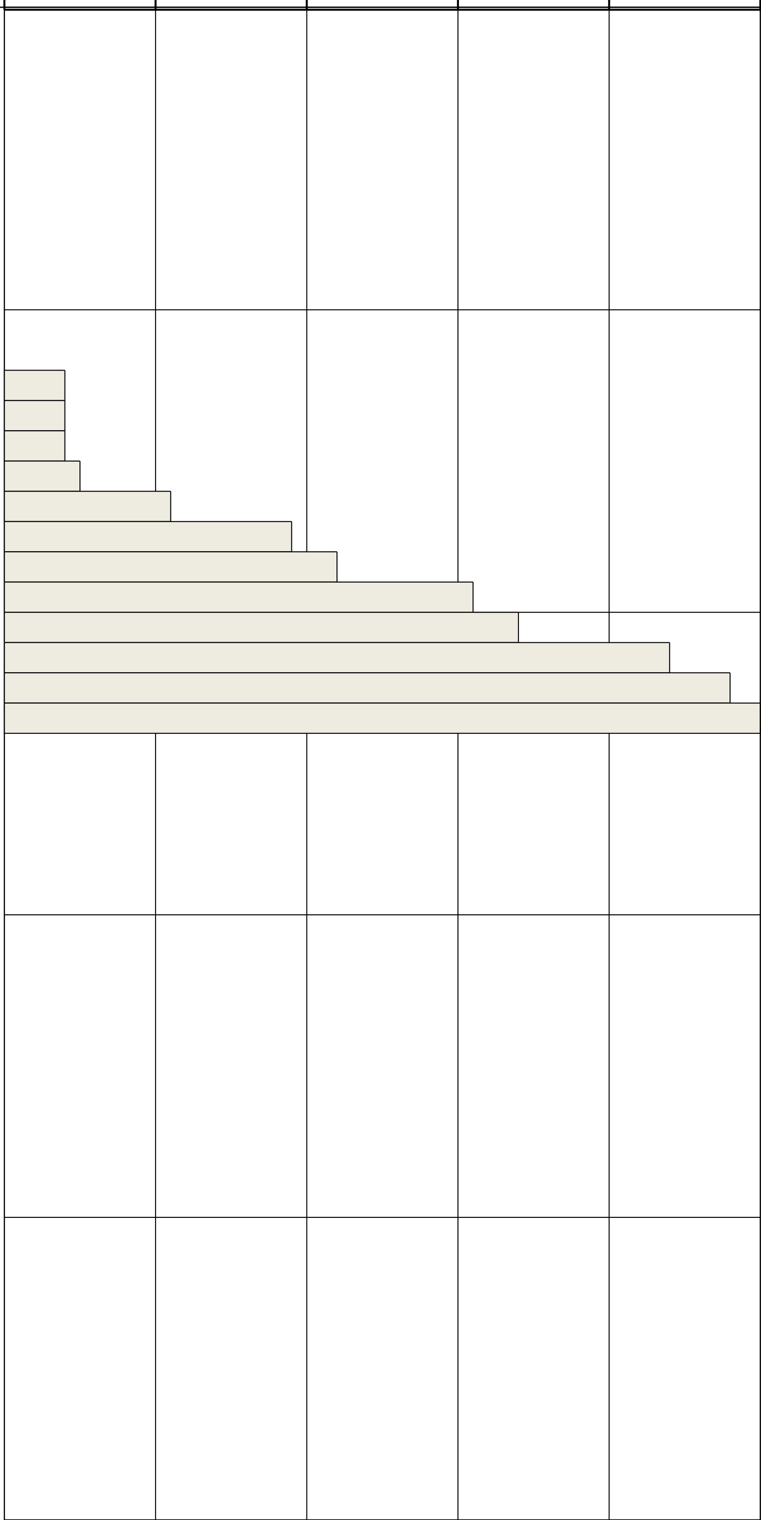
Geotechnical Engineering Limited

DYNAMIC PROBE RESULTS

DC3_DPSH09

CLIENT	VANTAGE DATA CENTRES UK		
SITE	IMPERIAL PARK DC3		
Date	19/01/2021	Easting	328520.6
Ground Level	14.65mOD	Northing	184509.6

Sheet	1 of 1
Scale	1:25
Depth (m)	2.38



Depth (m)	Blowcount / penetration (mm)	Torque (Nm)	Remarks
			Reddish brown sandy angular and subangular fine to coarse sandstone, slag and quartzite GRAVEL. MADE GROUND
			Brown slightly sandy slightly gravelly locally clayey SILT with a medium subangular sandstone cobble content. Gravel is angular and subangular fine to coarse sandstone, quartzite and rare slag. MADE GROUND
			Orangish brown slightly gravelly silty fine to coarse SAND. Gravel is subangular and subrounded fine to coarse sandstone and quartzite.
1.00			
	4 / 100		Inspection pit completed at 1.20m
	4 / 100		
	4 / 100		
	5 / 100		
	11 / 100		
	19 / 100		
	22 / 100		
	31 / 100		
2.00	34 / 100	0	
	44 / 100		
	48 / 100		
	50 / 80		
			Completed at 2.38m
3.00			
4.00			
5.00			

Method: BS EN ISO 22476-2:2005+A1:2011. Sacrificial cone used.

Probe type: Superheavy (63.5kg hammer mass/750mm drop)

Remarks: Dynamic Probe undertaken from base of inspection pit.

CONTRACT	CHECKED
36253	JH

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DYNAMIC PROBE RESULTS

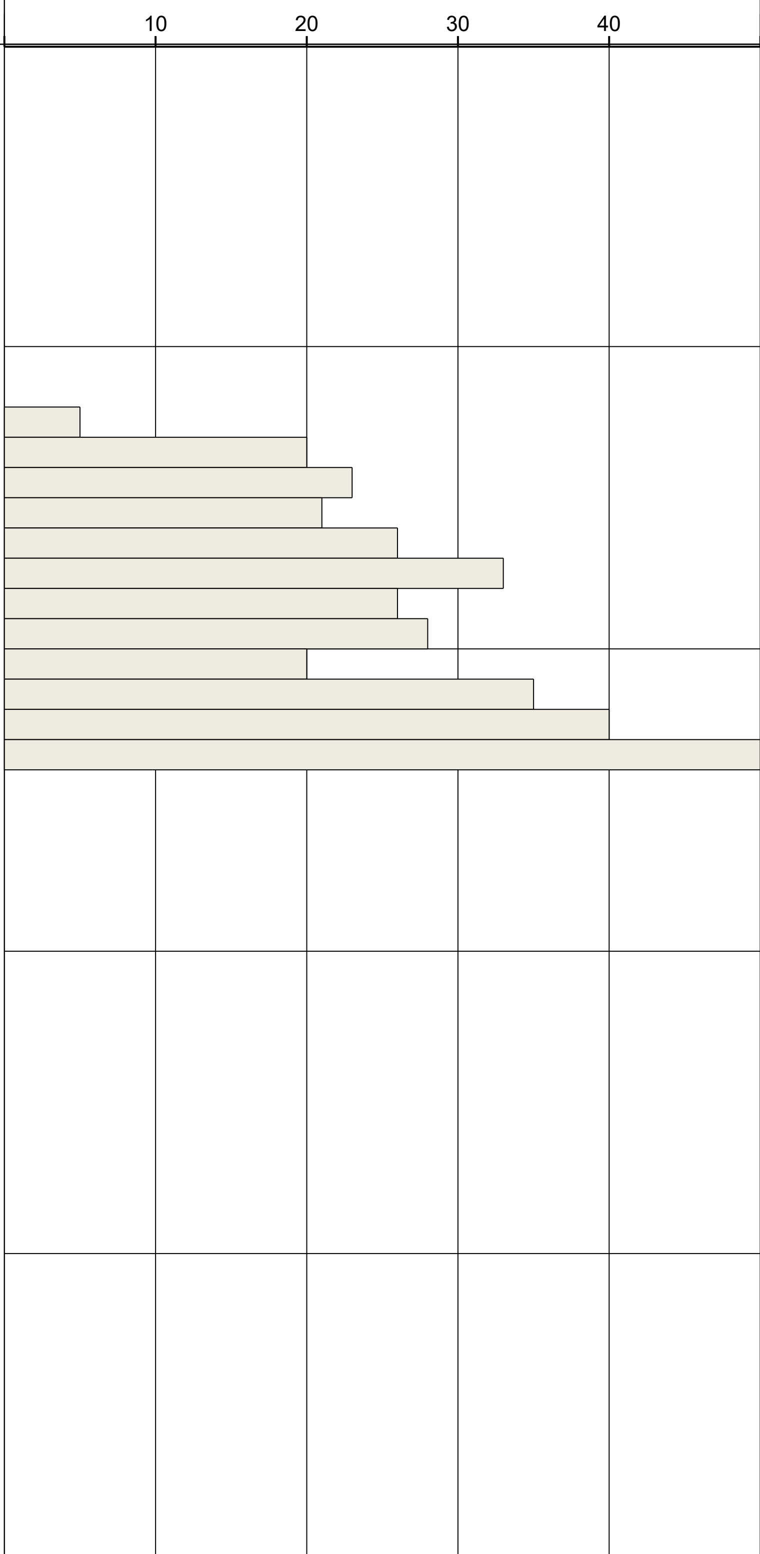
DC3_DPSH10

CLIENT	VANTAGE DATA CENTRES UK		
SITE	IMPERIAL PARK DC3		
Date	21/01/2021	Easting	328551.9
Ground Level	14.40mOD	Northing	184523.3

Sheet	1 of 1
Scale	1:25
Depth (m)	2.39

Depth (m)	Blowcount / penetration (mm)	Torque (Nm)
1.00		
	5 / 100	
	20 / 100	
	23 / 100	
	21 / 100	
	26 / 100	
	33 / 100	
	26 / 100	
	28 / 100	
2.00	20 / 100	0
	35 / 100	
	40 / 100	
	50 / 90	20
3.00		
4.00		
5.00		

Blows / 100mm



Remarks

Brown and reddish brown sandy clayey subangular and subrounded fine to coarse sandstone, quartzite and rare granite GRAVEL.
MADE GROUND

Dark greyish brown slightly gravelly silty fine to coarse SAND. Gravel is subrounded fine to coarse sandstone and quartzite.
MADE GROUND

Stiff reddish brown slightly gravelly sandy silty CLAY with a low subangular sandstone cobble content. Gravel is subangular fine to coarse sandstone and quartzite.

Inspection pit completed at 1.20m

Completed at 2.39m

Method: BS EN ISO 22476-2:2005+A1:2011. Sacrificial cone used.

Probe type: Superheavy (63.5kg hammer mass/750mm drop)

Remarks: Dynamic Probe undertaken from base of inspection pit.

CONTRACT	CHECKED
36253	JH

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Geotechnical Engineering Limited

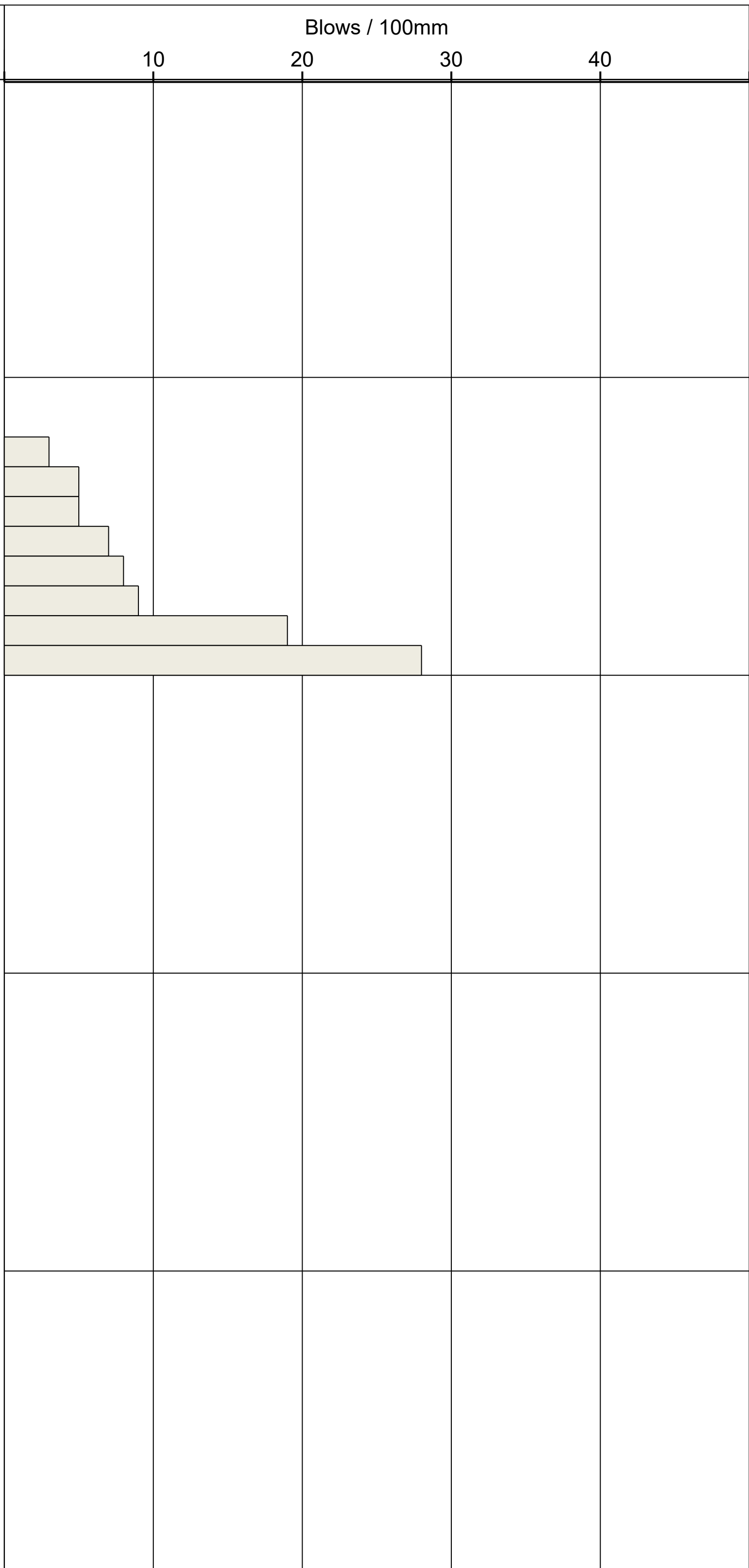
DYNAMIC PROBE RESULTS

DC3_DPSH11

CLIENT	VANTAGE DATA CENTRES UK		
SITE	IMPERIAL PARK DC3		
Date	27/01/2021	Easting	328485.9
Ground Level	14.63mOD	Northing	184441.9

Sheet	1 of 1
Scale	1:25
Depth (m)	2.00

Depth (m)	Blowcount / penetration (mm)
1.00	
	3 / 100
	5 / 100
	5 / 100
	7 / 100
	8 / 100
	9 / 100
	19 / 100
	28 / 100
2.00	
3.00	
4.00	
5.00	



Torque (Nm)

Remarks

MADE GROUND comprising black TARMACADAM.

MADE GROUND
Grey locally red GRAVEL and fine to coarse SAND. Gravel is angular to subrounded fine to coarse sandstone, mudstone, quartzite and rare slag.

MADE GROUND
Brown and orangish brown slightly gravelly slightly sandy clayey SILT. Gravel is subangular and subrounded fine to coarse quartzite and sandstone.
0.40 - 0.60m: Greyish brown.

Inspection pit completed at 1.20m

Completed at 2.00m

Method: BS EN ISO 22476-2:2005+A1:2011. Sacrificial cone used.

Probe type: Superheavy (63.5kg hammer mass/750mm drop)

Remarks: Dynamic Probe undertaken from base of inspection pit.

CONTRACT	CHECKED
36253	JH

Geotechnical Engineering Limited

DYNAMIC PROBE RESULTS

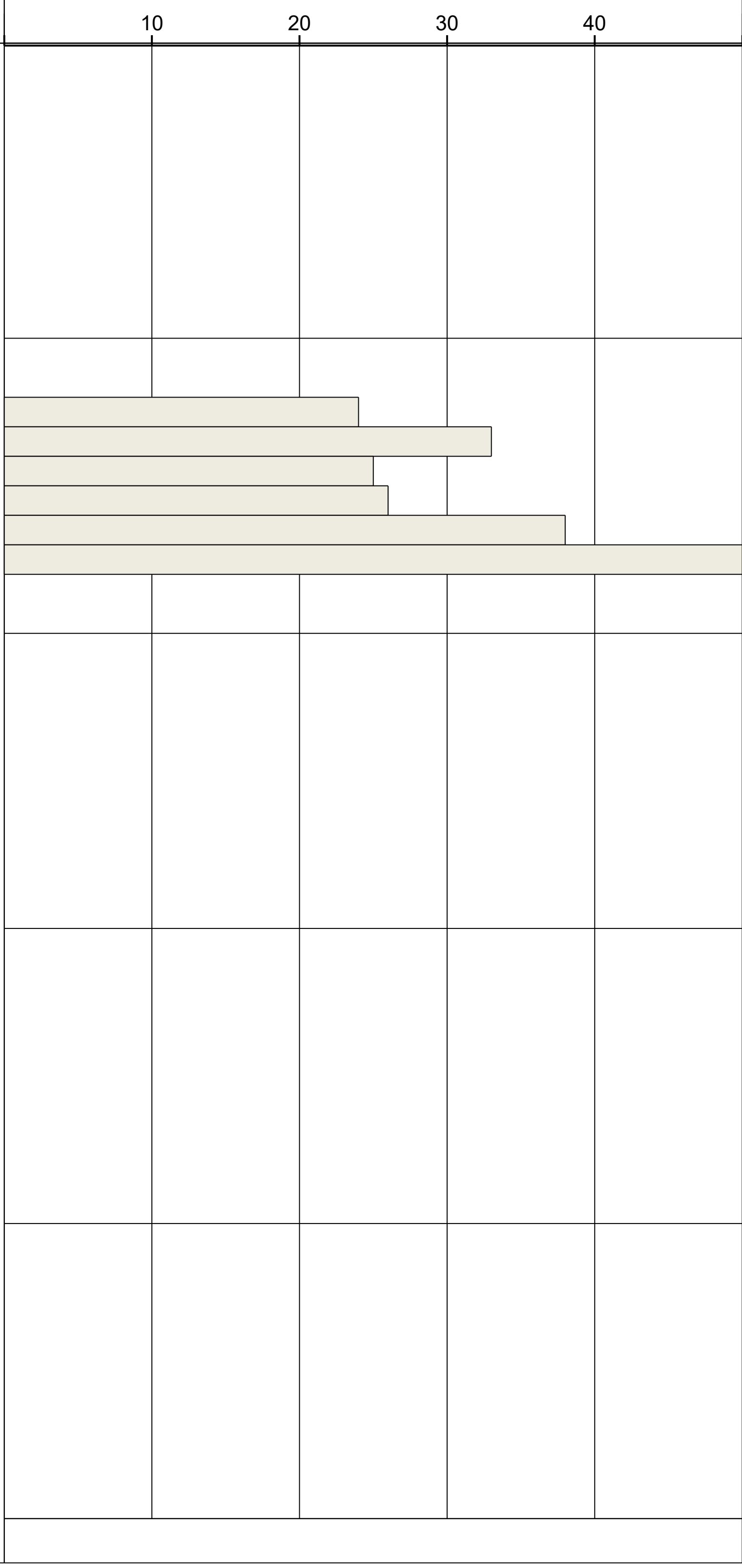
DC3_DPSH12

CLIENT	VANTAGE DATA CENTRES UK		
SITE	IMPERIAL PARK DC3		
Date	22/01/2021	Easting	328540.5
Ground Level	14.56mOD	Northing	184486.8

Sheet 1 of 1
Scale 1:25
Depth (m) 1.78

Depth (m)	Blowcount / penetration (mm)	Remarks
0.00		Brown sandy angular and subangular fine to coarse sandstone, concrete and slag GRAVEL. MADE GROUND
		Brown slightly gravelly sandy SILT with ra are subrounded sandstone cobble content. Gravel is subangular and subrounded fine to coarse sandstone and quartzite. MADE GROUND
		Brown and yellowish brown slightly silty gravelly fine to coarse SAND with a medium subrounded sandstone cobble content. Gravel is subrounded and rounded fine to coarse sandstone and quartzite.
1.00		
	24 / 100	Inspection pit completed at 1.20m
	33 / 100	
	25 / 100	
	26 / 100	
	38 / 100	
	50 / 80	
		Completed at 1.78m
2.00		
3.00		
4.00		
5.00		

Blows / 100mm



Torque (Nm)

Method: BS EN ISO 22476-2:2005+A1:2011. Sacrificial cone used.

Probe type: Superheavy (63.5kg hammer mass/750mm drop)

Remarks: Dynamic Probe undertaken from base of inspection pit.

CONTRACT	CHECKED
36253	JH

Geotechnical Engineering Limited

TRIAL PIT LOG

DC3_TP01

CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

Sheet 1 of 1

Start Date 26 January 2021 Easting 328400.4 Scale 1:25

End Date 28 January 2021 Northing 184497.2 Ground Level 15.01mOD Depth 3.20 m

sample no & type	sample depth (m) from to	test type & value	water record	description	depth (m)	reduced level (m)	legend
1B 1ES 2D	0.00 - 0.20 0.00 - 0.20 0.00 - 0.20			Grass over firm reddish brown slightly sandy gravelly CLAY. Gravel is subangular to rounded fine to coarse sandstone, concrete, rarely clinker, crystalline and mudstone. (MADE GROUND) 0.20m: Clear plastic membrane.	0.20	14.81	
				Brown clayey sandy angular to rounded fine to coarse sandstone, concrete, crystalline and rarely clinker GRAVEL. (MADE GROUND) 0.49m: Boundary dipping 45° North-West.	0.50	14.51	
2ES 3B 4D	0.80 - 1.00 0.80 - 1.00 0.80 - 1.00			Firm brown slightly sandy gravelly CLAY. Gravel is subangular to rounded fine to coarse sandstone, rarely concrete and clinker. (MADE GROUND)	1.00	14.01	
3ES 5B 6D 4ES 7B 8D	2.00 - 2.10 2.00 - 2.10 2.00 - 2.10 3.00 - 3.10 3.00 - 3.10 3.00 - 3.10			Dark orangish brown slightly silty very sandy subangular to well rounded fine to coarse sandstone, rarely crystalline GRAVEL with a low to medium subrounded to well rounded sandstone cobble content. Rare sandstone boulders	3.20	11.81	
				Trial pit Completed at 3.20m			

Equipment: CAT 308

Pit width x length: 0.70m x 3.50m Sidewall stability: Stable

Groundwater:

Depth Strike (m)	Rose to (m)	Time to rise (min)	Remarks
3.20	3.10	20	

Backfill details:

Depth Top (m)	Depth Base (m)	Material	Remarks
0.00	3.20	Arisings	Soakaway tests undertaken at 0.50 and 1.00m during excavation.

AGS

CONTRACT **36253**

CHECKED **JH**

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

Geotechnical Engineering Limited

SOAKAWAY TEST

CLIENT	VANTAGE DATA CENTRES UK
SITE	DC3 IMPERIAL PARK
DATE	26/01/2021

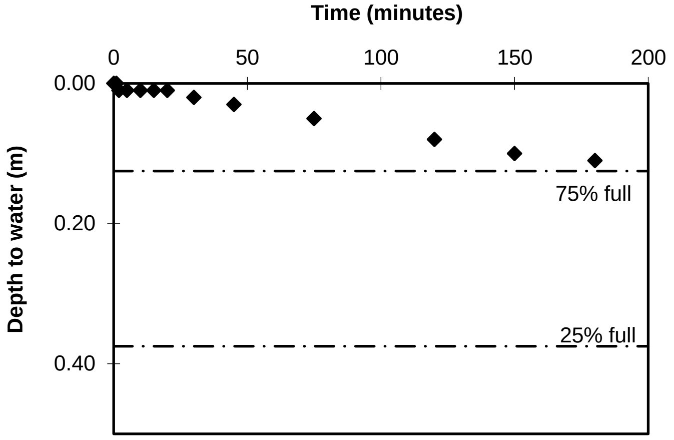
TRIAL PIT **DC3_TP01**

TEST 1

LENGTH	3.30	m
BREADTH	0.60	m
DEPTH	0.50	m
WATER LEVEL	Dry	m
FILL LEVEL	0.00	m
v_{p75-25}		m^3
a_{p50}		m^2
t_{p75-25}		min

soil infiltration rate, *f*

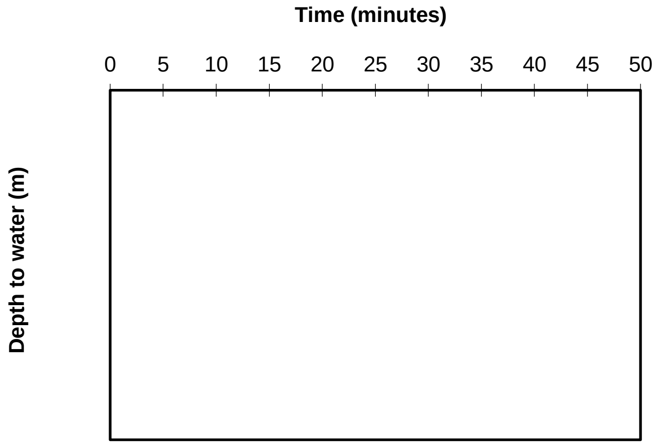
Insufficient fall in water level to calculate infiltration rate.



TEST 2

LENGTH		m
BREADTH		m
DEPTH		m
WATER LEVEL		m
FILL LEVEL		m
v_{p75-25}		m^3
a_{p50}		m^2
t_{p75-25}		min

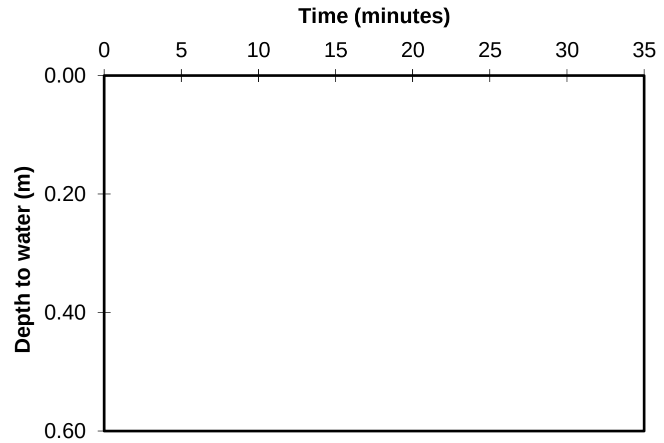
soil infiltration rate, *f*



TEST 3

LENGTH		m
BREADTH		m
DEPTH		m
WATER LEVEL		m
FILL LEVEL		m
v_{p75-25}		m^3
a_{p50}		m^2
t_{p75-25}		min

soil infiltration rate, *f*



Remarks	Test carried out in accordance with BRE DG 365 (2016).	CONTRACT **36253**	CHECKED **CT**

AB / JH

Geotechnical Engineering Limited

SOAKAWAY TEST

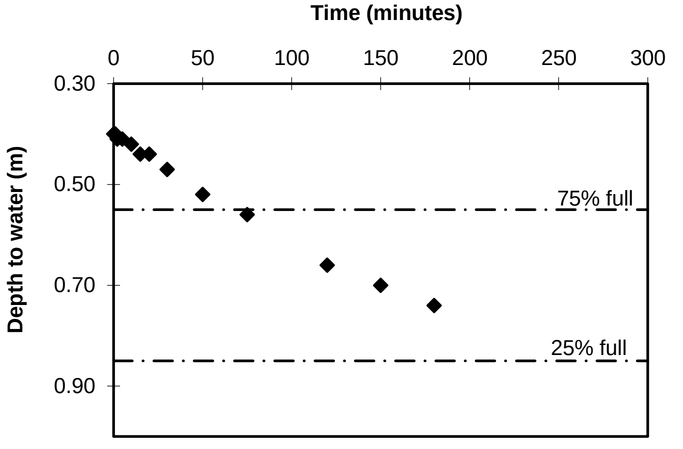
CLIENT	VANTAGE DATA CENTRES UK		
SITE	DC3 IMPERIAL PARK	TRIAL PIT	**DC3_TP01**
DATE	26/01/2021		

TEST 1

LENGTH	3.30	m
BREADTH	0.60	m
DEPTH	1.00	m
WATER LEVEL	Dry	m
FILL LEVEL	0.40	m
v_{p75-25}	0.594	m^3
a_{p50}	4.320	m^2
t_{p75-25}	180	min

soil infiltration rate, *f* **1.3×10^{-5} ms^{-1}**

Calculated by extrapolating timeline

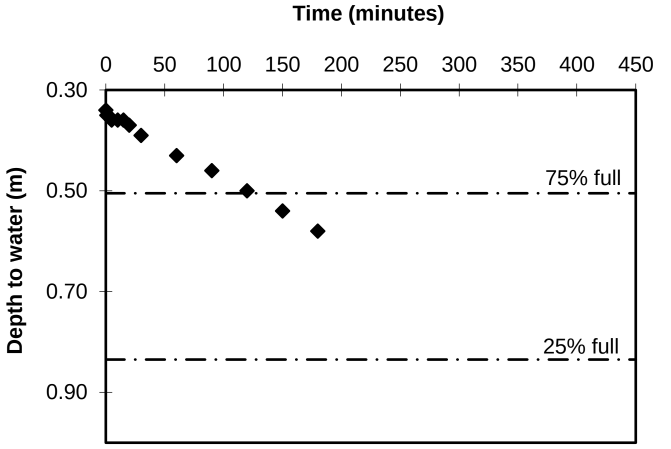


TEST 2

LENGTH	3.30	m
BREADTH	0.60	m
DEPTH	1.00	m
WATER LEVEL	Dry	m
FILL LEVEL	0.34	m
v_{p75-25}	0.653	m^3
a_{p50}	4.554	m^2
t_{p75-25}	250	min

soil infiltration rate, *f* **9.6×10^{-6} ms^{-1}**

Calculated by extrapolating timeline

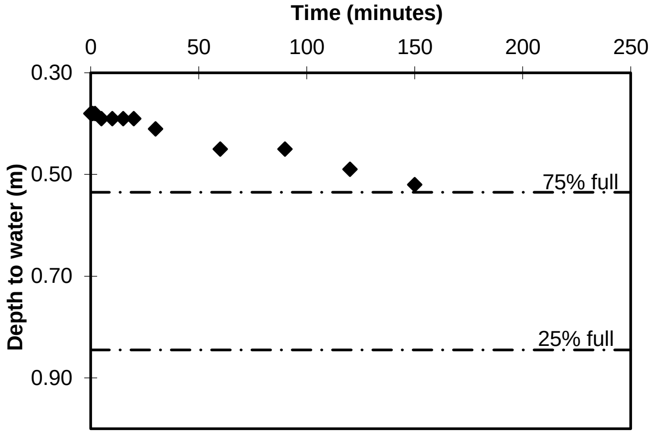


TEST 3

LENGTH	3.30	m
BREADTH	0.60	m
DEPTH	1.00	m
WATER LEVEL	Dry	m
FILL LEVEL	0.38	m
v_{p75-25}		m^3
a_{p50}		m^2
t_{p75-25}		min

soil infiltration rate, *f*

Insufficient fall in water level to calculate infiltration rate.



		CONTRACT	CHECKED
Remarks	Test carried out in accordance with BRE DG 365 (2016).	**36253**	**CT**

AB / JH

rev08 22/08/16 JH

Geotechnical Engineering Limited

TRIAL PIT LOG

DC3_TP02

CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

Sheet 1 of 1

Start Date 26 January 2021 Easting 328466.5 Scale 1:25

End Date 26 January 2021 Northing 184544.6 Ground Level 1.00mOD Depth 3.00 m

sample no & type	sample depth (m) from to	test type & value	water record	description	depth (m)	reduced level (m)	legend
				Greyish brown silty very sandy angular and subangular fine to coarse sandstone, rarely crystalline and clinker GRAVEL. Occasional rootlets. (MADE GROUND)	0.15	0.85	
1B 1ES 2D	0.20 - 0.30 0.20 - 0.30 0.20 - 0.30			Grey slightly silty very sandy angular and subangular fine to coarse sandstone and concrete, rarely crystalline GRAVEL. (MADE GROUND) 0.20m: 30mm blue plastic pipe in Eastern end of pit, not connected to anything as it comes out at surface approx. 10m North. 0.60m: Translucent white polymer membrane.	0.60	0.40	
2ES 3B 4D	1.00 - 1.10 1.00 - 1.10 1.00 - 1.10			Reddish brown silty very sandy angular and subangular fine to coarse sandstone, concrete and crystalline GRAVEL with a low subangular concrete cobble content. (MADE GROUND) 0.90 - 1.20m: Occasional concrete boulders 1.00m: Rubber pipe connector (200x200mm) and clay pipe fragments. Pipe doesn't continue into sidewalls so is likely just a feature of the made ground.	1.30	-0.30	
3ES 5B 6D 4ES 7B 8D	2.00 - 2.10 2.00 - 2.10 2.00 - 2.10 2.90 - 3.00 2.90 - 3.00 2.90 - 3.00		▼▽	Dark reddish brown silty sandy subangular to well rounded fine to coarse sandstone and mudstone GRAVEL with a low to medium subrounded sandstone cobble content. Rare sandstone boulders. 1.30m: Breeze block in sidewall of pit	3.00	-2.00	
				Trial pit Completed at 3.00m			

Equipment: CAT 308

Pit width x length: 0.70m x 3.80m Sidewall stability: Minor spalling 0.60 and 1.30m.

Groundwater:

Depth Strike (m)	Rose to (m)	Time to rise (min)	Remarks
3.00	2.90	20	

Backfill details:

Depth Top (m)	Depth Base (m)	Material	Remarks
0.00	3.00	Arisings	

AGS

CONTRACT **36253**

CHECKED **JH**

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

Geotechnical Engineering Limited

TRIAL PIT LOG

CLIENT	VANTAGE DATA CENTRES UK				**DC3_TP03**
SITE	IMPERIAL PARK DC3			Sheet	1 of 1
Start Date	25 January 2021	Easting	328507.4	Scale	1:25
End Date	25 January 2021	Northing	184589.1 Ground Level 14.51mOD	Depth	3.80 m

sample no & type	sample depth (m) from to	test type & value	water record	description	depth (m)	reduced level (m)	legend
				MADE GROUND comprising of black TARMACADAM. (MADE GROUND)	0.20	14.31	
1B 1ES 2D	0.20 - 0.30 0.20 - 0.30 0.20 - 0.30			Dark greyish brown sandy angular to rounded fine to coarse sandstone and concrete GRAVEL. Faint hydrocarbon odour. (MADE GROUND)	0.30	14.21	
				MADE GROUND comprising grey CONCRETE. (MADE GROUND)	0.35	14.16	
				Dark reddish brown silty sandy subangular to rounded fine to coarse sandstone, concrete and clinker GRAVEL with frequent pockets (up to 300x300mm) of firm gravelly clay. (MADE GROUND)	0.80	13.71	
2ES 3D 4B	0.90 - 1.00 0.90 - 1.00 0.90 - 1.00			Dark reddish brown silty very sandy subangular to well rounded fine to coarse sandstone, rarely crystalline and mudstone GRAVEL with a low to medium subrounded and rounded sandstone cobble content and rare sandstone boulders.			
3ES 5B 6D	2.10 - 2.20 2.10 - 2.20 2.10 - 2.20						
4ES 7B 8D	3.10 - 3.20 3.10 - 3.20 3.10 - 3.20				3.80	10.71	
				Trial pit Completed at 3.80m			

Equipment: CAT 308

Pit width x length: 0.80m x 3.00m   Sidewall stability: Stable

Groundwater:

Depth Strike (m)	Rose to (m)	Time to rise (min)	Remarks
3.80	3.70	20	

Backfill details:

Depth Top (m)	Depth Base (m)	Material	Remarks
0.00	3.80	Arisings	Soakaway tests undertaken at 1.00m during excavation.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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CONTRACT **36253**

CHECKED **JH**

Geotechnical Engineering Limited

SOAKAWAY TEST

CLIENT	VANTAGE DATA CENTRES UK
SITE	DC3 IMPERIAL PARK
DATE	25/01/2021

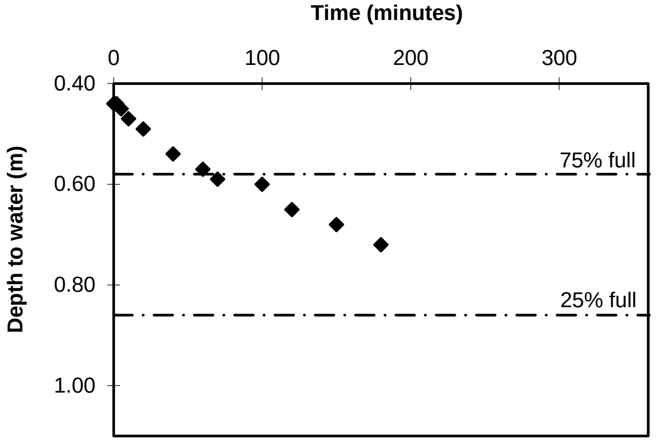
TRIAL PIT **DC3_TP03**

TEST 1

LENGTH	2.40	m
BREADTH	0.60	m
DEPTH	1.00	m
WATER LEVEL	Dry	m
FILL LEVEL	0.44	m
v_{p75-25}	0.403	m^3
a_{p50}	3.120	m^2
t_{p75-25}	325	min

soil infiltration rate, *f* **9.2x 10^{-6} ms^{-1}**

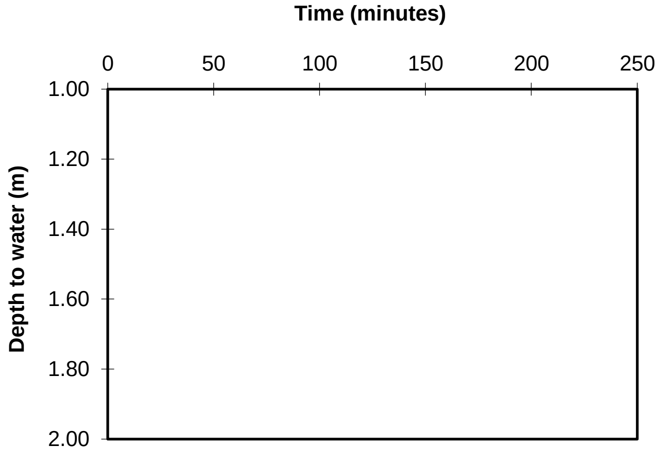
Calculated by extrapolating timeline



TEST 2

LENGTH	m
BREADTH	m
DEPTH	m
WATER LEVEL	m
FILL LEVEL	m
v_{p75-25}	m^3
a_{p50}	m^2
t_{p75-25}	min

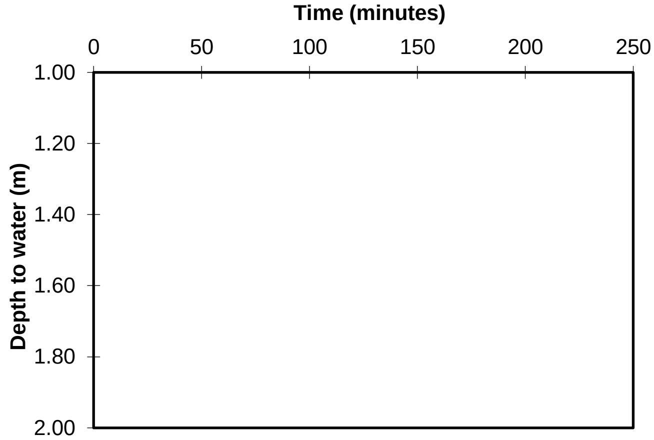
soil infiltration rate, *f*



TEST 3

LENGTH	m
BREADTH	m
DEPTH	m
WATER LEVEL	m
FILL LEVEL	m
v_{p75-25}	m^3
a_{p50}	m^2
t_{p75-25}	min

soil infiltration rate, *f*



Remarks	Test carried out in accordance with BRE DG 365 (2016).	CONTRACT **36523**	CHECKED **CT**

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SOAKAWAY TEST

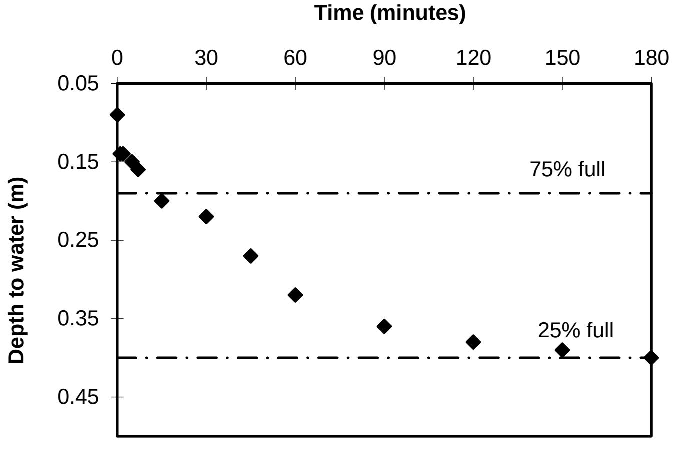
CLIENT	VANTAGE DATA CENTRES UK
SITE	DC3 IMPERIAL PARK
DATE	27/01/2021 - 28/01/2021

TRIAL PIT **DC3_TP03A**

TEST 1

LENGTH	1.30	m
BREADTH	0.55	m
DEPTH	0.50	m
WATER LEVEL	Dry	
FILL LEVEL	0.09	m
v_{p75-25}	0.147	m^3
a_{p50}	1.474	m^2
t_{p75-25}	167	min

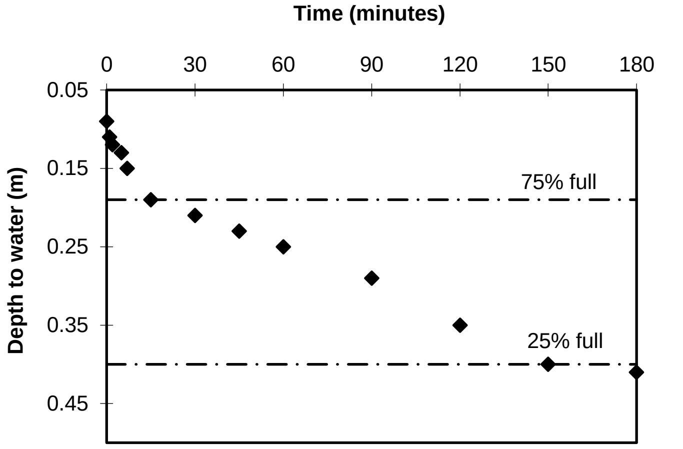
soil infiltration rate, *f* **1.0×10^{-5}** **ms^{-1}**



TEST 2

LENGTH	1.30	m
BREADTH	0.55	m
DEPTH	0.50	m
WATER LEVEL	Dry	
FILL LEVEL	0.09	m
v_{p75-25}	0.147	m^3
a_{p50}	1.474	m^2
t_{p75-25}	135	min

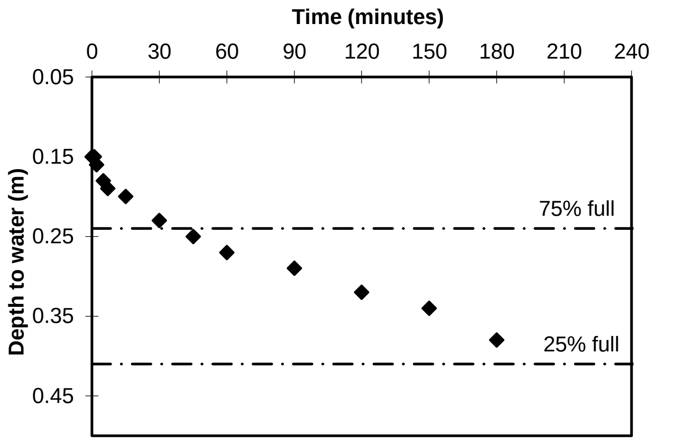
soil infiltration rate, *f* **1.2×10^{-5}** **ms^{-1}**



TEST 3

LENGTH	1.30	m
BREADTH	0.55	m
DEPTH	0.50	m
WATER LEVEL	Dry	
FILL LEVEL	0.15	m
v_{p75-25}	0.125	m^3
a_{p50}	1.363	m^2
t_{p75-25}	173	min

soil infiltration rate, *f* **8.9×10^{-6}** **ms^{-1}**



Remarks	Test carried out in accordance with BRE DG 365 (2016).	CONTRACT **36253**	CHECKED **CT**

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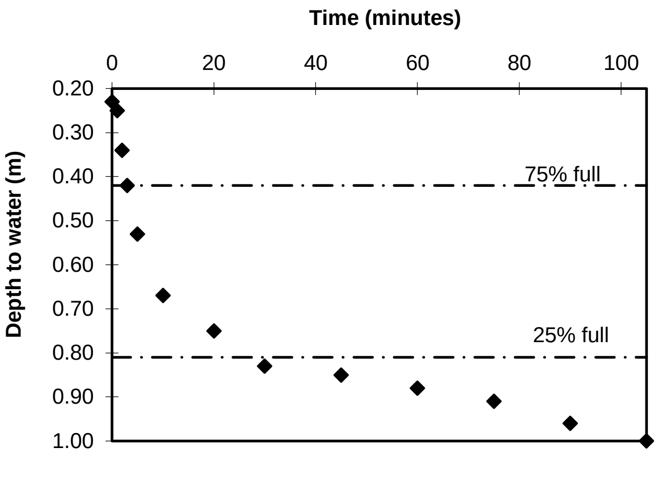
SOAKAWAY TEST

CLIENT	VANTAGE DATA CENTRES UK		
SITE	DC3 IMPERIAL PARK	TRIAL PIT	**DC3_TP03A**
DATE	28/01/2021 - 29/01/2021		

TEST 1

LENGTH	1.30	m
BREADTH	0.55	m
DEPTH	1.00	m
WATER LEVEL	Dry	
FILL LEVEL	0.23	m
v_{p75-25}	0.275	m^3
a_{p50}	2.140	m^2
t_{p75-25}	23	min

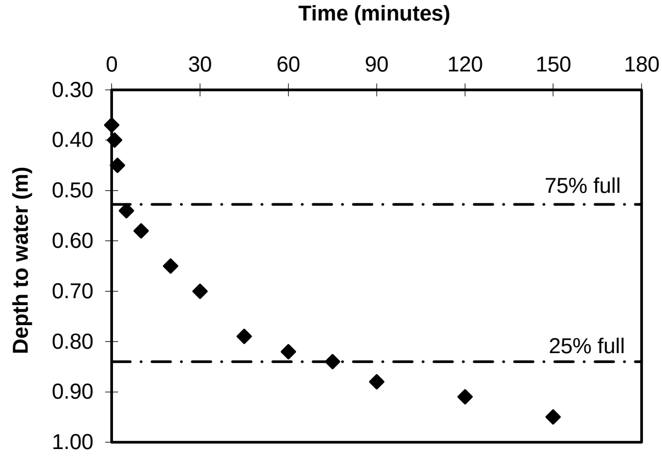
soil infiltration rate, *f* **9.3×10^{-5} ms^{-1}**



TEST 2

LENGTH	1.30	m
BREADTH	0.55	m
DEPTH	1.00	m
WATER LEVEL	Dry	
FILL LEVEL	0.37	m
v_{p75-25}	0.225	m^3
a_{p50}	1.880	m^2
t_{p75-25}	71	min

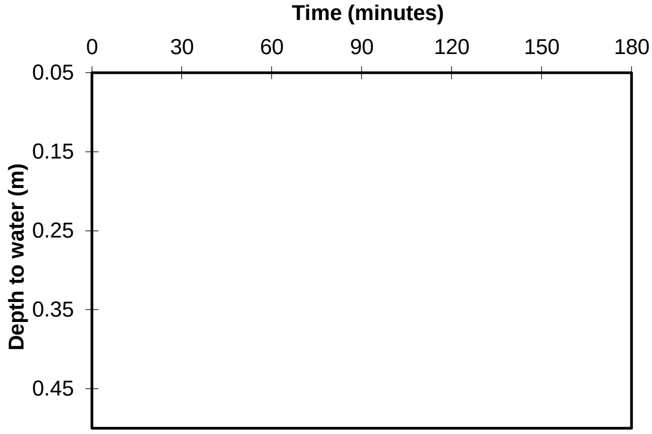
soil infiltration rate, *f* **2.8×10^{-5} ms^{-1}**



TEST 3

LENGTH		m
BREADTH		m
DEPTH		m
WATER LEVEL		
FILL LEVEL		m
v_{p75-25}		m^3
a_{p50}		m^2
t_{p75-25}		min

soil infiltration rate, *f*



Remarks	Test carried out in accordance with BRE DG 365 (2016).	CONTRACT **36253**	CHECKED **CT**

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TRIAL PIT LOG

DC3_TP04

CLIENT	VANTAGE DATA CENTRES UK			Sheet	1 of 1
SITE	IMPERIAL PARK DC3				
Start Date	28 January 2021	Easting	328428.5	Scale	1:25
End Date	28 January 2021	Northing	184448.9 Ground Level 14.56mOD	Depth	3.50 m

sample no & type	sample depth (m) from to	test type & value	water record	description	depth (m)	reduced level (m)	legend
				MADE GROUND comprising black TARMACADAM. (MADE GROUND)	0.07	14.49	
				Reddish brown slightly sandy silty angular to subrounded fine to coarse sandstone and crystalline GRAVEL. (MADE GROUND) 0.25m: grey fabric membrane at boundary	0.25	14.31	
1B 1ES 2D	0.30 - 0.40 0.30 - 0.40 0.30 - 0.40			Firm brownish grey slightly sandy slightly gravelly silty CLAY. Gravel is angular to subrounded fine and medium sandstone, rarely crystalline. (MADE GROUND)	0.40	14.16	
				Orangish brown silty very sandy angular to subrounded fine to coarse sandstone and rarely crystalline GRAVEL with rare locally frequent pockets (up to 200x300mm) of firm slightly sandy slightly gravelly clay. (MADE GROUND)	0.70	13.86	
2ES 3B 4D	1.00 - 1.10 1.00 - 1.10 1.00 - 1.10			Dark orangish brown very sandy locally slightly silty subangular to well rounded fine to coarse sandstone and rarely crystalline GRAVEL.			
3ES 5B 6D	2.00 - 2.10 2.00 - 2.10 2.00 - 2.10						
4ES 7B 8D	3.00 - 3.10 3.00 - 3.10 3.00 - 3.10						
			▼ ▽		3.50	11.06	
				Trial pit Completed at 3.50m			

Equipment: CAT 308

Pit width x length: 0.65m x 3.60m Sidewall stability: Stable

Groundwater:

Depth Strike (m)	Rose to (m)	Time to rise (min)	Remarks
3.50	3.40	20	

Backfill details:

Depth Top (m)	Depth Base (m)	Material	Remarks
0.00	3.50	Arisings	

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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TRIAL PIT LOG

CLIENT	VANTAGE DATA CENTRES UK				**DC3_TP05**
SITE	IMPERIAL PARK DC3			Sheet	1 of 1
Start Date	27 January 2021	Easting	328469.4	Scale	1:25
End Date	27 January 2021	Northing	184495.0 Ground Level 14.56mOD	Depth	2.90 m

sample no & type	sample depth (m) from to	test type & value	water record	description	depth (m)	reduced level (m)	legend
1B 1ES 2D	0.20 - 0.30 0.20 - 0.30 0.20 - 0.30			Moss over firm to stiff dark orangish brown slightly sandy gravelly CLAY with a low subrounded sandstone cobble content and frequent pockets (up to 100x200mm) of sand and gravel. Gravel is subangular to rounded fine to coarse sandstone, rarely crystalline and red brick. (MADE GROUND)	0.50	14.06	
2ES 3B 4D	0.90 - 1.00 0.90 - 1.00 0.90 - 1.00			Dark orangish brown very clayey very sandy subangular to rounded fine to coarse sandstone, rarely crystalline GRAVEL with a low to medium subrounded sandstone cobble content. 0.50m: Boundary irregular varying from 0.50 to1.20m.	1.50	13.06	
3ES 5B 6D 4ES 7B 8D	1.90 - 2.00 1.90 - 2.00 1.90 - 2.00 2.80 - 2.90 2.80 - 2.90 2.80 - 2.90			Dark orangish brown silty very gravelly fine and medium SAND with a low to medium subrounded sandstone cobble content. Gravel is subangular to rounded fine to coarse sandstone, rarely crystalline.	2.90	11.66	
				Trial pit Completed at 2.90m			

Equipment: CAT 308

Pit width x length: 0.70m x 4.00m Sidewall stability: Stable

Groundwater:

Depth Strike (m)	Rose to (m)	Time to rise (min)	Remarks
2.90	2.70	20	

Backfill details:

Depth Top (m)	Depth Base (m)	Material	Remarks
0.00	2.90	Arisings	

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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TRIAL PIT LOG

DC3_TP06

CLIENT	VANTAGE DATA CENTRES UK	Sheet	1 of 1
SITE	IMPERIAL PARK DC3	Scale	1:25
Start Date	28 January 2021	Easting	328504.5
End Date	28 January 2021	Northing	184546.1
Ground Level	14.79mOD	Depth	4.00 m

sample no & type	sample depth (m) from to	test type & value	water record	description	depth (m)	reduced level (m)	legend
1B 1ES 2D	0.00 - 0.30 0.00 - 0.30 0.00 - 0.30			Dark orangish brown slightly silty very sandy angular to subrounded fine to coarse sandstone concrete, crystalline, rarely mudstone and clinker GRAVEL with rare metal wire fragments (up to 1x1x 40mm), polymer sheet fragments, and clay pipe fragments (up to 20x30x40mm). (MADE GROUND)	0.60	14.19	
2ES 3B 4D	0.70 - 0.80 0.70 - 0.80 0.70 - 0.80			Reddish brown silty very sandy angular to subrounded fine to coarse sandstone and rarely crystalline GRAVEL. (MADE GROUND)	0.90	13.89	
3ES 5B 6D 4ES 7B 8D 10D 9B	1.90 - 2.10 1.90 - 2.10 1.90 - 2.10 2.90 - 3.10 2.90 - 3.10 2.90 - 3.10 3.80 - 4.00 3.80 - 4.00			Dark orangish brown very sandy locally slightly silty subangular to well rounded fine to coarse sandstone GRAVEL. 0.90 - 1.90m: Boundary irregular varying between 0.90 to 1.90m. 1.40 - 1.60m: Plastic ducting.	4.00	10.79	

Trial pit Completed at 4.00m

Equipment: CAT 308

Pit width x length: 0.70m x 3.90m

Sidewall stability: Stable

Groundwater:

Depth Strike (m)	Rose to (m)	Time to rise (min)	Remarks
4.00	3.90	20	

Backfill details:

Depth Top (m)	Depth Base (m)	Material	Remarks
0.00	4.00	Arisings	

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EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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TRIAL PIT LOG

DC3_TP07

CLIENT	VANTAGE DATA CENTRES UK						
SITE	IMPERIAL PARK DC3					Sheet	1 of 2
Start Date	27 January 2021	Easting	328541.6			Scale	1:25
End Date	28 January 2021	Northing	184539.6	Ground Level	14.73mOD	Depth	4.30 m

sample no & type	sample depth (m) from to	test type & value	water record	description	depth (m)	reduced level (m)	legend
				Firm to stiff brown slightly sandy gravelly clayey SILT. Gravel is angular to subrounded fine to coarse sandstone and crystalline. Frequent rootlets. (MADE GROUND)			
1B 1ES 2D	0.25 - 0.35 0.25 - 0.35 0.25 - 0.35			Stiff brown locally orangish brown slightly sandy gravelly silty CLAY with occasional pockets (up to 100x200mm) of sand and gravel. Gravel is angular to subrounded fine to coarse sandstone. (MADE GROUND)	0.25	14.48	
2ES 3B 4D	0.70 - 0.80 0.70 - 0.80 0.70 - 0.90			Dark orangish brown very silty very sandy subangular to well rounded fine to coarse sandstone rarely crystalline GRAVEL with a low to medium cobble content of subrounded sandstone. Rare sandstone boulders.	0.70	14.03	
3ES 5B 6D	1.70 - 1.80 1.70 - 1.80 1.70 - 1.80						
4ES 7B 8D	2.70 - 2.80 2.70 - 2.80 2.70 - 2.80			2.70m: Slightly silty.			
5ES	3.50 - 3.60			3.50 - 3.60m: Gravel satined black with viscous residue. No odour.			
10D 9B	3.70 - 3.80 3.70 - 3.80						

Continued Next Page

Equipment: CAT 308

Pit width x length: 0.70m x 4.00m

Sidewall stability: Stable

Groundwater:

Depth Strike (m)	Rose to (m)	Time to rise (min)	Remarks
4.30	4.20	20	

Backfill details:

Depth Top (m)	Depth Base (m)	Material	Remarks
0.00	4.30	Arisings	

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TRIAL PIT LOG

DC3_TP07

CLIENT	VANTAGE DATA CENTRES UK			Sheet	2 of 2
SITE	IMPERIAL PARK DC3				
Start Date	27 January 2021	Easting	328541.6	Scale	1:25
End Date	28 January 2021	Northing	184539.6	Ground Level 14.73mOD	Depth 4.30 m

sample no & type	sample depth (m) from to	test type & value	water record	description	depth (m)	reduced level (m)	legend
				Dark orangish brown very silty very sandy subangular to well rounded fine to coarse sandstone rarely crystalline GRAVEL with a low to medium cobble content of subrounded sandstone. Rare sandstone boulders.	4.30	10.43	
				Trial pit Completed at 4.30m			

Equipment: CAT 308

Pit width x length: 0.70m x 4.00m

Sidewall stability: Stable

Groundwater:

Depth Strike (m)	Rose to (m)	Time to rise (min)	Remarks
4.30	4.20	20	

Backfill details:

Depth Top (m)	Depth Base (m)	Material	Remarks
0.00	4.30	Arisings	

CONTRACT **36253**

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EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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TRIAL PIT LOG

CLIENT	VANTAGE DATA CENTRES UK				**DC3_TP08**
SITE	IMPERIAL PARK DC3			Sheet	1 of 1
Start Date	28 January 2021	Easting	328485.0	Scale	1:25
End Date	28 January 2021	Northing	184464.7 Ground Level 14.67mOD	Depth	3.00 m

sample no & type	sample depth (m) from to	test type & value	water record	description	depth (m)	reduced level (m)	legend
				MADE GROUND comprising black TARMACADAM. (MADE GROUND)	0.07	14.60	
1B 1ES 2D 2ES 3B 4D	0.20 - 0.30 0.20 - 0.30 0.20 - 0.30 0.40 - 0.60 0.40 - 0.60 0.40 - 0.60			Reddish brown silty sandy angular and subangular fine to coarse sandstone and crystalline, rarely brick GRAVEL. (MADE GROUND) 0.40m: Grey fabric membrane.	0.40	14.27	
				Stiff greyish brown slightly sandy slightly gravelly silty CLAY. Gravel is subangular to rounded fine and medium rarely coarse sandstone.	0.60	14.07	
3ES 5B 6D	1.00 - 1.10 1.00 - 1.10 1.00 - 1.10			Stiff reddish brown locally mottled white and greyish brown slightly sandy slightly gravelly silty CLAY with frequent pockets (up to 100x200mm) of reddish brown silty sand and gravel. Gravel is subangular to well rounded fine to coarse sandstone.	2.00	12.67	
4ES 7B 8D 10D 9B	2.00 - 2.10 2.00 - 2.10 2.00 - 2.10 2.90 - 3.00 2.90 - 3.00		▼ ▽	Dark orangish brown locally slightly silty very sandy subangular to well rounded fine to coarse sandstone, rarely crystalline GRAVEL.	3.00	11.67	
				Trial pit Completed at 3.00m			

Equipment:

Pit width x length: 0.70m x 3.30m

Sidewall stability: Stable

Groundwater:

Depth Strike (m)	Rose to (m)	Time to rise (min)	Remarks
3.00	2.90	20	

Backfill details:

Depth Top (m)	Depth Base (m)	Material	Remarks
0.00	3.00	Arisings	

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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TRIAL PIT LOG

DC3_TP09

CLIENT	VANTAGE DATA CENTRES UK			Sheet	1 of 2
SITE	IMPERIAL PARK DC3				
Start Date	25 January 2021	Easting	328534.7	Scale	1:25
End Date	25 January 2021	Northing	184497.2	Ground Level 14.74mOD	Depth 4.10 m

sample no & type	sample depth (m) from to	test type & value	water record	description	depth (m)	reduced level (m)	legend
1B 1ES 2D	0.00 - 0.30 0.00 - 0.30 0.00 - 0.30			Brown becoming reddish brown silty very sandy angular to subrounded fine to coarse sandstone GRAVEL. (MADE GROUND) 0.15m: Becomes reddish brown.			
				Firm greyish brown rarely mottled black slightly sandy silty CLAY with occasional pockets (up to 100x200mm) of silty very sandy angular to subrounded fine to coarse sandstone gravel. (MADE GROUND)	0.30	14.44	
2ES 3B 4D 3ES 5B 6D 4ES 7B 8D 10D	1.10 - 1.20 1.10 - 1.20 1.10 - 1.20 2.10 - 2.20 2.10 - 2.20 2.10 - 2.20 3.10 - 3.20 3.10 - 3.20 3.10 - 3.20 4.00 - 4.10		▼	Brown rarely greyish brown and reddish brown locally silty very sandy subangular to well rounded fine to coarse sandstone GRAVEL with a low to medium cobble content of subrounded and rounded sandstone. Rare sandstone boulders.	0.70	14.04	

Continued Next Page

Equipment: CAT 308

Pit width x length: 0.65m x 4.00m Sidewall stability: Stable

Groundwater:

Depth Strike (m)	Rose to (m)	Time to rise (min)	Remarks
4.10	4.00	20	

Backfill details:

Depth Top (m)	Depth Base (m)	Material	Remarks
0.00	4.10	Arisings	

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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TRIAL PIT LOG

CLIENT	VANTAGE DATA CENTRES UK						**DC3_TP09**
SITE	IMPERIAL PARK DC3					Sheet	2 of 2
Start Date	25 January 2021	Easting	328534.7			Scale	1:25
End Date	25 January 2021	Northing	184497.2	Ground Level	14.74mOD	Depth	4.10 m

sample no & type	sample depth (m) from to	test type & value	water record	description	depth (m)	reduced level (m)	legend
9B	4.00 - 4.10		▽	Brown rarely greyish brown and reddish brown locally silty very sandy subangular to well rounded fine to coarse sandstone GRAVEL with a low to medium cobble content of subrounded and rounded sandstone. Rare sandstone boulders.	4.10	10.64	
				Trial pit Completed at 4.10m			

Equipment: CAT 308

Pit width x length: 0.65m x 4.00m Sidewall stability: Stable

Groundwater:

Depth Strike (m)	Rose to (m)	Time to rise (min)	Remarks
4.10	4.00	20	

Backfill details:

Depth Top (m)	Depth Base (m)	Material	Remarks
0.00	4.10	Arisings	

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

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TRIAL PIT LOG

CLIENT	VANTAGE DATA CENTRES UK				**DC3_TP10**
SITE	IMPERIAL PARK DC3			Sheet	1 of 1
Start Date	26 January 2021	Easting	328450.7	Scale	1:25
End Date	26 January 2021	Northing	184407.7 Ground Level 14.58mOD	Depth	3.20 m

sample no & type	sample depth (m) from to	test type & value	water record	description	depth (m)	reduced level (m)	legend
				MADE GROUND comprising black TARMACADAM. (MADE GROUND)	0.07	14.51	
				Weakly cemented grey slightly silty very sandy angular and subangular fine to coarse sandstone rarely crystalline and mudstone GRAVEL. (MADE GROUND)	0.30	14.28	
1B 1ES 2D	0.40 - 0.50 0.40 - 0.50 0.40 - 0.50			Orangish brown clayey sandy angular and subangular fine to coarse sandstone rarely crystalline and clinker GRAVEL. (MADE GROUND)	0.40	14.18	
				Stiff brownish grey slightly sandy slightly gravelly silty CLAY. Gravel is subangular and subrounded medium and coarse sandstone. Faint organic odour. (MADE GROUND) 0.40m: Black fabric membrane	0.60	13.98	
2ES 3B 4D	0.80 - 1.00 0.80 - 1.00 0.80 - 1.00			Stiff orangish brown sandy gravelly CLAY. Gravel is subangular to rounded fine to coarse sandstone. (MADE GROUND)	1.00	13.58	
				Dark reddish brown clayey very sandy subangular to rounded fine to coarse sandstone GRAVEL with a low rounded sandstone cobble content.	1.80	12.78	
3ES 5B 6D	2.00 - 2.10 2.00 - 2.10 2.00 - 2.10			Dark reddish brown silty very sandy subrounded to well rounded fine to coarse sandstone GRAVEL.			
4ES 7B 8D	3.10 - 3.20 3.10 - 3.20 3.10 - 3.20		▼ ▽		3.20	11.38	
				Trial pit Completed at 3.20m			

Equipment: CAT 308

Pit width x length: 0.80m x 3.80m Sidewall stability: Stable

Groundwater:

Depth Strike (m)	Rose to (m)	Time to rise (min)	Remarks
3.20	3.10	20	

Backfill details:

Depth Top (m)	Depth Base (m)	Material	Remarks
0.00	3.20	Arisings	Soakaway tests undertaken at 0.50 and 1.00m during excavation.

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EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

Geotechnical Engineering Limited

SOAKAWAY TEST

CLIENT	VANTAGE DATA CENTRES UK
SITE	DC3 IMPERIAL PARK
DATE	26/01/2021

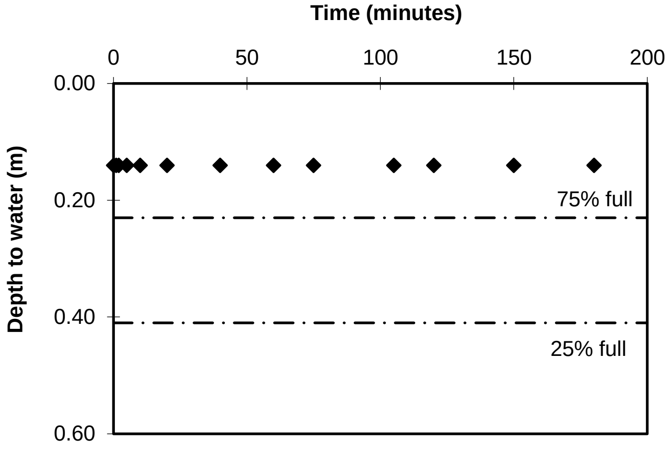
TRIAL PIT **DC3_TP10**

TEST 1

LENGTH	3.20	m
BREADTH	0.90	m
DEPTH	0.50	m
WATER LEVEL	Dry	m
FILL LEVEL	0.14	m
v_{p75-25}		m^3
a_{p50}		m^2
t_{p75-25}		min

soil infiltration rate, *f*

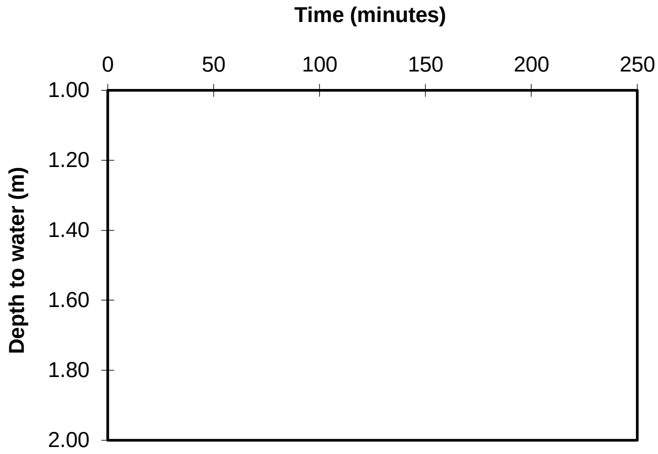
Insufficient fall in water level to calculate infiltration rate.



TEST 2

LENGTH		m
BREADTH		m
DEPTH		m
WATER LEVEL		m
FILL LEVEL		m
v_{p75-25}		m^3
a_{p50}		m^2
t_{p75-25}		min

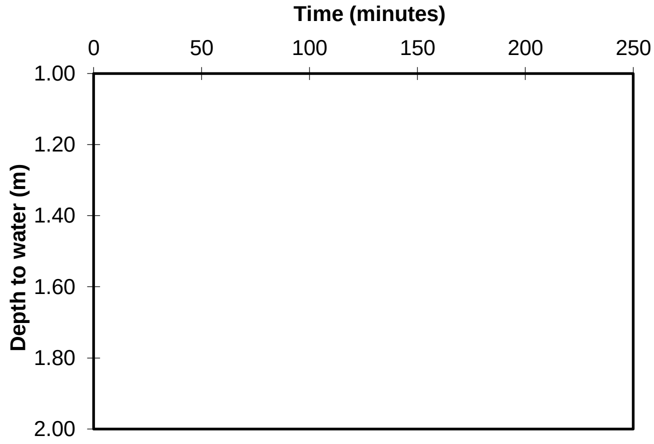
soil infiltration rate, *f*



TEST 3

LENGTH		m
BREADTH		m
DEPTH		m
WATER LEVEL		m
FILL LEVEL		m
v_{p75-25}		m^3
a_{p50}		m^2
t_{p75-25}		min

soil infiltration rate, *f*



Remarks Test carried out in accordance with BRE DG 365 (2016).	CONTRACT **36253**	CHECKED **CT**

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SOAKAWAY TEST

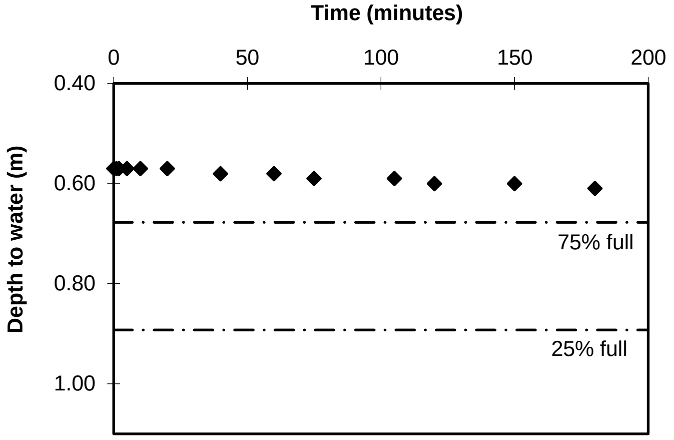
CLIENT	VANTAGE DATA CENTRES UK		
SITE	DC3 IMPERIAL PARK	TRIAL PIT	**DC3_TP10**
DATE	26/01/2021		

TEST 1

LENGTH	3.20	m
BREADTH	0.90	m
DEPTH	1.00	m
WATER LEVEL	Dry	m
FILL LEVEL	0.57	m
v_{p75-25}	0.691	m^3
a_{p50}	4.643	m^2
t_{p75-25}		min

soil infiltration rate, *f*

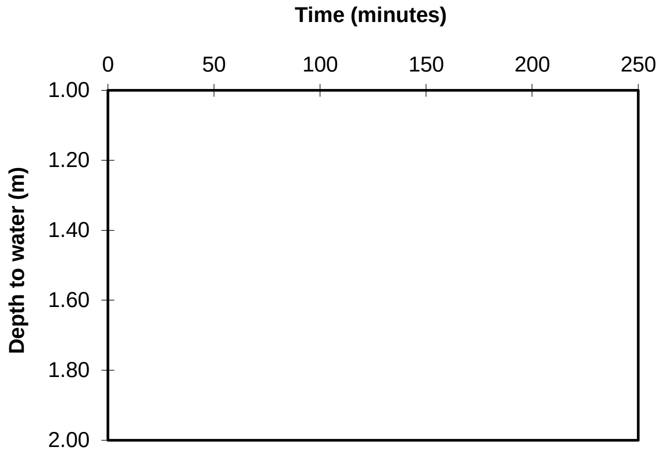
Insufficient fall in water level to calculate infiltration rate.



TEST 2

LENGTH		m
BREADTH		m
DEPTH		m
WATER LEVEL		m
FILL LEVEL		m
v_{p75-25}		m^3
a_{p50}		m^2
t_{p75-25}		min

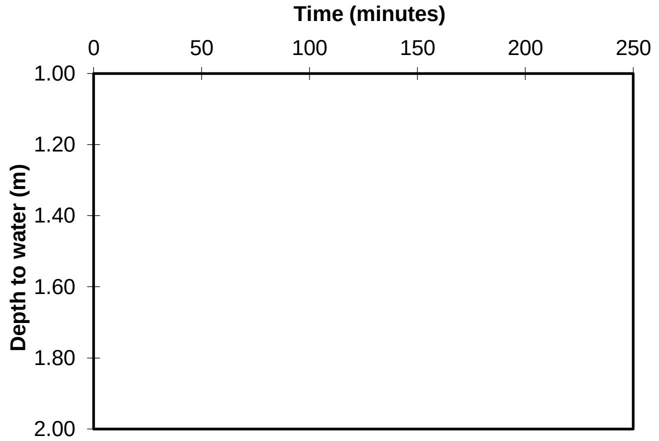
soil infiltration rate, *f*



TEST 3

LENGTH		m
BREADTH		m
DEPTH		m
WATER LEVEL		m
FILL LEVEL		m
v_{p75-25}		m^3
a_{p50}		m^2
t_{p75-25}		min

soil infiltration rate, *f*



Remarks	Test carried out in accordance with BRE DG 365 (2016).	CONTRACT **36253**	CHECKED **CT**

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Geotechnical Engineering Limited

TRIAL PIT LOG

DC3_TP11

CLIENT	VANTAGE DATA CENTRES UK			Sheet	1 of 2
SITE	IMPERIAL PARK DC3				
Start Date	25 January 2021	Easting	328524.1	Scale	1:25
End Date	25 January 2021	Northing	184454.0 Ground Level 14.38mOD	Depth	4.40 m

sample no & type	sample depth (m) from to	test type & value	water record	description	depth (m)	reduced level (m)	legend
				Dark brown locally reddish brown silty sandy angular to subrounded fine to coarse sandstone and clinker GRAVEL. Occasional roots (up to 4mm) and rootlets. (MADE GROUND)	0.50	13.88	
1B 1ES 2D	0.70 - 0.90 0.70 - 0.90 0.70 - 0.90			Dark brown clayey very sandy angular to subrounded fine to coarse sandstone GRAVEL with a low subrounded and rounded sandstone cobble content and rare pockets (up to 300x400mm) of firm brown sandy clay. (MADE GROUND)	0.90	13.48	
2ES 3B 4D	1.40 - 1.60 1.40 - 1.60 1.40 - 1.60			Dark brown rarely mottled reddish brown silty very sandy subangular to rounded fine to coarse sandstone rarely crystalline GRAVEL with a low to medium subrounded and rounded sandstone cobble content. Rare rounded sandstone boulders.			
3ES 5B 6D	2.40 - 2.60 2.40 - 2.60 2.40 - 2.60						
4ES 7B 8D	3.40 - 3.60 3.40 - 3.60 3.40 - 3.60						

Continued Next Page

Equipment: CAT 308

Pit width x length: 0.60m x 3.90m Sidewall stability: Stable

Groundwater:

Depth Strike (m)	Rose to (m)	Time to rise (min)	Remarks
4.40	4.30	20	

Backfill details:

Depth Top (m)	Depth Base (m)	Material	Remarks
0.00	4.40	Arisings	

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

AGS

CONTRACT **36253**

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Geotechnical Engineering Limited

TRIAL PIT LOG

DC3_TP11

CLIENT	VANTAGE DATA CENTRES UK			Sheet	2 of 2
SITE	IMPERIAL PARK DC3				
Start Date	25 January 2021	Easting	328524.1	Scale	1:25
End Date	25 January 2021	Northing	184454.0 Ground Level 14.38mOD	Depth	4.40 m

sample no & type	sample depth (m) from to	test type & value	water record	description	depth (m)	reduced level (m)	legend
10D 9B	4.30 - 4.40 4.30 - 4.40			Dark brown rarely mottled reddish brown silty very sandy subangular to rounded fine to coarse sandstone rarely crystalline GRAVEL with a low to medium subrounded and rounded sandstone cobble content. Rare rounded sandstone boulders.	4.40	9.98	
				Trial pit Completed at 4.40m			

Equipment: CAT 308

Pit width x length: 0.60m x 3.90m   Sidewall stability: Stable

Groundwater:

Depth Strike (m)	Rose to (m)	Time to rise (min)	Remarks
4.40	4.30	20	

Backfill details:

Depth Top (m)	Depth Base (m)	Material	Remarks
0.00	4.40	Arisings	

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

AGS

CONTRACT **36253**

CHECKED **JH**

Geotechnical Engineering Limited

TRIAL PIT LOG

DC3_TP12

CLIENT	VANTAGE DATA CENTRES UK			Sheet	1 of 2
SITE	IMPERIAL PARK DC3				
Start Date	27 January 2021	Easting	328580.4	Scale	1:25
End Date	29 January 2021	Northing	184487.4 Ground Level 14.28mOD	Depth	4.05 m

sample no & type	sample depth (m) from to	test type & value	water record	description	depth (m)	reduced level (m)	legend
1B 1ES 2D	0.10 - 0.30 0.10 - 0.30 0.10 - 0.30			MADE GROUND comprising black TARMACADAM. (MADE GROUND)	0.16	14.12	
				Bluish grey slightly silty sandy angular and subangular fine to coarse clinker, sandstone and brick GRAVEL. (MADE GROUND)	0.35	13.93	
2ES 3B 4D	0.50 - 0.60 0.50 - 0.60 0.50 - 0.60			Reddish brown slightly silty sandy angular and subangular fine to coarse sandstone, rarely crystalline and mudstone GRAVEL. (MADE GROUND) 0.45 - 0.49m: Firm bluish grey clay.	0.70	13.58	
3ES 5B 6D 4ES 7B 8D 10D 5ES 9B 11B 12D	1.00 - 1.10 1.00 - 1.10 1.00 - 1.10 2.00 - 2.10 2.00 - 2.10 2.00 - 2.10 3.00 - 3.10 3.00 - 3.10 3.00 - 3.10 3.90 - 4.00 3.90 - 4.00			Dark orangish brown slightly silty very sandy subangular to well rounded fine to coarse sandstone, rarely crystalline GRAVEL with a low to medium subangular to well rounded sandstone cobble content. Rare sandstone boulders. 0.70 - 2.40m: Locally slightly silty. 3.90 - 4.05m: Occasionally stained black with sticky residue on gravel. Slight hydrocarbon odour.			

Continued Next Page

Equipment: CAT 308

Pit width x length: 0.90m x 2.80m Sidewall stability: Stable

Groundwater: Groundwater not encountered

Depth Strike (m)	Rose to (m)	Time to rise (min)	Remarks

Backfill details:

Depth Top (m)	Depth Base (m)	Material	Remarks
0.00	4.05	Arisings	Soakaway tests undertaken at 0.50 and 1.00m during excavation.

AGS

CONTRACT **36253**

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EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

Geotechnical Engineering Limited

TRIAL PIT LOG

DC3_TP12

CLIENT	VANTAGE DATA CENTRES UK			Sheet	2 of 2
SITE	IMPERIAL PARK DC3				
Start Date	27 January 2021	Easting	328580.4	Scale	1:25
End Date	29 January 2021	Northing	184487.4 Ground Level 14.28mOD	Depth	4.05 m

sample no & type	sample depth (m) from to	test type & value	water record	description	depth (m)	reduced level (m)	legend
5ES	3.90 - 4.00			Dark orangish brown slightly silty very sandy subangular to well rounded fine to coarse sandstone, rarely crystalline GRAVEL with a low to medium subangular to well rounded sandstone cobble content. Rare sandstone boulders.	4.05	10.23	
				Trial pit Completed at 4.05m			

Equipment: CAT 308

Pit width x length: 0.90m x 2.80m Sidewall stability: Stable

Groundwater: Groundwater not encountered

Depth Strike (m)	Rose to (m)	Time to rise (min)	Remarks

Backfill details:

Depth Top (m)	Depth Base (m)	Material	Remarks
0.00	4.05	Arisings	Soakaway tests undertaken at 0.50 and 1.00m during excavation.

AGS

CONTRACT **36253**

CHECKED **JH**

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

Geotechnical Engineering Limited

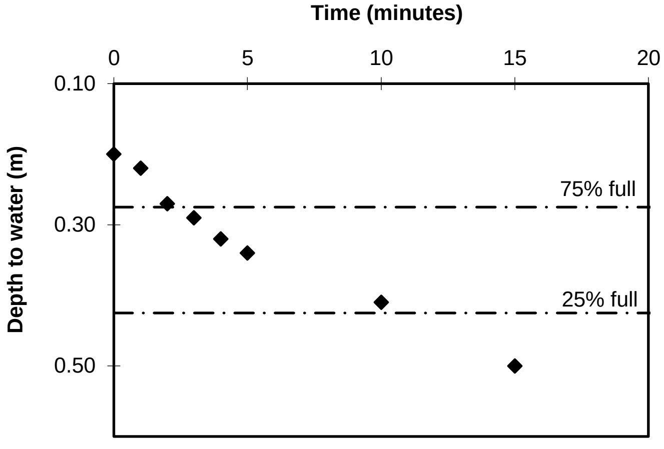
SOAKAWAY TEST

CLIENT	VANTAGE DATA CENTRES UK			
SITE	DC3 IMPERIAL PARK		TRIAL PIT	**DC3_TP12**
DATE	27/01/2021			

TEST 1

LENGTH	1.90	m
BREADTH	0.90	m
DEPTH	0.50	m
WATER LEVEL	Dry	m
FILL LEVEL	0.20	m
v_{p75-25}	0.257	m^3
a_{p50}	2.550	m^2
t_{p75-25}	9	min

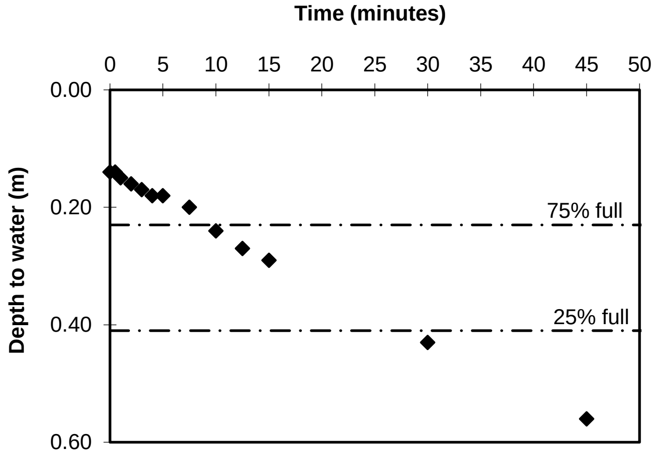
soil infiltration rate, *f* **1.9×10^{-4} ms^{-1}**



TEST 2

LENGTH	1.90	m
BREADTH	0.90	m
DEPTH	0.50	m
WATER LEVEL	Dry	m
FILL LEVEL	0.14	m
v_{p75-25}	0.308	m^3
a_{p50}	2.718	m^2
t_{p75-25}	21	min

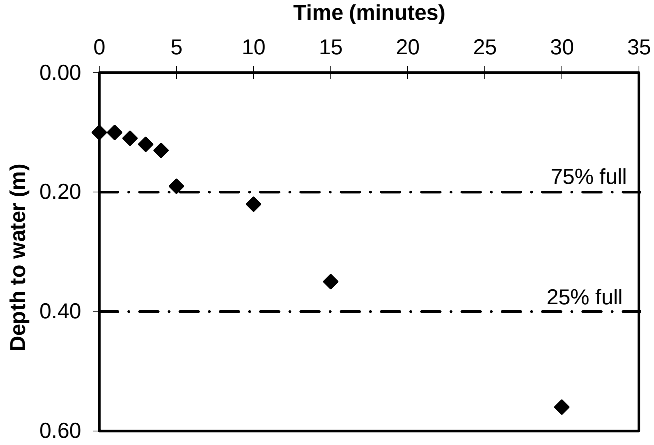
soil infiltration rate, *f* **9×10^{-4} ms^{-1}**



TEST 3

LENGTH	1.90	m
BREADTH	0.90	m
DEPTH	0.50	m
WATER LEVEL	Dry	m
FILL LEVEL	0.10	m
v_{p75-25}	0.342	m^3
a_{p50}	2.830	m^2
t_{p75-25}	12	min

soil infiltration rate, *f* **1.7×10^{-4} ms^{-1}**



Remarks	Test carried out in accordance with BRE DG 365 (2016).	CONTRACT **36253**	CHECKED **CT**

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Geotechnical Engineering Limited

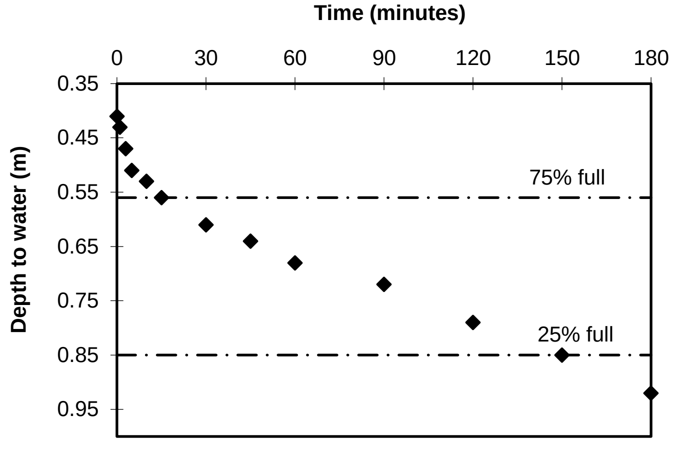
SOAKAWAY TEST

CLIENT	VANTAGE DATA CENTRES UK		
SITE	DC3 IMPERIAL PARK	TRIAL PIT	**DC3_TP12**
DATE	27/01/2021		

TEST 1

LENGTH	1.90 m
BREADTH	0.90 m
DEPTH	1.00 m
WATER LEVEL	Dry
FILL LEVEL	0.41 m
v_{p75-25}	0.504 m^3
a_{p50}	3.362 m^2
t_{p75-25}	135 min

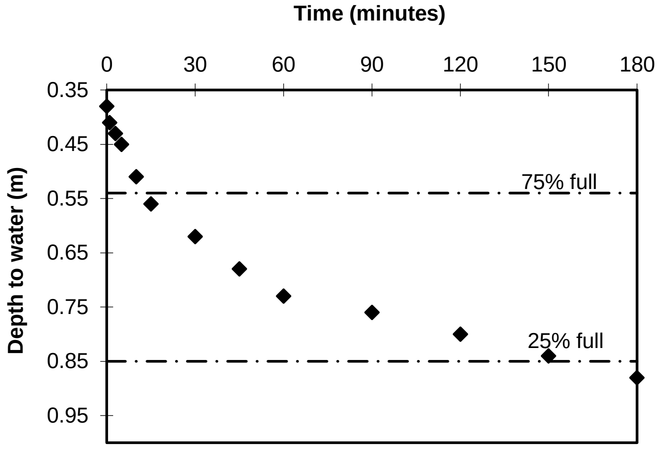
soil infiltration rate, *f* **1.9 x 10^{-5}** **ms^{-1}**



TEST 2

LENGTH	1.90 m
BREADTH	0.90 m
DEPTH	1.00 m
WATER LEVEL	Dry
FILL LEVEL	0.38 m
v_{p75-25}	0.530 m^3
a_{p50}	3.446 m^2
t_{p75-25}	143 min

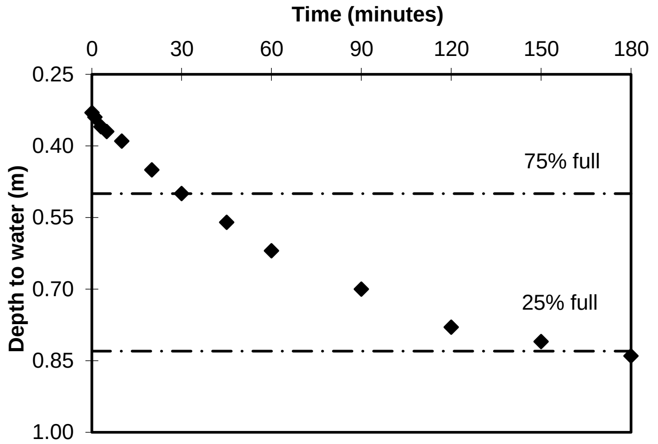
soil infiltration rate, *f* **1.8 x 10^{-5}** **ms^{-1}**



TEST 3

LENGTH	1.90 m
BREADTH	0.90 m
DEPTH	1.00 m
WATER LEVEL	Dry
FILL LEVEL	0.33 m
v_{p75-25}	0.573 m^3
a_{p50}	3.586 m^2
t_{p75-25}	148 min

soil infiltration rate, *f* **1.8 x 10^{-5}** **ms^{-1}**



Remarks	Test carried out in accordance with BRE DG 365 (2016).	CONTRACT	CHECKED
		36253	**CT**

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DYNAMIC CONE PENETROMETER TESTING

DC3-DCP01

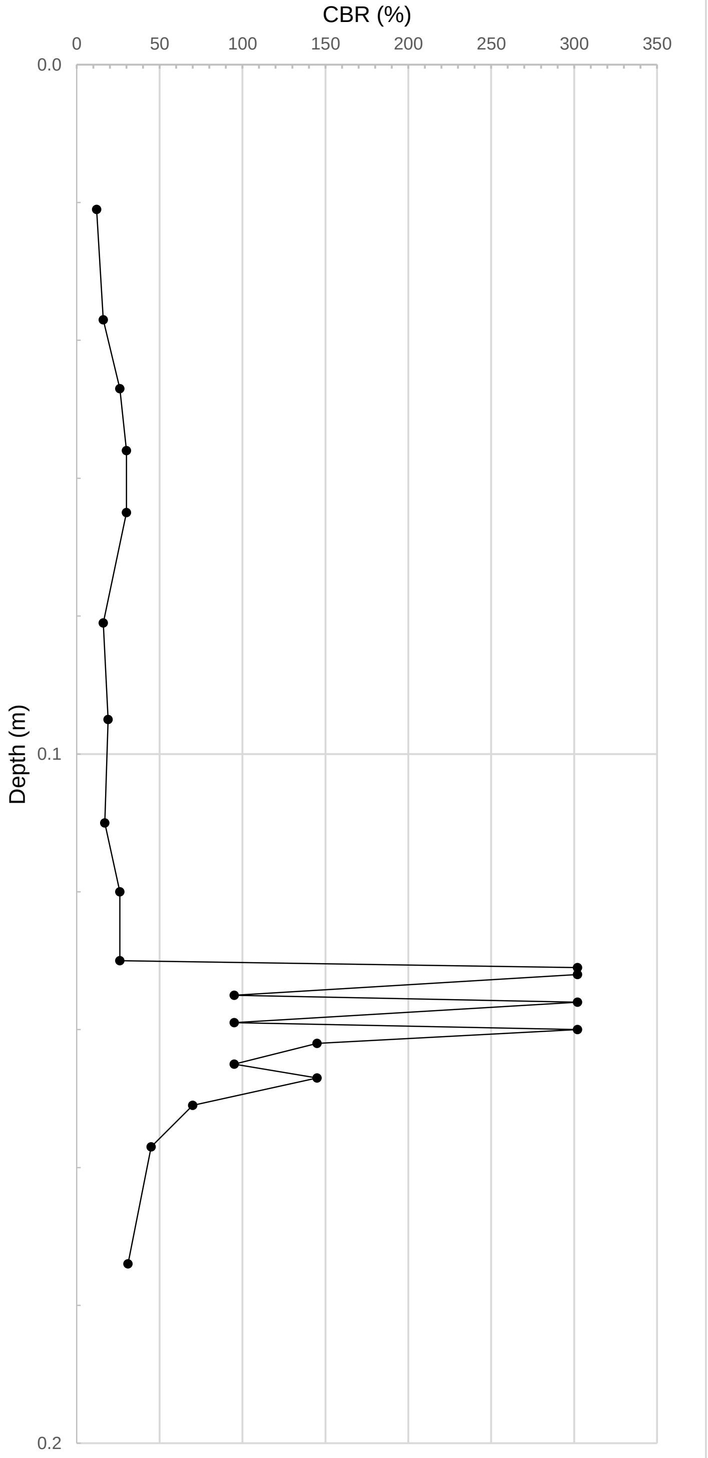
CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

DATE 19/01/2021

Initial Scale reading (mm) 0 Datum bgl (mm) 0

no. of blows	Scale reading (mm)	Penetration Increment (mm)	Depth bgl (m)	DCP (mm/blow)	CBR (%)
1	21	21	0.02	21	12
1	37	16	0.04	16	16
1	47	10	0.05	10	26
1	56	9	0.06	9	30
1	65	9	0.07	9	30
1	81	16	0.08	16	16
1	95	14	0.10	14	19
1	110	15	0.11	15	17
1	120	10	0.12	10	26
1	131	1	0.13	1	302
1	132	1	0.13	1	302
1	135	3	0.14	3	95
1	136	1	0.14	1	302
1	139	3	0.14	3	95
2	140	1	0.14	1	302
1	142	2	0.14	2	145
1	145	3	0.15	3	95
1	147	2	0.15	2	145
1	151	4	0.15	4	70
1	157	6	0.16	6	45
2	174	17	0.17	9	31



Remarks:
CBR correlation based on the relationship Log10 (CBR) = 2.48 - 1.057 * Log10 (mm/blow) developed by TRL taken from Highways England CS229: Data for Pavement Assessment (2020).

CONTRACT	CHECKED
36253	**JH**

Geotechnical Enigneering Limited

DYNAMIC CONE PENETROMETER TESTING

CLIENT VANTAGE DATA CENTRES UK

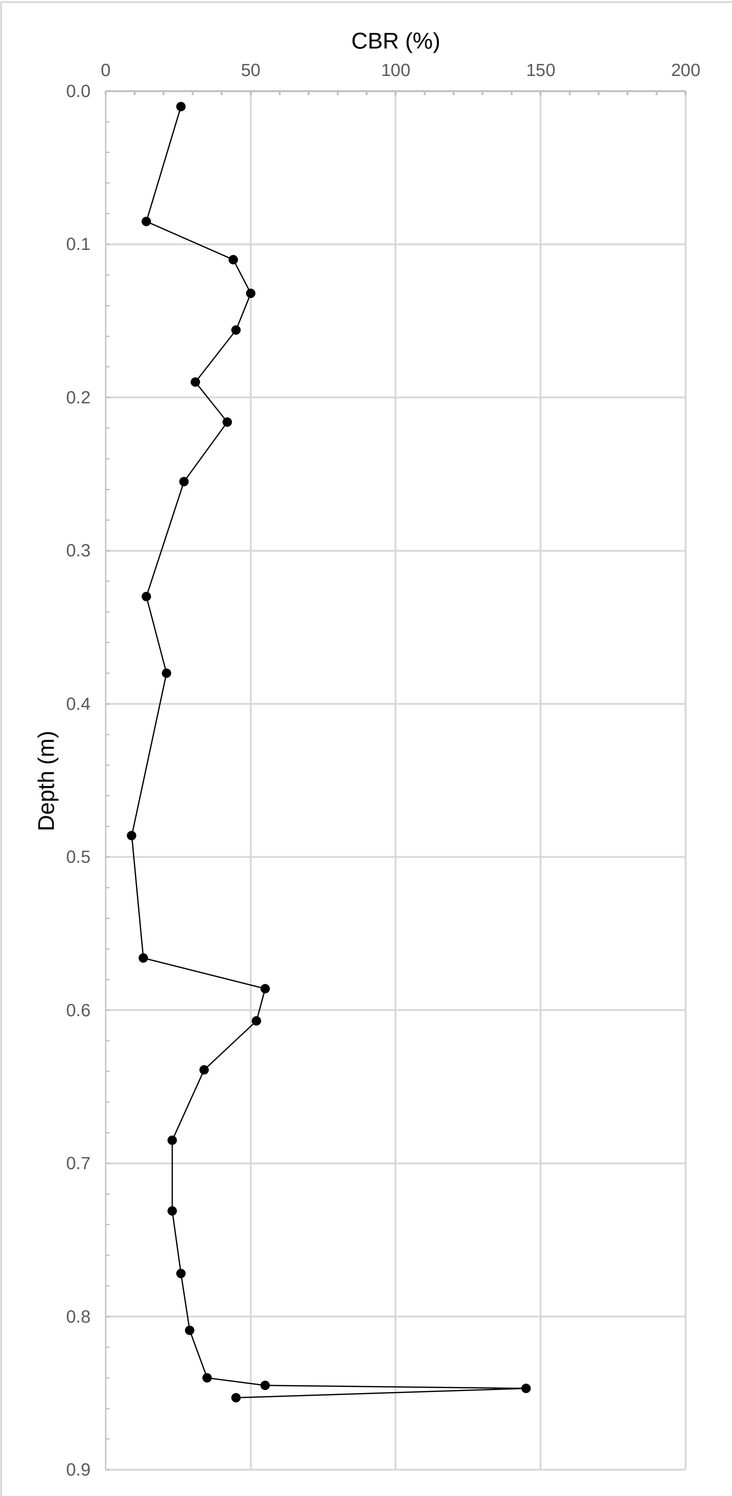
SITE IMPERIAL PARK DC3

DC3-DCP01A

DATE 19/01/2021

Initial Scale reading (mm) 0 Datum bgl (mm) 0

no. of blows	Scale reading (mm)	Penetration Increment (mm)	Depth bgl (m)	DCP (mm/blow)	CBR (%)
1	10	10	0.01	10	26
4	85	75	0.09	19	14
4	110	25	0.11	6	44
4	132	22	0.13	6	50
4	156	24	0.16	6	45
4	190	34	0.19	9	31
4	216	26	0.22	7	42
4	255	39	0.26	10	27
4	330	75	0.33	19	14
4	486	106	0.49	27	9
4	566	80	0.57	20	13
4	586	20	0.59	5	55
4	607	21	0.61	5	52
4	639	32	0.64	8	34
4	685	46	0.69	12	23
4	731	46	0.73	12	23
4	772	41	0.77	10	26
4	809	37	0.81	9	29
4	840	31	0.84	8	35
1	845	5	0.85	5	55
1	847	2	0.85	2	145
1	853	6	0.85	6	45



Remarks:
CBR correlation based on the relationship Log10 (CBR) = 2.48 - 1.057 * Log10 (mm/blow) developed by TRL taken from Highways England CS229: Data for Pavement Assessment (2020).

CONTRACT	CHECKED
36253	**JH**

Geotechnical Enigneering Limited

DYNAMIC CONE PENETROMETER TESTING

DC3-DCP02

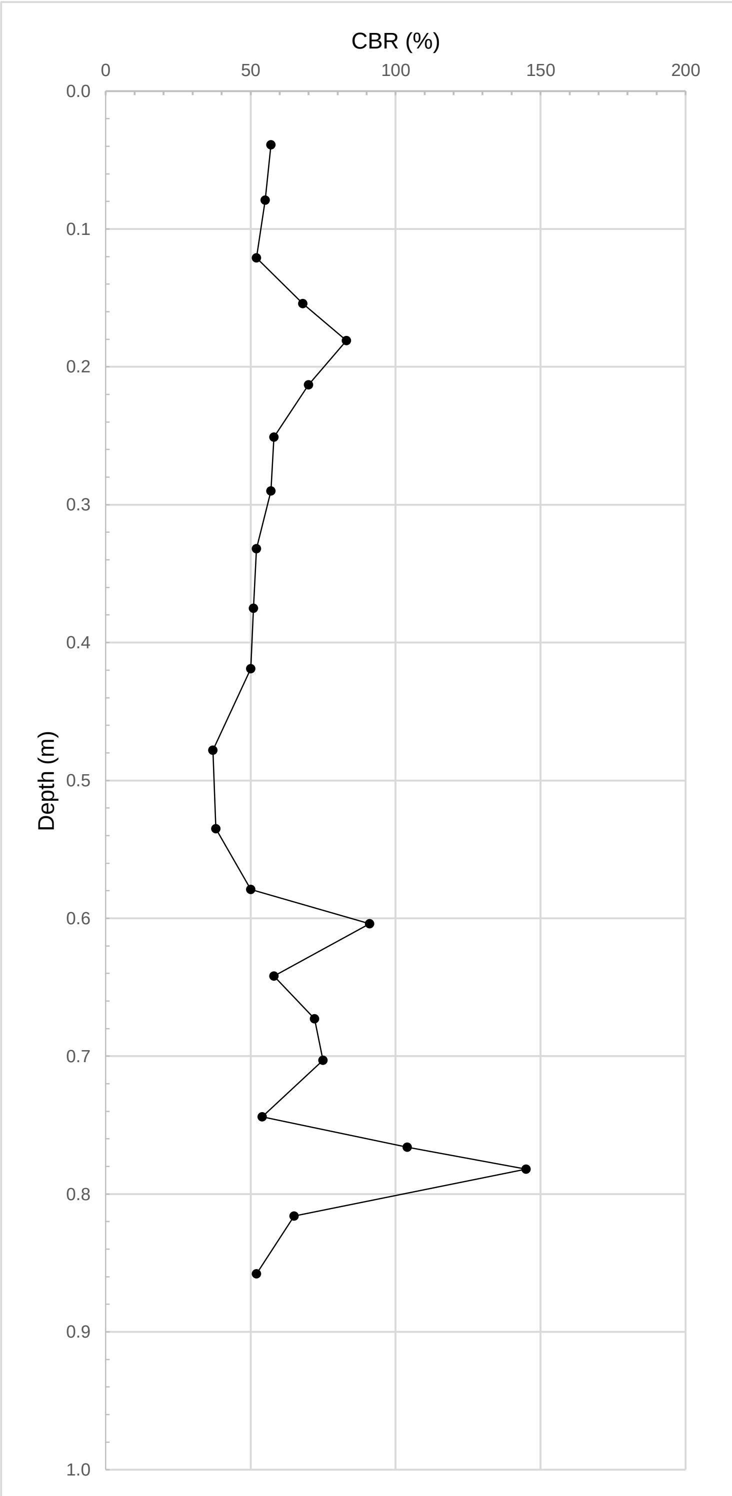
CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

DATE 20/01/2021

Initial Scale reading (mm) 1 Datum bgl (mm) 0

no. of blows	Scale reading (mm)	Penetration Increment (mm)	Depth bgl (m)	DCP (mm/blow)	CBR (%)
8	40	39	0.04	5	57
8	80	40	0.08	5	55
8	122	42	0.12	5	52
8	155	33	0.15	4	68
8	182	27	0.18	3	83
8	214	32	0.21	4	70
8	252	38	0.25	5	58
8	291	39	0.29	5	57
8	333	42	0.33	5	52
8	420	44	0.42	6	50
8	479	59	0.48	7	37
8	536	57	0.54	7	38
8	580	44	0.58	6	50
8	605	25	0.60	3	91
8	643	38	0.64	5	58
8	674	31	0.67	4	72
8	704	30	0.70	4	75
8	745	41	0.74	5	54
8	767	22	0.77	3	104
8	783	16	0.78	2	145
8	817	34	0.82	4	65
8	859	42	0.86	5	52



Remarks:
CBR correlation based on the relationship Log10 (CBR) = 2.48 - 1.057 * Log10 (mm/blow) developed by TRL taken from Highways England CS229: Data for Pavement Assessment (2020).

CONTRACT	CHECKED
36253	**JH**

Geotechnical Enigneering Limited

DYNAMIC CONE PENETROMETER TESTING

DC3-DCP03

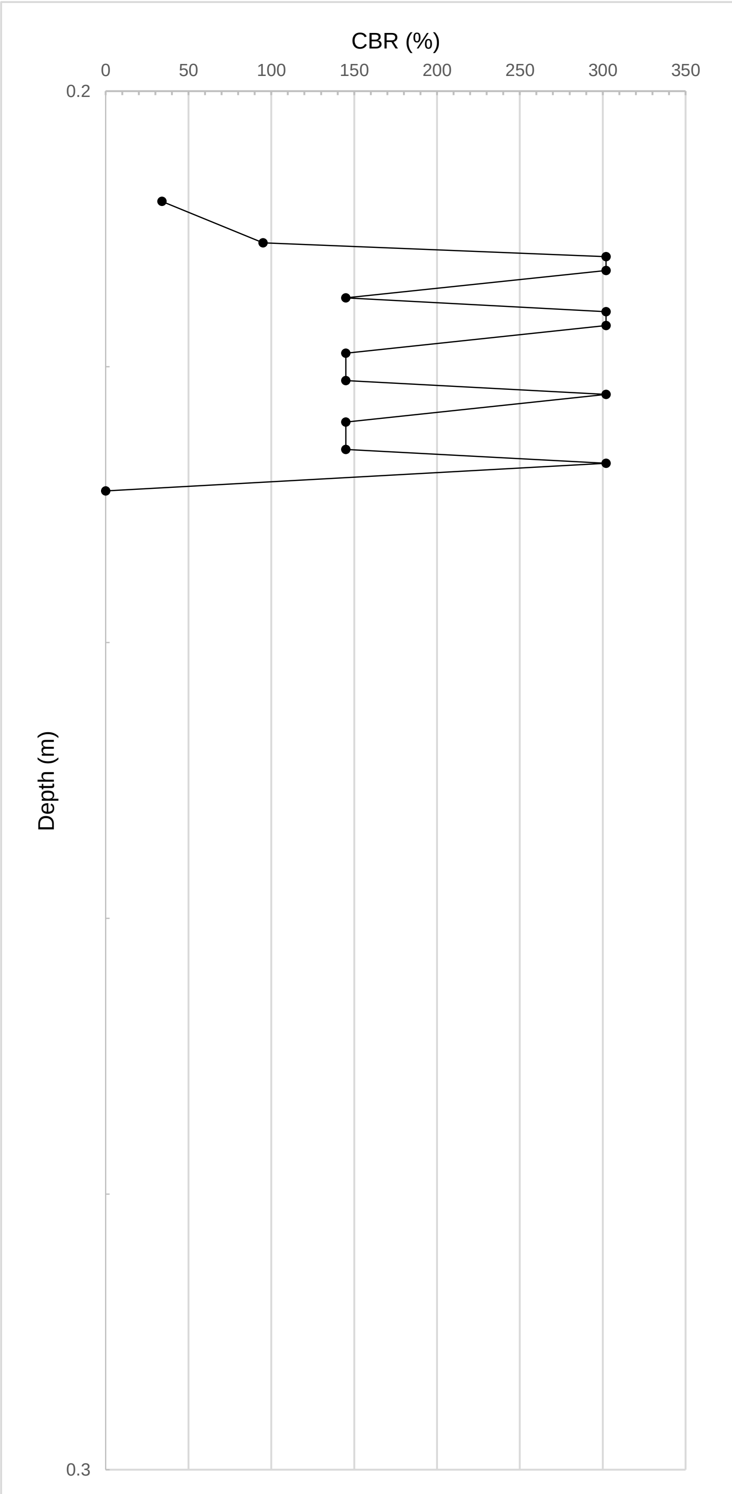
CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

DATE 22/01/2021

Initial Scale reading (mm) 118 Datum bgl (mm) 200

no. of blows	Scale reading (mm)	Penetration Increment (mm)	Depth bgl (m)	DCP (mm/blow)	CBR (%)
1	126	8	0.21	8	34
1	129	3	0.21	3	95
1	130	1	0.21	1	302
1	131	1	0.21	1	302
1	133	2	0.22	2	145
1	134	1	0.22	1	302
1	135	1	0.22	1	302
1	137	2	0.22	2	145
1	139	2	0.22	2	145
1	142	2	0.22	2	145
1	144	2	0.23	2	145
1	145	1	0.23	1	302
1	147	0	0.23	0	0



Remarks:
CBR correlation based on the relationship Log10 (CBR) = 2.48 - 1.057 * Log10 (mm/blow) developed by TRL taken from Highways England CS229: Data for Pavement Assessment (2020).

CONTRACT	CHECKED
36253	**JH**

Geotechnical Enigneering Limited

DYNAMIC CONE PENETROMETER TESTING

DC3-DCP03A

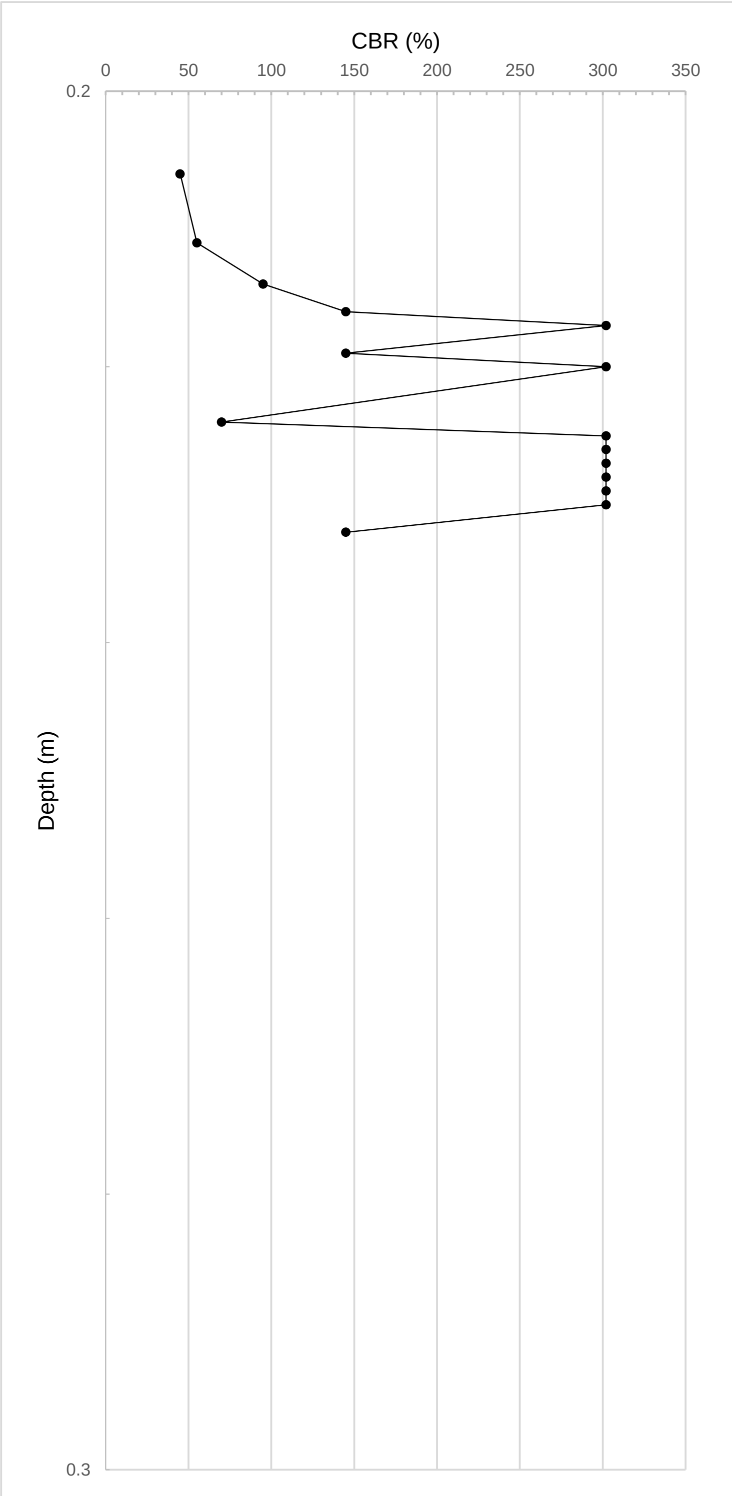
CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

DATE 22/01/2021

Initial Scale reading (mm) 117 Datum bgl (mm) 200

no. of blows	Scale reading (mm)	Penetration Increment (mm)	Depth bgl (m)	DCP (mm/blow)	CBR (%)
1	123	6	0.21	6	45
1	128	5	0.21	5	55
1	131	3	0.21	3	95
1	133	2	0.22	2	145
1	134	1	0.22	1	302
1	136	2	0.22	2	145
1	137	1	0.22	1	302
1	141	4	0.22	4	70
1	142	1	0.23	1	302
1	144	1	0.23	1	302
1	145	1	0.23	1	302
1	146	1	0.23	1	302
1	147	1	0.23	1	302
1	149	2	0.23	2	145



Remarks:
CBR correlation based on the relationship Log10 (CBR) = 2.48 - 1.057 * Log10 (mm/blow) developed by TRL taken from Highways England CS229: Data for Pavement Assessment (2020).

CONTRACT	CHECKED
36253	**JH**

Geotechnical Enigneering Limited

DYNAMIC CONE PENETROMETER TESTING

DC3-DCP04

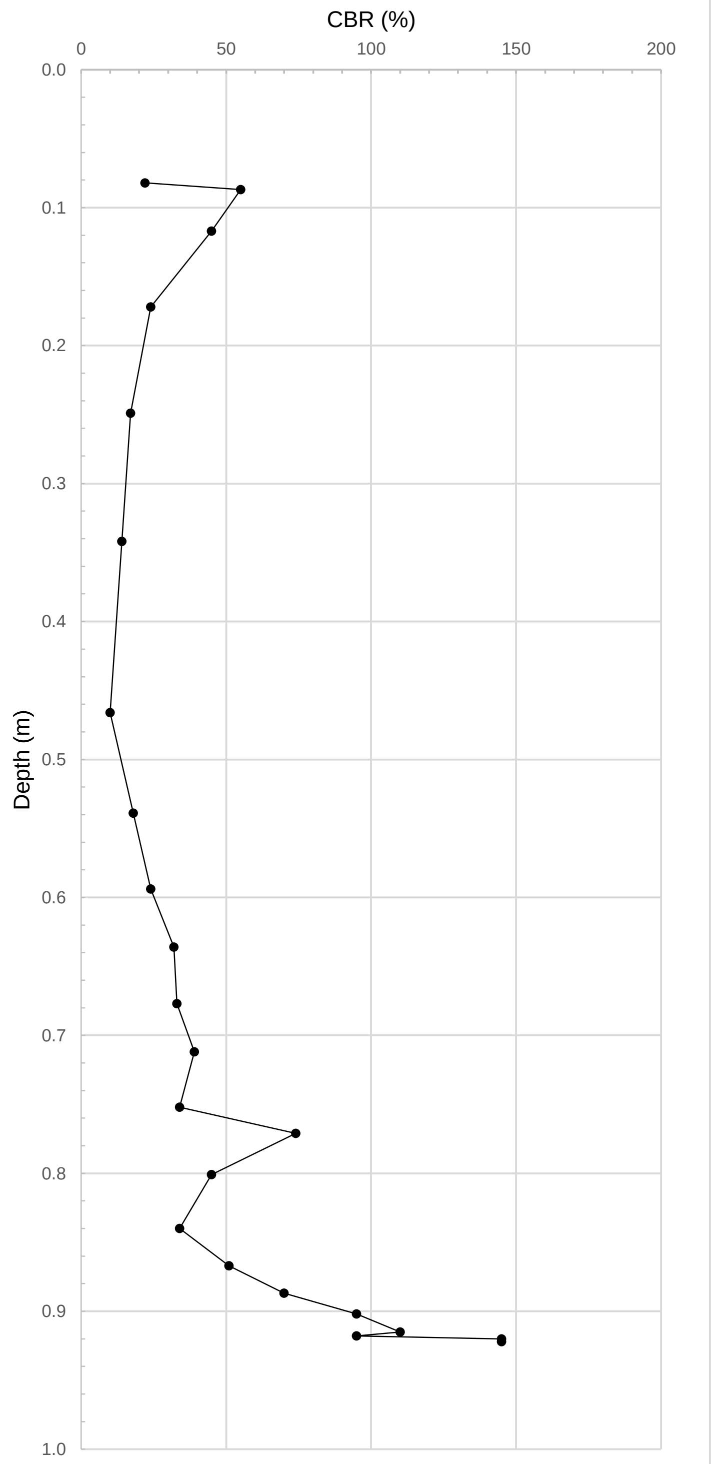
CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

DATE 29/01/2021

Initial Scale reading (mm) 4 Datum bgl (mm) 70

no. of blows	Scale reading (mm)	Penetration Increment (mm)	Depth bgl (m)	DCP (mm/blow)	CBR (%)
1	16	12	0.08	12	22
1	21	5	0.09	5	55
5	51	30	0.12	6	45
5	106	55	0.17	11	24
5	183	77	0.25	15	17
5	276	93	0.34	19	14
5	400	124	0.47	25	10
5	473	73	0.54	15	18
5	528	55	0.59	11	24
5	611	41	0.68	8	33
5	646	35	0.71	7	39
5	686	40	0.75	8	34
5	705	19	0.77	4	74
5	735	30	0.80	6	45
5	774	39	0.84	8	34
5	801	27	0.87	5	51
5	821	20	0.89	4	70
5	836	15	0.90	3	95
5	849	13	0.92	3	110
1	852	3	0.92	3	95
1	854	2	0.92	2	145
1	856	2	0.92	2	145



Remarks:
CBR correlation based on the relationship Log10 (CBR) = 2.48 - 1.057 * Log10 (mm/blow) developed by TRL taken from Highways England CS229: Data for Pavement Assessment (2020).

CONTRACT	CHECKED
36253	**JH**

Geotechnical Enigneering Limited

DYNAMIC CONE PENETROMETER TESTING

CLIENT VANTAGE DATA CENTRES UK

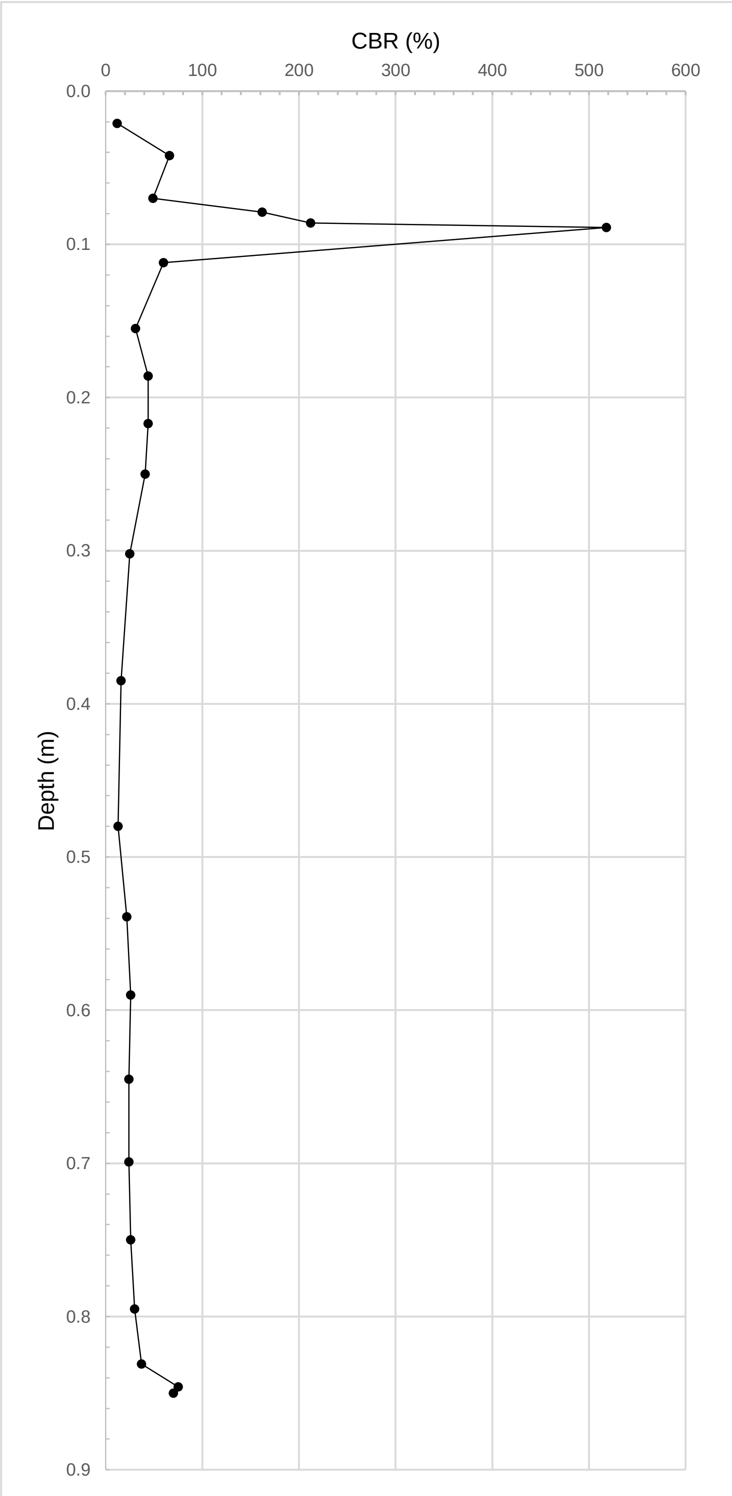
SITE IMPERIAL PARK DC3

DC3-DCP05

DATE 19/01/2021

Initial Scale reading (mm) 5 Datum bgl (mm) 0

no. of blows	Scale reading (mm)	Penetration Increment (mm)	Depth bgl (m)	DCP (mm/blow)	CBR (%)
1	26	21	0.02	21	12
5	47	21	0.04	4	66
5	75	28	0.07	6	49
5	84	9	0.08	2	162
5	91	7	0.09	1	212
5	94	3	0.09	1	518
5	117	23	0.11	5	60
5	160	43	0.16	9	31
5	191	31	0.19	6	44
5	255	33	0.25	7	41
5	307	52	0.30	10	25
5	390	83	0.39	17	16
5	485	95	0.48	19	13
5	544	59	0.54	12	22
5	595	51	0.59	10	26
5	650	55	0.65	11	24
5	704	54	0.70	11	24
5	755	51	0.75	10	26
5	800	45	0.80	9	30
5	836	36	0.83	7	37
4	851	15	0.85	4	75
1	855	4	0.85	4	70



Remarks:
CBR correlation based on the relationship Log10 (CBR) = 2.48 - 1.057 * Log10 (mm/blow) developed by TRL taken from Highways England CS229: Data for Pavement Assessment (2020).

CONTRACT	CHECKED
36253	**JH**

Geotechnical Enigneering Limited

DYNAMIC CONE PENETROMETER TESTING

DC3-DCP06

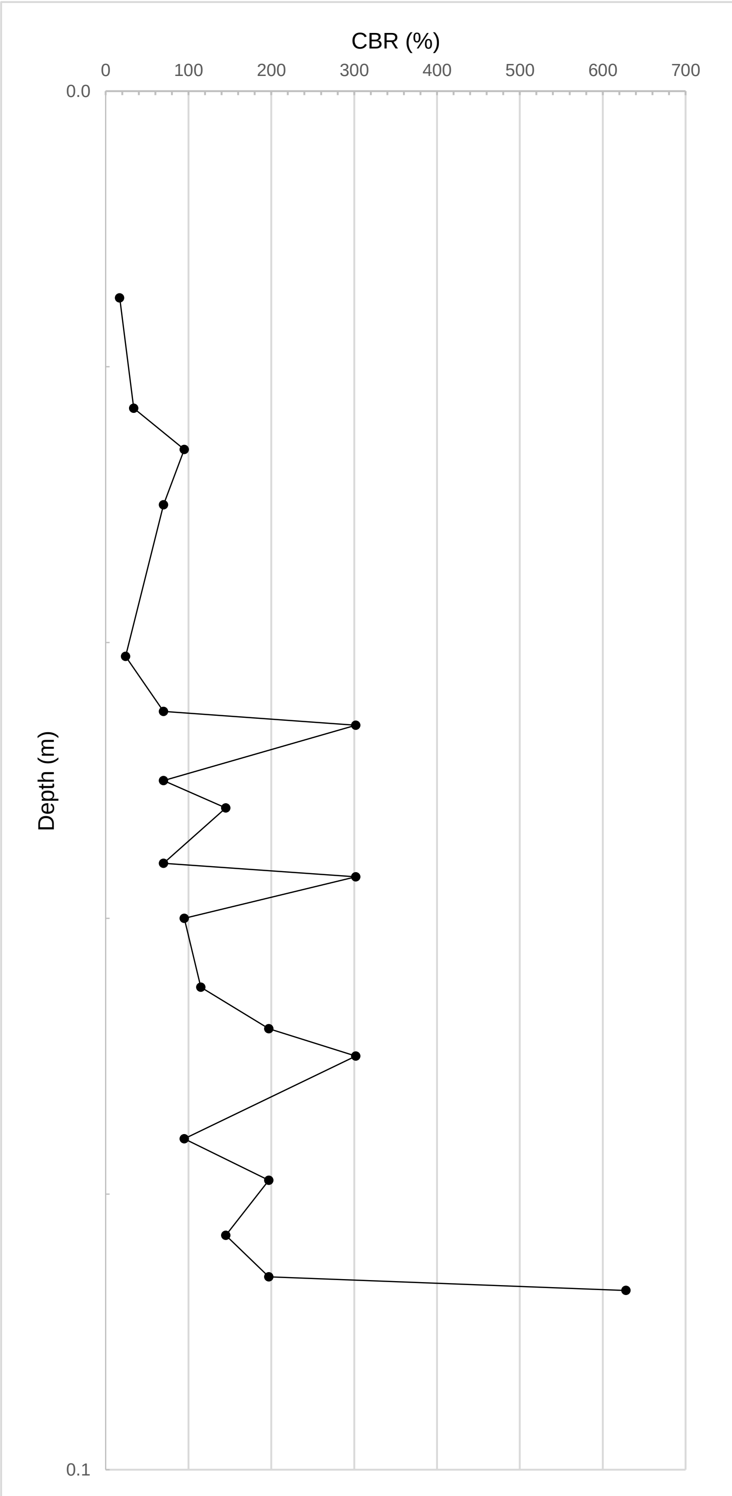
CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

DATE 18/01/2021

Initial Scale reading (mm) 144 Datum bgl (mm) 0

no. of blows	Scale reading (mm)	Penetration Increment (mm)	Depth bgl (m)	DCP (mm/blow)	CBR (%)
1	159	15	0.02	15	17
1	167	8	0.02	8	34
1	170	3	0.03	3	95
1	174	4	0.03	4	70
1	185	11	0.04	11	24
1	189	4	0.05	4	70
1	190	1	0.05	1	302
1	194	4	0.05	4	70
1	196	2	0.05	2	145
2	201	1	0.06	1	302
1	204	3	0.06	3	95
2	209	5	0.07	3	115
2	212	3	0.07	2	197
2	214	2	0.07	1	302
2	220	6	0.08	3	95
2	223	3	0.08	2	197
2	227	4	0.08	2	145
4	230	3	0.09	2	197
4	231	1	0.09	1	628



Remarks:
CBR correlation based on the relationship Log10 (CBR) = 2.48 - 1.057 * Log10 (mm/blow) developed by TRL taken from Highways England CS229: Data for Pavement Assessment (2020).

CONTRACT	CHECKED
36253	**JH**

Geotechnical Enigneering Limited

DYNAMIC CONE PENETROMETER TESTING

DC3-DCP07

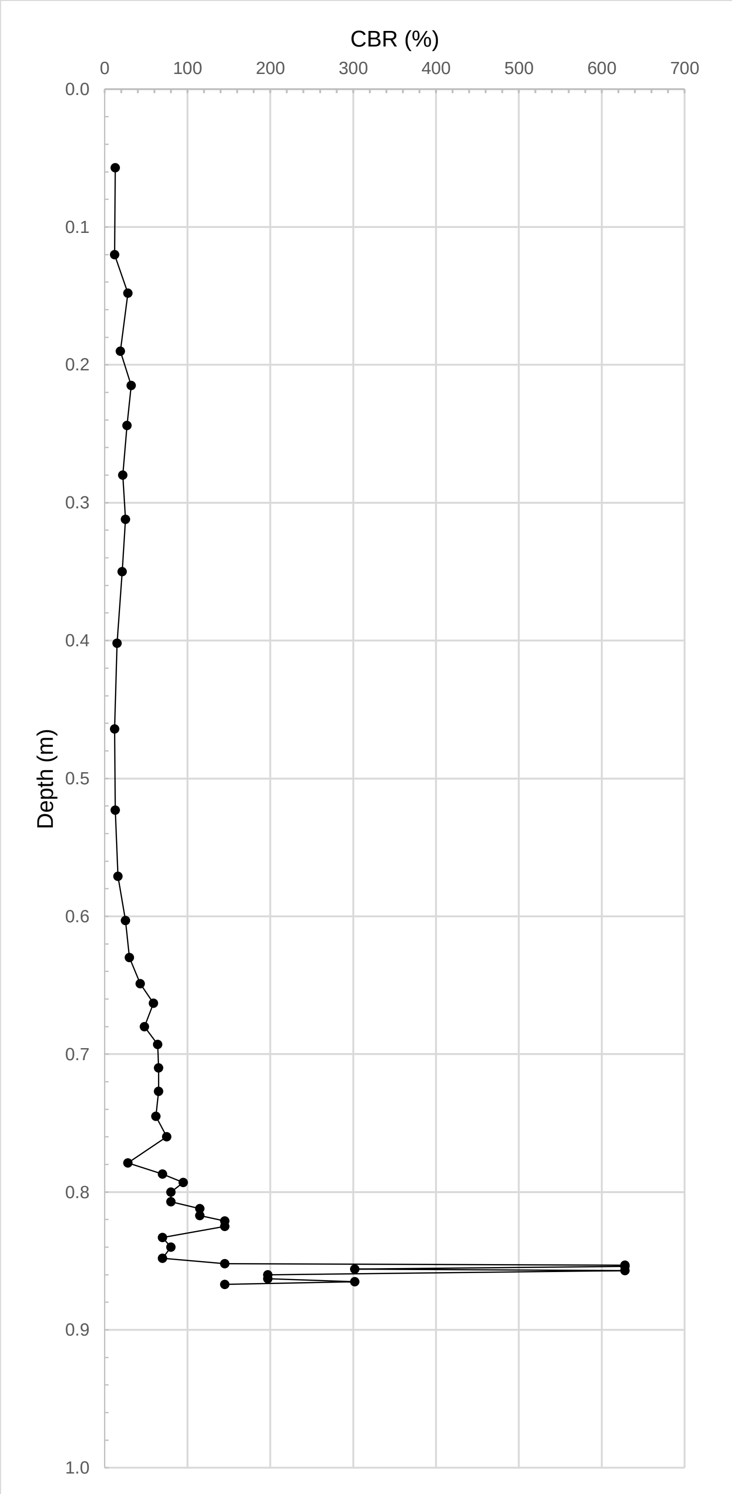
CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

DATE 18/01/2021

Initial Scale reading (mm) 130 Datum bgl (mm) 0

no. of blows	Scale reading (mm)	Penetration Increment (mm)	Depth bgl (m)	DCP (mm/blow)	CBR (%)
3	187	57	0.06	19	13
3	250	63	0.12	21	12
3	278	28	0.15	9	28
3	320	42	0.19	14	19
3	345	25	0.22	8	32
3	374	29	0.24	10	27
3	410	36	0.28	12	22
3	442	32	0.31	11	25
3	480	38	0.35	13	21
3	594	62	0.46	21	12
3	653	59	0.52	20	13
3	701	48	0.57	16	16
3	733	32	0.60	11	25
3	760	27	0.63	9	30
3	779	19	0.65	6	43
3	793	14	0.66	5	59
3	810	17	0.68	6	48
3	823	13	0.69	4	64
4	840	17	0.71	4	65
4	857	17	0.73	4	65
4	875	18	0.75	5	62
4	890	15	0.76	4	75
2	909	19	0.78	10	28
2	917	8	0.79	4	70
2	923	6	0.79	3	95
2	930	7	0.80	4	80
2	937	7	0.81	4	80
2	942	5	0.81	3	115
2	947	5	0.82	3	115
2	951	4	0.82	2	145
2	955	4	0.83	2	145
2	963	8	0.83	4	70
2	970	7	0.84	4	80
2	978	8	0.85	4	70
2	982	4	0.85	2	145
4	983	1	0.85	1	628
2	984	1	0.85	1	628
2	986	2	0.86	1	302
2	987	1	0.86	1	628
2	990	3	0.86	2	197
2	993	3	0.86	2	197
2	995	2	0.87	1	302
1	997	2	0.87	2	145



Remarks:
CBR correlation based on the relationship Log10 (CBR) = 2.48 - 1.057 * Log10 (mm/blow) developed by TRL taken from Highways England CS229: Data for Pavement Assessment (2020).

CONTRACT	CHECKED
36253	**JH**

Geotechnical Enigneering Limited

DYNAMIC CONE PENETROMETER TESTING

CLIENT VANTAGE DATA CENTRES UK

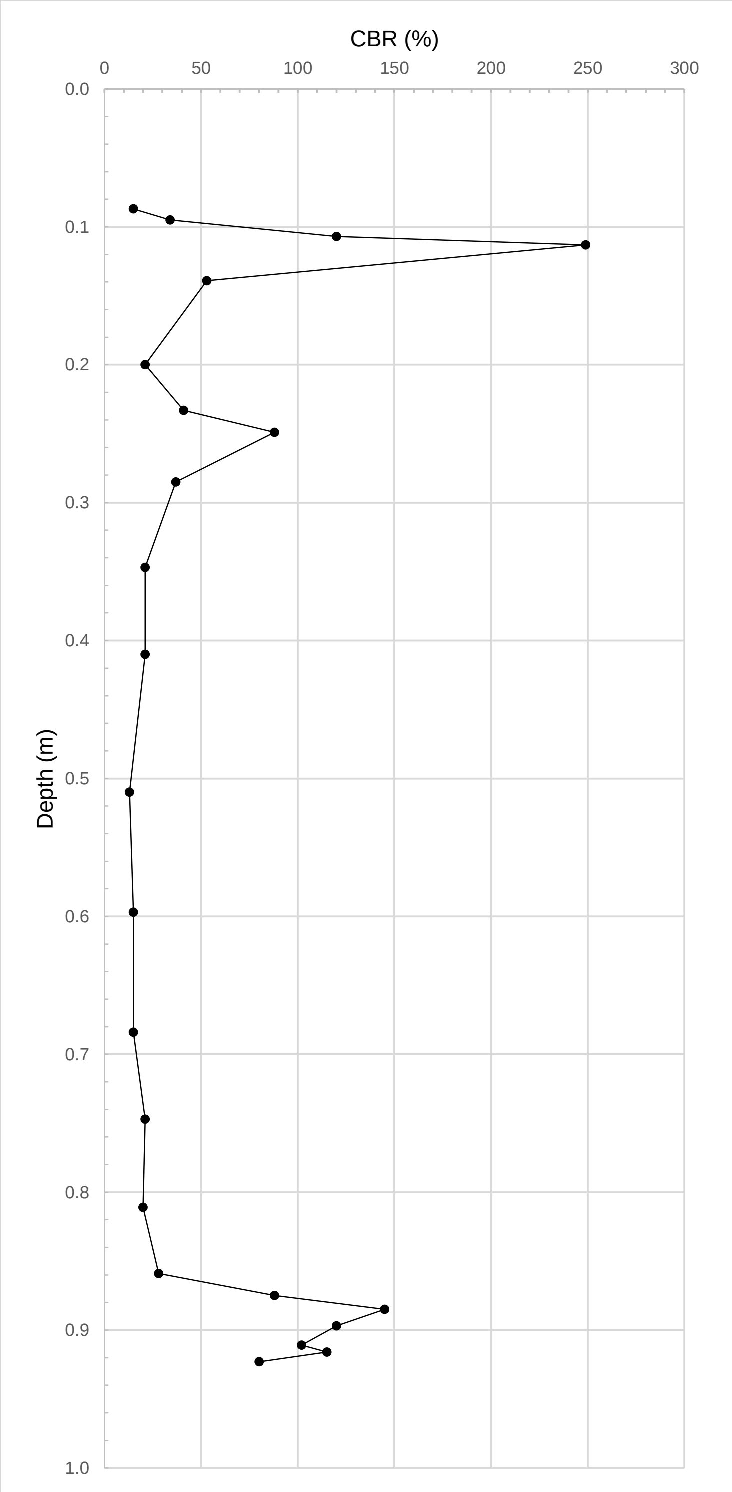
SITE IMPERIAL PARK DC3

DC3-DCP08

DATE 29/01/2021

Initial Scale reading (mm) 27 Datum bgl (mm) 70

no. of blows	Scale reading (mm)	Penetration Increment (mm)	Depth bgl (m)	DCP (mm/blow)	CBR (%)
1	44	17	0.09	17	15
1	52	8	0.10	8	34
5	64	12	0.11	2	120
5	70	6	0.11	1	249
5	96	26	0.14	5	53
5	157	61	0.20	12	21
5	190	33	0.23	7	41
5	206	16	0.25	3	88
5	242	36	0.29	7	37
5	367	63	0.41	13	21
5	467	100	0.51	20	13
5	554	87	0.60	17	15
5	641	87	0.68	17	15
5	704	63	0.75	13	21
5	768	64	0.81	13	20
5	816	48	0.86	10	28
5	832	16	0.88	3	88
5	842	10	0.89	2	145
5	854	12	0.90	2	120
5	868	14	0.91	3	102
2	873	5	0.92	3	115
2	880	7	0.92	4	80



Remarks:
CBR correlation based on the relationship Log10 (CBR) = 2.48 - 1.057 * Log10 (mm/blow) developed by TRL taken from Highways England CS229: Data for Pavement Assessment (2020).

CONTRACT	CHECKED
36253	**JH**

Geotechnical Enigneering Limited

DYNAMIC CONE PENETROMETER TESTING

DC3-DCP09

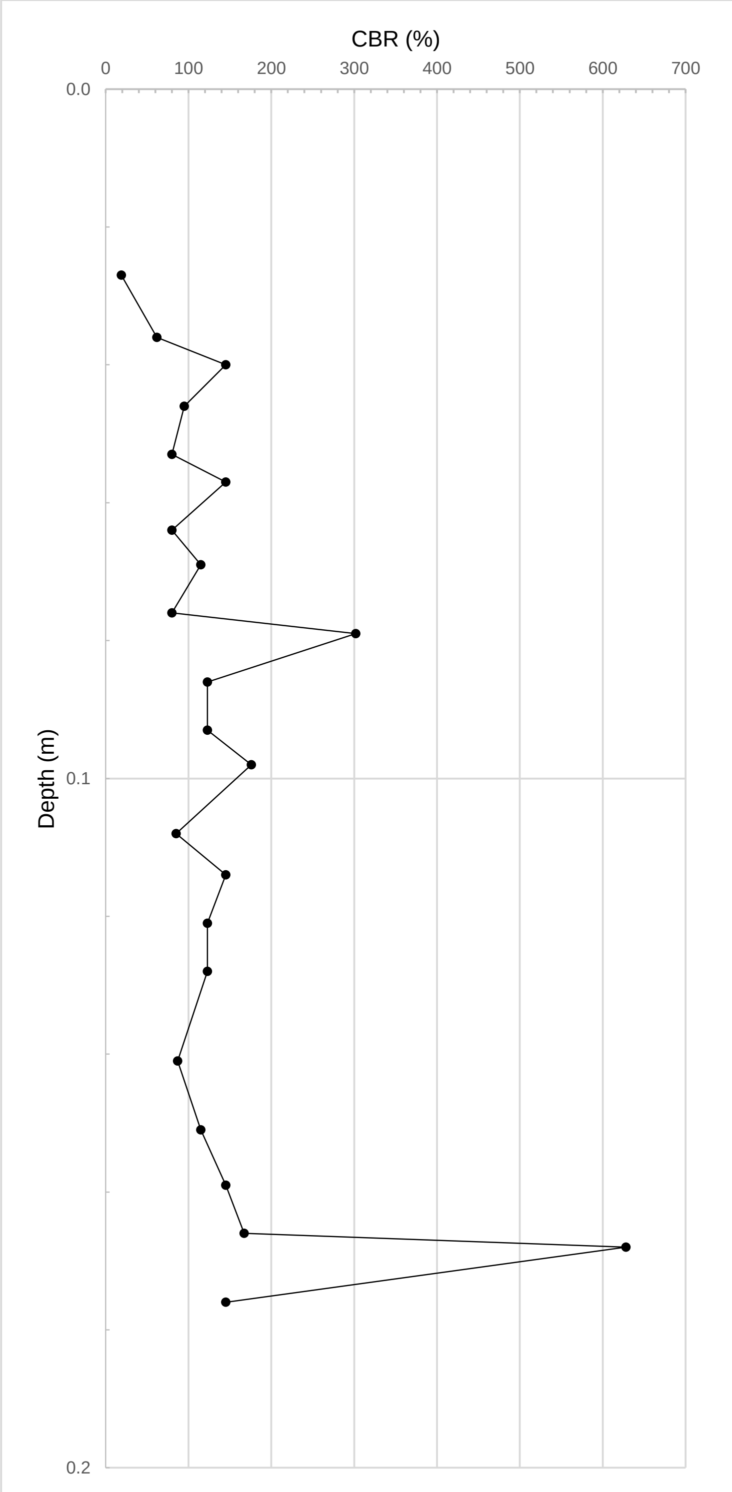
CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

DATE 18/01/2021

Initial Scale reading (mm) 104 Datum bgl (mm) 0

no. of blows	Scale reading (mm)	Penetration Increment (mm)	Depth bgl (m)	DCP (mm/blow)	CBR (%)
2	131	27	0.03	14	19
2	140	9	0.04	5	62
2	144	4	0.04	2	145
2	150	6	0.05	3	95
2	157	7	0.05	4	80
2	161	4	0.06	2	145
2	168	7	0.06	4	80
2	173	5	0.07	3	115
2	180	7	0.08	4	80
3	190	7	0.09	2	123
3	197	7	0.09	2	123
3	202	5	0.10	2	176
3	212	10	0.11	3	85
3	218	6	0.11	2	145
3	225	7	0.12	2	123
3	232	7	0.13	2	123
4	245	13	0.14	3	87
4	255	10	0.15	3	115
4	263	8	0.16	2	145
4	270	7	0.17	2	167
4	272	2	0.17	1	628
4	280	8	0.18	2	145



Remarks:
CBR correlation based on the relationship Log10 (CBR) = 2.48 - 1.057 * Log10 (mm/blow) developed by TRL taken from Highways England CS229: Data for Pavement Assessment (2020).

CONTRACT	CHECKED
36253	**JH**

Geotechnical Enigneering Limited

DYNAMIC CONE PENETROMETER TESTING

DC3-DCP09A

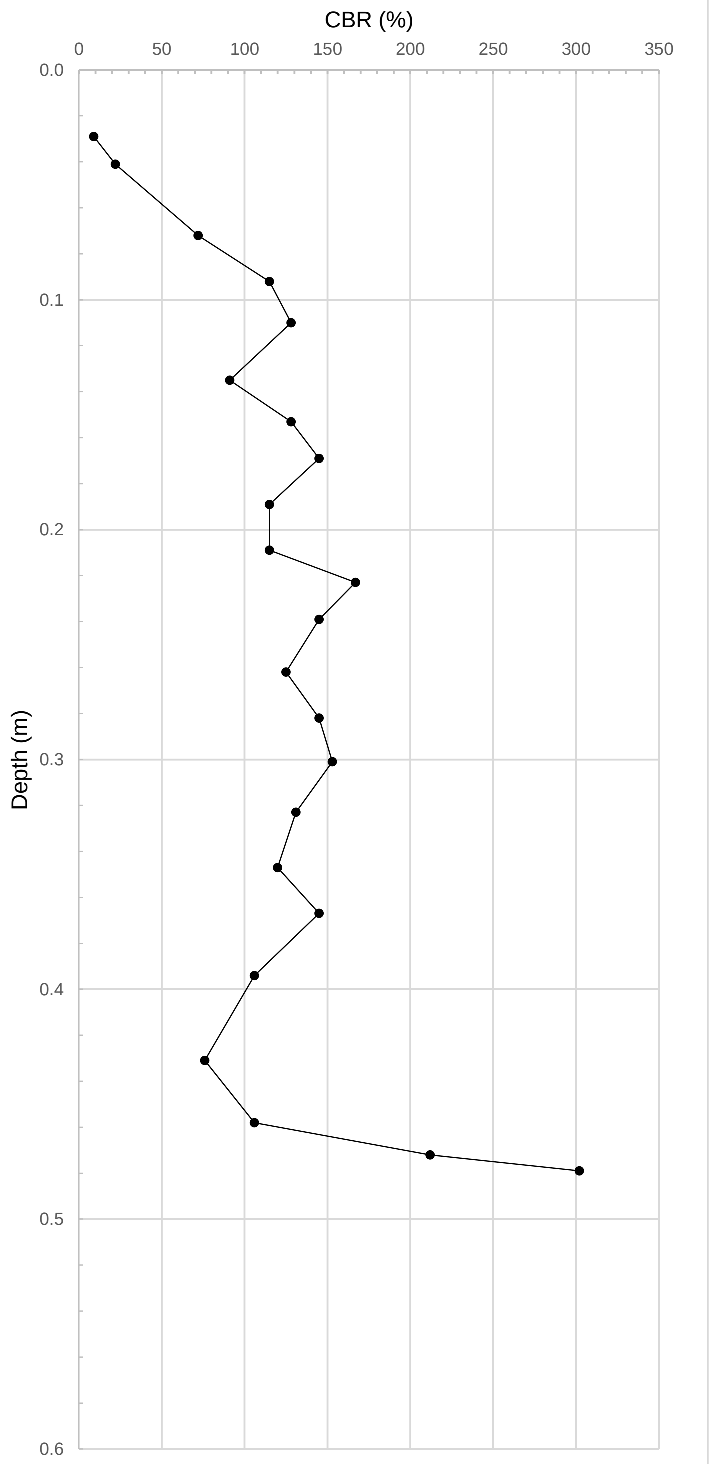
CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

DATE 18/01/2021

Initial Scale reading (mm) 103 Datum bgl (mm) 0

no. of blows	Scale reading (mm)	Penetration Increment (mm)	Depth bgl (m)	DCP (mm/blow)	CBR (%)
1	132	29	0.03	29	9
1	144	12	0.04	12	22
8	175	31	0.07	4	72
8	195	20	0.09	3	115
8	213	18	0.11	2	128
8	238	25	0.14	3	91
8	256	18	0.15	2	128
8	272	16	0.17	2	145
8	292	20	0.19	3	115
8	326	14	0.22	2	167
8	342	16	0.24	2	145
10	365	23	0.26	2	125
10	385	20	0.28	2	145
10	404	19	0.30	2	153
10	426	22	0.32	2	131
10	450	24	0.35	2	120
10	470	20	0.37	2	145
10	497	27	0.39	3	106
10	534	37	0.43	4	76
10	561	27	0.46	3	106
10	575	14	0.47	1	212
7	582	7	0.48	1	302



Remarks:
CBR correlation based on the relationship Log10 (CBR) = 2.48 - 1.057 * Log10 (mm/blow) developed by TRL taken from Highways England CS229: Data for Pavement Assessment (2020).

CONTRACT	CHECKED
36253	**JH**

Geotechnical Enigneering Limited

DYNAMIC CONE PENETROMETER TESTING

DC3-DCP10

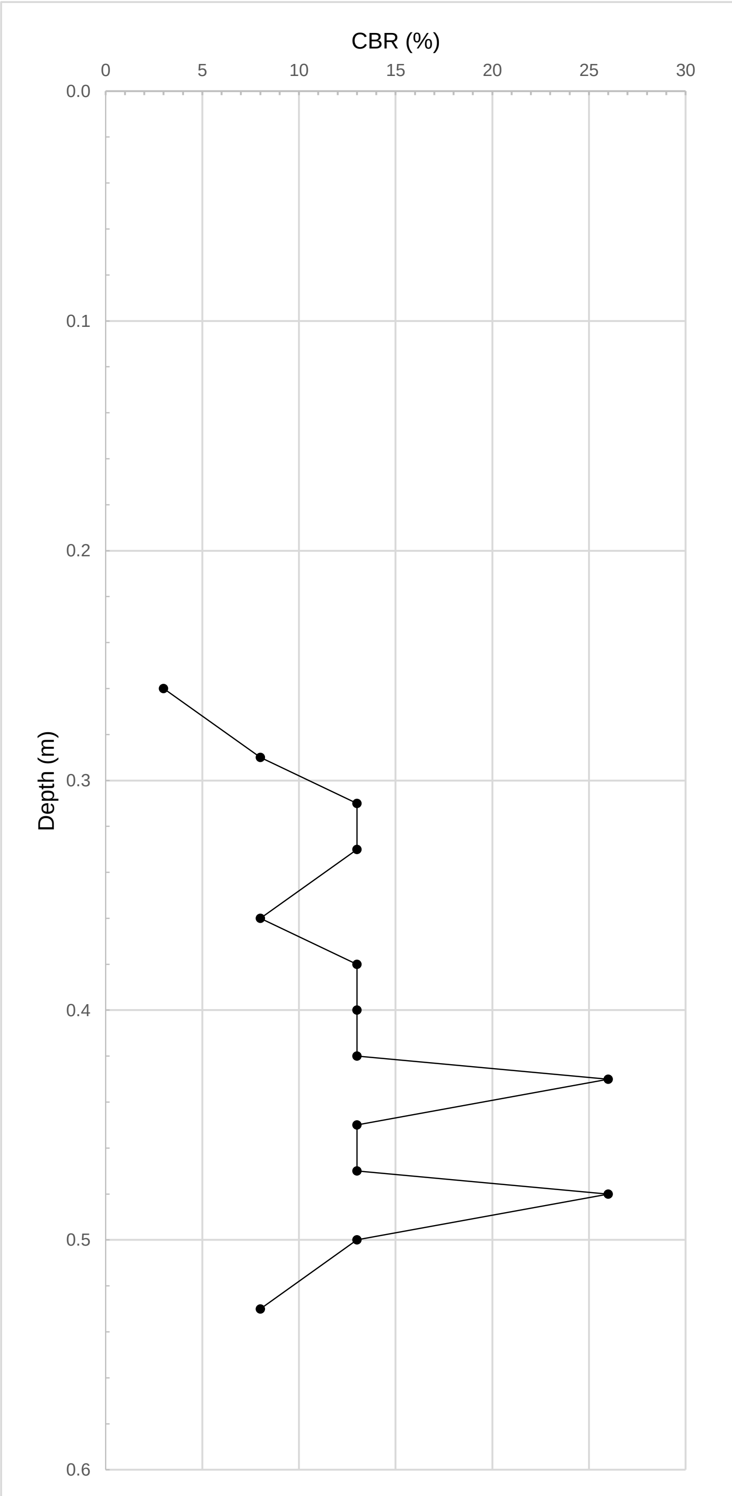
CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

DATE 22/01/2021

Initial Scale reading (mm) 20 Datum bgl (mm) 180

no. of blows	Scale reading (mm)	Penetration Increment (mm)	Depth bgl (m)	DCP (mm/blow)	CBR (%)
1	100	80	0.26	80	3
1	130	30	0.29	30	8
1	150	20	0.31	20	13
1	170	20	0.33	20	13
1	200	30	0.36	30	8
1	220	20	0.38	20	13
1	240	20	0.40	20	13
1	260	20	0.42	20	13
1	270	10	0.43	10	26
1	310	20	0.47	20	13
1	320	10	0.48	10	26
1	340	20	0.50	20	13
1	370	30	0.53	30	8



Remarks:
CBR correlation based on the relationship Log10 (CBR) = 2.48 - 1.057 * Log10 (mm/blow) developed by TRL taken from Highways England CS229: Data for Pavement Assessment (2020).

CONTRACT	CHECKED
36253	**JH**

Geotechnical Enigneering Limited

DYNAMIC CONE PENETROMETER TESTING

DC3-DCP11

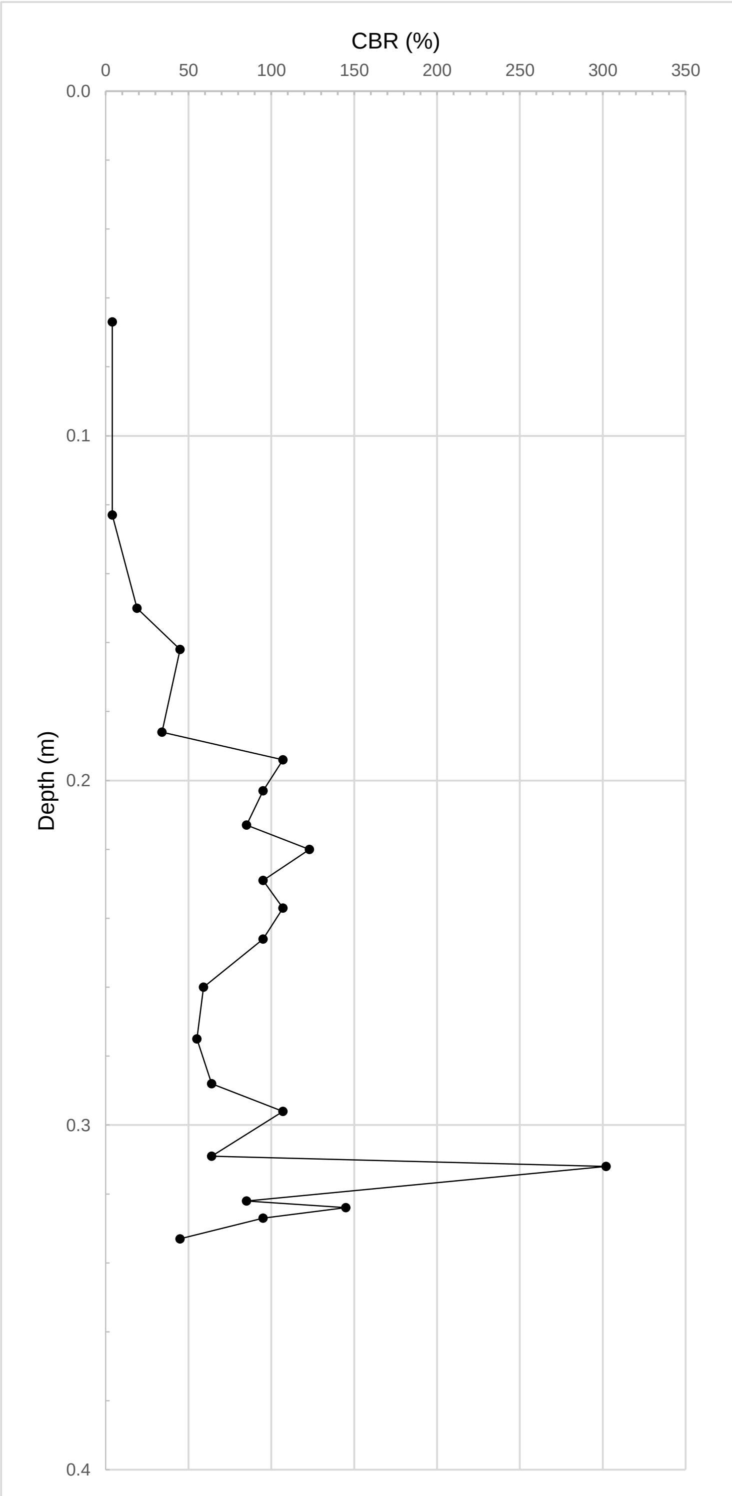
CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

DATE 18/01/2021

Initial Scale reading (mm) 120 Datum bgl (mm) 0

no. of blows	Scale reading (mm)	Penetration Increment (mm)	Depth bgl (m)	DCP (mm/blow)	CBR (%)
1	187	67	0.07	67	4
1	243	56	0.12	56	4
2	270	27	0.15	14	19
2	282	12	0.16	6	45
3	306	24	0.19	8	34
3	314	8	0.19	3	107
3	323	9	0.20	3	95
3	333	10	0.21	3	85
3	340	7	0.22	2	123
3	357	8	0.24	3	107
3	366	9	0.25	3	95
3	380	14	0.26	5	59
3	395	15	0.28	5	55
3	408	13	0.29	4	64
3	416	8	0.30	3	107
3	429	13	0.31	4	64
3	432	3	0.31	1	302
3	442	10	0.32	3	85
2	444	2	0.32	2	145
1	447	3	0.33	3	95
1	453	6	0.33	6	45



Remarks:
CBR correlation based on the relationship Log10 (CBR) = 2.48 - 1.057 * Log10 (mm/blow) developed by TRL taken from Highways England CS229: Data for Pavement Assessment (2020).

CONTRACT	CHECKED
36253	**JH**

Geotechnical Enigneering Limited

DYNAMIC CONE PENETROMETER TESTING

CLIENT VANTAGE DATA CENTRES UK

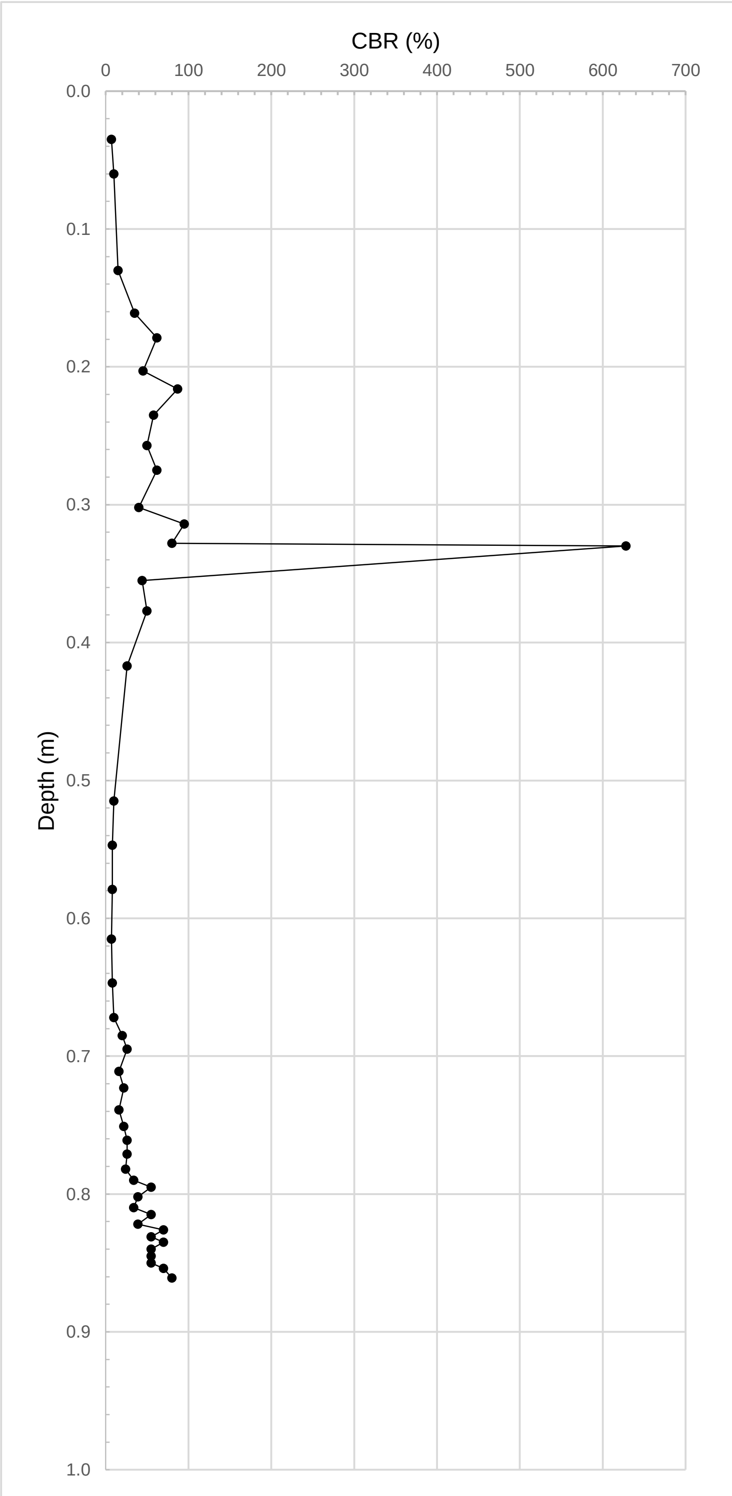
SITE IMPERIAL PARK DC3

DC3-DCP11A

DATE 18/01/2021

Initial Scale reading (mm) 135 Datum bgl (mm) 0

no. of blows	Scale reading (mm)	Penetration Increment (mm)	Depth bgl (m)	DCP (mm/blow)	CBR (%)
1	170	35	0.04	35	7
1	195	25	0.06	25	10
4	265	70	0.13	18	15
4	296	31	0.16	8	35
4	314	18	0.18	5	62
4	338	24	0.20	6	45
4	351	13	0.22	3	87
4	370	19	0.24	5	58
4	392	22	0.26	6	50
4	437	27	0.30	7	40
4	449	12	0.31	3	95
4	463	14	0.33	4	80
4	465	2	0.33	1	628
4	490	25	0.36	6	44
4	512	22	0.38	6	50
4	552	40	0.42	10	26
4	650	98	0.52	25	10
1	682	32	0.55	32	8
1	714	32	0.58	32	8
1	750	36	0.62	36	7
1	782	32	0.65	32	8
1	807	25	0.67	25	10
1	820	13	0.69	13	20
1	830	10	0.70	10	26
1	846	16	0.71	16	16
1	858	12	0.72	12	22
1	874	16	0.74	16	16
1	886	12	0.75	12	22
1	896	10	0.76	10	26
1	906	10	0.77	10	26
1	917	11	0.78	11	24
1	925	8	0.79	8	34
1	930	5	0.80	5	55
1	937	7	0.80	7	39
1	945	8	0.81	8	34
1	950	5	0.82	5	55
1	957	7	0.82	7	39
1	961	4	0.83	4	70
1	966	5	0.83	5	55
1	970	4	0.84	4	70
1	975	5	0.84	5	55
1	980	5	0.85	5	55
1	985	5	0.85	5	55
1	989	4	0.85	4	70
2	996	7	0.86	4	80



Remarks:
CBR correlation based on the relationship Log10 (CBR) = 2.48 - 1.057 * Log10 (mm/blow) developed by TRL taken from Highways England CS229: Data for Pavement Assessment (2020).

CONTRACT	CHECKED
36253	**JH**

Geotechnical Enigneering Limited

DYNAMIC CONE PENETROMETER TESTING

DC3-DCP12

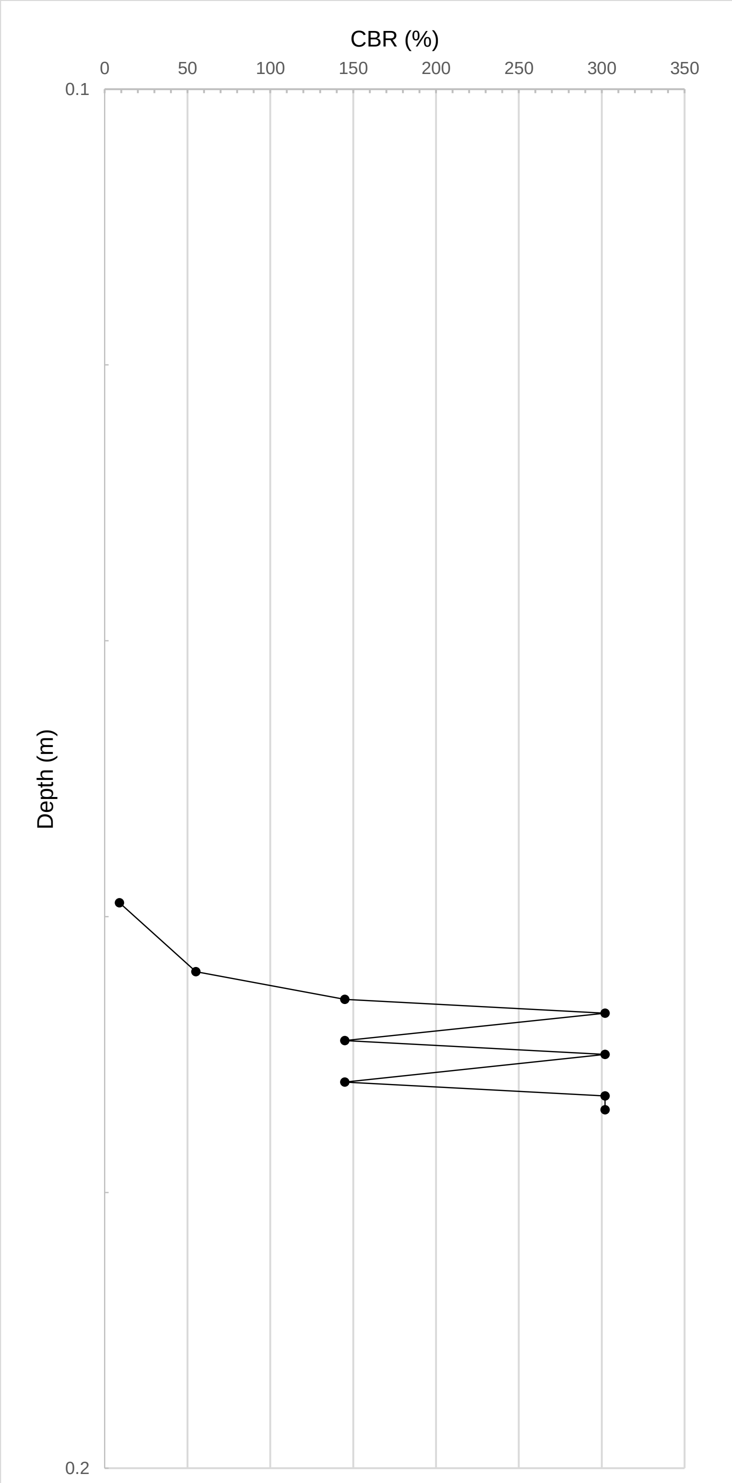
CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

DATE 22/01/2021

Initial Scale reading (mm) 81 Datum bgl (mm) 130

no. of blows	Scale reading (mm)	Penetration Increment (mm)	Depth bgl (m)	DCP (mm/blow)	CBR (%)
1	110	29	0.16	29	9
1	115	5	0.16	5	55
1	117	2	0.17	2	145
1	118	1	0.17	1	302
1	120	2	0.17	2	145
1	121	1	0.17	1	302
1	123	2	0.17	2	145
1	124	1	0.17	1	302
1	125	1	0.17	1	302

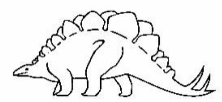


Remarks:
CBR correlation based on the relationship Log10 (CBR) = 2.48 - 1.057 * Log10 (mm/blow) developed by TRL taken from Highways England CS229: Data for Pavement Assessment (2020).

CONTRACT	CHECKED
36253	**JH**

Geotechnical Enigneering Limited

DYNAMIC CONE PENETROMETER TESTING



CLIENT VANTAGE DATA CENTRES UK

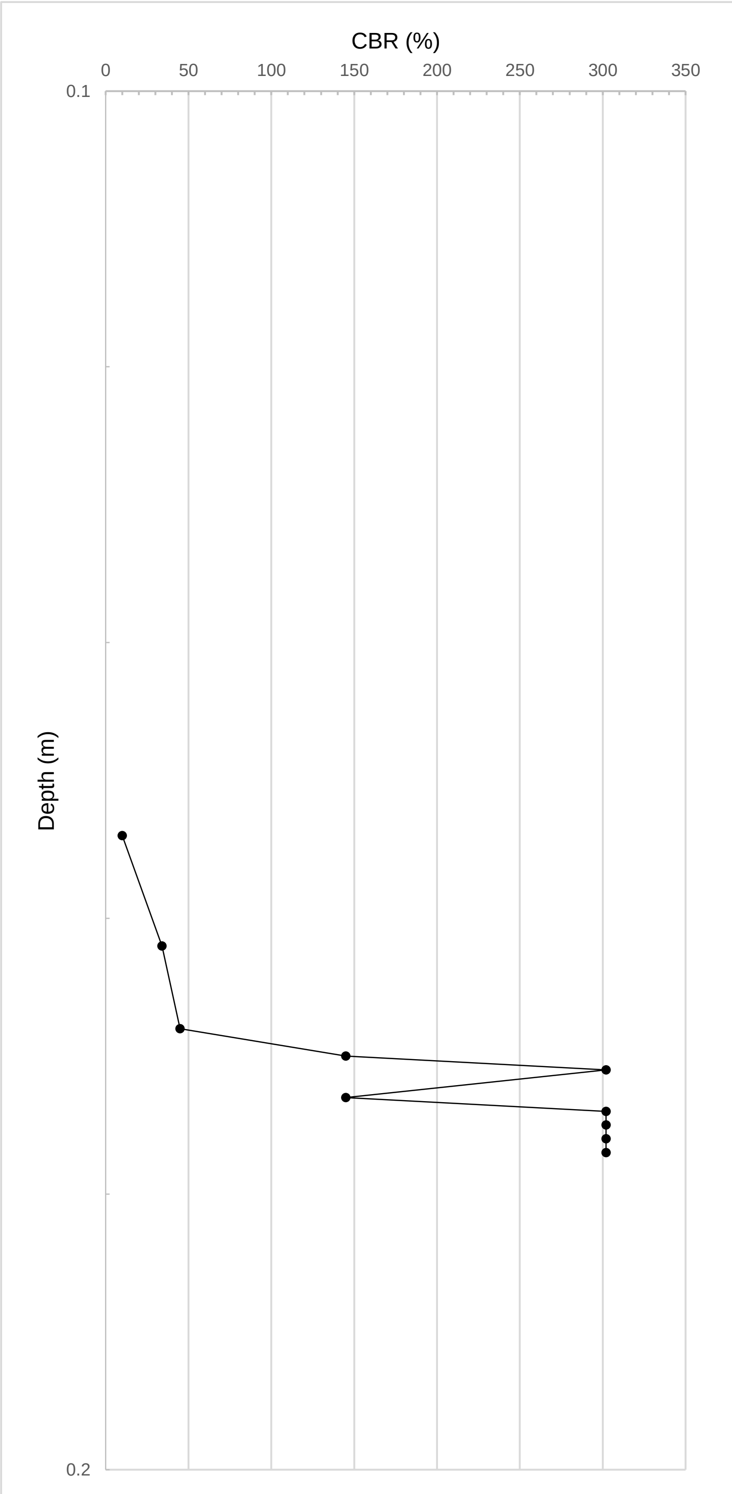
DC3-DCP12A

SITE IMPERIAL PARK DC3

DATE 22/01/2021

Initial Scale reading (mm) 82 Datum bgl (mm) 130

no. of blows	Scale reading (mm)	Penetration Increment (mm)	Depth bgl (m)	DCP (mm/blow)	CBR (%)
1	106	24	0.15	24	10
1	114	8	0.16	8	34
1	120	6	0.17	6	45
1	122	2	0.17	2	145
1	123	1	0.17	1	302
1	125	2	0.17	2	145
1	126	1	0.17	1	302
1	127	1	0.18	1	302
1	128	1	0.18	1	302



Remarks:
CBR correlation based on the relationship Log10 (CBR) = 2.48 - 1.057 * Log10 (mm/blow) developed by TRL taken from Highways England CS229: Data for Pavement Assessment (2020).

CONTRACT	CHECKED
36253	**JH**

APPENDIX B

MONITORING DATA

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: VANTAGE DATA CENTRES UK

SITE: IMPERIAL PARK DC3

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	termperature (°C)	water level (m - bgl)	remarks
DC3_BH01	12/02/2021 10:41	1031	-7								-1.2			
DC3_BH01	12/02/2021 10:42	1030	-7								-1.2			
DC3_BH01	12/02/2021 10:43	1030	-7								-1.1			
DC3_BH01	12/02/2021 10:44	1029	-7								-1.2			
DC3_BH01	12/02/2021 10:45	1029	-7								-1.2			
DC3_BH01	12/02/2021 10:46			0.5	0.0	10.2	0.0	40	397	5.0				
DC3_BH01	12/02/2021 10:47			0.5	0.0	10.6	0.0	60	402	4.6				
DC3_BH01	12/02/2021 10:48			0.5	0.0	11.4	0.0	60	366	4.4				
DC3_BH01	12/02/2021 10:49			0.4	0.0	12.1	0.0	60	352	4.4				
DC3_BH01	12/02/2021 10:50			0.4	0.0	12.2	0.0	60	380	4.6				
DC3_BH01	12/02/2021 10:51			0.4	0.0	12.2	0.0	70	435	4.9				
DC3_BH01	12/02/2021 10:52			0.4	0.0	12.1	0.0	80	511	5.1				
DC3_BH01	12/02/2021 10:53			0.4	0.0	11.9	0.0	100	570	5.4				
DC3_BH01	12/02/2021 10:54			0.4	0.0	11.9	0.0	110	613	5.3				
DC3_BH01	12/02/2021 10:55			0.3	0.0	12.1	0.0	110	635	5.2				
DC3_BH01	12/02/2021 10:59												2.80	
DC3_BH01	17/02/2021 10:47	1004	0								0.0			

remarks

# denotes results exceeding capacity of gas monitoring equipment

VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene

CONTRACT	CHECKED
36253	**JH**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: VANTAGE DATA CENTRES UK

SITE: IMPERIAL PARK DC3

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	termperature (°C)	water level (m - bgl)	remarks
DC3_BH01	17/02/2021 10:48	1004	0								0.0			
DC3_BH01	17/02/2021 10:49	1004	0								0.0			
DC3_BH01	17/02/2021 10:50	1004	0								0.0			
DC3_BH01	17/02/2021 10:51	1003	0								0.0			
DC3_BH01	17/02/2021 10:52	1003	0								0.0			
DC3_BH01	17/02/2021 12:30			0.0	0.0	12.3	0.0	50	485	4.4				
DC3_BH01	17/02/2021 12:31			0.0	0.0	12.2	0.0	90	589	4.4				
DC3_BH01	17/02/2021 12:32			0.0	0.0	14.5	0.0	90	456	3.2				
DC3_BH01	17/02/2021 12:33			0.0	0.0	14.7	0.0	70	345	2.5				
DC3_BH01	17/02/2021 12:34			0.0	0.0	15.2	0.0	60	295	2.2				
DC3_BH01	17/02/2021 12:35			0.0	0.0	15.5	0.0	50	241	1.8				
DC3_BH01	17/02/2021 12:40												2.37	
DC3_BH01	03/03/2021 09:35	1027	-186								-12.7	4		
DC3_BH01	03/03/2021 09:36	1027	-153								-11.1			
DC3_BH01	03/03/2021 09:37	1027	-127								-9.8			
DC3_BH01	03/03/2021 09:38	1027	-120								-9.1			
DC3_BH01	03/03/2021 09:39	1027	-168								-11.7			

remarks	CONTRACT	CHECKED
# denotes results exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene	**36253**	**JH**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: VANTAGE DATA CENTRES UK

SITE: IMPERIAL PARK DC3

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	termperature (°C)	water level (m - bgl)	remarks
DC3_BH01	03/03/2021 09:40			0.9	0.0	17.0	0.0	0	10	1.1				
DC3_BH01	03/03/2021 09:41			1.0	0.0	16.0	0.0	0	10	1.2				
DC3_BH01	03/03/2021 09:42			0.9	0.0	16.2	0.0	0	0	1.0				
DC3_BH01	03/03/2021 09:43			0.8	0.0	16.3	0.0	0	0	0.9				
DC3_BH01	03/03/2021 09:44			0.8	0.0	16.4	0.0	0	0	0.7				
DC3_BH01	03/03/2021 09:49												2.95	
DC3_BH01	13/04/2021 12:56	1034	-7								-1.3	12		
DC3_BH01	13/04/2021 12:57	1034	-7								-1.2	12		
DC3_BH01	13/04/2021 12:58	1034	-7								-1.1	12		
DC3_BH01	13/04/2021 12:59	1035	-7								-1.1	12		
DC3_BH01	13/04/2021 13:00	1035	-7								-1.2	12		
DC3_BH01	13/04/2021 13:01	1035	-7								-1.1	12		
DC3_BH01	13/04/2021 13:04									10.9				Max
DC3_BH01	13/04/2021 13:10									8.8				Steady
DC3_BH01	13/04/2021 13:12			0.1	0.0	20.1	0.0	0	0					
DC3_BH01	13/04/2021 13:13			0.6	0.0	13.0	0.0	0	0					
DC3_BH01	13/04/2021 13:14			0.5	0.0	12.8	0.0	0	0					

remarks

# denotes results exceeding capacity of gas monitoring equipment

VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene

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Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: VANTAGE DATA CENTRES UK

SITE: IMPERIAL PARK DC3

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	termperature (°C)	water level (m - bgl)	remarks
DC3_BH01	13/04/2021 13:15			0.5	0.0	13.4	0.0	0	0					
DC3_BH01	13/04/2021 13:16			0.4	0.0	13.9	0.0	0	0					
DC3_BH01	13/04/2021 13:17			0.4	0.0	13.9	0.0	0	0					
DC3_BH01	13/04/2021 13:18												3.24	

remarks

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VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene

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GAS AND GROUNDWATER LEVELS

CLIENT: VANTAGE DATA CENTRES UK

SITE: IMPERIAL PARK DC3

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	termperature (°C)	water level (m - bgl)	remarks
DC3_BH03	12/02/2021 09:32	1031	-10								-1.6	1		
DC3_BH03	12/02/2021 09:33	1031	-10								-1.6	1		
DC3_BH03	12/02/2021 09:34	1031	-9								-1.6	1		
DC3_BH03	12/02/2021 09:35	1031	-9								-1.6	1		
DC3_BH03	12/02/2021 09:36	1031	-9								-1.6	1		
DC3_BH03	12/02/2021 09:38			0.1	0.0	18.5	0.0	40	440	0.8				
DC3_BH03	12/02/2021 09:39			0.1	0.0	18.8	0.0	60	449	0.7				
DC3_BH03	12/02/2021 09:40			0.1	0.0	19.0	0.0	70	428	0.6				
DC3_BH03	12/02/2021 09:41			0.1	0.0	19.0	0.0	70	398	0.5				
DC3_BH03	12/02/2021 09:42			0.1	0.0	19.1	0.0	60	369	0.4				
DC3_BH03	12/02/2021 11:09			0.1	0.0	18.2	0.0	80	527	1.6				
DC3_BH03	12/02/2021 11:10			0.1	0.0	18.5	0.0	90	536	1.6				
DC3_BH03	12/02/2021 11:11			0.1	0.0	18.7	0.0	100	518	1.6				
DC3_BH03	12/02/2021 11:12			0.1	0.0	18.8	0.0	100	502	1.6				
DC3_BH03	12/02/2021 11:13			0.1	0.0	18.8	0.0	100	476	1.5				
DC3_BH03	12/02/2021 11:14			0.1	0.0	18.9	0.0	90	456	1.5				
DC3_BH03	12/02/2021 11:15			0.1	0.0	19.0	0.0	90	438	1.5				

remarks

# denotes results exceeding capacity of gas monitoring equipment

VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene

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GAS AND GROUNDWATER LEVELS

CLIENT: VANTAGE DATA CENTRES UK

SITE: IMPERIAL PARK DC3

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	termperature (°C)	water level (m - bgl)	remarks
DC3_BH03	12/02/2021 11:16			0.1	0.0	19.0	0.0	80	421	1.4				
DC3_BH03	12/02/2021 11:17			0.1	0.0	19.0	0.0	80	408	1.4				
DC3_BH03	12/02/2021 11:18			0.1	0.0	19.1	0.0	80	390	1.3				
DC3_BH03	12/02/2021 11:19			0.0	0.0	19.1	0.0	70	376	1.3				
DC3_BH03	12/02/2021 11:20			0.0	0.0	19.1	0.0	70	359	1.2				
DC3_BH03	12/02/2021 11:24												3.42	
DC3_BH03	17/02/2021 09:58	1004	-203								-20.2			
DC3_BH03	17/02/2021 09:59	1004	-203								-20.2			
DC3_BH03	17/02/2021 10:00	1004	-69								-11.1			
DC3_BH03	17/02/2021 10:01	1004	-17								-3.3			
DC3_BH03	17/02/2021 10:02	1004	0								0.0			
DC3_BH03	17/02/2021 10:11			0.0	0.0	19.8	0.0	25	223	0.1				
DC3_BH03	17/02/2021 10:12			0.0	0.0	19.5	0.0	60	411	0.0				
DC3_BH03	17/02/2021 10:13			0.1	0.0	19.4	0.0	80	530	0.2				
DC3_BH03	17/02/2021 10:14			0.1	0.0	19.3	0.0	110	625	0.3				
DC3_BH03	17/02/2021 10:15			0.1	0.0	19.2	0.0	140	729	0.4				
DC3_BH03	17/02/2021 10:16			0.0	0.0	20.0	0.0	100	400	0.2				

remarks

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VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene

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GAS AND GROUNDWATER LEVELS

CLIENT: VANTAGE DATA CENTRES UK

SITE: IMPERIAL PARK DC3

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	termperature (°C)	water level (m - bgl)	remarks
DC3_BH03	17/02/2021 10:17			0.0	0.0	20.0	0.0	80	340	0.2				
DC3_BH03	17/02/2021 10:18			0.0	0.0	19.9	0.0	70	329	0.1				
DC3_BH03	17/02/2021 10:19			9.0	0.0	19.9	0.0	60	315	0.1				
DC3_BH03	17/02/2021 10:20			0.0	0.0	20.0	0.0	60	299	0.1				
DC3_BH03	17/02/2021 10:21			0.0	0.0	20.0	0.0	60	290	0.1				
DC3_BH03	17/02/2021 10:22			0.0	0.0	20.0	0.0	60	271	0.1				
DC3_BH03	17/02/2021 10:23			0.0	0.0	20.0	0.0	50	255	0.0				
DC3_BH03	17/02/2021 10:24			0.0	0.0	20.0	0.0	50	245	0.0				
DC3_BH03	17/02/2021 10:25			0.0	0.0	20.1	0.0	50	230	0.0				
DC3_BH03	17/02/2021 12:44			0.0	0.0	20.3	0.0	25	70	0.0				
DC3_BH03	17/02/2021 12:45			0.0	0.0	20.2	0.0	25	80	0.0				
DC3_BH03	17/02/2021 12:46			0.0	0.0	20.0	0.0	25	170	0.0				
DC3_BH03	17/02/2021 12:47			0.0	0.0	19.8	0.0	30	241	0.0				
DC3_BH03	17/02/2021 12:48			0.0	0.0	19.7	0.0	50	349	0.1				
DC3_BH03	17/02/2021 12:49			0.0	0.0	19.7	0.0	70	479	0.1				
DC3_BH03	17/02/2021 12:50												3.38	
DC3_BH03	03/03/2021 09:08	1027	-216								-15.4	4		

remarks

# denotes results exceeding capacity of gas monitoring equipment

VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene

CONTRACT	CHECKED
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GAS AND GROUNDWATER LEVELS

CLIENT: VANTAGE DATA CENTRES UK

SITE: IMPERIAL PARK DC3

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	termperature (°C)	water level (m - bgl)	remarks
DC3_BH03	03/03/2021 09:09	1027	-189								-13.5			
DC3_BH03	03/03/2021 09:10	1027	-184								-13.0			
DC3_BH03	03/03/2021 09:11	1027	-184								-13.0			
DC3_BH03	03/03/2021 09:12	1027	-182								-12.9			
DC3_BH03	03/03/2021 09:13			0.3	0.0	18.9	0.0	0	17	0.0				
DC3_BH03	03/03/2021 09:14			0.2	0.0	19.4	0.0	0	53	0.0				
DC3_BH03	03/03/2021 09:15			0.2	0.0	19.5	0.0	0	49	0.0				
DC3_BH03	03/03/2021 09:16			0.1	0.0	19.6	0.0	0	43	0.0				
DC3_BH03	03/03/2021 09:17			0.1	0.0	19.8	0.0	0	33	0.0				
DC3_BH03	03/03/2021 09:22												3.60	
DC3_BH03	13/04/2021 15:07	1031	-6								-0.9	12		
DC3_BH03	13/04/2021 15:08	1031	-7								-1.0	12		
DC3_BH03	13/04/2021 15:09	1031	-7								-1.0	12		
DC3_BH03	13/04/2021 15:10	1031	-6								-1.0	12		
DC3_BH03	13/04/2021 15:11	1031	-6								-1.0	12		
DC3_BH03	13/04/2021 15:12	1031	-6								-1.0	12		
DC3_BH03	13/04/2021 15:15									4.0				Max

remarks

# denotes results exceeding capacity of gas monitoring equipment

VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene

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Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: VANTAGE DATA CENTRES UK

SITE: IMPERIAL PARK DC3

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	termperature (°C)	water level (m - bgl)	remarks
DC3_BH03	13/04/2021 15:20									3.7				Steady
DC3_BH03	13/04/2021 15:22			0.3	0.0	17.9	0.0	0	0					
DC3_BH03	13/04/2021 15:23			0.4	0.0	14.6	0.0	0	0					
DC3_BH03	13/04/2021 15:24			0.4	0.0	14.0	0.0	0	0					
DC3_BH03	13/04/2021 15:25			0.4	0.0	13.9	0.0	0	0					
DC3_BH03	13/04/2021 15:26			0.4	0.0	12.9	0.0	0	0					
DC3_BH03	13/04/2021 15:27			0.4	0.0	13.6	0.0	0	0					
DC3_BH03	13/04/2021 15:28												3.93	

remarks

# denotes results exceeding capacity of gas monitoring equipment

VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene

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GAS AND GROUNDWATER LEVELS

CLIENT: VANTAGE DATA CENTRES UK

SITE: IMPERIAL PARK DC3

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	termperature (°C)	water level (m - bgl)	remarks
DC3_BH05	12/02/2021 10:16	1031	-358								-26.8			
DC3_BH05	12/02/2021 10:17	1031	-240								-16.6			
DC3_BH05	12/02/2021 10:18	1031	-203								-14.5			
DC3_BH05	12/02/2021 10:19	1031	-172								-12.7			
DC3_BH05	12/02/2021 10:20	1031	-157								-11.5			
DC3_BH05	12/02/2021 10:21	1032	-140								-10.5			
DC3_BH05	12/02/2021 10:22	1032	-107								-9.3			
DC3_BH05	12/02/2021 10:23	1033	-98								-7.9			
DC3_BH05	12/02/2021 10:24	1033	-92								-7.4			
DC3_BH05	12/02/2021 10:25	1033	-76								-6.5			
DC3_BH05	12/02/2021 10:26	1033	-64								-6.8			
DC3_BH05	12/02/2021 10:27	1033	-57								-5.4			
DC3_BH05	12/02/2021 10:28	1033	-52								-5.0			
DC3_BH05	12/02/2021 10:29	1033	-38								-4.2			
DC3_BH05	12/02/2021 10:30	1033	-4								-4.4			
DC3_BH05	12/02/2021 10:32			0.0	0.0	19.2	0.0	0	0	0.0				
DC3_BH05	12/02/2021 10:33			0.0	0.0	19.2	0.0	0	0	0.0				

remarks

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VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene

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GAS AND GROUNDWATER LEVELS

CLIENT: VANTAGE DATA CENTRES UK

SITE: IMPERIAL PARK DC3

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	termperature (°C)	water level (m - bgl)	remarks
DC3_BH05	12/02/2021 10:34			0.0	0.0	19.2	0.0	0	0	0.0				
DC3_BH05	12/02/2021 10:35			0.0	0.0	19.2	0.0	0	0	0.0				
DC3_BH05	12/02/2021 10:36			0.0	0.0	19.2	0.0	0	0	0.0				
DC3_BH05	12/02/2021 10:40												2.16	
DC3_BH05	17/02/2021 11:15	1003	0								0.0			
DC3_BH05	17/02/2021 11:16	1003	0								0.0			
DC3_BH05	17/02/2021 11:17	1003	0								0.0			
DC3_BH05	17/02/2021 11:18	1003	0								0.0			
DC3_BH05	17/02/2021 11:19	1003	0								0.0			
DC3_BH05	17/02/2021 11:20	1003	0								0.0			
DC3_BH05	17/02/2021 11:22			0.0	0.0	20.0	0.0	0	50	0.0				
DC3_BH05	17/02/2021 11:23			0.0	0.0	19.5	0.0	25	140	0.1				
DC3_BH05	17/02/2021 11:24			0.0	0.0	20.3	0.0	25	70	0.0				
DC3_BH05	17/02/2021 11:25			0.0	0.0	20.3	0.0	25	35	0.0				
DC3_BH05	17/02/2021 11:26			0.0	0.0	20.3	0.0	0	30	0.0				
DC3_BH05	17/02/2021 11:27			0.0	0.0	20.3	0.0	0	29	0.0				
DC3_BH05	17/02/2021 11:28			0.0	0.0	20.3	0.0	0	20	0.0				

remarks

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VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene

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GAS AND GROUNDWATER LEVELS

CLIENT: VANTAGE DATA CENTRES UK

SITE: IMPERIAL PARK DC3

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	termperature (°C)	water level (m - bgl)	remarks
DC3_BH05	17/02/2021 11:29			0.0	0.0	20.4	0.0	0	10	0.0				
DC3_BH05	17/02/2021 11:30			0.0	0.0	20.4	0.0	0	10	0.0				
DC3_BH05	17/02/2021 11:31			0.0	0.0	20.4	0.0	0	10	0.0				
DC3_BH05	17/02/2021 11:32			0.0	0.0	20.4	0.0	0	10	0.0				
DC3_BH05	17/02/2021 11:35												2.20	
DC3_BH05	03/03/2021 09:55	1027	-423								-29.6	4		
DC3_BH05	03/03/2021 09:56	1027	-308								-21.0			
DC3_BH05	03/03/2021 09:57	1027	-273								-18.4			
DC3_BH05	03/03/2021 09:58	1027	-265								-18.1			
DC3_BH05	03/03/2021 09:59	1027	-275								-18.5			
DC3_BH05	03/03/2021 10:00			1.1	0.0	18.4	0.0	30	432	0.8				
DC3_BH05	03/03/2021 10:01			1.3	0.0	17.9	0.0	100	722	0.9				
DC3_BH05	03/03/2021 10:02			1.2	0.0	18.2	0.0	130	709	1.1				
DC3_BH05	03/03/2021 10:03			1.1	0.0	18.3	0.0	120	685	1.1				
DC3_BH05	03/03/2021 10:04			1.2	0.0	18.4	0.0	120	670	1.1				
DC3_BH05	03/03/2021 10:09												2.75	
DC3_BH05	13/04/2021 16:05	1030	-10								-1.5	12		

remarks

# denotes results exceeding capacity of gas monitoring equipment

VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene

CONTRACT	CHECKED
36253	**JH**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: VANTAGE DATA CENTRES UK

SITE: IMPERIAL PARK DC3

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	termperature (°C)	water level (m - bgl)	remarks
DC3_BH05	13/04/2021 16:06	1030	-11								-1.8	12		
DC3_BH05	13/04/2021 16:07	1030	-11								-1.8	12		
DC3_BH05	13/04/2021 16:08	1030	-11								-1.7	12		
DC3_BH05	13/04/2021 16:09	1030	-11								-1.7	12		
DC3_BH05	13/04/2021 16:10	1030	-11								-1.7	12		
DC3_BH05	13/04/2021 16:12									32.3				Max
DC3_BH05	13/04/2021 16:17									32.1				Steady
DC3_BH05	13/04/2021 16:20			3.0	0.0	16.1	0.0	0	0					
DC3_BH05	13/04/2021 16:21			3.2	0.0	9.8	0.0	0	0					
DC3_BH05	13/04/2021 16:22			3.2	0.0	9.7	0.0	0	0					
DC3_BH05	13/04/2021 16:23			3.2	0.0	9.7	0.0	0	0					
DC3_BH05	13/04/2021 16:24			3.2	0.0	9.6	0.0	0	0					
DC3_BH05	13/04/2021 16:25			3.2	0.0	9.6	0.0	0	0					
DC3_BH05	13/04/2021 16:28												3.14	

remarks

# denotes results exceeding capacity of gas monitoring equipment

VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene

CONTRACT	CHECKED
36253	**JH**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: VANTAGE DATA CENTRES UK

SITE: IMPERIAL PARK DC3

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	termperature (°C)	water level (m - bgl)	remarks
DC3_BH07	12/02/2021 09:54	1030	-10								-1.5			
DC3_BH07	12/02/2021 09:55	1030	-5								-2.6			
DC3_BH07	12/02/2021 09:56	1030	-9								-1.8			
DC3_BH07	12/02/2021 09:57	1030	-11								-1.8			
DC3_BH07	12/02/2021 09:58	1030	-12								-1.9			
DC3_BH07	12/02/2021 09:59	1030	-7								-1.2			
DC3_BH07	12/02/2021 10:00	1030	-12								-1.9			
DC3_BH07	12/02/2021 10:01	1030	-8								-1.8			
DC3_BH07	12/02/2021 10:02	1030	-11								-1.8			
DC3_BH07	12/02/2021 10:05			1.5	0.0	16.1	0.0	0	17	1.5				
DC3_BH07	12/02/2021 10:06			1.5	0.0	15.9	0.0	0	15	1.5				
DC3_BH07	12/02/2021 10:07			1.5	0.0	15.9	0.0	0	11	1.5				
DC3_BH07	12/02/2021 10:08			1.5	0.0	15.9	0.0	0	11	1.5				
DC3_BH07	12/02/2021 10:09			1.6	0.0	15.8	0.0	0	11	1.5				
DC3_BH07	12/02/2021 10:13												4.63	
DC3_BH07	17/02/2021 09:06	1004	0								0.0			
DC3_BH07	17/02/2021 09:07	1004	0								0.0			

remarks

# denotes results exceeding capacity of gas monitoring equipment

VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene

CONTRACT	CHECKED
36253	**JH**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: VANTAGE DATA CENTRES UK

SITE: IMPERIAL PARK DC3

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	termperature (°C)	water level (m - bgl)	remarks
DC3_BH07	17/02/2021 09:08	1004	0								0.0			
DC3_BH07	17/02/2021 09:09	1004	0								0.0			
DC3_BH07	17/02/2021 09:10	1004	0								0.0			
DC3_BH07	17/02/2021 09:11	1004	0								0.0			
DC3_BH07	17/02/2021 09:14			1.2	0.0	17.1	0.0	0	0	0.4				
DC3_BH07	17/02/2021 09:15			1.2	0.0	17.1	0.0	0	0	0.4				
DC3_BH07	17/02/2021 09:16			1.7	0.0	15.9	0.0	0	0	0.5				
DC3_BH07	17/02/2021 09:17			1.7	0.0	15.9	0.0	0	0	0.5				
DC3_BH07	17/02/2021 09:18			1.7	0.0	15.8	0.0	0	0	0.5				
DC3_BH07	17/02/2021 09:19			1.7	0.0	15.8	0.0	0	0	0.5				
DC3_BH07	17/02/2021 09:20			1.8	0.0	15.8	0.0	0	0	0.5				
DC3_BH07	17/02/2021 09:21			1.8	0.0	15.8	0.0	0	0	0.5				
DC3_BH07	17/02/2021 09:22			1.8	0.0	15.7	0.0	0	0	0.4				
DC3_BH07	17/02/2021 09:23			1.8	0.0	15.7	0.0	0	0	0.4				
DC3_BH07	17/02/2021 09:24			1.8	0.0	15.7	0.0	0	0	0.4				
DC3_BH07	17/02/2021 09:26												4.72	
DC3_BH07	03/03/2021 08:26	1027	-147								-10.6	4		

remarks

# denotes results exceeding capacity of gas monitoring equipment

VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene

CONTRACT	CHECKED
36253	**JH**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: VANTAGE DATA CENTRES UK

SITE: IMPERIAL PARK DC3

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	termperature (°C)	water level (m - bgl)	remarks
DC3_BH07	03/03/2021 08:27	1027	-218								-15.0			
DC3_BH07	03/03/2021 08:28	1027	-228								-15.6			
DC3_BH07	03/03/2021 08:29	1027	-244								-15.8			
DC3_BH07	03/03/2021 08:30	1027	-241								-16.1			
DC3_BH07	03/03/2021 08:31			1.7	0.0	17.1	0.0	0	0	0.0				
DC3_BH07	03/03/2021 08:32			1.7	0.0	16.5	0.0	0	0	0.1				
DC3_BH07	03/03/2021 08:33			1.7	0.0	16.4	0.0	0	0	0.0				
DC3_BH07	03/03/2021 08:34			1.8	0.0	16.4	0.0	0	0	0.0				
DC3_BH07	03/03/2021 08:35			1.8	0.0	16.3	0.0	0	0	0.0				
DC3_BH07	03/03/2021 08:39												4.86	
DC3_BH07	13/04/2021 16:32	1028	-7								-1.0	12		
DC3_BH07	13/04/2021 16:33	1028	-7								-1.1	12		
DC3_BH07	13/04/2021 16:34	1028	-7								-1.1	12		
DC3_BH07	13/04/2021 16:35	1028	-7								-1.1	12		
DC3_BH07	13/04/2021 16:36	1028	-7								-1.1	12		
DC3_BH07	13/04/2021 16:37	1028	-7								-1.1	12		
DC3_BH07	13/04/2021 16:40									8.2				Max

remarks

# denotes results exceeding capacity of gas monitoring equipment

VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene

CONTRACT	CHECKED
36253	**JH**

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT: VANTAGE DATA CENTRES UK

SITE: IMPERIAL PARK DC3

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H2O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	termperature (°C)	water level (m - bgl)	remarks
DC3_BH07	13/04/2021 16:45									6.1				Steady
DC3_BH07	13/04/2021 16:47			0.4	0.0	16.7	0.0	0	0					
DC3_BH07	13/04/2021 16:48			3.5	0.0	14.4	0.0	0	0					
DC3_BH07	13/04/2021 16:49			3.6	0.0	14.3	0.0	0	0					
DC3_BH07	13/04/2021 16:50			3.6	0.0	14.1	0.0	0	0					
DC3_BH07	13/04/2021 16:51			3.6	0.0	14.3	0.0	0	0					
DC3_BH07	13/04/2021 16:52			3.6	0.0	14.2	0.0	0	0					
DC3_BH07	13/04/2021 16:55												5.27	

remarks

# denotes results exceeding capacity of gas monitoring equipment

VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene

CONTRACT	CHECKED
36253	**JH**

APPENDIX C

LABORATORY TESTING

2718

GEOTECHNICAL ENGINEERING LIMITED

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Version No.	1
Page No.	1 of 11
Date of Issue	23/02/2021

For the attention of Imogen Soley / Matthew Hollow

TEST REPORT

PROJECT/SITE	DC3 IMPERIAL PARK	Samples received	26/01/2021
GEL REPORT NUMBER	36253	Schedule received	01/02/2021
Your ref/PO:		Testing commenced	05/02/2021
Test report refers to	Schedule A	Status	Final

SUMMARY OF RESULTS ATTACHED

TEST METHOD & DESCRIPTION	QUANTITY	ACCREDITED TEST
BS EN ISO 17892-4: 2016: 5.2, Particle Size Distribution - Wet Sieve	6	YES
Organic Matter Content (Subcontracted)	3	YES
BRE SD1 Suite C (Subcontracted)	2	YES

Remarks	Approved Signatories:
This report may not be partially reproduced without written permission from this laboratory.	**T Best (Deputy Laboratory Manager)** E Crimp (Senior Engineer) J Hanson (Director) N Parry (Director)
The results reported relate to samples received in the laboratory	

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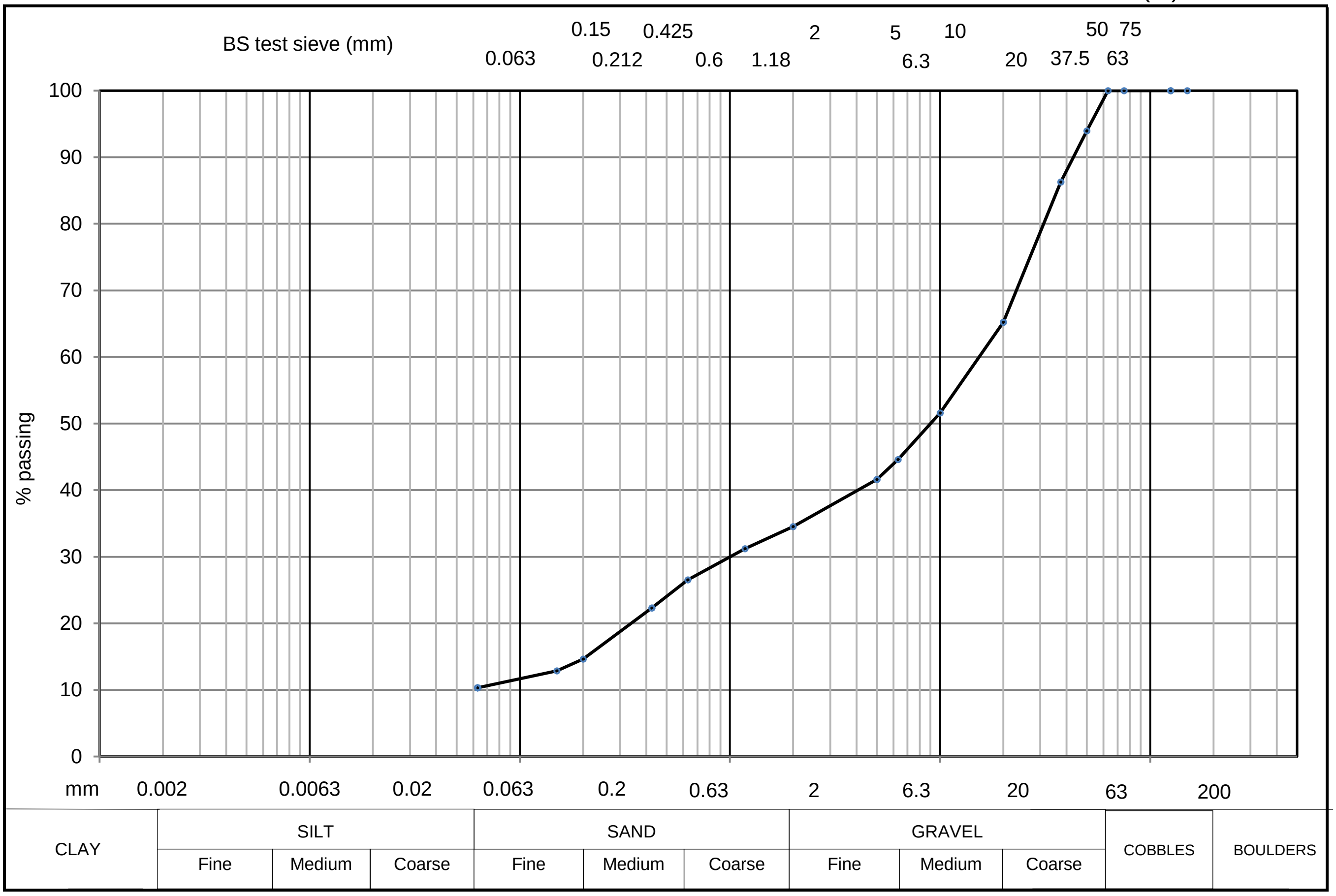
Payments: Geotechnical Engineering Limited
Sort code: 16-22-11 **Bank account**: 11125135

Geotechnical Engineering Limited

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_TP03
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	4B
		SAMPLE DEPTH (m)	0.90
DESCRIPTION	Brown clayey very sandy GRAVEL	SPECIMEN TOP (m)	0.90
		SPECIMEN BASE (m)	1.00



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY		150		5	42	20	
SILT							
SILT & CLAY	10	75		2	35	6	
SAND	24						
GRAVEL	65	63	100	1.18	31	2	
COBBLE & BOULDER	0						
test method(s)	5.2	50	94	0.63	27		
test method		37.5	86	0.425	22		
5.2 - sieving		20	65	0.2	15		
5.3 - sedimentation by hydrometer		10	52	0.15	13		
5.4 - sedimentation by pipette		6.3	45	0.063	10		

remarks

# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892

Particle density assigned an assumed value of 2.70 Mg/m3

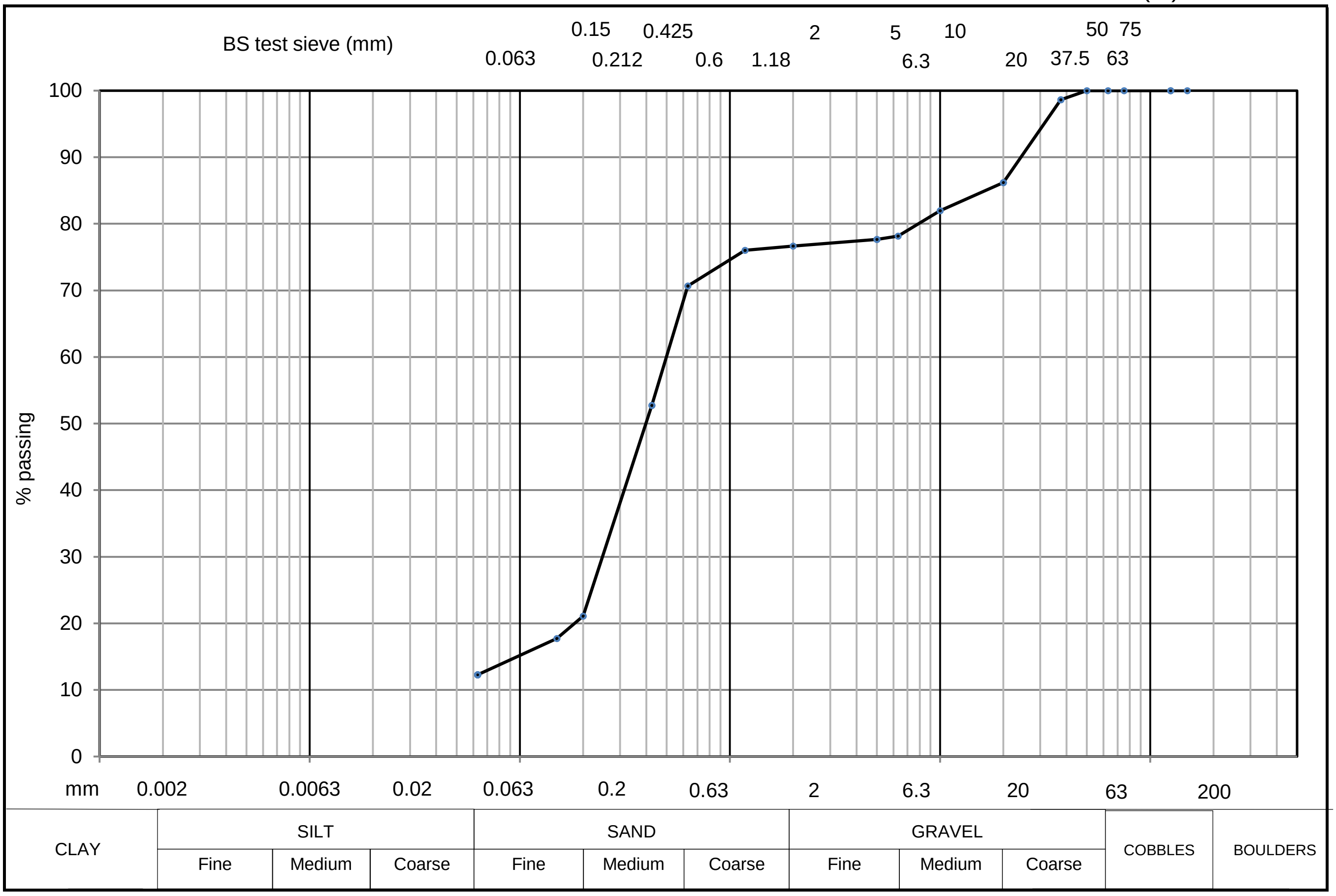
CONTRACT	CHECKED
36253	**TB**

Geotechnical Engineering Limited

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_TP05
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	5B
		SAMPLE DEPTH (m)	1.90
DESCRIPTION	Orangish brown clayey very gravelly SAND	SPECIMEN TOP (m)	1.90
		SPECIMEN BASE (m)	2.00



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY							
SILT		150		5	78	20	
SILT & CLAY	12						
SAND	64	75		2	77	6	
GRAVEL	23						
COBBLE & BOULDER	0	63		1.18	76	2	
test method(s)	5.2	50	100	0.63	71		
test method		37.5	99	0.425	53		
5.2 - sieving		20	86	0.2	21		
5.3 - sedimentation by hydrometer		10	82	0.15	18		
5.4 - sedimentation by pipette		6.3	78	0.063	12		

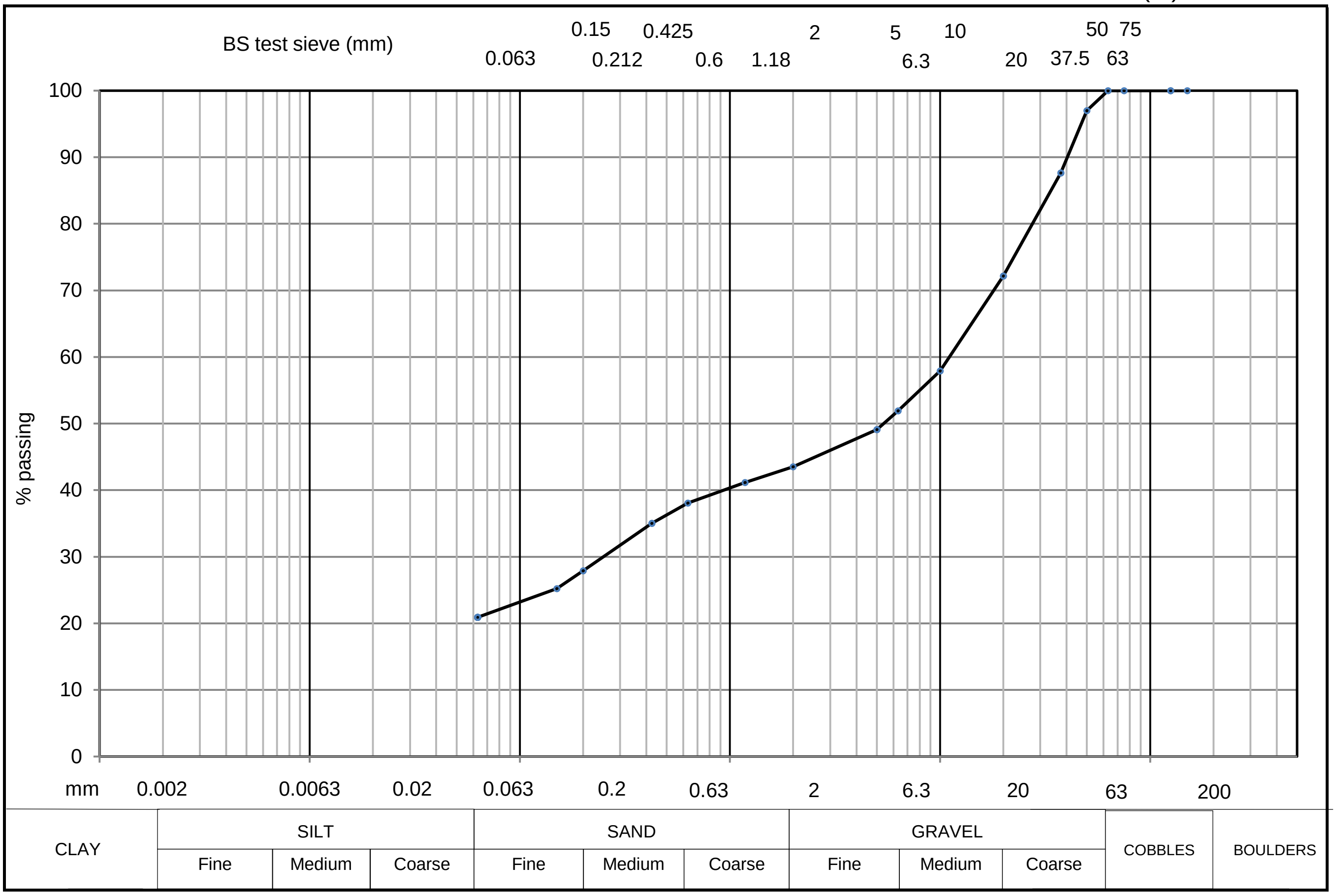
remarks	CONTRACT	CHECKED
# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3	**36253**	**TB**

Geotechnical Engineering Limited

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_TP07
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	3B
		SAMPLE DEPTH (m)	0.70
DESCRIPTION	Orangish brown very clayey very sandy GRAVEL	SPECIMEN TOP (m)	0.70
		SPECIMEN BASE (m)	0.80



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY							
SILT		150		5	49	20	
SILT & CLAY	21						
SAND	23	75		2	44	6	
GRAVEL	56						
COBBLE & BOULDER	0	63	100	1.18	41	2	
test method(s)	5.2	50	97	0.63	38		
test method		37.5	88	0.425	35		
5.2 - sieving		20	72	0.2	28		
5.3 - sedimentation by hydrometer		10	58	0.15	25		
5.4 - sedimentation by pipette		6.3	52	0.063	21		

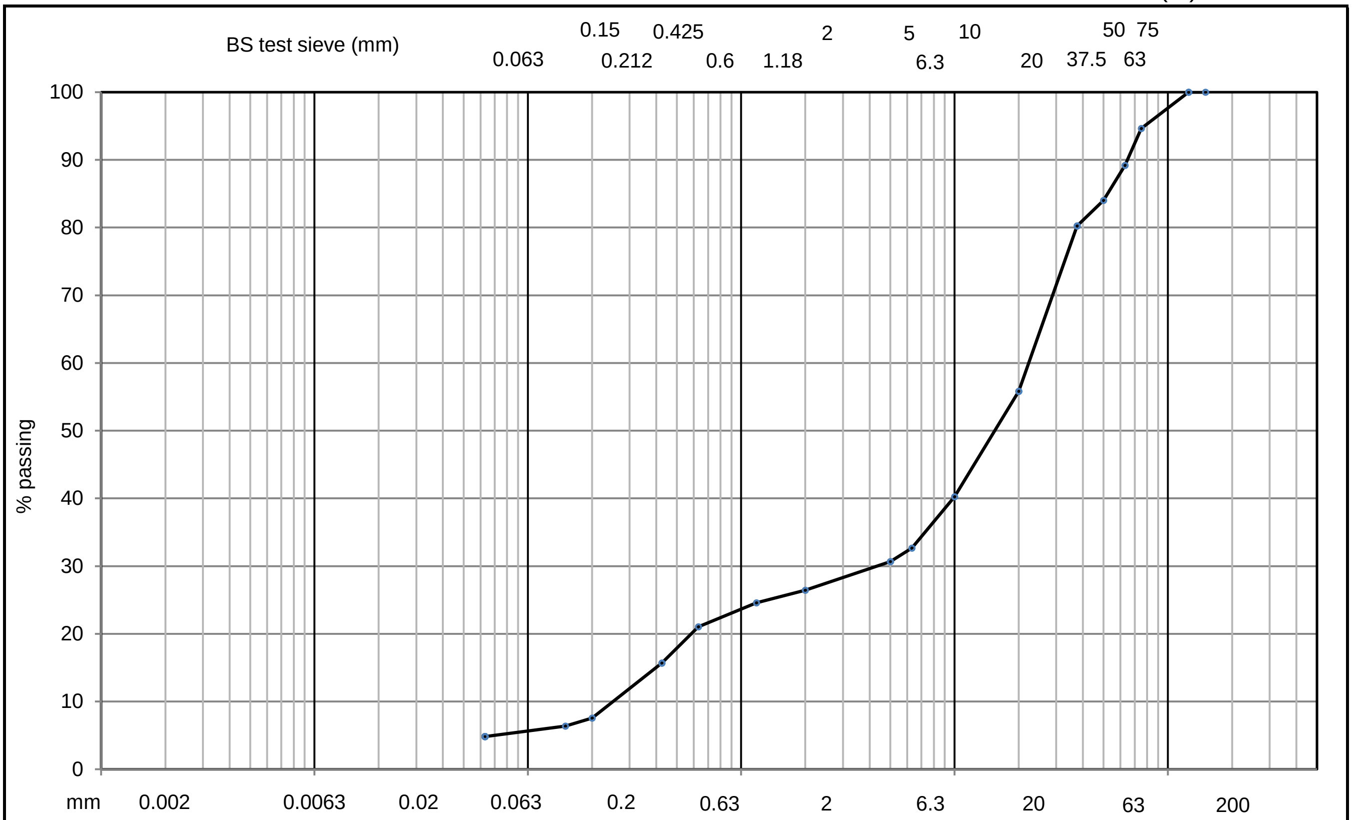
remarks	CONTRACT	CHECKED
# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3	**36253**	**TB**

Geotechnical Engineering Limited

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_TP09
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	3B
		SAMPLE DEPTH (m)	1.10
DESCRIPTION	Brown slightly clayey very sandy GRAVEL with medium cobble content	SPECIMEN TOP (m)	1.10
		SPECIMEN BASE (m)	1.20



CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse		

soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (μm)	% finer
CLAY							
SILT		150	100	5	31	20	
SILT & CLAY	5						
SAND	22	75	95	2	26	6	
GRAVEL	63						
COBBLE & BOULDER	11	63	89	1.18	25	2	
test method(s)	5.2#	50	84	0.63	21		
test method		37.5	80	0.425	16		
5.2 - sieving		20	56	0.2	8		
5.3 - sedimentation by hydrometer		10	40	0.15	6		
5.4 - sedimentation by pipette		6.3	33	0.063	5		

remarks

# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892

Particle density assigned an assumed value of 2.70 Mg/m3

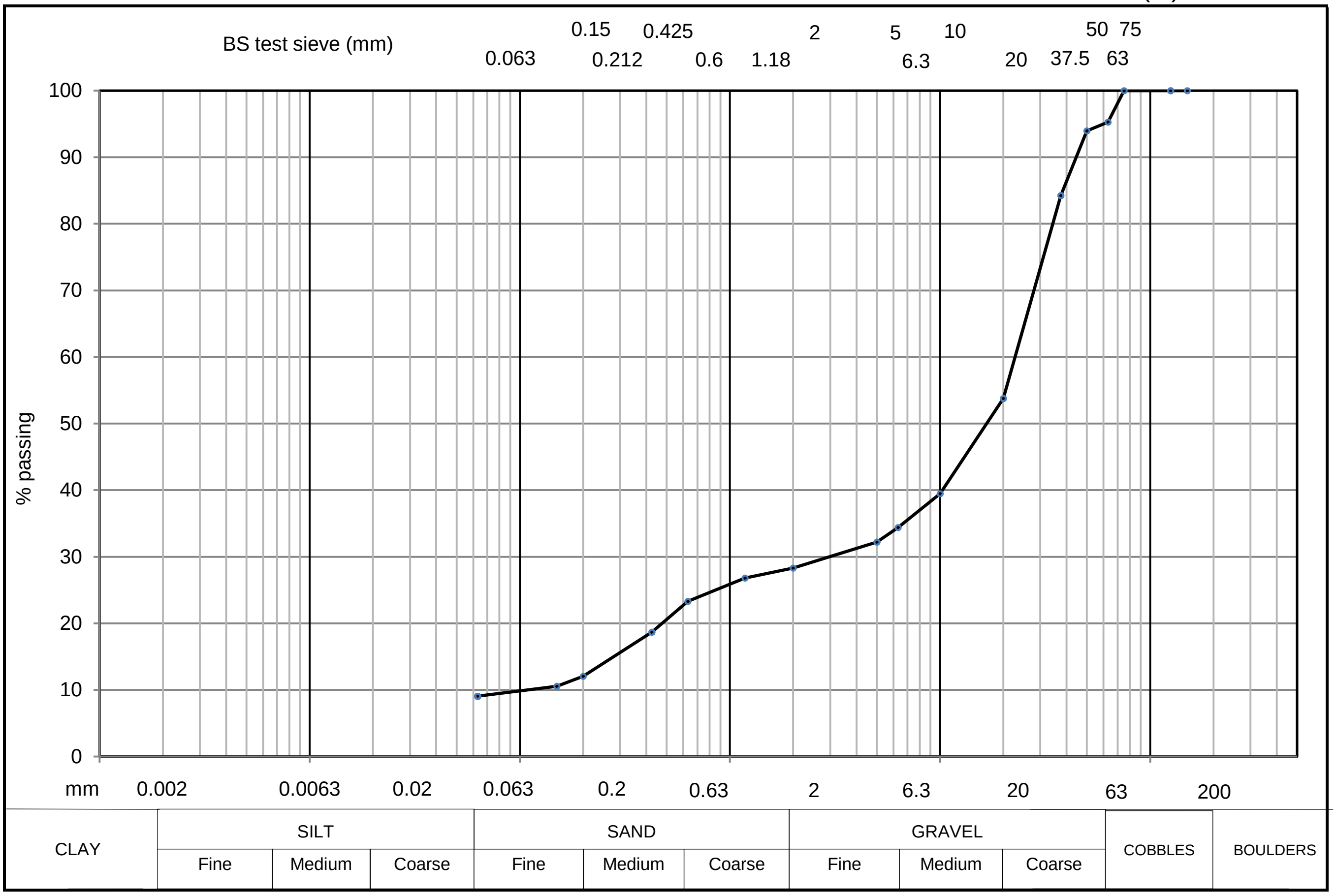
CONTRACT	CHECKED
36253	**TB**

Geotechnical Engineering Limited

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_TP10
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	5B
		SAMPLE DEPTH (m)	2.00
DESCRIPTION	Orangish brown clayey sandy GRAVEL with low cobble content	SPECIMEN TOP (m)	2.00
		SPECIMEN BASE (m)	2.10



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY							
SILT		150		5	32	20	
SILT & CLAY	9						
SAND	19	75	100	2	28	6	
GRAVEL	67						
COBBLE & BOULDER	5	63	95	1.18	27	2	
test method(s)	5.2#	50	94	0.63	23		
test method		37.5	84	0.425	19		
5.2 - sieving		20	54	0.2	12		
5.3 - sedimentation by hydrometer		10	39	0.15	11		
5.4 - sedimentation by pipette		6.3	34	0.063	9		

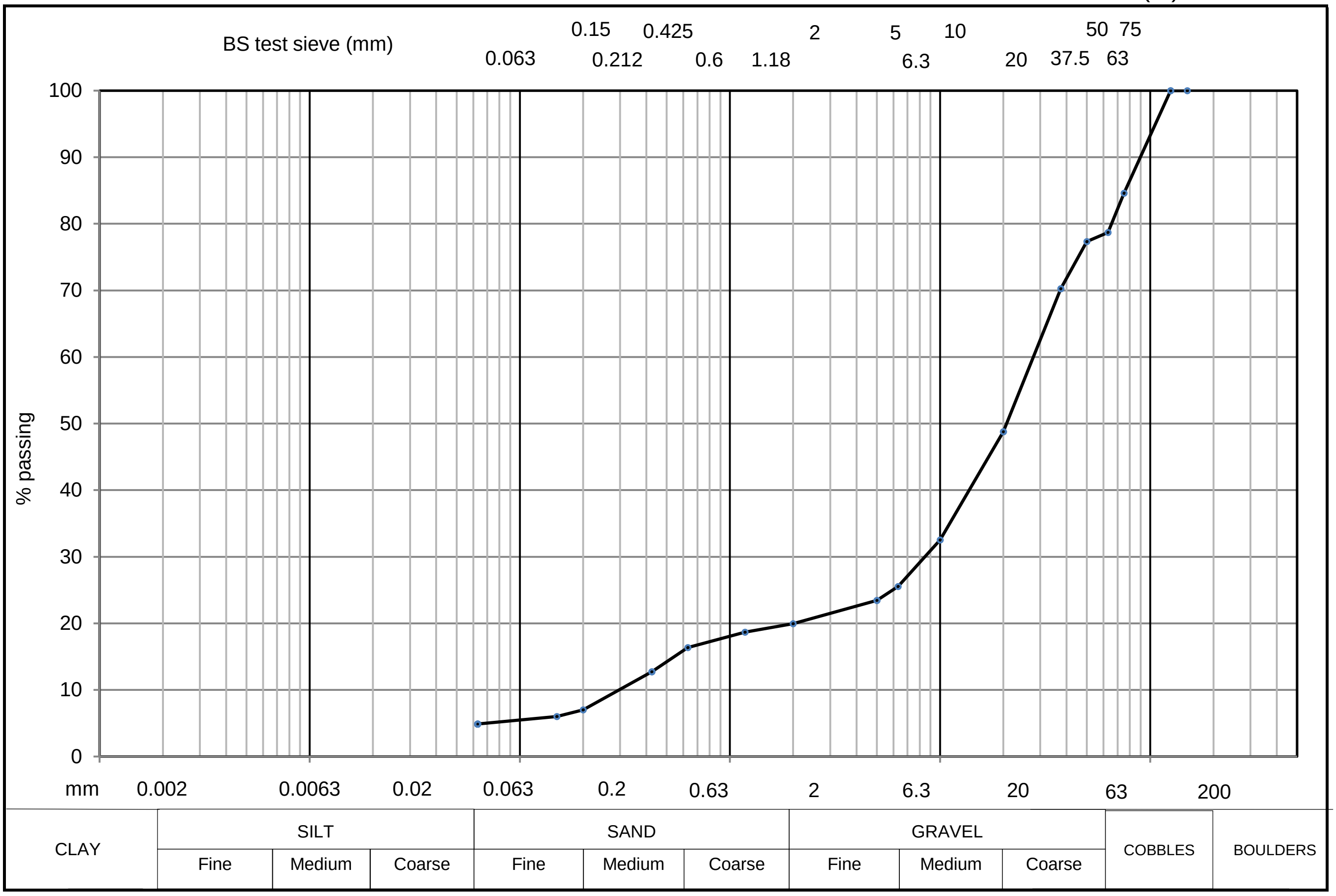
remarks	CONTRACT	CHECKED
# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3	**36253**	**TB**

Geotechnical Engineering Limited

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_TP11
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	3B
		SAMPLE DEPTH (m)	1.40
DESCRIPTION	Brown slightly clayey sandy GRAVEL with high cobble content	SPECIMEN TOP (m)	1.40
		SPECIMEN BASE (m)	1.60



soil type	% fraction
CLAY	
SILT	
SILT & CLAY	5
SAND	15
GRAVEL	59
COBBLE & BOULDER	21
test method(s)	5.2#

test method

5.2 - sieving

5.3 - sedimentation by hydrometer

5.4 - sedimentation by pipette

BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
150	100	5	23	20	
75	85	2	20	6	
63	79	1.18	19	2	
50	77	0.63	16		
37.5	70	0.425	13		
20	49	0.2	7		
10	33	0.15	6		
6.3	26	0.063	5		

remarks

# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892

Particle density assigned an assumed value of 2.70 Mg/m3

CONTRACT	CHECKED
36253	**TB**

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

2183

Final Report

Report No.:	21-03817-1		
Initial Date of Issue:	15-Feb-2021		
Client	Geotechnical Engineering Ltd		
Client Address:	Centurion House Olympus Park Quedgeley Gloucester Gloucestershire GL2 4NF		
Contact(s):	GEL Tom Best		
Project	36253 DC3 Imperial Park		
Quotation No.:		**Date Received:**	10-Feb-2021
Order No.:	36253/TB	**Date Instructed:**	10-Feb-2021
No. of Samples:	4		
Turnaround (Wkdays):	5	**Results Due:**	16-Feb-2021
Date Approved:	15-Feb-2021		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Results - Soil

Project: 36253 DC3 Imperial Park

Client: Geotechnical Engineering Ltd				**Chemtest Job No.:**	21-03817	21-03817	21-03817	21-03817
Quotation No.:				**Chemtest Sample ID.:**	1138691	1138692	1138693	1138694
Order No.: 36253/TB				Client Sample Ref.:	4	3	3	4
				Sample Location:	DC3_TP03	DC3_TP07	DC3_TP09	DC3_TP11
				Sample Type:	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	0.9	0.7	1.1	1.4
				Bottom Depth (m):	1	0.9	1.2	1.6
				Date Sampled:	05-Feb-2021	05-Feb-2021	05-Feb-2021	05-Feb-2021
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Moisture	N	2030	%	0.020	4.6	13	2.2	9.5
pH	U	2010		4.0		8.4	8.9	
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010		< 0.010	0.013	
Total Sulphur	U	2175	%	0.010		< 0.010	0.012	
Sulphate (Acid Soluble)	U	2430	%	0.010		0.012	0.014	
Organic Matter	U	2625	%	0.40	2.4	0.76		< 0.40

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.

Report Information

Key	
U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operation procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

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GEOTECHNICAL ENGINEERING LIMITED

geotechnical

For the attention of	Imogen Soley / Matthew Hollow	Version No.	1
		Page No.	1 of 10
		Date of Issue	02/03/2021

TEST REPORT

PROJECT/SITE	IMPERIAL PARK DC3	Samples received	26/01/2021
GEL REPORT NUMBER	36253	Schedule received	05/02/2021
Your ref/PO:		Testing commenced	05/02/2021
Test report refers to	Schedule B	Status	Final

SUMMARY OF RESULTS ATTACHED

TEST METHOD & DESCRIPTION	QUANTITY	ACCREDITED TEST
BS EN ISO 17892-1: 2014:5. Water Content	8	YES
BS1377: Part 2: 1990:4.2-4.4&5.2-5.4, Liquid & Plastic Limits	7	YES
BS EN ISO 17892-4: 2016: 5.2, Particle Size Distribution - Wet Sieve	3	YES
Sulphate Content - 2:1 Water Soluble (subcontracted)	4	YES
Loss On Ignition (subcontracted)	3	YES

Remarks	Approved Signatories:
This report may not be partially reproduced without written permission from this laboratory.	T Best (Deputy Laboratory Manager) E Crimp (Senior Engineer) J Hanson (Director) N Parry (Director) **W Jones (Laboratory Manager)**
The results reported relate to samples received in the laboratory	

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Geotechnical Engineering Limited

LIQUID AND PLASTIC LIMITS

BS.1377 : PART 2 : 1990 : 4 and 5

CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

borehole /trial pit no.	sample no./type	sample depth (m)	specimen depth (m)	natural water content (%)	specimen preparation and test method	fraction >0.425 mm (%)	liquid limit (%)	plastic limit (%)	plasticity index (%)	description and remarks
DC3_BH02	16D	7.50	7.50	26.8	BXE	55	74	45	29	Reddish brown mottled grey slightly sandy gravelly silty CLAY tending to mudstone
DC3_BH03	14D	7.90	7.90	38.4	BXE	22	80	45	35	Reddish brown mottled grey slightly sandy slightly gravelly clayey SILT tending to mudstone
DC3_BH03	16D	8.70	8.70	21.1	BXE	45	62	38	24	Reddish brown mottled grey slightly sandy gravelly clayey SILT tending to mudstone
DC3_BH05	3D	0.60	0.60	19.8	BXE	29	35	21	14	Orangish brown slightly sandy slightly gravelly silty CLAY
DC3_BH05	5D	1.20	1.20	13.8	BXE	26	29	17	12	Brown slightly sandy slightly gravelly silty CLAY
DC3_BH05	15D	7.00	7.00	9.7	E					Light brown slightly clayey slightly sandy GRAVEL
DC3_BH05	20D	9.00	9.00	25.0	BXE	27	65	36	29	Reddish brown mottled grey slightly sandy slightly gravelly clayey SILT tending to mudstone
DC3_TP08	6D	1.00	1.00	18.8	BXE	13	36	18	18	Orangish brown slightly sandy slightly gravelly silty CLAY

general remarks

natural water content determined in accordance with BS EN ISO 17892 - 1 : 2014 (unless specified)

NP denotes non plastic

# denotes sample tested is smaller than that which is recommended in accordance with BS1377 or BS EN ISO 17892

specimen preparation		test method	CONTRACT	CHECKED
A - as received	D - oven dried (60oC)	X - cone penetrometer (test 4.3)	**36253**	**WNJ**
B - washed on 0.425mm sieve	E - oven dried (105oC)	Y - cone penetrometer (test 4.4)		
C - air dried	F - not known	Z - casagrande apparatus (test 4.5)		

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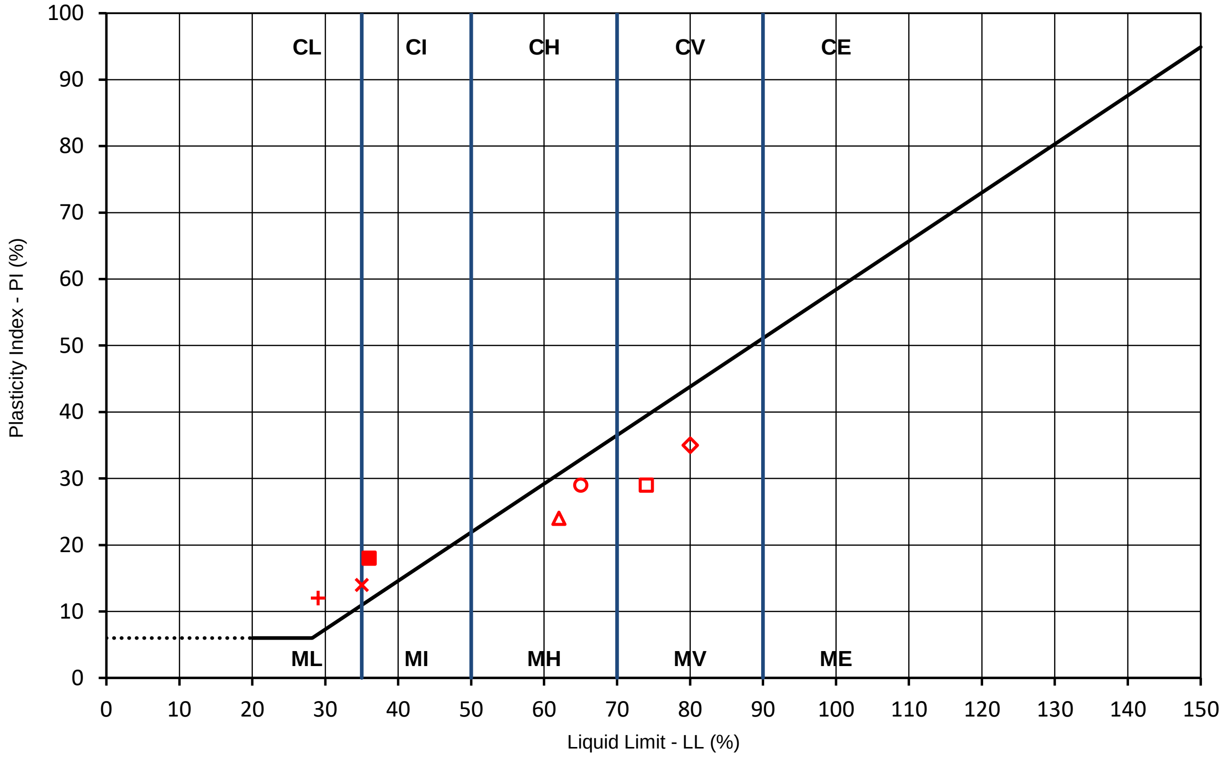
ATTERBERG LINE PLOT

CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3



	BH/TP No.	depth (m)	LL	PL	PI	remarks
□	DC3_BH02	7.50	74	45	29	
◇	DC3_BH03	7.90	80	45	35	
△	DC3_BH03	8.70	62	38	24	
×	DC3_BH05	0.60	35	21	14	
+	DC3_BH05	1.20	29	17	12	
○	DC3_BH05	9.00	65	36	29	
■	DC3_TP08	1.00	36	18	18	

CONTRACT	CHECKED
36253	**WNJ**

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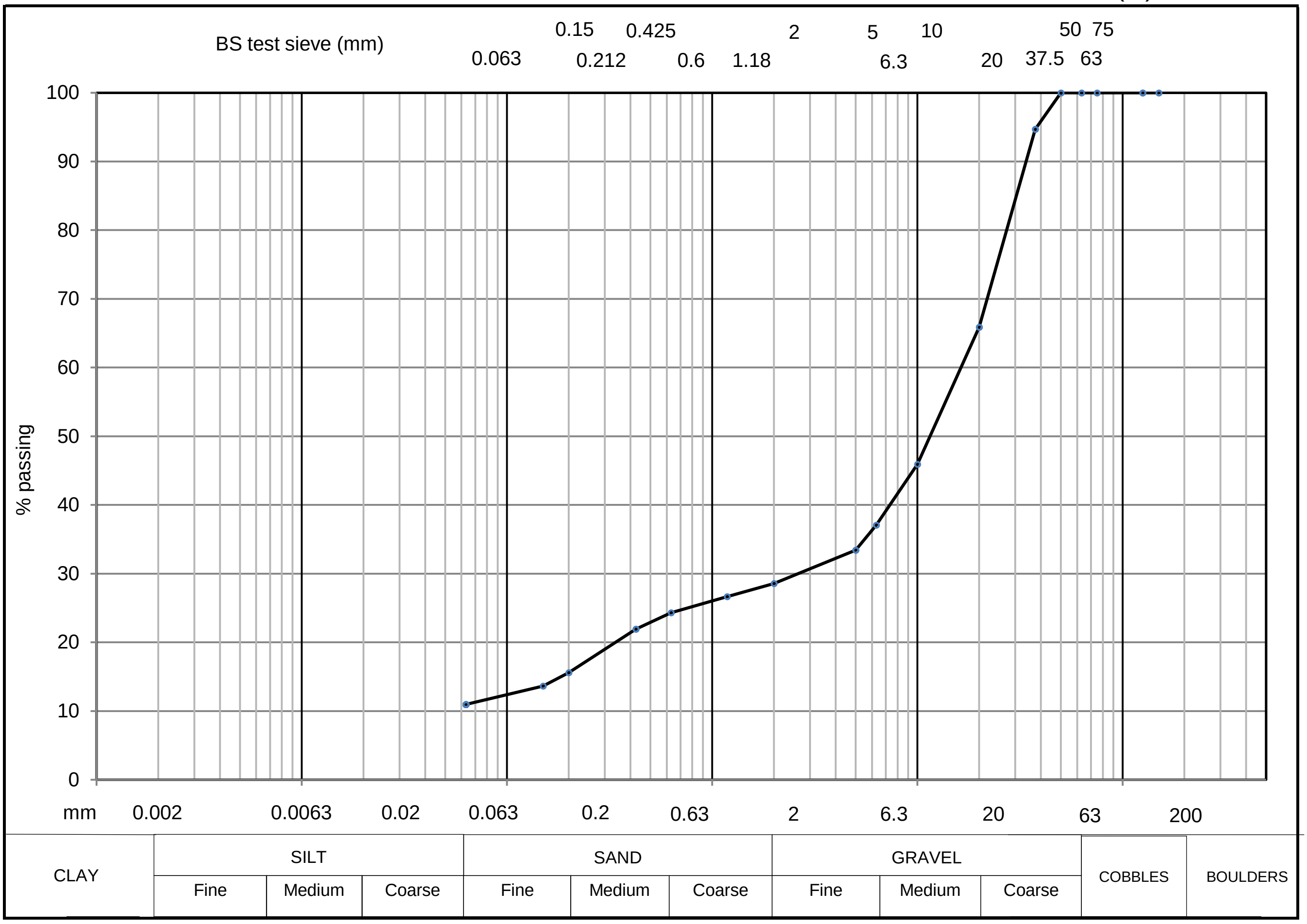
PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_BH03
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	4B
		SAMPLE DEPTH (m)	0.90
DESCRIPTION	Brown clayey sandy GRAVEL	SPECIMEN TOP (m)	0.90
		SPECIMEN BASE (m)	1.10



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (μm)	% finer
CLAY							
SILT		150		5	33	20	
SILT & CLAY	11						
SAND	18	75		2	29	6	
GRAVEL	71						
COBBLE & BOULDER	0	63		1.18	27	2	
test method(s)	5.2	50	100	0.63	24		
test method		37.5	95	0.425	22		
5.2 - sieving		20	66	0.2	16		
5.3 - sedimentation by hydrometer		10	46	0.15	14		
5.4 - sedimentation by pipette		6.3	37	0.063	11		

remarks

# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892

Particle density assigned an assumed value of 2.70 Mg/m3

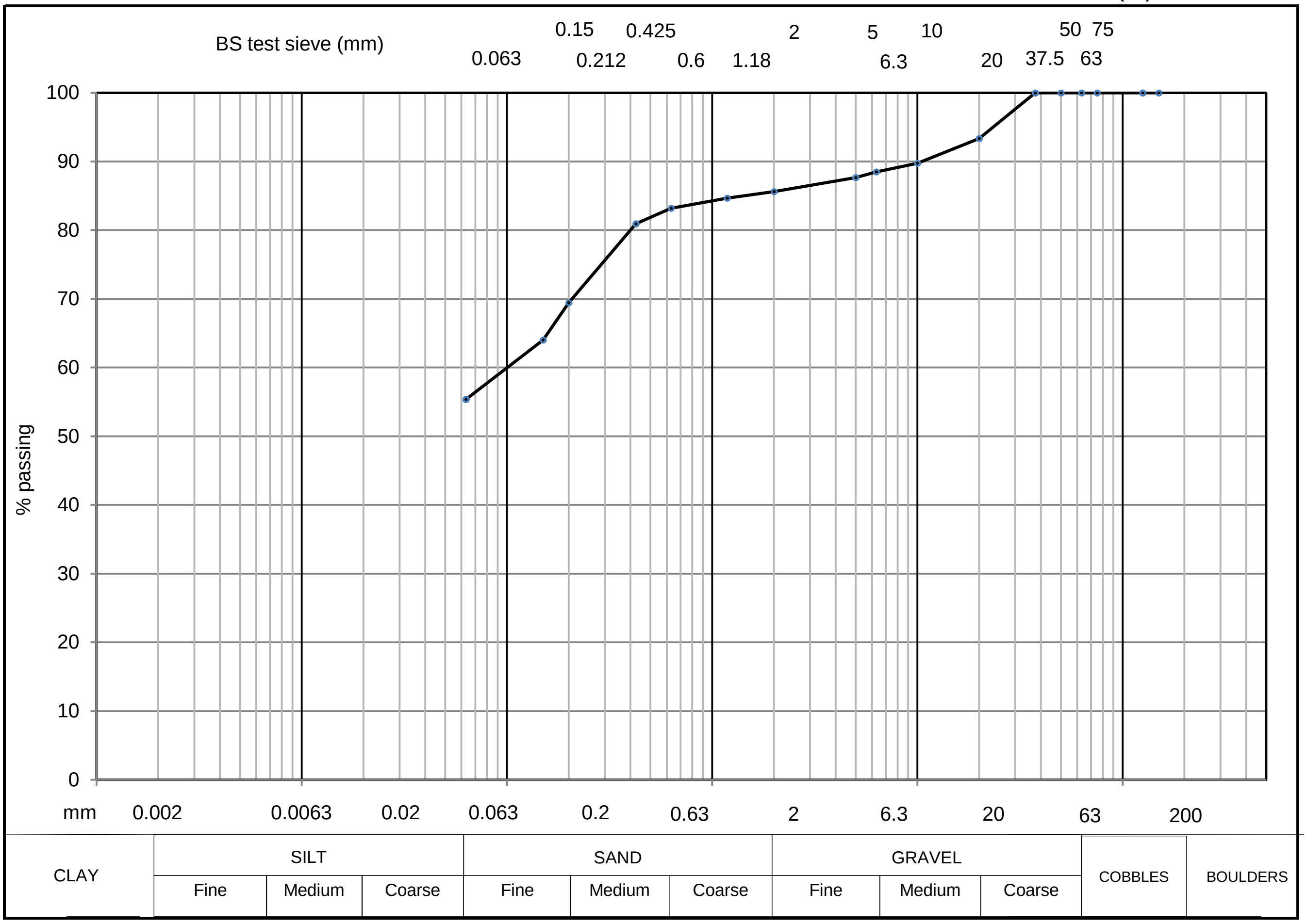
CONTRACT	CHECKED
36253	**WNJ**

Geotechnical Engineering Limited

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_TP08
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	5B
		SAMPLE DEPTH (m)	1.00
DESCRIPTION	Orangish brown slightly gravelly slightly sandy CLAY	SPECIMEN TOP (m)	1.00
		SPECIMEN BASE (m)	1.10



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (μm)	% finer
CLAY							
SILT		150		5	88	20	
SILT & CLAY	55						
SAND	30	75		2	86	6	
GRAVEL	14						
COBBLE & BOULDER	0	63		1.18	85	2	
test method(s)	5.2	50		0.63	83		
test method		37.5	100	0.425	81		
5.2 - sieving		20	93	0.2	69		
5.3 - sedimentation by hydrometer		10	90	0.15	64		
5.4 - sedimentation by pipette		6.3	88	0.063	55		

remarks

# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892

Particle density assigned an assumed value of 2.70 Mg/m3

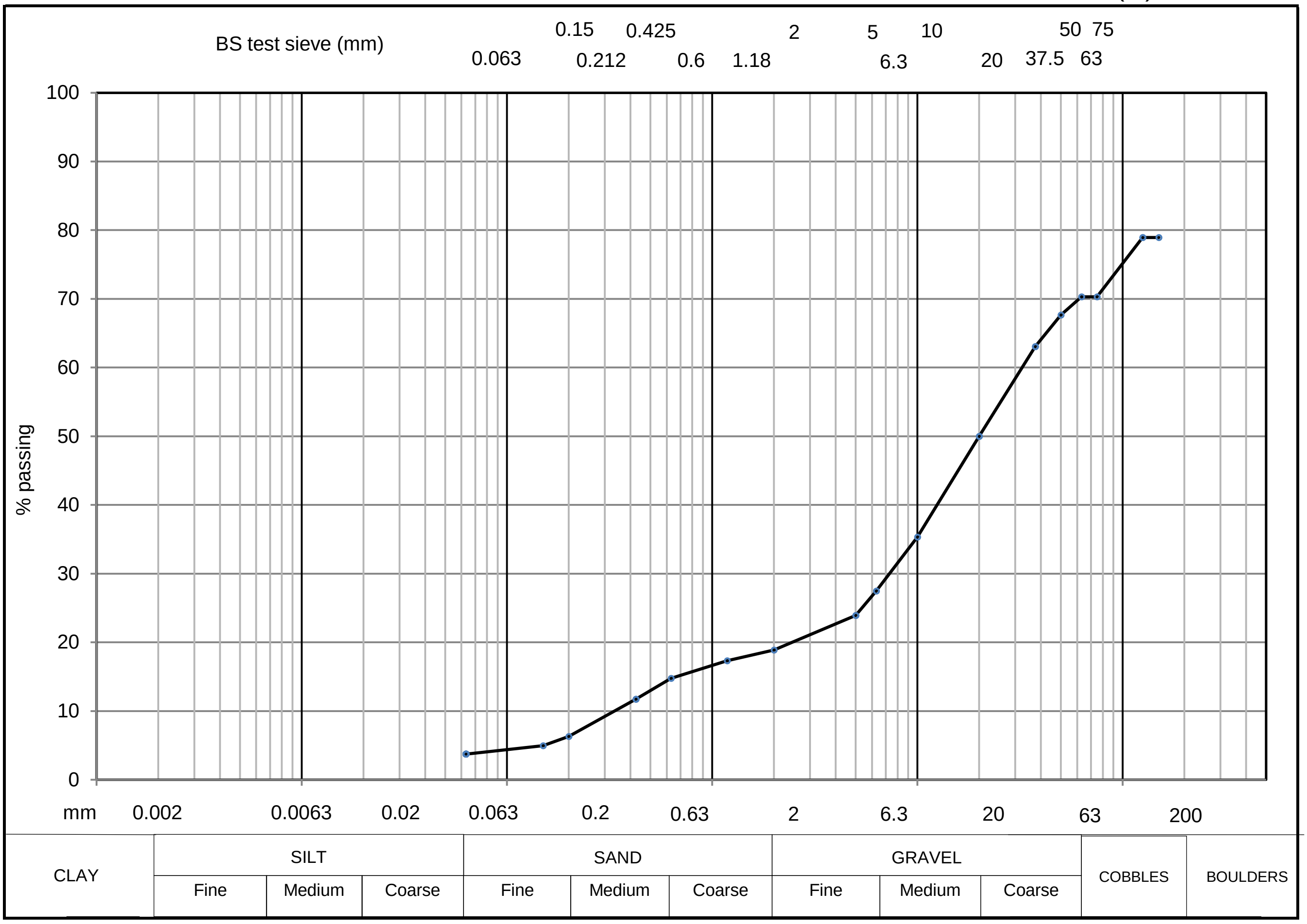
CONTRACT	CHECKED
36253	**WNJ**

Geotechnical Engineering Limited

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_TP12
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	7B
		SAMPLE DEPTH (m)	2.00
DESCRIPTION	Brown slightly clayey sandy GRAVEL with high cobble content	SPECIMEN TOP (m)	2.00
		SPECIMEN BASE (m)	2.10



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (μm)	% finer
CLAY							
SILT		150	79	5	24	20	
SILT & CLAY	4						
SAND	15	75	70	2	19	6	
GRAVEL	51						
COBBLE & BOULDER	30	63	70	1.18	17	2	
test method(s)	5.2	50	68	0.63	15		
test method		37.5	63	0.425	12		
5.2 - sieving		20	50	0.2	6		
5.3 - sedimentation by hydrometer		10	35	0.15	5		
5.4 - sedimentation by pipette		6.3	27	0.063	4		

remarks

# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892

Particle density assigned an assumed value of 2.70 Mg/m3

CONTRACT	CHECKED
36253	**WNJ**

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UKAS TESTING 2183

Final Report

Report No.:	21-03834-1
Initial Date of Issue:	15-Feb-2021
Client	Geotechnical Engineering Ltd
Client Address:	Centurion House Olympus Park Quedgeley Gloucester Gloucestershire GL2 4NF
Contact(s):	GEL Tom Best
Project	36253 B DC3 Imperial Park

Quotation No.:		**Date Received:**	10-Feb-2021
Order No.:	36253/TB	**Date Instructed:**	10-Feb-2021
No. of Samples:	7		
Turnaround (Wkdays):	5	**Results Due:**	16-Feb-2021
Date Approved:	15-Feb-2021		

Approved By:

Details: Glynn Harvey, Technical Manager

Results - Soil

Project: 36253 B DC3 Imperial Park

Client: Geotechnical Engineering Ltd				**Chemtest Job No.:**	21-03834	21-03834	21-03834	21-03834	21-03834	21-03834	21-03834
Quotation No.:				**Chemtest Sample ID.:**	1138761	1138762	1138763	1138764	1138765	1138766	1138767
Order No.: 36253/TB				Client Sample Ref.:	4	3	7	5	5	6	7
				Sample Location:	DC3_BH02	DC3_BH03	DC3_BH03	DC3_BH05	DC3_TP08	DC3_TP08	DC3_TP12
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	1.10	0.90	1.50	1.20	1.00	1.00	2.00
				Bottom Depth (m):	1.20	1.10	1.60	1.65	1.10	1.10	2.10
				Date Sampled:	08-Feb-2021	08-Feb-2021	08-Feb-2021	08-Feb-2021	08-Feb-2021	08-Feb-2021	08-Feb-2021
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
Moisture	N	2030	%	0.020	5.7	7.5	7.0	10	15	14	6.8
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.23		0.032	< 0.010		< 0.010	
LOI	U	2610	%	0.10		2.5			3.5		2.4

Test Methods

SOP	Title	Parameters included	Method summary
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operation procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

2718

GEOTECHNICAL ENGINEERING LIMITED

geotechnical

For the attention of	Imogen Soley / Matthew Hollow	Version No.	1
		Page No.	1 of 11
		Date of Issue	02/03/2021

TEST REPORT

PROJECT/SITE	IMPERIAL PARK DC3	Samples received	26/01/2021
GEL REPORT NUMBER	36253	Schedule received	17/02/2021
Your ref/PO:		Testing commenced	18/02/2021
Test report refers to	Schedule C	Status	Final

SUMMARY OF RESULTS ATTACHED

TEST METHOD & DESCRIPTION	QUANTITY	ACCREDITED TEST
BS EN ISO 17892-1: 2014:5. Water Content	4	YES
BS1377: Part 2: 1990:4.2-4.4&5.2-5.4, Liquid & Plastic Limits	3	YES
BS EN ISO 17892-3: 2015:5, Particle Density - Pycnometer	3	YES
BS EN ISO 17892-4: 2016: 5.2, Particle Size Distribution - Wet Sieve	3	YES
BRE SD1 Suite C (Subcontracted)	4	YES
Loss On Ignition (subcontracted)	1	YES

Remarks

This report may not be partially reproduced without written permission from this laboratory.

The results reported relate to samples received in the laboratory

Approved Signatories:

T Best (Deputy Laboratory Manager) E Crimp (Senior Engineer)

J Hanson (Director) N Parry (Director) **W Jones (Laboratory Manager)**

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Registered number: 00700739
VAT Number: 682 5857 89

Payments: Geotechnical Engineering Limited
Sort code: 16-22-11 **Bank account**: 11125135

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LIQUID AND PLASTIC LIMITS

BS.1377 : PART 2 : 1990 : 4 and 5

CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

borehole /trial pit no.	sample no./type	sample depth (m)	specimen depth (m)	natural water content (%)	specimen preparation and test method	fraction >0.425 mm (%)	liquid limit (%)	plastic limit (%)	plasticity index (%)	description and remarks
DC3_BH01	16C	6.70	7.70	19.7	BXE	33	54	33	21	Reddish brown slightly sandy slightly gravelly clayey SILT tending to mudstone
DC3_BH01	17D	7.25	7.25	27.6	BXE	13	76	44	32	Reddish brown mottled grey slightly gravelly slightly sandy clayey SILT tedning to mudstone
DC3_BH06	4D	0.60	0.60	15.7	BXE	17	31	19	12	Brown slightly gravelly slightly sandy silty CLAY
DC3_BH06	11C	5.20	6.10	31.4	E					Reddish brown mottled grey slightly sandy slightly gravelly silty CLAY tending to mudstone

general remarks

natural water content determined in accordance with BS EN ISO 17892 - 1 : 2014 (unless specified)

NP denotes non plastic

# denotes sample tested is smaller than that which is recommended in accordance with BS1377 or BS EN ISO 17892

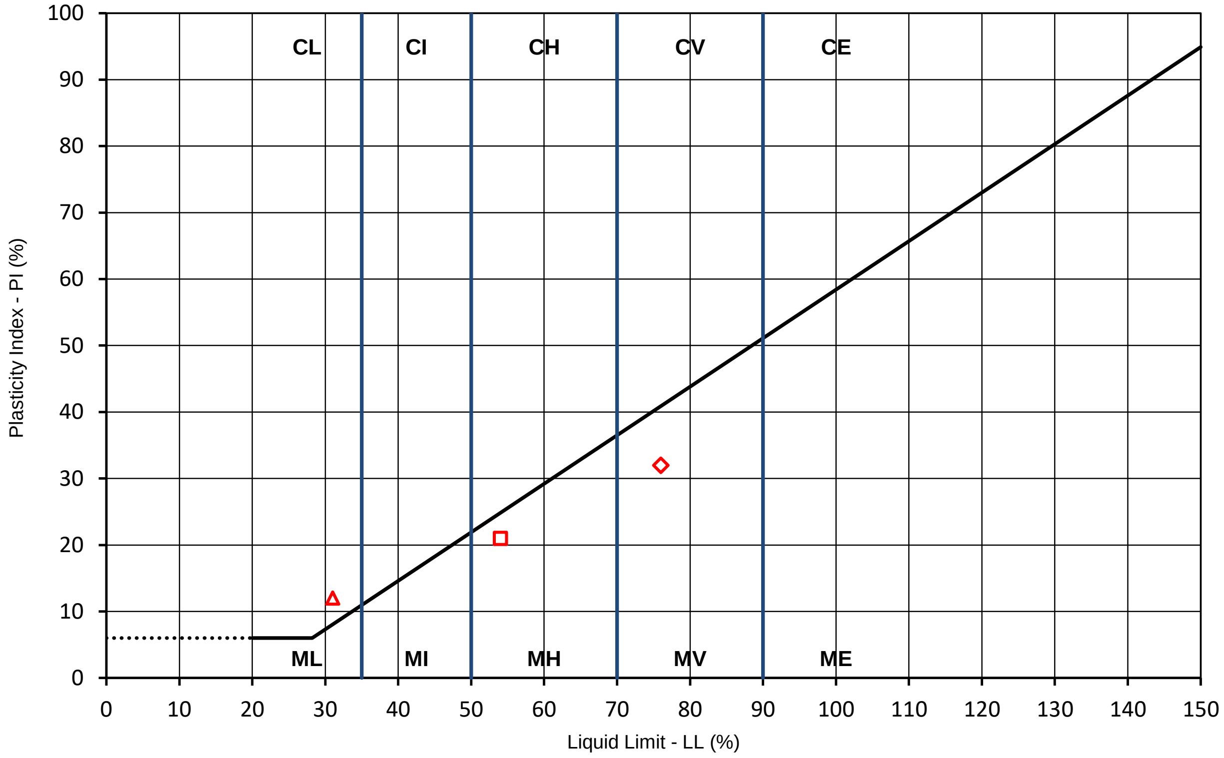
specimen preparation		test method	CONTRACT	CHECKED
A - as received	D - oven dried (60^{o}C)	X - cone penetrometer (test 4.3)	**36253**	**WNJ**
B - washed on 0.425mm sieve	E - oven dried (105^{o}C)	Y - cone penetrometer (test 4.4)		
C - air dried	F - not known	Z - casagrande apparatus (test 4.5)		

Geotechnical Engineering Limited

ATTERBERG LINE PLOT

CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3



	BH/TP No.	depth (m)	LL	PL	PI	remarks
□	DC3_BH01	7.70	54	33	21	
◇	DC3_BH01	7.25	76	44	32	
△	DC3_BH06	0.60	31	19	12	

CONTRACT	CHECKED
36253	**WNJ**

Geotechnical Engineering Limited

PARTICLE DENSITY - PYCNOMETER METHOD

BS EN ISO 17892 - 3 : 2015 : 5

CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

borehole /trial pit no.	sample no./type	sample depth (m)	specimen depth (m)	test method	mean particle density Mg/m^3	description and remarks
DC3_BH04B	18D	8.50	8.50	SP	2.76	Reddish brown slightly sandy slightly gravelly silty CLAY tending to mudstone
DC3_BH04B	20D	10.00	10.00	SP	2.67	Reddish brown slightly sandy gravelly clayey SILT tending to mudstone
DC3_BH06	11C	5.20	6.10	SP	2.74	Reddish brown mottled grey slightly sandy slightly gravelly silty CLAY tending to mudstone

general remarks

# denotes sample tested is smaller than that which is recommended in accordance with BS EN ISO 17892

test method

SP - small pycnometer ~ 50ml (test 5.1)

LP - large pycnometer ~ 100ml (test 5.1)

CONTRACT **36253**

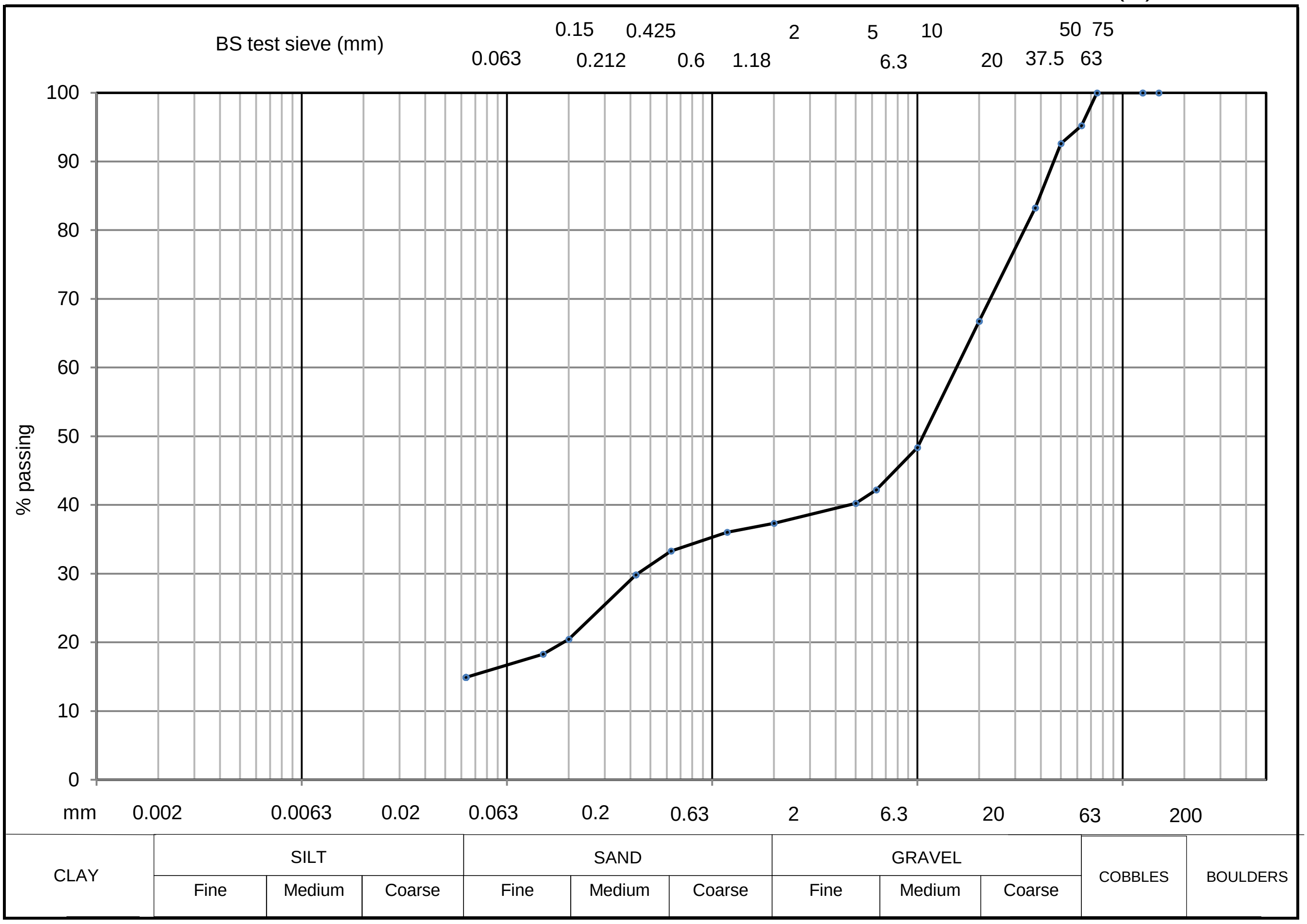
CHECKED **WNJ**

Geotechnical Engineering Limited

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_BH01
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	6B
		SAMPLE DEPTH (m)	1.00
DESCRIPTION	Orangish brown clayey very sandy GRAVEL with low cobble content	SPECIMEN TOP (m)	1.00
		SPECIMEN BASE (m)	1.20



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (μm)	% finer
CLAY							
SILT		150		5	40	20	
SILT & CLAY	15						
SAND	22	75	100	2	37	6	
GRAVEL	58						
COBBLE & BOULDER	5	63	95	1.18	36	2	
test method(s)	5.2#	50	93	0.63	33		
test method		37.5	83	0.425	30		
5.2 - sieving		20	67	0.2	20		
5.3 - sedimentation by hydrometer		10	48	0.15	18		
5.4 - sedimentation by pipette		6.3	42	0.063	15		

remarks

# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892

Particle density assigned an assumed value of 2.70 Mg/m3

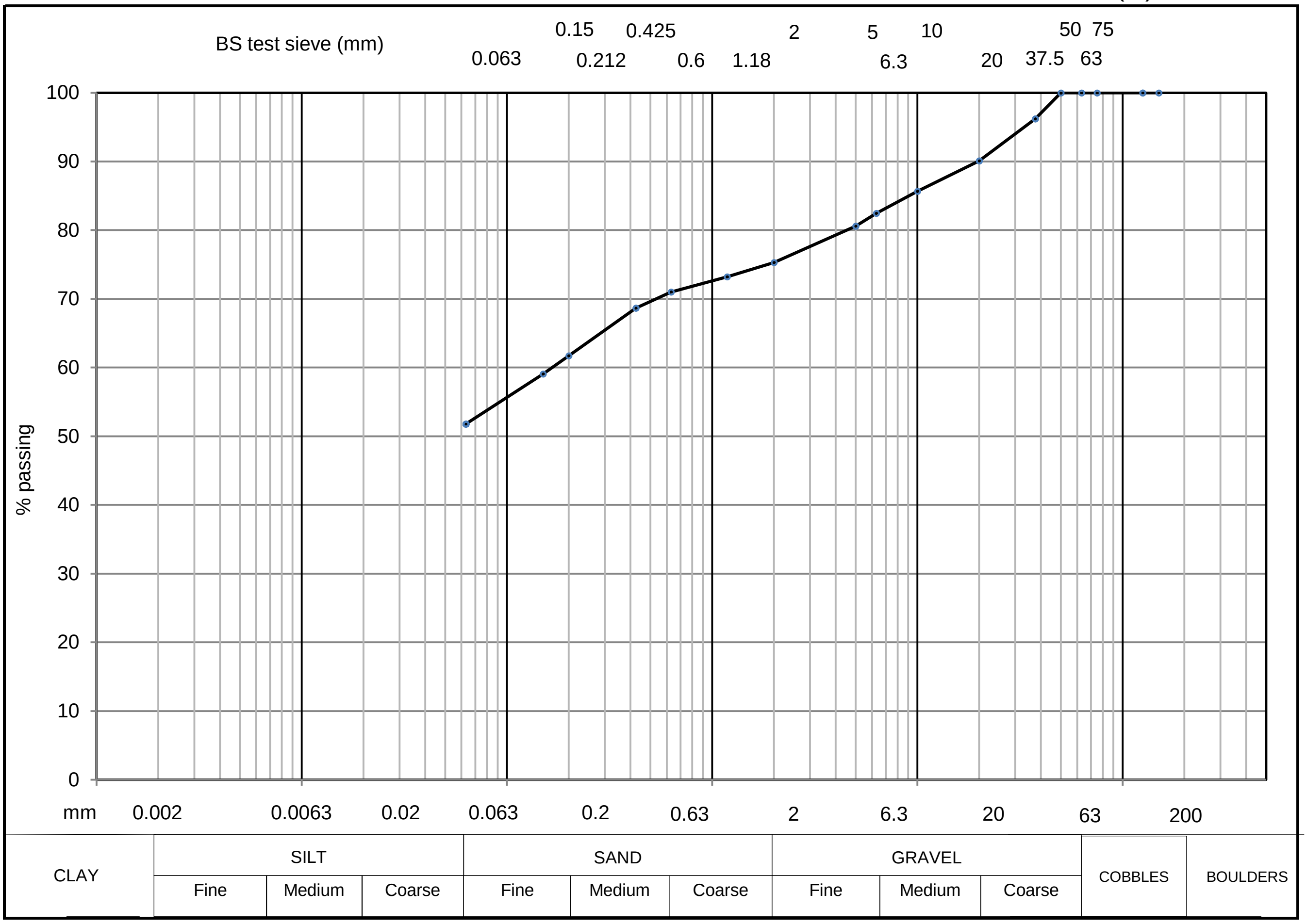
CONTRACT	CHECKED
36253	**WNJ**

Geotechnical Engineering Limited

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_BH06
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	3B
		SAMPLE DEPTH (m)	0.60
DESCRIPTION	Brown slightly sandy slightly gravelly silty CLAY	SPECIMEN TOP (m)	0.60
		SPECIMEN BASE (m)	0.80



soil type	% fraction
CLAY	
SILT	
SILT & CLAY	52
SAND	24
GRAVEL	25
COBBLE & BOULDER	0
test method(s)	5.2

test method

5.2 - sieving

5.3 - sedimentation by hydrometer

5.4 - sedimentation by pipette

BS test sieve (mm)	% passing	BS test sieve (mm)	% passing
150		5	81
75		2	75
63		1.18	73
50	100	0.63	71
37.5	96	0.425	69
20	90	0.2	62
10	86	0.15	59
6.3	82	0.063	52

BS test sieve (μm)	% finer
20	
6	
2	

remarks

# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892

Particle density assigned an assumed value of 2.70 Mg/m3

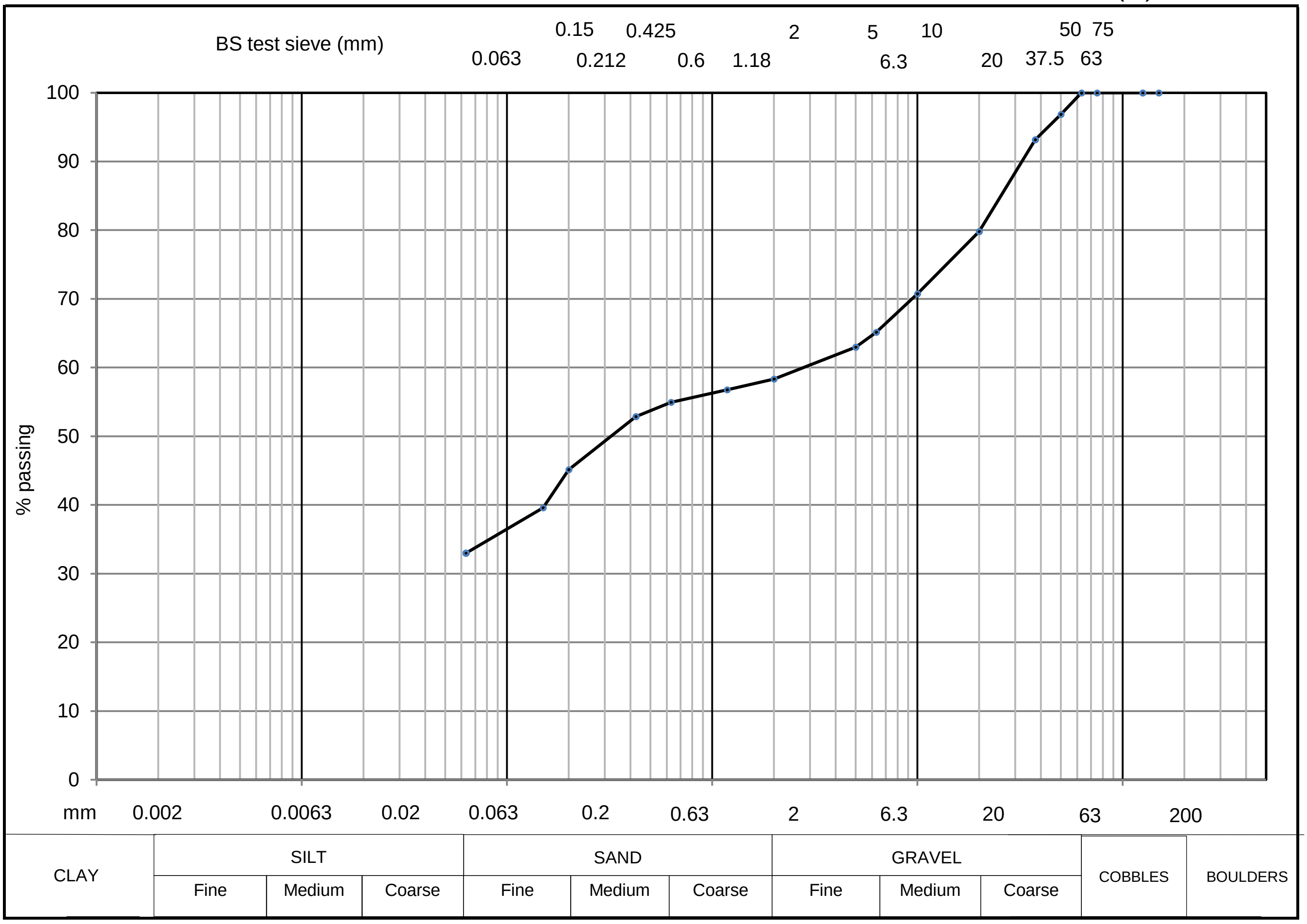
CONTRACT	CHECKED
36253	**WNJ**

Geotechnical Engineering Limited

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_BH07
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	5B
		SAMPLE DEPTH (m)	1.10
DESCRIPTION	Brown very sandy very clayey GRAVEL	SPECIMEN TOP (m)	1.10
		SPECIMEN BASE (m)	1.20



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (μm)	% finer
CLAY							
SILT		150		5	63	20	
SILT & CLAY	33						
SAND	25	75		2	58	6	
GRAVEL	42						
COBBLE & BOULDER	0	63	100	1.18	57	2	
test method(s)	5.2	50	97	0.63	55		
test method		37.5	93	0.425	53		
5.2 - sieving		20	80	0.2	45		
5.3 - sedimentation by hydrometer		10	71	0.15	40		
5.4 - sedimentation by pipette		6.3	65	0.063	33		

remarks	CONTRACT	CHECKED
# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3	**36253**	**WNJ**

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

UKAS TESTING 2183

Final Report

Report No.:	21-05303-1		
Initial Date of Issue:	25-Feb-2021		
Client	Geotechnical Engineering Ltd		
Client Address:	Centurion House Olympus Park Quedgeley Gloucester Gloucestershire GL2 4NF		
Contact(s):	GEL Tom Best		
Project	36253 C DC3 Imperial Park		
Quotation No.:		**Date Received:**	22-Feb-2021
Order No.:	36253/TB	**Date Instructed:**	22-Feb-2021
No. of Samples:	5		
Turnaround (Wkdays):	5	**Results Due:**	26-Feb-2021
Date Approved:	25-Feb-2021		

Approved By:

Details: Glynn Harvey, Technical Manager

Results - Soil

Project: 36253 C DC3 Imperial Park

Client: Geotechnical Engineering Ltd				**Chemtest Job No.:**	21-05303	21-05303	21-05303	21-05303	21-05303
Quotation No.:				**Chemtest Sample ID.:**	1145772	1145773	1145774	1145775	1145776
Order No.: 36253/TB				Client Sample Ref.:	5	6	3	6	7
				Sample Location:	DC3_BH01	DC3_BH04B	DC3_BH06	DC3_BH06	DC3_BH07
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	1	1.2	0.6	1.2	1.2
				Bottom Depth (m):	1.2	2	0.8	2.2	1.53
				Date Sampled:	18-Feb-2021	18-Feb-2021	18-Feb-2021	18-Feb-2021	18-Feb-2021
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
Moisture	N	2030	%	0.020	9.3	12	12	7.1	7.7
pH	U	2010		4.0	8.7	8.2		8.4	8.3
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010		< 0.010	< 0.010
Total Sulphur	U	2175	%	0.010	< 0.010	< 0.010		< 0.010	< 0.010
Sulphate (Acid Soluble)	U	2430	%	0.010	< 0.010	< 0.010		< 0.010	< 0.010
LOI	U	2610	%	0.10			3.0		

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.

Report Information

Key	
U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

2718

GEOTECHNICAL ENGINEERING LIMITED

geotechnical

For the attention of	Jeremy Bowyer / Matthew Hollow	Version No.	1
		Page No.	1 of 13
		Date of Issue	02/03/2021

TEST REPORT

PROJECT/SITE	IMPERIAL PARK DC3	Samples received	26/01/2021
GEL REPORT NUMBER	36253	Schedule received	03/03/2021
Your ref/PO:		Testing commenced	18/02/2021
Test report refers to	Schedule D	Status	Final

SUMMARY OF RESULTS ATTACHED

TEST METHOD & DESCRIPTION	QUANTITY	ACCREDITED TEST
BS EN ISO 17892-1: 2014:5. Water Content	4	YES
BS1377: Part 2: 1990:4.2-4.4&5.2-5.4, Liquid & Plastic Limits	4	YES
BS EN ISO 17892-4: 2016: 5.2, Particle Size Distribution - Wet Sieve	10	YES

Remarks	Approved Signatories:
This report may not be partially reproduced without written permission from this laboratory.	T Best (Deputy Laboratory Manager) E Crimp (Senior Engineer) J Hanson (Director) N Parry (Director) **W Jones (Laboratory Manager)**
The results reported relate to samples received in the laboratory	

Doc TR01 Rev No. 22 Revision date 02/01/20 DC:JH

Geotechnical Engineering Ltd
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Gloucester GL2 4NF

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VAT Number: 682 5857 89

Payments: Geotechnical Engineering Limited
Sort code: 16-22-11 **Bank account**: 11125135

Geotechnical Engineering Limited

LIQUID AND PLASTIC LIMITS

BS.1377 : PART 2 : 1990 : 4 and 5

CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3

borehole /trial pit no.	sample		specimen depth (m)	natural water content (%)	specimen preparation and test method	fraction >0.425 mm (%)	liquid limit (%)	plastic limit (%)	plasticity index (%)	description and remarks
	no./type	depth (m)								
DC3_BH04B	3D	0.60	0.60	19.1	BXE	10	34	21	13	Brown slightly sandy slightly gravelly silty CLAY
DC3_BH07	4D	0.30	0.30	15.3	BXE	16	28	17	11	Brown slightly sandy slightly gravelly silty CLAY
DC3_TP07	2D	0.25	0.25	15.8	BXE	5	29	18	11	Brown slightly gravelly slightly sandy silty CLAY
DC3_TP08	4D	0.40	0.40	16.6	BXE	12	32	18	14	Orangish brown slightly gravelly slightly sandy silty CLAY

general remarks

natural water content determined in accordance with BS EN ISO 17892 - 1 : 2014 (unless specified)

NP denotes non plastic

# denotes sample tested is smaller than that which is recommended in accordance with BS1377 or BS EN ISO 17892

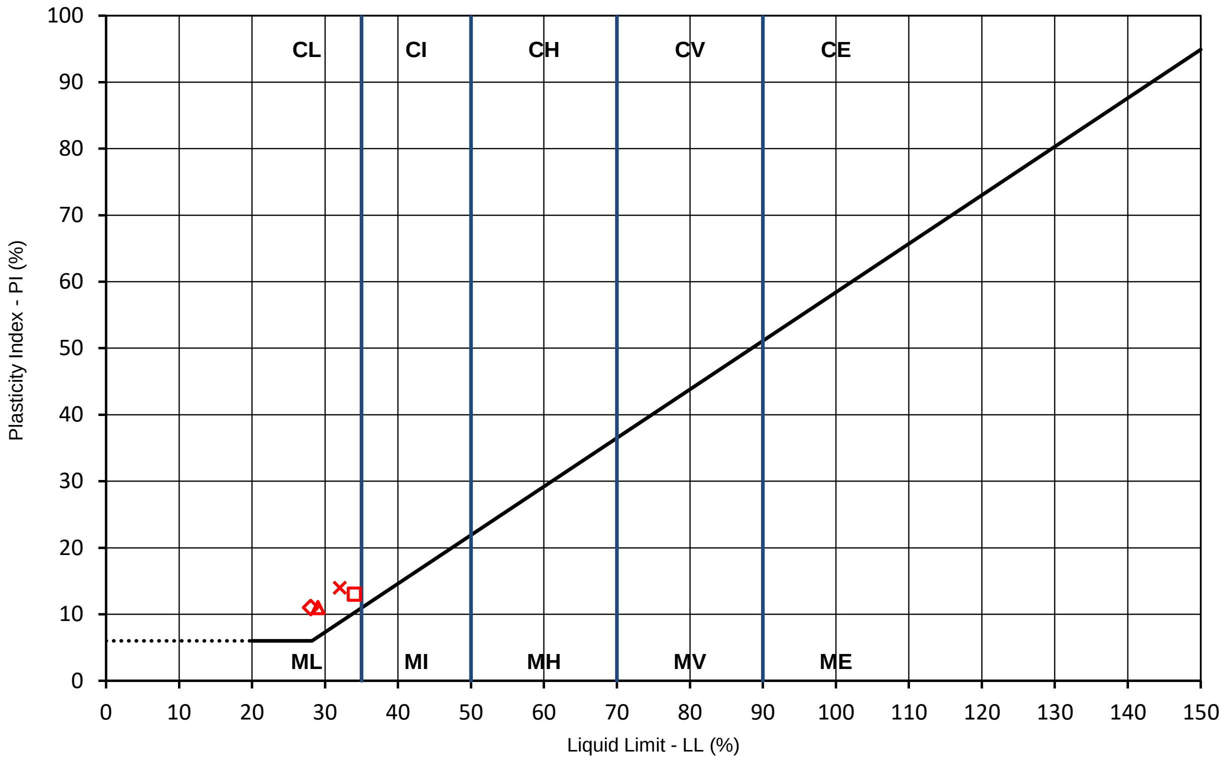
specimen preparation		test method	CONTRACT	CHECKED
A - as received	D - oven dried (60°C)	X - cone penetrometer (test 4.3)	**36253**	**WNJ**
B - washed on 0.425mm sieve	E - oven dried (105°C)	Y - cone penetrometer (test 4.4)		
C - air dried	F - not known	Z - casagrande apparatus (test 4.5)		

Geotechnical Engineering Limited

ATTERBERG LINE PLOT

CLIENT VANTAGE DATA CENTRES UK

SITE IMPERIAL PARK DC3



	BH/TP No.	depth (m)	LL	PL	PI	remarks
□	DC3_BH04B	0.60	34	21	13	
◇	DC3_BH07	0.30	28	17	11	
△	DC3_TP07	0.25	29	18	11	
×	DC3_TP08	0.40	32	18	14	

CONTRACT	CHECKED
36253	**WNJ**

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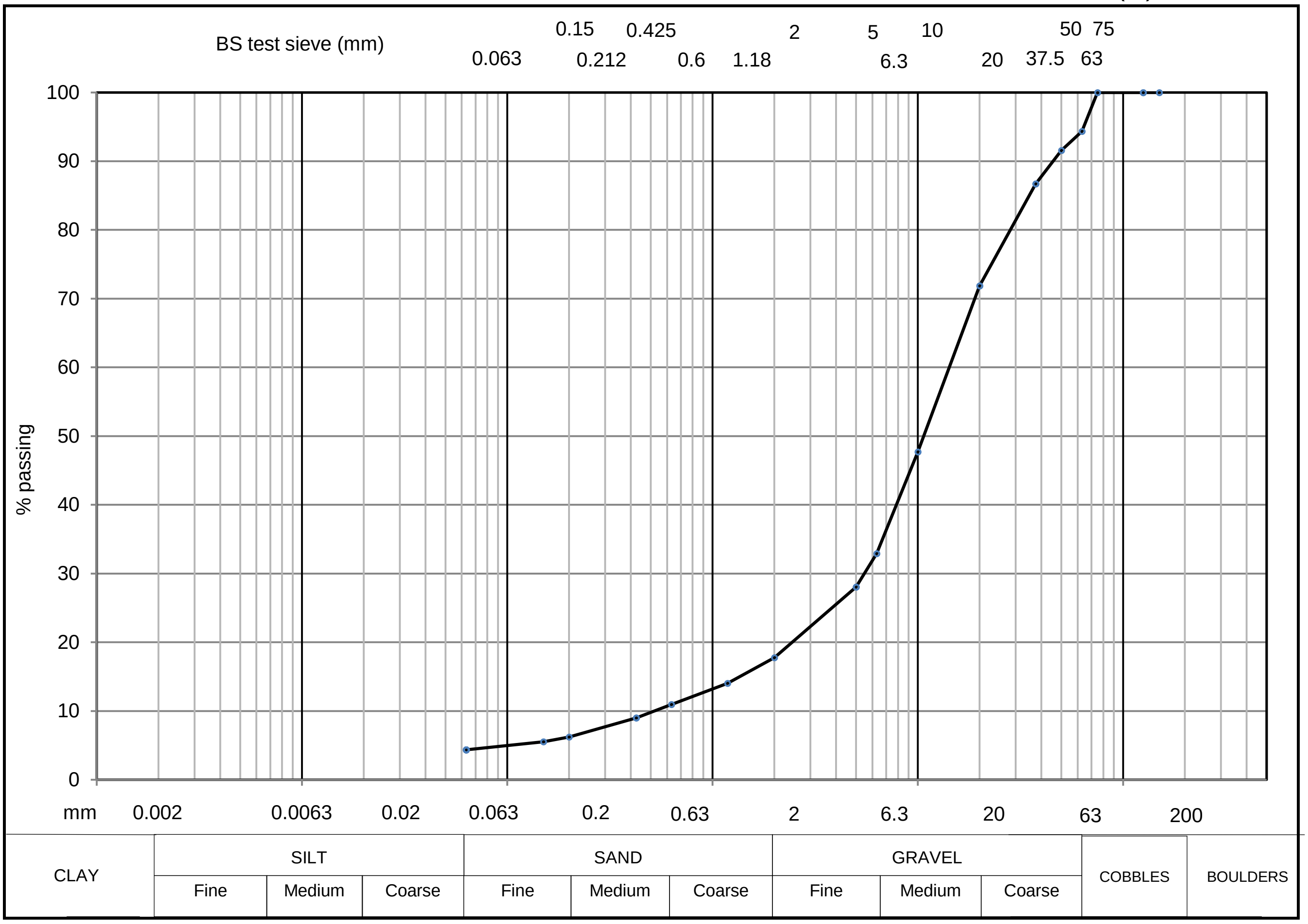
PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_BH02
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	1B
		SAMPLE DEPTH (m)	0.40
DESCRIPTION	Brown slightly clayey sandy GRAVEL with medium cobble content	SPECIMEN TOP (m)	0.40
		SPECIMEN BASE (m)	0.60



soil type	% fraction
CLAY	
SILT	
SILT & CLAY	4
SAND	13
GRAVEL	77
COBBLE & BOULDER	6
test method(s)	5.2#

test method

5.2 - sieving

5.3 - sedimentation by hydrometer

5.4 - sedimentation by pipette

BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (μm)	% finer
150		5	28	20	
75	100	2	18	6	
63	94	1.18	14	2	
50	92	0.63	11		
37.5	87	0.425	9		
20	72	0.2	6		
10	48	0.15	6		
6.3	33	0.063	4		

remarks

# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892

Particle density assigned an assumed value of 2.70 Mg/m3

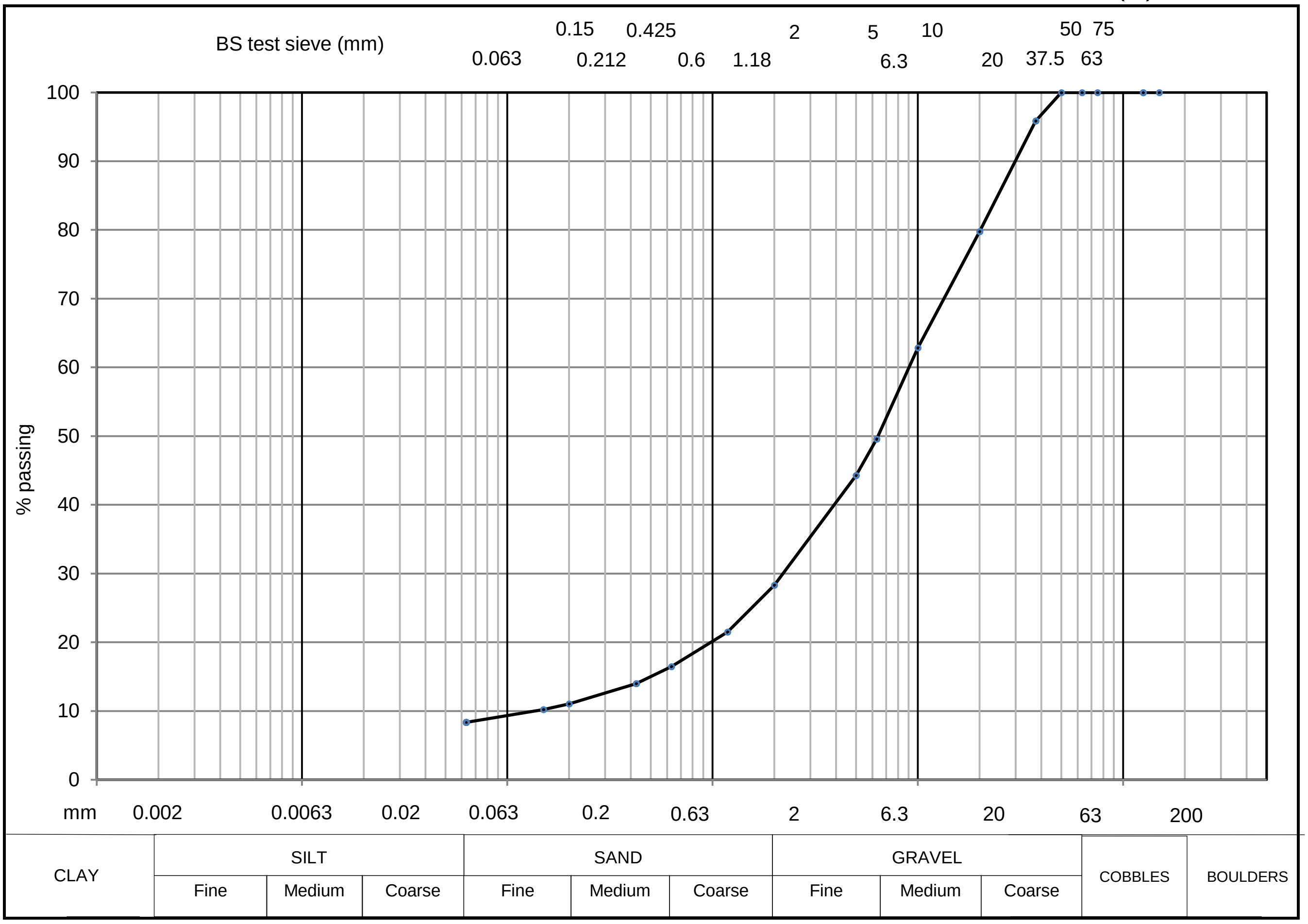
CONTRACT	CHECKED
36253	**WNJ**

Geotechnical Engineering Limited

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_BH03
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	2B
		SAMPLE DEPTH (m)	0.50
DESCRIPTION	Brown clayey sandy GRAVEL	SPECIMEN TOP (m)	0.50
		SPECIMEN BASE (m)	0.70



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY							
SILT		150		5	44	20	
SILT & CLAY	8						
SAND	20	75		2	28	6	
GRAVEL	72						
COBBLE & BOULDER	0	63		1.18	21	2	
test method(s)	5.2	50	100	0.63	16		
test method		37.5	96	0.425	14		
5.2 - sieving		20	80	0.2	11		
5.3 - sedimentation by hydrometer		10	63	0.15	10		
5.4 - sedimentation by pipette		6.3	50	0.063	8		

remarks	CONTRACT	CHECKED
# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3	**36253**	**WNJ**

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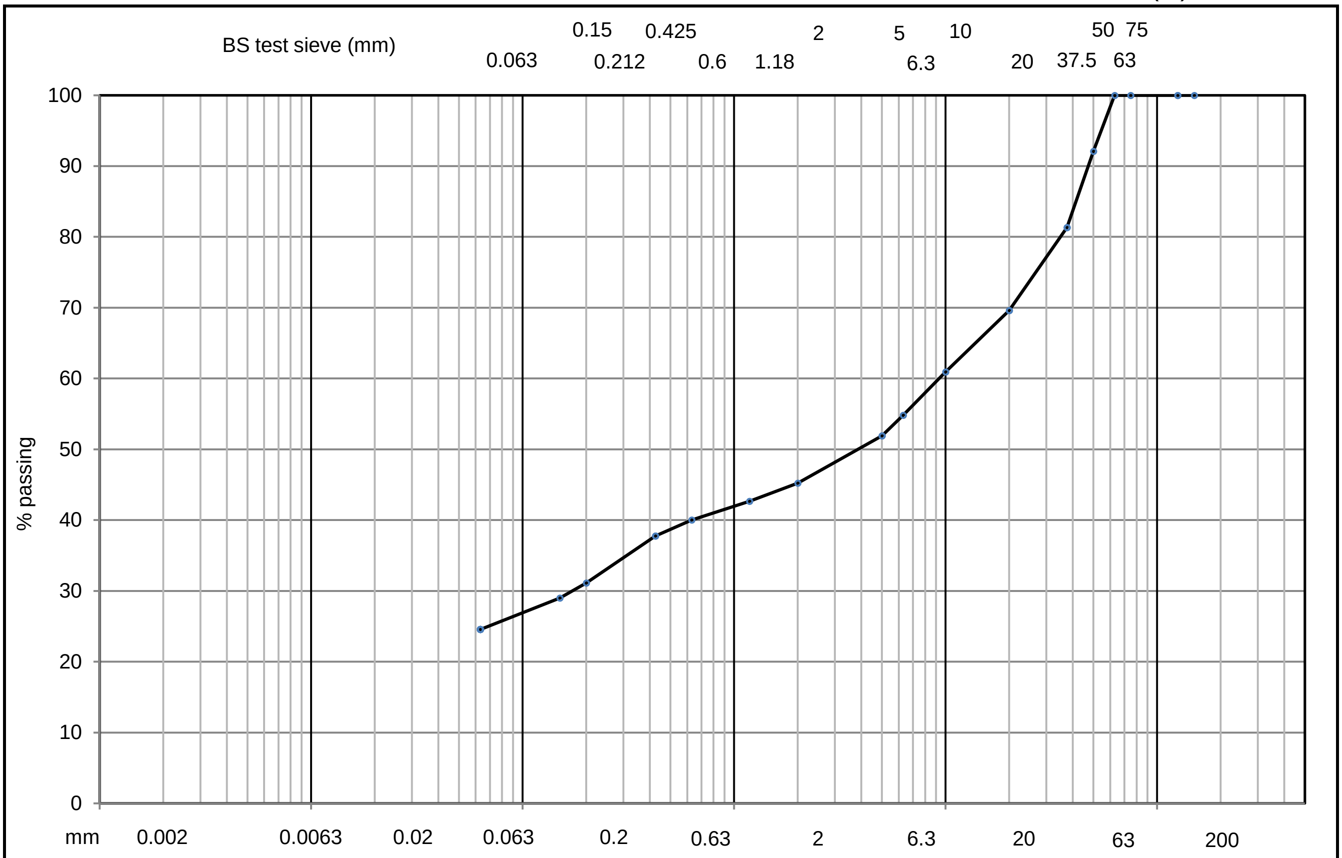
PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_BH04B
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	2B
		SAMPLE DEPTH (m)	0.20
DESCRIPTION	Brown very sandy very clayey GRAVEL	SPECIMEN TOP (m)	0.20
		SPECIMEN BASE (m)	0.40



CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse		

soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY							
SILT		150		5	52	20	
SILT & CLAY	25						
SAND	21	75		2	45	6	
GRAVEL	55						
COBBLE & BOULDER	0	63	100	1.18	43	2	
test method(s)	5.2	50	92	0.63	40		
test method		37.5	81	0.425	38		
5.2 - sieving		20	70	0.2	31		
5.3 - sedimentation by hydrometer		10	61	0.15	29		
5.4 - sedimentation by pipette		6.3	55	0.063	25		

remarks

# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892

Particle density assigned an assumed value of 2.70 Mg/m3

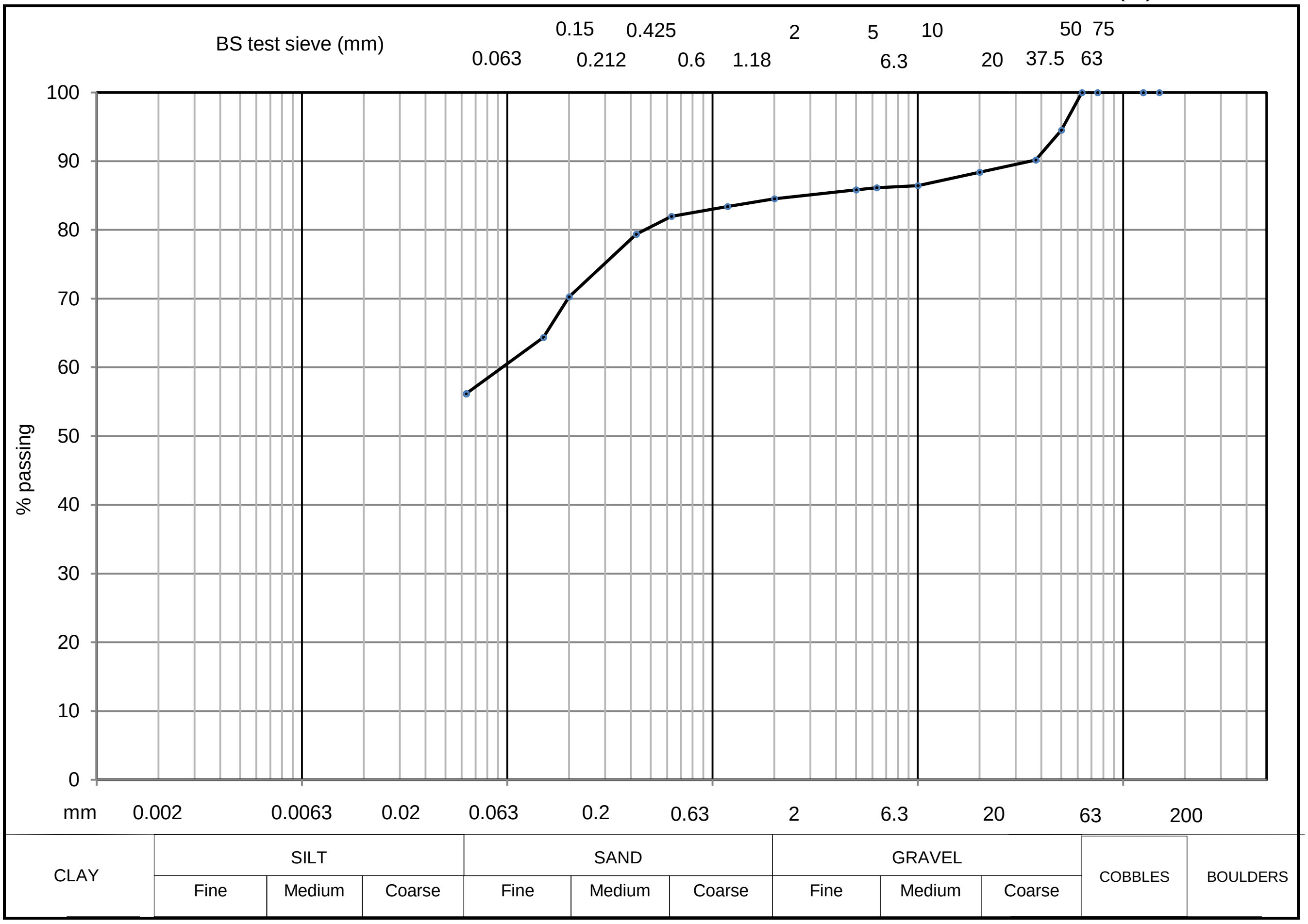
CONTRACT	CHECKED
36253	**WNJ**

Geotechnical Engineering Limited

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_BH07
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	3B
		SAMPLE DEPTH (m)	0.30
DESCRIPTION	Brown slightly gravelly slightly sandy silty CLAY	SPECIMEN TOP (m)	0.30
		SPECIMEN BASE (m)	0.50



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (μm)	% finer
CLAY							
SILT		150		5	86	20	
SILT & CLAY	56						
SAND	28	75		2	85	6	
GRAVEL	15						
COBBLE & BOULDER	0	63	100	1.18	83	2	
test method(s)	5.2	50	95	0.63	82		
test method		37.5	90	0.425	79		
5.2 - sieving		20	88	0.2	70		
5.3 - sedimentation by hydrometer		10	86	0.15	64		
5.4 - sedimentation by pipette		6.3	86	0.063	56		

remarks

# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892

Particle density assigned an assumed value of 2.70 Mg/m3

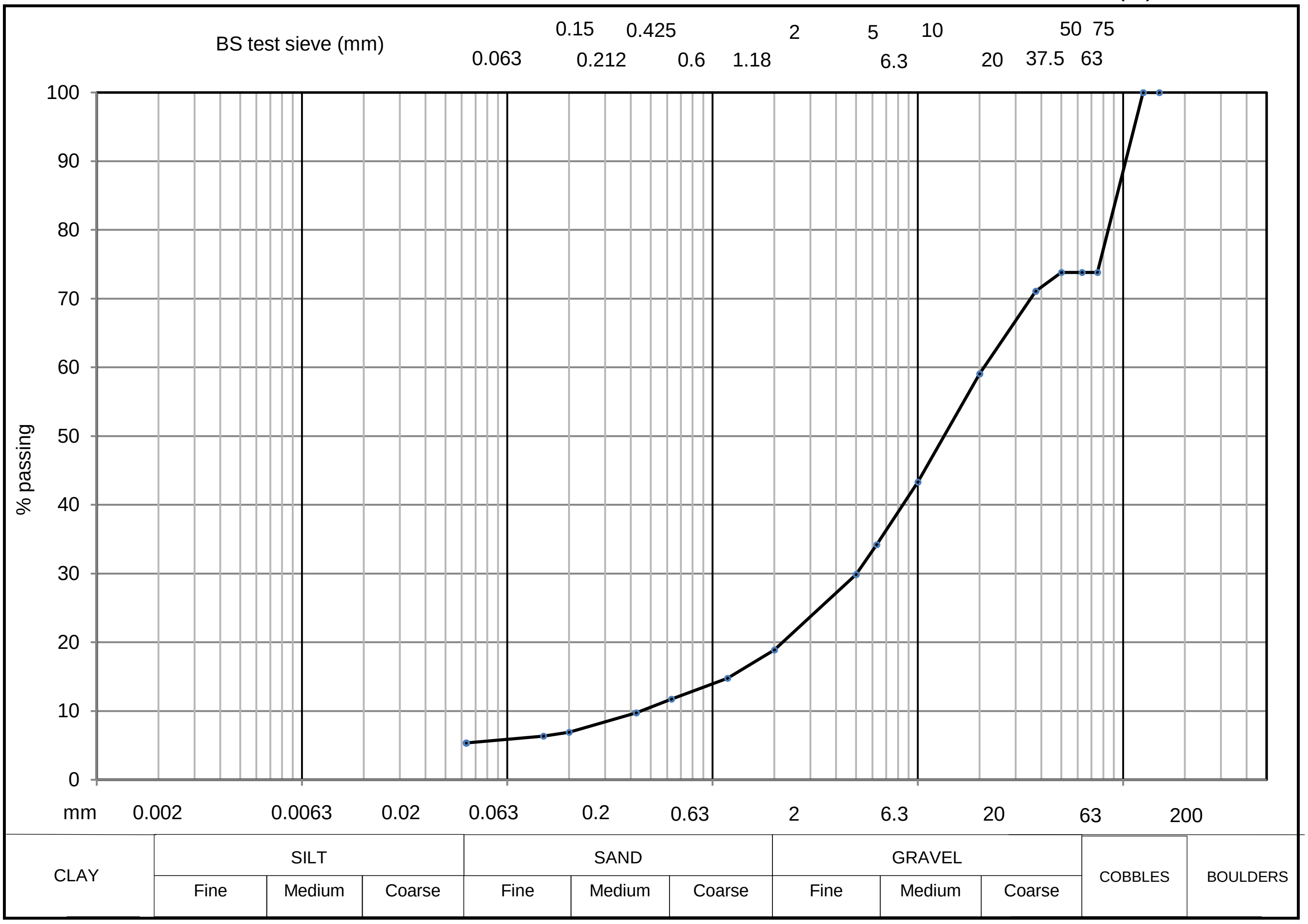
CONTRACT	CHECKED
36253	**WNJ**

Geotechnical Engineering Limited

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_TP02
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	3B
		SAMPLE DEPTH (m)	1.00
DESCRIPTION	Brown clayey sandy GRAVEL with high cobble content (concrete gravel)	SPECIMEN TOP (m)	1.00
		SPECIMEN BASE (m)	1.10



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY							
SILT		150	100	5	30	20	
SILT & CLAY	5						
SAND	14	75	74	2	19	6	
GRAVEL	55						
COBBLE & BOULDER	26	63	74	1.18	15	2	
test method(s)	5.2#	50	74	0.63	12		
test method		37.5	71	0.425	10		
5.2 - sieving		20	59	0.2	7		
5.3 - sedimentation by hydrometer		10	43	0.15	6		
5.4 - sedimentation by pipette		6.3	34	0.063	5		

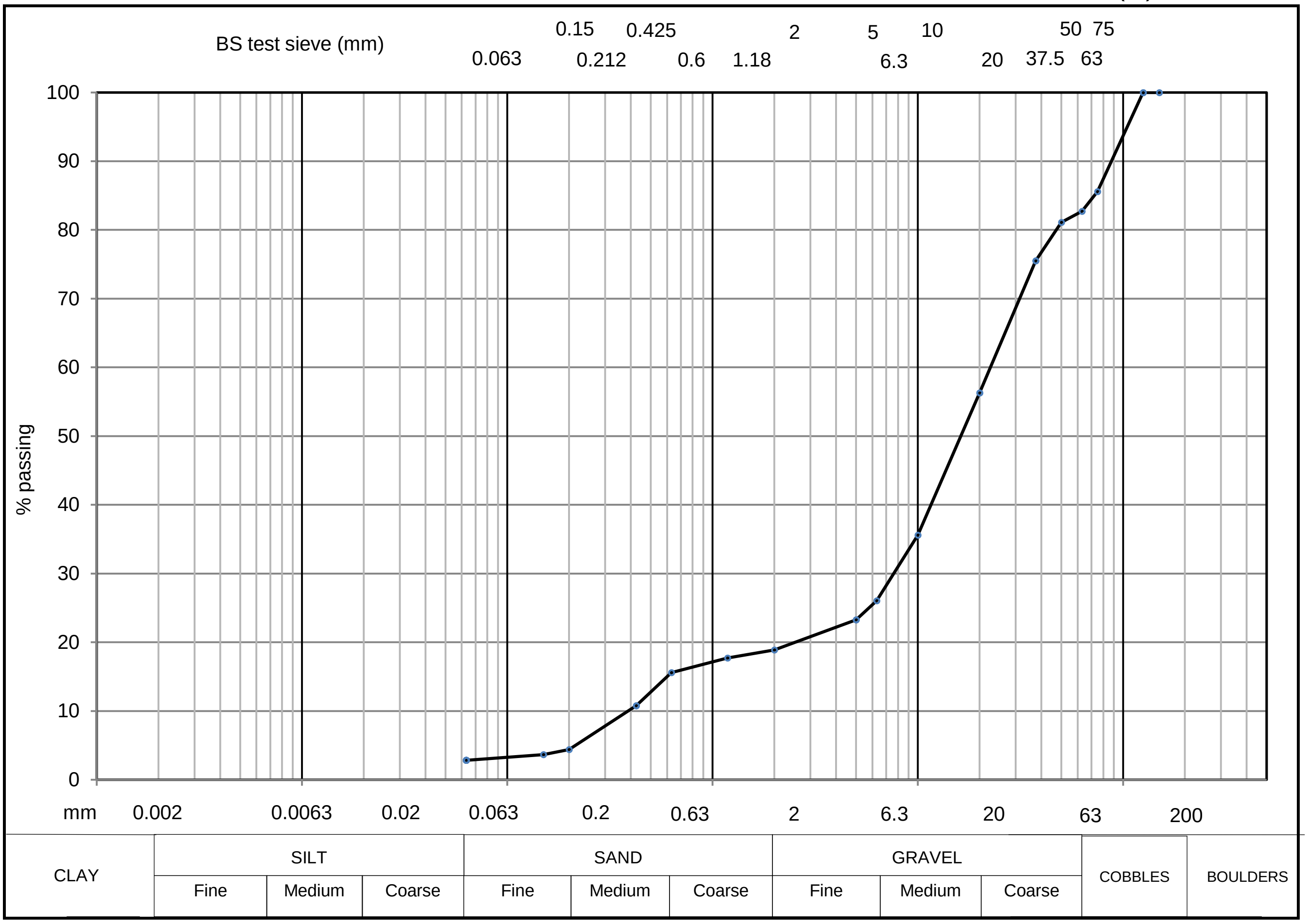
remarks	CONTRACT	CHECKED
# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892 Particle density assigned an assumed value of 2.70 Mg/m3	**36253**	**WNJ**

Geotechnical Engineering Limited

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_TP02
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	5B
		SAMPLE DEPTH (m)	2.00
DESCRIPTION	Brown slightly clayey sandy GRAVEL with medium cobble content	SPECIMEN TOP (m)	2.00
		SPECIMEN BASE (m)	2.10



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (μm)	% finer
CLAY							
SILT		150	100	5	23	20	
SILT & CLAY	3						
SAND	16	75	86	2	19	6	
GRAVEL	64						
COBBLE & BOULDER	17	63	83	1.18	18	2	
test method(s)	5.2#	50	81	0.63	16		
test method		37.5	76	0.425	11		
5.2 - sieving		20	56	0.2	4		
5.3 - sedimentation by hydrometer		10	36	0.15	4		
5.4 - sedimentation by pipette		6.3	26	0.063	3		

remarks

# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892

Particle density assigned an assumed value of 2.70 Mg/m3

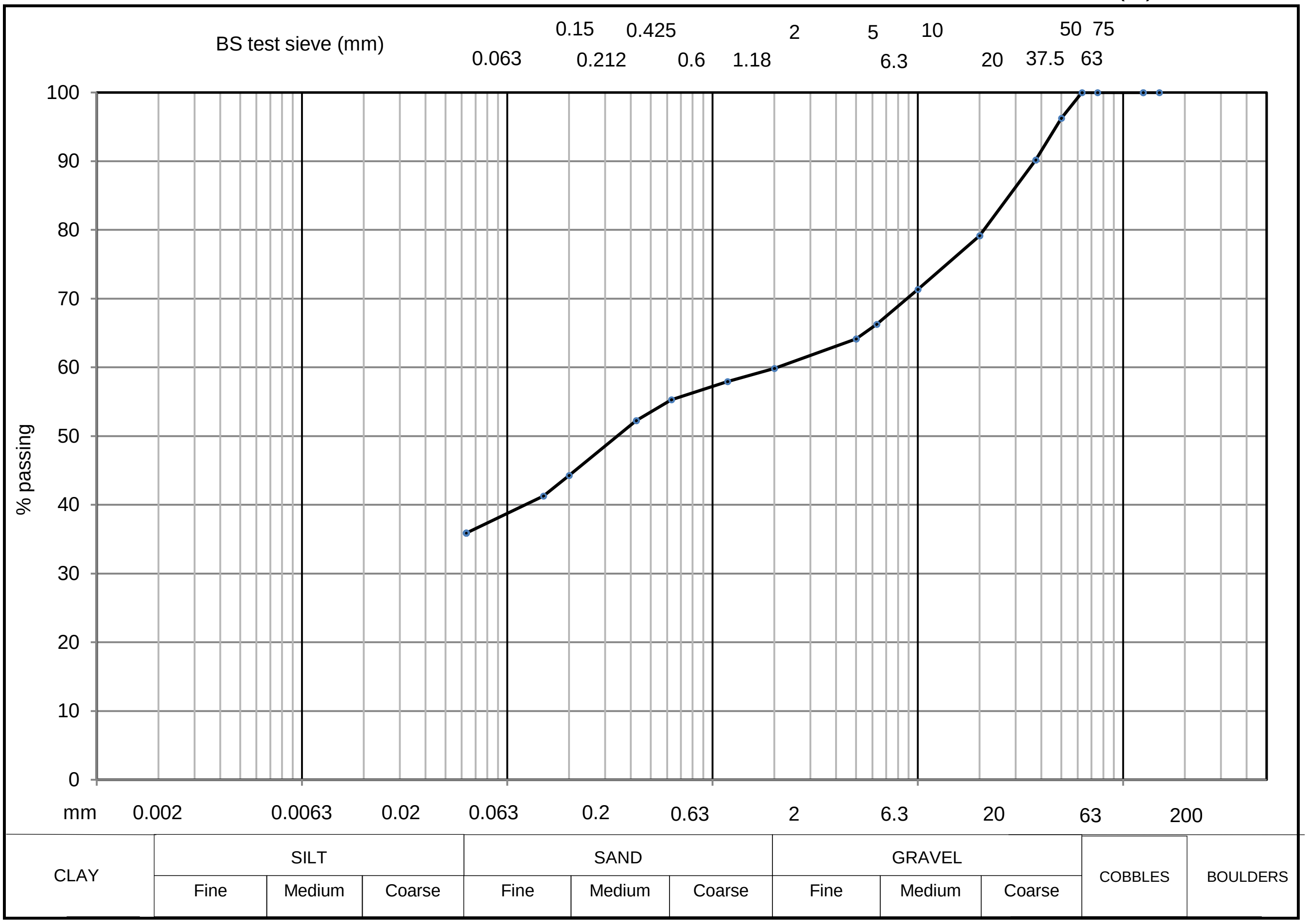
CONTRACT	CHECKED
36253	**WNJ**

Geotechnical Engineering Limited

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_TP05
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	1B
		SAMPLE DEPTH (m)	0.20
DESCRIPTION	Brown slightly sandy gravelly CLAY	SPECIMEN TOP (m)	0.20
		SPECIMEN BASE (m)	0.30



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (µm)	% finer
CLAY							
SILT		150		5	64	20	
SILT & CLAY	36						
SAND	24	75		2	60	6	
GRAVEL	40						
COBBLE & BOULDER	0	63	100	1.18	58	2	
test method(s)	5.2	50	96	0.63	55		
test method		37.5	90	0.425	52		
5.2 - sieving		20	79	0.2	44		
5.3 - sedimentation by hydrometer		10	71	0.15	41		
5.4 - sedimentation by pipette		6.3	66	0.063	36		

remarks

# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892

Particle density assigned an assumed value of 2.70 Mg/m3

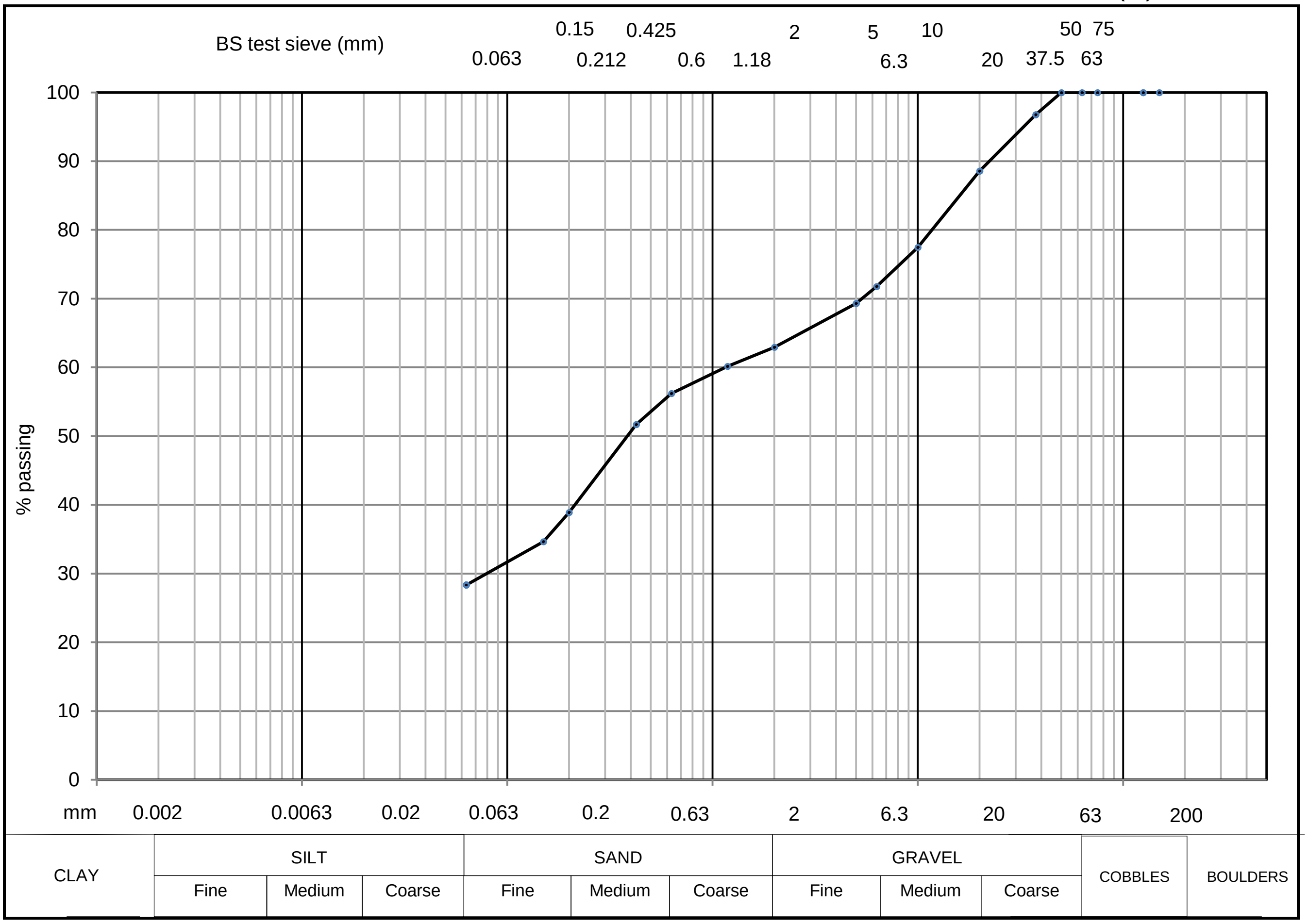
CONTRACT	CHECKED
36253	**WNJ**

Geotechnical Engineering Limited

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_TP05
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	3B
		SAMPLE DEPTH (m)	0.90
DESCRIPTION	Brown very clayey very sandy GRAVEL	SPECIMEN TOP (m)	0.90
		SPECIMEN BASE (m)	1.00



soil type	% fraction
CLAY	
SILT	
SILT & CLAY	28
SAND	35
GRAVEL	37
COBBLE & BOULDER	0
test method(s)	5.2

test method

5.2 - sieving

5.3 - sedimentation by hydrometer

5.4 - sedimentation by pipette

BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (μm)	% finer
150		5	69	20	
75		2	63	6	
63		1.18	60	2	
50	100	0.63	56		
37.5	97	0.425	52		
20	89	0.2	39		
10	77	0.15	35		
6.3	72	0.063	28		

remarks

# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892

Particle density assigned an assumed value of 2.70 Mg/m3

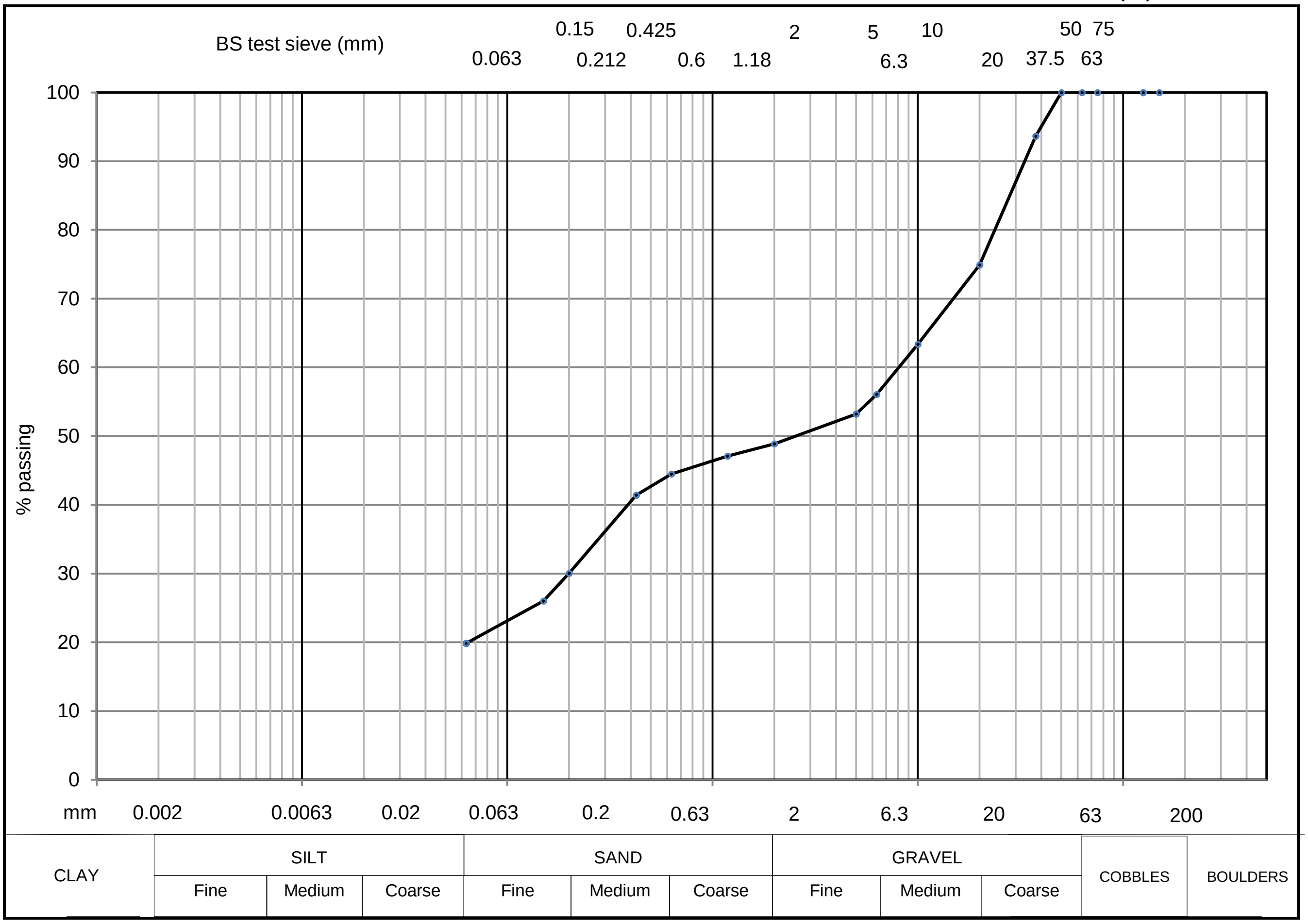
CONTRACT	CHECKED
36253	**WNJ**

Geotechnical Engineering Limited

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_TP11
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	1B
		SAMPLE DEPTH (m)	0.70
DESCRIPTION	Brown clayey very sandy GRAVEL	SPECIMEN TOP (m)	0.70
		SPECIMEN BASE (m)	0.90



soil type	% fraction
CLAY	
SILT	
SILT & CLAY	20
SAND	29
GRAVEL	51
COBBLE & BOULDER	0
test method(s)	5.2

test method

5.2 - sieving

5.3 - sedimentation by hydrometer

5.4 - sedimentation by pipette

BS test sieve (mm)	% passing	BS test sieve (mm)	% passing
150		5	53
75		2	49
63		1.18	47
50	100	0.63	44
37.5	94	0.425	41
20	75	0.2	30
10	63	0.15	26
6.3	56	0.063	20

BS test sieve (µm)	% finer
20	
6	
2	

remarks

# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892

Particle density assigned an assumed value of 2.70 Mg/m3

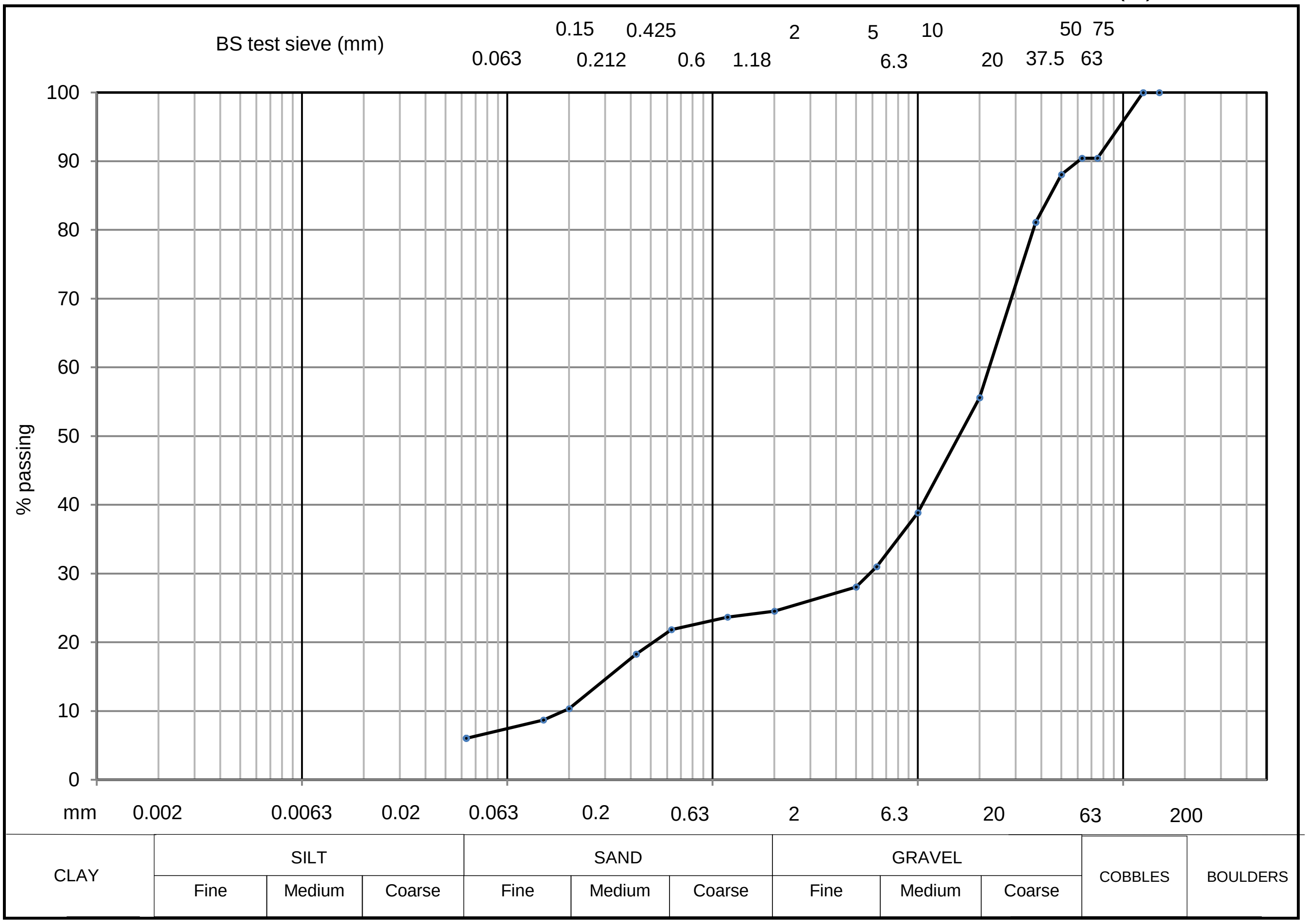
CONTRACT	CHECKED
36253	**WNJ**

Geotechnical Engineering Limited

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892 - 4 : 2016 : 5

CLIENT	VANTAGE DATA CENTRES UK	BH/TP No.	DC3_TP11
SITE	IMPERIAL PARK DC3	SAMPLE No./TYPE	7B
		SAMPLE DEPTH (m)	3.40
DESCRIPTION	Brown clayey sandy GRAVEL with medium cobble content	SPECIMEN TOP (m)	3.40
		SPECIMEN BASE (m)	3.60



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	BS test sieve (μm)	% finer
CLAY							
SILT		150	100	5	28	20	
SILT & CLAY	6						
SAND	19	75	90	2	25	6	
GRAVEL	66						
COBBLE & BOULDER	10	63	90	1.18	24	2	
test method(s)	5.2#	50	88	0.63	22		
test method		37.5	81	0.425	18		
5.2 - sieving		20	56	0.2	10		
5.3 - sedimentation by hydrometer		10	39	0.15	9		
5.4 - sedimentation by pipette		6.3	31	0.063	6		

remarks

# denotes sample tested is smaller than that which is recommended in accordance with BS EN 17892

Particle density assigned an assumed value of 2.70 Mg/m3

CONTRACT	CHECKED
36253	**WNJ**

APPENDIX D

CHEMICAL ANALYSES

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Analytical Report Number : 21-53971

Replaces Analytical Report Number: 21-53971, issue no. 2
Additional analysis undertaken.

Project / Site name:	DC3 Imperial Park	**Samples received on:**	27/01/2021
Your job number:	36253	**Samples instructed on/ Analysis started on:**	29/01/2021
Your order number:		**Analysis completed by:**	18/02/2021
Report Issue Number:	3	**Report issued on:**	18/02/2021
Samples Analysed:	3 soil samples		

Signed: Karoline Marek

Karolina Marek
PL Head of Reporting Team
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.

Analytical Report Number: 21-53971
Project / Site name: DC3 Imperial Park

Lab Sample Number				1753421	1753422	1753423
Sample Reference				DC3_TP03	DC3_TP09	DC3_TP11
Sample Number				1	1	1
Depth (m)				0.20-0.30	0.00-0.30	0.70-0.90
Date Sampled				25/01/2021	25/01/2021	25/01/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	6.5	4.2	7.7
Total mass of sample received	kg	0.001	NONE	1.5	1.5	1.5
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected
General Inorganics						
pH - Automated	pH Units	N/A	MCERTS	10.1	8.9	8.5
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1
Free Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.25	0.036	0.035
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	500	72	69
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	248	36.2	34.7
Sulphide	mg/kg	1	MCERTS	2400	100	75
Ammoniacal Nitrogen as N	mg/kg	0.5	MCERTS	< 0.5	< 0.5	< 0.5
Ammoniacal Nitrogen as NH3	mg/kg	0.5	MCERTS	< 0.5	< 0.5	< 0.5
Organic Matter	%	0.1	MCERTS	1.2	0.2	0.2
Total Organic Carbon (TOC)	%	0.1	MCERTS	0.7	0.1	0.1
Total Phenols						
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Speciated PAHs						
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Total PAH						
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80	< 0.80

Analytical Report Number: 21-53971
Project / Site name: DC3 Imperial Park

Lab Sample Number				1753421	1753422	1753423
Sample Reference				DC3_TP03	DC3_TP09	DC3_TP11
Sample Number				1	1	1
Depth (m)				0.20-0.30	0.00-0.30	0.70-0.90
Date Sampled				25/01/2021	25/01/2021	25/01/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Heavy Metals / Metalloids						
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	9.8	8.8	8.3
Boron (water soluble)	mg/kg	0.2	MCERTS	2.6	< 0.2	0.4
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	1.5	16	0.7
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	10	9.3	20
Copper (aqua regia extractable)	mg/kg	1	MCERTS	7.7	14	12
Lead (aqua regia extractable)	mg/kg	1	MCERTS	23	370	41
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	10	6.5	23
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	100	860	80
Monoaromatics & Oxygenates						
Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Petroleum Hydrocarbons						
TPH C10 - C40	mg/kg	10	MCERTS	240	< 10	< 10
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	7.9	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	16	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	84	< 8.0	< 8.0
TPH-CWG - Aliphatic > EC35 - EC44	mg/kg	8.4	NONE	26	< 8.4	< 8.4
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	110	< 10	< 10
TPH-CWG - Aliphatic (EC5 - EC44)	mg/kg	10	NONE	130	< 10	< 10
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10	< 10	< 10
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	65	< 10	< 10
TPH-CWG - Aromatic > EC35 - EC44	mg/kg	8.4	NONE	40	< 8.4	< 8.4
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	68	< 10	< 10
TPH-CWG - Aromatic (EC5 - EC44)	mg/kg	10	NONE	110	< 10	< 10

Analytical Report Number: 21-53971
Project / Site name: DC3 Imperial Park

Lab Sample Number				1753421	1753422	1753423
Sample Reference				DC3_TP03	DC3_TP09	DC3_TP11
Sample Number				1	1	1
Depth (m)				0.20-0.30	0.00-0.30	0.70-0.90
Date Sampled				25/01/2021	25/01/2021	25/01/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status			
PCBs by GC-MS						
PCB Congener 28	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001
PCB Congener 52	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001
PCB Congener 101	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001
PCB Congener 118	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001
PCB Congener 138	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001
PCB Congener 153	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001
PCB Congener 180	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001
Total PCBs by GC-MS						
Total PCBs	mg/kg	0.007	MCERTS	< 0.007	-	< 0.007
Glycols						
1,2-Butanediol	mg/kg	10	NONE	< 10	< 10	< 10
1,2-Propanediol	mg/kg	10	NONE	< 10	< 10	< 10
1,3-Butanediol	mg/kg	10	NONE	< 10	< 10	< 10
1,3-Propanediol	mg/kg	10	NONE	< 10	< 10	< 10
1,4-Butanediol	mg/kg	10	NONE	< 10	< 10	< 10
1,5-Pentanediol	mg/kg	10	NONE	< 10	< 10	< 10
Diethylene Glycol	mg/kg	10	NONE	< 10	< 10	< 10
Ethylene Glycol	mg/kg	10	NONE	< 10	< 10	< 10
Triethylene Glycol	mg/kg	10	NONE	< 10	< 10	< 10
Thiourea	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number : 21-53971
Project / Site name: DC3 Imperial Park

* 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 *
1753421	DC3_TP03	1	0.20-0.30	Brown loam and sand with gravel.
1753422	DC3_TP09	1	0.00-0.30	Brown loam and clay with gravel.
1753423	DC3_TP11	1	0.70-0.90	Brown loam and clay with gravel.

Analytical Report Number : 21-53971
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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
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.	L038-PL	D	MCERTS
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
Free cyanide in soil	Determination of free cyanide 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
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	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.	In house method.	L009-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
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-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
Total cyanide in soil	Determination of total cyanide 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
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Ammonia as NH3 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

Analytical Report Number : 21-53971
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in soil	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the discrete analyser (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
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	NONE
Determination of glycols in soil by GC-MS.	Determination of glycols in soil by GC-MS.	In-house method	L059B-PL	D	NONE
TPH Banding in Soil by FID	Determination of hexane extractable hydrocarbons in soil by GC-FID.	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	W	MCERTS
Sulphate, water soluble, in soil (1hr extraction)	Sulphate, water soluble, in soil (1hr extraction)	In-house method	L038-PL	D	MCERTS
TO - Thiourea in soil	Determination of alkylthioureas by LC-UV/LC-MS	In-house method		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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Analytical Report Number : 21-53977

Replaces Analytical Report Number: 21-53977, issue no. 2
Additional analysis undertaken.

Project / Site name:	DC3 Imperial Park	**Samples received on:**	28/01/2021
Your job number:	36253	**Samples instructed on/ Analysis started on:**	29/01/2021
Your order number:		**Analysis completed by:**	18/02/2021
Report Issue Number:	3	**Report issued on:**	18/02/2021
Samples Analysed:	3 soil samples		

Signed: Karoline Marek

Karolina Marek
PL Head of Reporting Team
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.

Analytical Report Number: 21-53977
Project / Site name: DC3 Imperial Park

Lab Sample Number				1753439	1753440	1753441
Sample Reference				DC3_BH03	DC3_TP02	DC3_TP10
Sample Number				1	2	3
Depth (m)				0.50-0.70	1.00-1.10	2.00-2.10
Date Sampled				25/01/2021	27/01/2021	27/01/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	3.3	6.7	6.5
Total mass of sample received	kg	0.001	NONE	1.5	1.5	1.5

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	11.1	10.1	8.3
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1
Free Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.065	0.13	0.023
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	130	260	47
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	64.9	128	23.4
Sulphide	mg/kg	1	MCERTS	< 1.0	140	85
Ammoniacal Nitrogen as N	mg/kg	0.5	MCERTS	< 0.5	< 0.5	< 0.5
Ammoniacal Nitrogen as NH3	mg/kg	0.5	MCERTS	< 0.5	< 0.5	< 0.5
Organic Matter	%	0.1	MCERTS	< 0.1	0.2	< 0.1
Total Organic Carbon (TOC)	%	0.1	MCERTS	< 0.1	0.1	< 0.1

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80	< 0.80

Analytical Report Number: 21-53977
Project / Site name: DC3 Imperial Park

Lab Sample Number				1753439	1753440	1753441
Sample Reference				DC3_BH03	DC3_TP02	DC3_TP10
Sample Number				1	2	3
Depth (m)				0.50-0.70	1.00-1.10	2.00-2.10
Date Sampled				25/01/2021	27/01/2021	27/01/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Heavy Metals / Metalloids						
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	12	9.5	9.5
Boron (water soluble)	mg/kg	0.2	MCERTS	1.6	2.2	0.3
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	13	0.4	< 0.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	8.4	13	20
Copper (aqua regia extractable)	mg/kg	1	MCERTS	24	7.1	11
Lead (aqua regia extractable)	mg/kg	1	MCERTS	270	18	13
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	7.2	14	33
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	600	56	73
Monoaromatics & Oxygenates						
Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Petroleum Hydrocarbons						
TPH C10 - C40	mg/kg	10	MCERTS	< 10	< 10	< 10
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic > EC35 - EC44	mg/kg	8.4	NONE	< 8.4	< 8.4	< 8.4
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	< 10	< 10
TPH-CWG - Aliphatic (EC5 - EC44)	mg/kg	10	NONE	< 10	< 10	< 10
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10	< 10	< 10
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	< 10	< 10	< 10
TPH-CWG - Aromatic > EC35 - EC44	mg/kg	8.4	NONE	< 8.4	< 8.4	< 8.4
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	< 10	< 10
TPH-CWG - Aromatic (EC5 - EC44)	mg/kg	10	NONE	< 10	< 10	< 10

Analytical Report Number: 21-53977
Project / Site name: DC3 Imperial Park

Lab Sample Number				1753439	1753440	1753441
Sample Reference				DC3_BH03	DC3_TP02	DC3_TP10
Sample Number				1	2	3
Depth (m)				0.50-0.70	1.00-1.10	2.00-2.10
Date Sampled				25/01/2021	27/01/2021	27/01/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
PCBs by GC-MS						
PCB Congener 28	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
PCB Congener 52	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
PCB Congener 101	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
PCB Congener 118	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
PCB Congener 138	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
PCB Congener 153	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
PCB Congener 180	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
Total PCBs by GC-MS						
Total PCBs	mg/kg	0.007	MCERTS	< 0.007	< 0.007	< 0.007
Glycols						
1,2-Butanediol	mg/kg	10	NONE	< 10	< 10	< 10
1,2-Propanediol	mg/kg	10	NONE	< 10	< 10	< 10
1,3-Butanediol	mg/kg	10	NONE	< 10	< 10	< 10
1,3-Propanediol	mg/kg	10	NONE	< 10	< 10	< 10
1,4-Butanediol	mg/kg	10	NONE	< 10	< 10	< 10
1,5-Pentanediol	mg/kg	10	NONE	< 10	< 10	< 10
Diethylene Glycol	mg/kg	10	NONE	< 10	< 10	< 10
Ethylene Glycol	mg/kg	10	NONE	< 10	< 10	< 10
Triethylene Glycol	mg/kg	10	NONE	< 10	< 10	< 10
Thiourea	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05

U/S = Unsuitable Sample   I/S = Insufficient Sample

Analytical Report Number : 21-53977
Project / Site name: DC3 Imperial Park

* 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 *
1753439	DC3_BH03	1	0.50-0.70	Brown loam and clay with gravel.
1753440	DC3_TP02	2	1.00-1.10	Brown loam and clay with gravel.
1753441	DC3_TP10	3	2.00-2.10	Brown loam and clay with gravel.

Analytical Report Number : 21-53977
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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
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.	L038-PL	D	MCERTS
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
Free cyanide in soil	Determination of free cyanide 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
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	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.	In house method.	L009-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
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-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
Total cyanide in soil	Determination of total cyanide 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
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Ammonia as NH3 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

Analytical Report Number : 21-53977
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in soil	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the discrete analyser (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
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	NONE
Determination of glycols in soil by GC-MS.	Determination of glycols in soil by GC-MS.	In-house method	L059B-PL	D	NONE
TPH Banding in Soil by FID	Determination of hexane extractable hydrocarbons in soil by GC-FID.	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	W	MCERTS
Sulphate, water soluble, in soil (1hr extraction)	Sulphate, water soluble, in soil (1hr extraction)	In-house method	L038-PL	D	MCERTS
TO - Thiourea in soil	Determination of alkylthioureas by LC-UV/LC-MS	In-house method		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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Analytical Report Number : 21-54067

Replaces Analytical Report Number: 21-54067, issue no. 2
Additional analysis undertaken.

Project / Site name:	DC3 Imperial Park	**Samples received on:**	01/02/2021
Your job number:	36253	**Samples instructed on/ Analysis started on:**	01/02/2021
Your order number:		**Analysis completed by:**	18/02/2021
Report Issue Number:	3	**Report issued on:**	18/02/2021
Samples Analysed:	3 soil samples		

Signed: Karoline Marek

Karolina Marek
PL Head of Reporting Team
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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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.

Analytical Report Number: 21-54067
Project / Site name: DC3 Imperial Park

Lab Sample Number				1753953	1753954	1753955
Sample Reference				DC3_TP05	DC3_TP07	DC3_TP12
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.20-0.30	3.50-3.60	0.10-0.30
Date Sampled				27/01/2021	27/01/2021	27/01/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	13	4.5	4.8
Total mass of sample received	kg	0.001	NONE	1.7	1.0	1.0
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected
General Inorganics						
pH - Automated	pH Units	N/A	MCERTS	6.8	7.7	10.5
Total Cyanide	mg/kg	1	MCERTS	1	< 1	< 1
Free Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.04	0.021	1.2
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	81	43	2400
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	40.3	21.4	1180
Sulphide	mg/kg	1	MCERTS	90	< 1.0	< 1.0
Ammoniacal Nitrogen as N	mg/kg	0.5	MCERTS	< 0.5	< 0.5	< 0.5
Ammoniacal Nitrogen as NH3	mg/kg	0.5	MCERTS	< 0.5	< 0.5	< 0.5
Organic Matter	%	0.1	MCERTS	1.5	< 0.1	1.4
Total Organic Carbon (TOC)	%	0.1	MCERTS	0.8	< 0.1	0.8
Total Phenols						
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Speciated PAHs						
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Total PAH						
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80	< 0.80

Analytical Report Number: 21-54067
Project / Site name: DC3 Imperial Park

Lab Sample Number				1753953	1753954	1753955
Sample Reference				DC3_TP05	DC3_TP07	DC3_TP12
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.20-0.30	3.50-3.60	0.10-0.30
Date Sampled				27/01/2021	27/01/2021	27/01/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Heavy Metals / Metalloids						
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	8.5	5.9	3.0
Boron (water soluble)	mg/kg	0.2	MCERTS	0.9	< 0.2	7.8
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	1.5
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	26	13	8
Copper (aqua regia extractable)	mg/kg	1	MCERTS	22	16	15
Lead (aqua regia extractable)	mg/kg	1	MCERTS	21	7.1	69
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	24	27	2.5
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	4.8
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	64	60	110
Monoaromatics & Oxygenates						
Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Petroleum Hydrocarbons						
TPH C10 - C40	mg/kg	10	MCERTS	42	< 10	1100
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	8.2
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	5.7	< 2.0	11
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	8.7	< 8.0	15
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	13	< 8.0	130
TPH-CWG - Aliphatic > EC35 - EC44	mg/kg	8.4	NONE	35	< 8.4	120
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	28	< 10	170
TPH-CWG - Aliphatic (EC5 - EC44)	mg/kg	10	NONE	62	< 10	290
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10	< 10	12
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	< 10	< 10	330
TPH-CWG - Aromatic > EC35 - EC44	mg/kg	8.4	NONE	< 8.4	< 8.4	570
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	< 10	340
TPH-CWG - Aromatic (EC5 - EC44)	mg/kg	10	NONE	< 10	< 10	910

Analytical Report Number: 21-54067
Project / Site name: DC3 Imperial Park

Lab Sample Number				1753953	1753954	1753955
Sample Reference				DC3_TP05	DC3_TP07	DC3_TP12
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.20-0.30	3.50-3.60	0.10-0.30
Date Sampled				27/01/2021	27/01/2021	27/01/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
PCBs by GC-MS						
PCB Congener 28	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001
PCB Congener 52	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001
PCB Congener 101	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001
PCB Congener 118	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001
PCB Congener 138	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001
PCB Congener 153	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001
PCB Congener 180	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001
Total PCBs by GC-MS						
Total PCBs	mg/kg	0.007	MCERTS	< 0.007	-	< 0.007
Glycols						
1,2-Butanediol	mg/kg	10	NONE	< 10	-	< 10
1,2-Propanediol	mg/kg	10	NONE	< 10	-	< 10
1,3-Butanediol	mg/kg	10	NONE	< 10	-	< 10
1,3-Propanediol	mg/kg	10	NONE	< 10	-	< 10
1,4-Butanediol	mg/kg	10	NONE	< 10	-	< 10
1,5-Pentanediol	mg/kg	10	NONE	< 10	-	< 10
Diethylene Glycol	mg/kg	10	NONE	< 10	-	< 10
Ethylene Glycol	mg/kg	10	NONE	< 10	-	< 10
Triethylene Glycol	mg/kg	10	NONE	< 10	-	< 10
Thiourea	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05

U/S = Unsuitable Sample   I/S = Insufficient Sample

Analytical Report Number : 21-54067
Project / Site name: DC3 Imperial Park

* 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 *
1753953	DC3_TP05	None Supplied	0.20-0.30	Light brown clay and sand with gravel.
1753954	DC3_TP07	None Supplied	3.50-3.60	Light brown loam and sand with gravel.
1753955	DC3_TP12	None Supplied	0.10-0.30	Light brown loam and sand with gravel.

Analytical Report Number : 21-54067
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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
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.	L038-PL	D	MCERTS
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
Free cyanide in soil	Determination of free cyanide 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
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	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.	In house method.	L009-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
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-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
Total cyanide in soil	Determination of total cyanide 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
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Ammonia as NH3 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

Analytical Report Number : 21-54067
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in soil	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the discrete analyser (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
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	NONE
Determination of glycols in soil by GC-MS.	Determination of glycols in soil by GC-MS.	In-house method	L059B-PL	D	NONE
TPH Banding in Soil by FID	Determination of hexane extractable hydrocarbons in soil by GC-FID.	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	W	MCERTS
Sulphate, water soluble, in soil (1hr extraction)	Sulphate, water soluble, in soil (1hr extraction)	In-house method	L038-PL	D	MCERTS
TO - Thiourea in soil	Determination of alkylthioureas by LC-UV/LC-MS	In-house method		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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Analytical Report Number : 21-54073

Project / Site name:	DC3 Imperial Park	**Samples received on:**	01/02/2021
Your job number:	36253	**Samples instructed on/ Analysis started on:**	01/02/2021
Your order number:		**Analysis completed by:**	05/02/2021
Report Issue Number:	1	**Report issued on:**	05/02/2021
Samples Analysed:	1 10:1 WAC sample		

Signed:

Rachel Bradley
Deputy Quality Manager
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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Waste Acceptance Criteria Analytical Results

Report No:	**21-54073**						
					Client:	**GEOENG**	
Location	**DC3 Imperial Park**						
Lab Reference (Sample Number)	1753973 / 1753974				**Landfill Waste Acceptance Criteria Limits**		
Sampling Date	27/01/2021				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID	DC3_TP12						
Depth (m)	0.50-0.60						
Solid Waste Analysis							
TOC (%)**	0.3				3%	5%	6%
Loss on Ignition (%) **	-				--	--	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)	< 0.85				100	--	--
pH (units)**	-				--	>6	--
Acid Neutralisation Capacity (mol / kg)	-				--	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 *	0.0025			0.0233	0.5	2	25
Barium *	0.0730			0.670	20	100	300
Cadmium *	< 0.0001			< 0.0008	0.04	1	5
Chromium *	0.0015			0.014	0.5	10	70
Copper *	0.011			0.10	2	50	100
Mercury *	< 0.0005			< 0.0050	0.01	0.2	2
Molybdenum *	< 0.0004			< 0.0040	0.5	10	30
Nickel *	0.0021			0.020	0.4	10	40
Lead *	0.0051			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 *	0.014			0.13	4	50	200
Chloride *	4.2			39	800	15000	25000
Fluoride	0.057			0.52	10	150	500
Sulphate *	23			210	1000	20000	50000
TDS*	42			390	4000	60000	100000
Phenol Index (Monohydric Phenols) *	< 0.010			< 0.10	1	-	-
DOC	4.63			42.5	500	800	1000
Leach Test Information							
Stone Content (%)	< 0.1						
Sample Mass (kg)	2.0						
Dry Matter (%)	95						
Moisture (%)	4.8						

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.

Analytical Report Number : 21-54073
Project / Site name: DC3 Imperial Park

* 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 *
1753973	DC3_TP12	None Supplied	0.50-0.60	Light brown sand with gravel.

Analytical Report Number : 21-54073
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
BS EN 12457-2 (10:1) Leachate Prep	10:1 (as recieved, moisture adjusted) end over end extraction with water for 24 hours. Eluate filtered prior to analysis.	In-house method based on BSEN12457-2.	L043-PL	W	NONE
Mineral Oil (Soil) C10 - C40	Determination of mineral oil fraction extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L076-PL	D	NONE
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Speciated WAC-17 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. MCERTS accredited except Coronene.	L064-PL	D	NONE
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-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
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
BTEX in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Total BTEX in soil (Poland)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073-PL	W	MCERTS
Metals in leachate by ICP-OES	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil""	L039-PL	W	ISO 17025
Chloride 10:1 WAC	Determination of Chloride colorimetrically by discrete analyser.	In house based on MEWAM Method ISBN 0117516260.	L082-PL	W	ISO 17025
Fluoride 10:1 WAC	Determination of fluoride in leachate by 1:1ratio with a buffer solution followed by Ion Selective Electrode.	In-house method based on Use of Total Ionic Strength Adjustment Buffer for Electrode Determination"	L033B-PL	W	ISO 17025
Sulphate 10:1 WAC	Determination of sulphate in leachate by ICP-OES	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil""	L039-PL	W	ISO 17025
Total dissolved solids 10:1 WAC	Determination of total dissolved solids in water by electrometric measurement.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L004-PL	W	ISO 17025
Monohydric phenols 10:1 WAC	Determination of phenols in leachate by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	ISO 17025
Dissolved organic carbon 10:1 WAC	Determination of dissolved inorganic carbon in leachate by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE

Analytical Report Number : 21-54073
Project / Site name: DC3 Imperial Park

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

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

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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Analytical Report Number : 21-54426

Replaces Analytical Report Number: 21-54426, issue no. 4
Report format change.

Project / Site name:	DC3 Imperial Park	**Samples received on:**	01/02/2021
Your job number:	36253	**Samples instructed on/ Analysis started on:**	02/02/2021
Your order number:		**Analysis completed by:**	26/02/2021
Report Issue Number:	5	**Report issued on:**	03/03/2021
Samples Analysed:	2 soil samples		

Signed:

Rachel Bradley
Deputy Quality Manager
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.

Analytical Report Number: 21-54426
Project / Site name: DC3 Imperial Park

Lab Sample Number				1756407	1756408
Sample Reference				DC3_BH05	DC3_TP06
Sample Number				2	1
Depth (m)				0.60-0.80	0.00-0.30
Date Sampled				28/01/2021	28/01/2021
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	8.9	4.6
Total mass of sample received	kg	0.001	NONE	1.9	2
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected
General Inorganics					
pH - Automated	pH Units	N/A	MCERTS	8.9	11.8
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1
Free Cyanide	mg/kg	1	MCERTS	< 1	< 1
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.066	0.065
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	130	130
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	65.5	65
Sulphide	mg/kg	1	MCERTS	< 1.0	81
Ammoniacal Nitrogen as N	mg/kg	0.5	MCERTS	< 0.5	< 0.5
Ammoniacal Nitrogen as NH3	mg/kg	0.5	MCERTS	< 0.5	< 0.5
Organic Matter	%	0.1	MCERTS	0.4	1.2
Total Organic Carbon (TOC)	%	0.1	MCERTS	0.2	0.7
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

Analytical Report Number: 21-54426
Project / Site name: DC3 Imperial Park

Lab Sample Number				1756407	1756408
Sample Reference				DC3_BH05	DC3_TP06
Sample Number				2	1
Depth (m)				0.60-0.80	0.00-0.30
Date Sampled				28/01/2021	28/01/2021
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
Heavy Metals / Metalloids					
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	6.3	14
Boron (water soluble)	mg/kg	0.2	MCERTS	0.3	1.4
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.5	6.3
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	21	14
Copper (aqua regia extractable)	mg/kg	1	MCERTS	18	32
Lead (aqua regia extractable)	mg/kg	1	MCERTS	13	68
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	15	15
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	52	210
Monoaromatics & Oxygenates					
Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0
Petroleum Hydrocarbons					
TPH C10 - C40	mg/kg	10	MCERTS	< 10	< 10
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	< 8.0	< 8.0
TPH-CWG - Aliphatic > EC35 - EC44	mg/kg	8.4	NONE	< 8.4	< 8.4
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	< 10
TPH-CWG - Aliphatic (EC5 - EC44)	mg/kg	10	NONE	< 10	< 10
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10	< 10
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	< 10	< 10
TPH-CWG - Aromatic > EC35 - EC44	mg/kg	8.4	NONE	< 8.4	< 8.4
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	< 10
TPH-CWG - Aromatic (EC5 - EC44)	mg/kg	10	NONE	< 10	< 10

Analytical Report Number: 21-54426
Project / Site name: DC3 Imperial Park

Lab Sample Number				1756407	1756408
Sample Reference				DC3_BH05	DC3_TP06
Sample Number				2	1
Depth (m)				0.60-0.80	0.00-0.30
Date Sampled				28/01/2021	28/01/2021
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
PCBs by GC-MS					
PCB Congener 28	mg/kg	0.001	MCERTS	< 0.001	< 0.001
PCB Congener 52	mg/kg	0.001	MCERTS	< 0.001	< 0.001
PCB Congener 101	mg/kg	0.001	MCERTS	< 0.001	< 0.001
PCB Congener 118	mg/kg	0.001	MCERTS	< 0.001	< 0.001
PCB Congener 138	mg/kg	0.001	MCERTS	< 0.001	< 0.001
PCB Congener 153	mg/kg	0.001	MCERTS	< 0.001	< 0.001
PCB Congener 180	mg/kg	0.001	MCERTS	< 0.001	< 0.001
Total PCBs by GC-MS					
Total PCBs	mg/kg	0.007	MCERTS	< 0.007	< 0.007
Glycols					
1,2-Butanediol	mg/kg	10	NONE	< 10	< 10
1,2-Propanediol	mg/kg	10	NONE	< 10	< 10
1,3-Butanediol	mg/kg	10	NONE	< 10	< 10
1,3-Propanediol	mg/kg	10	NONE	< 10	< 10
1,4-Butanediol	mg/kg	10	NONE	< 10	< 10
1,5-Pentanediol	mg/kg	10	NONE	< 10	< 10
Diethylene Glycol	mg/kg	10	NONE	< 10	< 10
Ethylene Glycol	mg/kg	10	NONE	< 10	< 10
Triethylene Glycol	mg/kg	10	NONE	< 10	< 10
Thiourea					
Thiourea	mg/kg	0.05	NONE	< 0.05	< 0.05

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number : 21-54426
Project / Site name: DC3 Imperial Park

* 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 *
1756407	DC3_BH05	2	0.60-0.80	Light brown clay and sand with gravel.
1756408	DC3_TP06	1	0.00-0.30	Light brown sand with gravel.

Analytical Report Number : 21-54426
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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.	L038-PL	D	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
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
Free cyanide in soil	Determination of free cyanide 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
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	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.	In house method.	L009-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
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-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
Total cyanide in soil	Determination of total cyanide 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
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Ammonia as NH3 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

Analytical Report Number : 21-54426
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in soil	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the discrete analyser (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
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	NONE
Determination of glycols in soil by GC-MS.	Determination of glycols in soil by GC-MS.	In-house method	L059B-PL	D	NONE
TPH Banding in Soil by FID	Determination of hexane extractable hydrocarbons in soil by GC-FID.	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	W	MCERTS
Sulphate, water soluble, in soil (1hr extraction)	Sulphate, water soluble, in soil (1hr extraction)	In-house method	L038-PL	D	MCERTS
TO - Thiourea in soil	Determination of alkylthioureas by LC-UV/LC-MS	In-house method		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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Analytical Report Number : 21-54511

Replaces Analytical Report Number: 21-54511, issue no. 4
Report format change.

Project / Site name:	DC3 Imperial Park	**Samples received on:**	03/02/2021
Your job number:	36253	**Samples instructed on/ Analysis started on:**	03/02/2021
Your order number:		**Analysis completed by:**	01/03/2021
Report Issue Number:	5	**Report issued on:**	03/03/2021
Samples Analysed:	2 soil samples		

Signed:

Rachel Bradley
Deputy Quality Manager
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.

Analytical Report Number: 21-54511
Project / Site name: DC3 Imperial Park

Lab Sample Number				1756816	1756817
Sample Reference				DC3_BH04B	DC3_BH02
Sample Number				4	2
Depth (m)				1.70-1.80	0.40-0.60
Date Sampled				01/02/2021	01/02/2021
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
Stone Content	%	0.1	NONE	< 0.1	31
Moisture Content	%	0.01	NONE	11	2.3
Total mass of sample received	kg	0.001	NONE	2	2
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected
General Inorganics					
pH - Automated	pH Units	N/A	MCERTS	8.3	11.6
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1
Free Cyanide	mg/kg	1	MCERTS	< 1	< 1
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.021	0.037
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	42	73
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	20.8	36.7
Sulphide	mg/kg	1	MCERTS	1.4	47
Ammoniacal Nitrogen as N	mg/kg	0.5	MCERTS	< 0.5	< 0.5
Ammoniacal Nitrogen as NH3	mg/kg	0.5	MCERTS	< 0.5	< 0.5
Organic Matter	%	0.1	MCERTS	0.3	1
Total Organic Carbon (TOC)	%	0.1	MCERTS	0.1	0.6
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

Analytical Report Number: 21-54511
Project / Site name: DC3 Imperial Park

Lab Sample Number				1756816	1756817
Sample Reference				DC3_BH04B	DC3_BH02
Sample Number				4	2
Depth (m)				1.70-1.80	0.40-0.60
Date Sampled				01/02/2021	01/02/2021
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
Heavy Metals / Metalloids					
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	8.1	13
Boron (water soluble)	mg/kg	0.2	MCERTS	0.3	1.8
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	3.4
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	21	12
Copper (aqua regia extractable)	mg/kg	1	MCERTS	22	36
Lead (aqua regia extractable)	mg/kg	1	MCERTS	15	20
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	23	14
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	49	94
Monoaromatics & Oxygenates					
Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0
Petroleum Hydrocarbons					
TPH C10 - C40	mg/kg	10	MCERTS	27	43
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	3.3
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	9.2
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	18	25
TPH-CWG - Aliphatic > EC35 - EC44	mg/kg	8.4	NONE	< 8.4	< 8.4
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	22	38
TPH-CWG - Aliphatic (EC5 - EC44)	mg/kg	10	NONE	22	38
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10	< 10
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	< 10	< 10
TPH-CWG - Aromatic > EC35 - EC44	mg/kg	8.4	NONE	< 8.4	< 8.4
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	< 10
TPH-CWG - Aromatic (EC5 - EC44)	mg/kg	10	NONE	< 10	< 10

Analytical Report Number: 21-54511
Project / Site name: DC3 Imperial Park

Lab Sample Number				1756816	1756817
Sample Reference				DC3_BH04B	DC3_BH02
Sample Number				4	2
Depth (m)				1.70-1.80	0.40-0.60
Date Sampled				01/02/2021	01/02/2021
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
PCBs by GC-MS					
PCB Congener 28	mg/kg	0.001	MCERTS	< 0.001	< 0.001
PCB Congener 52	mg/kg	0.001	MCERTS	< 0.001	< 0.001
PCB Congener 101	mg/kg	0.001	MCERTS	< 0.001	< 0.001
PCB Congener 118	mg/kg	0.001	MCERTS	< 0.001	< 0.001
PCB Congener 138	mg/kg	0.001	MCERTS	< 0.001	< 0.001
PCB Congener 153	mg/kg	0.001	MCERTS	< 0.001	< 0.001
PCB Congener 180	mg/kg	0.001	MCERTS	< 0.001	< 0.001
Total PCBs by GC-MS					
Total PCBs	mg/kg	0.007	MCERTS	< 0.007	< 0.007
Glycols					
1,2-Butanediol	mg/kg	10	NONE	< 10	< 10
1,2-Propanediol	mg/kg	10	NONE	< 10	< 10
1,3-Butanediol	mg/kg	10	NONE	< 10	< 10
1,3-Propanediol	mg/kg	10	NONE	< 10	< 10
1,4-Butanediol	mg/kg	10	NONE	< 10	< 10
1,5-Pentanediol	mg/kg	10	NONE	< 10	< 10
Diethylene Glycol	mg/kg	10	NONE	< 10	< 10
Ethylene Glycol	mg/kg	10	NONE	< 10	< 10
Triethylene Glycol	mg/kg	10	NONE	< 10	< 10
Thiourea					
Thiourea	mg/kg	0.05	NONE	< 0.05	< 0.05

U/S = Unsuitable Sample   I/S = Insufficient Sample

Analytical Report Number : 21-54511
Project / Site name: DC3 Imperial Park

* 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 *
1756816	DC3_BH04B	4	1.70-1.80	Brown clay and sand.
1756817	DC3_BH02	2	0.40-0.60	Light brown sand with stones.

Analytical Report Number : 21-54511
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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
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.	L038-PL	D	MCERTS
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
Free cyanide in soil	Determination of free cyanide 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
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	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.	In house method.	L009-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
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-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
Total cyanide in soil	Determination of total cyanide 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
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Ammonia as NH3 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

Analytical Report Number : 21-54511
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in soil	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the discrete analyser (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
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	NONE
Determination of glycols in soil by GC-MS.	Determination of glycols in soil by GC-MS.	In-house method	L059B-PL	D	NONE
TPH Banding in Soil by FID	Determination of hexane extractable hydrocarbons in soil by GC-FID.	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	W	MCERTS
Sulphate, water soluble, in soil (1hr extraction)	Sulphate, water soluble, in soil (1hr extraction)	In-house method	L038-PL	D	MCERTS
TO - Thiourea in soil	Determination of alkylthioureas by LC-UV/LC-MS	In-house method		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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Analytical Report Number : 21-54514

Project / Site name:	DC3 Imperial Park	**Samples received on:**	03/02/2021
Your job number:	36253	**Samples instructed on/ Analysis started on:**	03/02/2021
Your order number:		**Analysis completed by:**	09/02/2021
Report Issue Number:	1	**Report issued on:**	09/02/2021
Samples Analysed:	1 10:1 WAC sample		

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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Waste Acceptance Criteria Analytical Results

Report No:	**21-54514**						
					Client: GEOENG		
Location	**DC3 Imperial Park**						
Lab Reference (Sample Number)	1756828 / 1756829				**Landfill Waste Acceptance Criteria Limits**		
Sampling Date	01/02/2021				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID	DC3_BH04B 4						
Depth (m)	1.70-1.80						
Solid Waste Analysis							
TOC (%)**	0.2				3%	5%	6%
Loss on Ignition (%) **	-				--	--	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)	< 0.85				100	--	--
pH (units)**	-				--	>6	--
Acid Neutralisation Capacity (mol / kg)	-				--	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 *	< 0.0010			< 0.0100	0.5	2	25
Barium *	0.0025			0.0228	20	100	300
Cadmium *	< 0.0001			< 0.0008	0.04	1	5
Chromium *	< 0.0004			< 0.0040	0.5	10	70
Copper *	< 0.0007			< 0.0070	2	50	100
Mercury *	< 0.0005			< 0.0050	0.01	0.2	2
Molybdenum *	0.0008			0.0072	0.5	10	30
Nickel *	0.0017			0.016	0.4	10	40
Lead *	0.0014			0.012	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 *	0.0084			0.076	4	50	200
Chloride *	1.0			9.3	800	15000	25000
Fluoride	0.053			< 0.50	10	150	500
Sulphate *	4.6			41	1000	20000	50000
TDS*	22			200	4000	60000	100000
Phenol Index (Monohydric Phenols) *	< 0.010			< 0.10	1	-	-
DOC	5.50			49.4	500	800	1000
Leach Test Information							
Stone Content (%)	< 0.1						
Sample Mass (kg)	2.0						
Dry Matter (%)	89						
Moisture (%)	11						

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.

Analytical Report Number : 21-54514
Project / Site name: DC3 Imperial Park

* 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 *
1756828	DC3_BH04B	4	1.70-1.80	Brown clay and sand.

Analytical Report Number : 21-54514
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
BS EN 12457-2 (10:1) Leachate Prep	10:1 (as recieved, moisture adjusted) end over end extraction with water for 24 hours. Eluate filtered prior to analysis.	In-house method based on BSEN12457-2.	L043-PL	W	NONE
Mineral Oil (Soil) C10 - C40	Determination of mineral oil fraction extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L076-PL	D	NONE
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Speciated WAC-17 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. MCERTS accredited except Coronene.	L064-PL	D	NONE
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-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
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
BTEX in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Total BTEX in soil (Poland)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073-PL	W	MCERTS
Metals in leachate by ICP-OES	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil""	L039-PL	W	ISO 17025
Chloride 10:1 WAC	Determination of Chloride colorimetrically by discrete analyser.	In house based on MEWAM Method ISBN 0117516260.	L082-PL	W	ISO 17025
Fluoride 10:1 WAC	Determination of fluoride in leachate by 1:1ratio with a buffer solution followed by Ion Selective Electrode.	In-house method based on Use of Total Ionic Strength Adjustment Buffer for Electrode Determination"	L033B-PL	W	ISO 17025
Sulphate 10:1 WAC	Determination of sulphate in leachate by ICP-OES	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil""	L039-PL	W	ISO 17025
Total dissolved solids 10:1 WAC	Determination of total dissolved solids in water by electrometric measurement.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L004-PL	W	ISO 17025
Monohydric phenols 10:1 WAC	Determination of phenols in leachate by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	ISO 17025
Dissolved organic carbon 10:1 WAC	Determination of dissolved inorganic carbon in leachate by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE

Analytical Report Number : 21-54514
Project / Site name: DC3 Imperial Park

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

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

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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Analytical Report Number : 21-54532

Replaces Analytical Report Number: 21-54532, issue no. 4
Report format change.

Project / Site name:	DC3 Imperial Park	**Samples received on:**	01/02/2021
Your job number:	36253	**Samples instructed on/ Analysis started on:**	03/02/2021
Your order number:		**Analysis completed by:**	24/02/2021
Report Issue Number:	5	**Report issued on:**	24/02/2021
Samples Analysed:	2 soil samples		

Signed:

Rachel Bradley
Deputy Quality Manager
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.

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soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
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Analytical Report Number: 21-54532
Project / Site name: DC3 Imperial Park

Lab Sample Number				1757073	1757074
Sample Reference				DC3_TP08	DC3_TP04
Sample Number				2	1
Depth (m)				0.40-0.60	0.30-0.40
Date Sampled				28/01/2021	28/01/2021
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	11	4.6
Total mass of sample received	kg	0.001	NONE	1.4	2
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected
General Inorganics					
pH - Automated	pH Units	N/A	MCERTS	8.1	8.5
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1
Free Cyanide	mg/kg	1	MCERTS	< 1	< 1
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.0036	0.0046
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	7.1	9.2
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	3.6	4.6
Sulphide	mg/kg	1	MCERTS	17	29
Ammoniacal Nitrogen as N	mg/kg	0.5	MCERTS	3	< 0.5
Ammoniacal Nitrogen as NH3	mg/kg	0.5	MCERTS	3.7	< 0.5
Organic Matter	%	0.1	MCERTS	0.5	0.8
Total Organic Carbon (TOC)	%	0.1	MCERTS	0.3	0.4
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

Analytical Report Number: 21-54532
Project / Site name: DC3 Imperial Park

Lab Sample Number				1757073	1757074
Sample Reference				DC3_TP08	DC3_TP04
Sample Number				2	1
Depth (m)				0.40-0.60	0.30-0.40
Date Sampled				28/01/2021	28/01/2021
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
Heavy Metals / Metalloids					
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	9.1	10
Boron (water soluble)	mg/kg	0.2	MCERTS	0.3	< 0.2
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	23	18
Copper (aqua regia extractable)	mg/kg	1	MCERTS	21	18
Lead (aqua regia extractable)	mg/kg	1	MCERTS	16	14
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	21	27
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	53	68
Monoaromatics & Oxygenates					
Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0
Petroleum Hydrocarbons					
TPH C10 - C40	mg/kg	10	MCERTS	< 10	< 10
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	< 8.0	< 8.0
TPH-CWG - Aliphatic > EC35 - EC44	mg/kg	8.4	NONE	< 8.4	< 8.4
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	< 10
TPH-CWG - Aliphatic (EC5 - EC44)	mg/kg	10	NONE	< 10	< 10
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10	< 10
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	< 10	< 10
TPH-CWG - Aromatic > EC35 - EC44	mg/kg	8.4	NONE	< 8.4	< 8.4
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	< 10
TPH-CWG - Aromatic (EC5 - EC44)	mg/kg	10	NONE	< 10	< 10

Analytical Report Number: 21-54532
Project / Site name: DC3 Imperial Park

Lab Sample Number				1757073	1757074
Sample Reference				DC3_TP08	DC3_TP04
Sample Number				2	1
Depth (m)				0.40-0.60	0.30-0.40
Date Sampled				28/01/2021	28/01/2021
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
Glycols					
1,2-Butanediol	mg/kg	10	NONE	< 10	< 10
1,2-Propanediol	mg/kg	10	NONE	< 10	< 10
1,3-Butanediol	mg/kg	10	NONE	< 10	< 10
1,3-Propanediol	mg/kg	10	NONE	< 10	< 10
1,4-Butanediol	mg/kg	10	NONE	< 10	< 10
1,5-Pentanediol	mg/kg	10	NONE	< 10	< 10
Diethylene Glycol	mg/kg	10	NONE	< 10	< 10
Ethylene Glycol	mg/kg	10	NONE	< 10	< 10
Triethylene Glycol	mg/kg	10	NONE	< 10	< 10
Thiourea	mg/kg	0.05	NONE	< 0.05	< 0.05

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number : 21-54532
Project / Site name: DC3 Imperial Park

* 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 *
1757073	DC3_TP08	2	0.40-0.60	Light brown clay and sand.
1757074	DC3_TP04	1	0.30-0.40	Light brown sand with gravel.

Analytical Report Number : 21-54532
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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.	L038-PL	D	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
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
Free cyanide in soil	Determination of free cyanide 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
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	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.	In house method.	L009-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
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-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
Total cyanide in soil	Determination of total cyanide 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
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Ammonia as NH3 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
Ammoniacal Nitrogen as N in soil	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the discrete analyser (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

Analytical Report Number : 21-54532
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	NONE
Determination of glycols in soil by GC-MS.	Determination of glycols in soil by GC-MS.	In-house method	L059B-PL	D	NONE
TPH Banding in Soil by FID	Determination of hexane extractable hydrocarbons in soil by GC-FID.	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	W	MCERTS
Sulphate, water soluble, in soil (1hr extraction)	Sulphate, water soluble, in soil (1hr extraction)	In-house method	L038-PL	D	MCERTS
TO - Thiourea in soil	Determination of alkylthioureas by LC-UV/LC-MS	In-house method		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.
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Analytical Report Number : 21-56841

Replaces Analytical Report Number: 21-56841, issue no. 2
Report format change.

Project / Site name:	DC3 Imperial Park	**Samples received on:**	04/02/2021
Your job number:	36253	**Samples instructed on/ Analysis started on:**	15/02/2021
Your order number:		**Analysis completed by:**	26/02/2021
Report Issue Number:	3	**Report issued on:**	03/03/2021
Samples Analysed:	1 soil sample		

Signed:

Rachel Bradley
Deputy Quality Manager
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.

Analytical Report Number: 21-56841
Project / Site name: DC3 Imperial Park

Lab Sample Number				1770401
Sample Reference				DC3_BH01
Sample Number				2
Depth (m)				0.60-0.80
Date Sampled				03/02/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**	
Stone Content	%	0.1	NONE	< 0.1
Moisture Content	%	0.01	NONE	11
Total mass of sample received	kg	0.001	NONE	2

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.4
Total Cyanide	mg/kg	1	MCERTS	< 1
Free Cyanide	mg/kg	1	MCERTS	< 1
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.055
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	110
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	54.6
Sulphide	mg/kg	1	MCERTS	< 1.0
Ammoniacal Nitrogen as N	mg/kg	0.5	MCERTS	< 0.5
Ammoniacal Nitrogen as NH3	mg/kg	0.5	MCERTS	< 0.5
Organic Matter	%	0.1	MCERTS	0.5
Total Organic Carbon (TOC)	%	0.1	MCERTS	0.3

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80

Analytical Report Number: 21-56841
Project / Site name: DC3 Imperial Park

Lab Sample Number				1770401
Sample Reference				DC3_BH01
Sample Number				2
Depth (m)				0.60-0.80
Date Sampled				03/02/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**	
Heavy Metals / Metalloids				
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	7.7
Boron (water soluble)	mg/kg	0.2	MCERTS	0.3
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	22
Copper (aqua regia extractable)	mg/kg	1	MCERTS	20
Lead (aqua regia extractable)	mg/kg	1	MCERTS	14
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	25
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	56
Monoaromatics & Oxygenates				
Benzene	µg/kg	1	MCERTS	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0
p & m-xylene	µg/kg	1	MCERTS	< 1.0
o-xylene	µg/kg	1	MCERTS	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0
Petroleum Hydrocarbons				
TPH C10 - C40	mg/kg	10	MCERTS	< 10
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	< 8.0
TPH-CWG - Aliphatic > EC35 - EC44	mg/kg	8.4	NONE	< 8.4
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10
TPH-CWG - Aliphatic (EC5 - EC44)	mg/kg	10	NONE	< 10
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	< 10
TPH-CWG - Aromatic > EC35 - EC44	mg/kg	8.4	NONE	< 8.4
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10
TPH-CWG - Aromatic (EC5 - EC44)	mg/kg	10	NONE	< 10

Analytical Report Number: 21-56841
Project / Site name: DC3 Imperial Park

Lab Sample Number				1770401
Sample Reference				DC3_BH01
Sample Number				2
Depth (m)				0.60-0.80
Date Sampled				03/02/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**	
PCBs by GC-MS				
PCB Congener 28	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 52	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 101	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 118	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 138	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 153	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 180	mg/kg	0.001	MCERTS	< 0.001
Total PCBs by GC-MS				
Total PCBs	mg/kg	0.007	MCERTS	< 0.007
Glycols				
1,2-Butanediol	mg/kg	10	NONE	< 10
1,2-Propanediol	mg/kg	10	NONE	< 10
1,3-Butanediol	mg/kg	10	NONE	< 10
1,3-Propanediol	mg/kg	10	NONE	< 10
1,4-Butanediol	mg/kg	10	NONE	< 10
1,5-Pentanediol	mg/kg	10	NONE	< 10
Diethylene Glycol	mg/kg	10	NONE	< 10
Ethylene Glycol	mg/kg	10	NONE	< 10
Triethylene Glycol	mg/kg	10	NONE	< 10
Thiourea				
Thiourea	mg/kg	0.05	NONE	< 0.05

U/S = Unsuitable Sample   I/S = Insufficient Sample

Analytical Report Number : 21-56841
Project / Site name: DC3 Imperial Park

* 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 *
1770401	DC3_BH01	2	0.60-0.80	Brown clay and sand.

Analytical Report Number : 21-56841
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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.	L038-PL	D	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
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
Free cyanide in soil	Determination of free cyanide 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
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	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.	In house method.	L009-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
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-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
Total cyanide in soil	Determination of total cyanide 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
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Ammonia as NH3 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

Analytical Report Number : 21-56841
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in soil	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the discrete analyser (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
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	NONE
Determination of glycols in soil by GC-MS.	Determination of glycols in soil by GC-MS.	In-house method	L059B-PL	D	NONE
TPH Banding in Soil by FID	Determination of hexane extractable hydrocarbons in soil by GC-FID.	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	W	MCERTS
Sulphate, water soluble, in soil (1hr extraction)	Sulphate, water soluble, in soil (1hr extraction)	In-house method	L038-PL	D	MCERTS
TO - Thiourea in soil	Determination of alkylthioureas by LC-UV/LC-MS	In-house method		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.

Analytical Report Number : 21-56841
Project / Site name: DC3 Imperial Park

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
DC3_BH01	2	S	1770401	c	Free cyanide in soil	L080-PL	c
DC3_BH01	2	S	1770401	c	Sulphide in soil	L010-PL	c
DC3_BH01	2	S	1770401	c	Total cyanide in soil	L080-PL	c

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Analytical Report Number : 21-58494

Project / Site name:	DC3 Imperial Park	**Samples received on:**	05/02/2021
Your job number:	36253	**Samples instructed on/ Analysis started on:**	23/02/2021
Your order number:		**Analysis completed by:**	01/03/2021
Report Issue Number:	1	**Report issued on:**	01/03/2021
Samples Analysed:	1 bulk sample - 1 soil sample		

Signed: A. Czerwińska

Agnieszka Czerwińska
Technical Reviewer (Reporting Team)
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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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.

Analytical Report Number: 21-58494
Project / Site name: DC3 Imperial Park

Lab Sample Number				1779903
Sample Reference				DC3_BH07
Sample Number				2
Depth (m)				0.30-0.50
Date Sampled				02/02/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**	
Stone Content	%	0.1	NONE	< 0.1
Moisture Content	%	0.01	NONE	12
Total mass of sample received	kg	0.001	NONE	1.8
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected
General Inorganics				
pH - Automated	pH Units	N/A	MCERTS	8.2
Total Cyanide	mg/kg	1	MCERTS	< 1
Free Cyanide	mg/kg	1	MCERTS	< 1
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.043
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	86
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	43.2
Sulphide	mg/kg	1	MCERTS	< 1.0
Ammoniacal Nitrogen as N	mg/kg	0.5	MCERTS	< 0.5
Ammoniacal Nitrogen as NH3	mg/kg	0.5	MCERTS	< 0.5
Total Organic Carbon (TOC)	%	0.1	MCERTS	0.4
Total Phenols				
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0
Speciated PAHs				
Naphthalene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05
Total PAH				
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80

Analytical Report Number: 21-58494
Project / Site name: DC3 Imperial Park

Lab Sample Number				1779903
Sample Reference				DC3_BH07
Sample Number				2
Depth (m)				0.30-0.50
Date Sampled				02/02/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**	
Heavy Metals / Metalloids				
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	8.9
Boron (water soluble)	mg/kg	0.2	MCERTS	0.5
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	22
Copper (aqua regia extractable)	mg/kg	1	MCERTS	17
Lead (aqua regia extractable)	mg/kg	1	MCERTS	23
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	23
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	59
Monoaromatics & Oxygenates				
Benzene	µg/kg	1	MCERTS	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0
p & m-xylene	µg/kg	1	MCERTS	< 1.0
o-xylene	µg/kg	1	MCERTS	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0
Petroleum Hydrocarbons				
TPH C10 - C40	mg/kg	10	MCERTS	< 10
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	< 8.0
TPH-CWG - Aliphatic > EC35 - EC44	mg/kg	8.4	NONE	< 8.4
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10
TPH-CWG - Aliphatic (EC5 - EC44)	mg/kg	10	NONE	< 10
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	< 10
TPH-CWG - Aromatic > EC35 - EC44	mg/kg	8.4	NONE	< 8.4
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10
TPH-CWG - Aromatic (EC5 - EC44)	mg/kg	10	NONE	< 10

Analytical Report Number: 21-58494
Project / Site name: DC3 Imperial Park

Lab Sample Number				1779903
Sample Reference				DC3_BH07
Sample Number				2
Depth (m)				0.30-0.50
Date Sampled				02/02/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**	
PCBs by GC-MS				
PCB Congener 28	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 52	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 101	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 118	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 138	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 153	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 180	mg/kg	0.001	MCERTS	< 0.001
Total PCBs by GC-MS				
Total PCBs	mg/kg	0.007	MCERTS	< 0.007
Glycols				
1,2-Butanediol	mg/kg	10	NONE	< 10
1,2-Propanediol	mg/kg	10	NONE	< 10
1,3-Butanediol	mg/kg	10	NONE	< 10
1,3-Propanediol	mg/kg	10	NONE	< 10
1,4-Butanediol	mg/kg	10	NONE	< 10
1,5-Pentanediol	mg/kg	10	NONE	< 10
Diethylene Glycol	mg/kg	10	NONE	< 10
Ethylene Glycol	mg/kg	10	NONE	< 10
Triethylene Glycol	mg/kg	10	NONE	< 10
Thiourea				
Thiourea	mg/kg	0.05	NONE	< 0.05

U/S = Unsuitable Sample   I/S = Insufficient Sample

Analytical Report Number: 21-58494
Project / Site name: DC3 Imperial Park

Lab Sample Number				1779904
Sample Reference				DC3_DPSH02
Sample Number				None Supplied
Depth (m)				0.40
Date Sampled				03/02/2021
Time Taken				None Supplied
Analytical Parameter (Bulk Analysis)	**Units**	**Limit of detection**	**Accreditation Status**	
Asbestos Identification	Type	N/A	ISO 17025	No Asbestos Detected

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number : 21-58494
Project / Site name: DC3 Imperial Park

* 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 *
1779903	DC3_BH07	2	0.30-0.50	Brown clay and sand with gravel.

Analytical Report Number : 21-58494
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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.	L038-PL	D	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
Asbestos identification in Bulks	Asbestos Identification in bulk material with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	W	ISO 17025
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
Free cyanide in soil	Determination of free cyanide 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
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	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
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
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-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
Total cyanide in soil	Determination of total cyanide 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
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Ammonia as NH3 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

Analytical Report Number : 21-58494
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in soil	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the discrete analyser (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
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	NONE
Determination of glycols in soil by GC-MS.	Determination of glycols in soil by GC-MS.	In-house method	L059B-PL	D	NONE
TPH Banding in Soil by FID	Determination of hexane extractable hydrocarbons in soil by GC-FID.	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	W	MCERTS
Sulphate, water soluble, in soil (1hr extraction)	Sulphate, water soluble, in soil (1hr extraction)	In-house method	L038-PL	D	MCERTS
TO - Thiourea in soil	Determination of alkylthioureas by LC-UV/LC-MS	In-house method		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.

Sample Deviation Report

Analytical Report Number : 21-58494
Project / Site name: DC3 Imperial Park

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
DC3_BH07	2	S	1779903	c	Free cyanide in soil	L080-PL	c
DC3_BH07	2	S	1779903	c	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	c
DC3_BH07	2	S	1779903	c	Monohydric phenols in soil	L080-PL	c
DC3_BH07	2	S	1779903	c	PCB's By GC-MS in soil	L027-PL	c
DC3_BH07	2	S	1779903	c	Speciated EPA-16 PAHs in soil	L064-PL	c
DC3_BH07	2	S	1779903	c	Sulphide in soil	L010-PL	c
DC3_BH07	2	S	1779903	c	TO - Thiourea in soil	None Supplied	c
DC3_BH07	2	S	1779903	c	TPH Banding in Soil by FID	L076-PL	c
DC3_BH07	2	S	1779903	c	TPH in (Soil)	L076-PL	c
DC3_BH07	2	S	1779903	c	TPHCWG (Soil)	L088/76-PL	c
DC3_BH07	2	S	1779903	c	Total cyanide in soil	L080-PL	c

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

UKAS TESTING 4041

Analytical

i2

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Analytical Report Number : 21-57610

Project / Site name:	DC3 Imperial Park	**Samples received on:**	18/02/2021
Your job number:	36253	**Samples instructed on/ Analysis started on:**	18/02/2021
Your order number:		**Analysis completed by:**	23/02/2021
Report Issue Number:	1	**Report issued on:**	23/02/2021
Samples Analysed:	4 water samples		

Signed:

Joanna Wawrzeczko
Technical Reviewer (Reporting Team)
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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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.

UKAS TESTING 4041

Analytical Environmental Science

Analytical Report Number: 21-57610
Project / Site name: DC3 Imperial Park

Lab Sample Number				1774761	1774762	1774763	1774764
Sample Reference				DC3_BH01	DC3_BH03	DC3_BH05	DC3_BH07
Sample Number				1	1	1	1
Depth (m)				2.37	3.38	2.20	4.72
Date Sampled				17/02/2021	17/02/2021	17/02/2021	17/02/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**				
General Inorganics							
pH	pH Units	N/A	ISO 17025	6.7	7.5	7.2	7.1
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10
Free Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10
Sulphate as SO4	mg/l	0.045	ISO 17025	54.1	39.9	25	41.3
Sulphide	µg/l	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0
Chloride	mg/l	0.15	ISO 17025	17	8.5	8.3	12
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	< 15	29	17	< 15
Ammoniacal Nitrogen as NH3	µg/l	15	ISO 17025	< 15	35	20	< 15
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	1.93	0.7	2.57	0.95
Total Organic Carbon (TOC)	mg/l	0.1	ISO 17025	2.91	7.21	3.4	3.87
Total Phenols							
Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10
Speciated PAHs							
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Total PAH							
Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16
Heavy Metals / Metalloids							
Boron (dissolved)	µg/l	10	ISO 17025	44	81	42	49
Arsenic (dissolved)	µg/l	0.15	ISO 17025	0.46	< 0.15	0.35	< 0.15
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.03	< 0.02	< 0.02	0.03
Chromium (dissolved)	µg/l	0.2	ISO 17025	1.5	1.2	1.9	1.3
Copper (dissolved)	µg/l	0.5	ISO 17025	1.6	0.8	2.7	5.9
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	0.3	< 0.2	< 0.2
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	5.7	1.3	8.4	2
Selenium (dissolved)	µg/l	0.6	ISO 17025	3.5	1.9	1.5	1.5
Zinc (dissolved)	µg/l	0.5	ISO 17025	4.4	1.6	4.3	6.2

UKAS TESTING 4041

Analytical Environmental Science

Analytical Report Number: 21-57610
Project / Site name: DC3 Imperial Park

Lab Sample Number				1774761	1774762	1774763	1774764
Sample Reference				DC3_BH01	DC3_BH03	DC3_BH05	DC3_BH07
Sample Number				1	1	1	1
Depth (m)				2.37	3.38	2.20	4.72
Date Sampled				17/02/2021	17/02/2021	17/02/2021	17/02/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**				
Monoaromatics & Oxygenates							
Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
Petroleum Hydrocarbons							
TPH1 (C10 - C40)	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10
PCBs by GC-MS							
PCB Congener 28	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02	< 0.02
PCB Congener 52	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02	< 0.02
PCB Congener 101	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02	< 0.02
PCB Congener 118	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02	< 0.02
PCB Congener 138	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02	< 0.02
PCB Congener 153	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02	< 0.02
PCB Congener 180	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02	< 0.02
PCBs by GC-MS							
Total PCBs	µg/l	0.14	NONE	< 0.14	< 0.14	< 0.14	< 0.14

UKAS TESTING 4041

Analytical Environmental Science

Analytical Report Number: 21-57610
Project / Site name: DC3 Imperial Park

Lab Sample Number				1774761	1774762	1774763	1774764
Sample Reference				DC3_BH01	DC3_BH03	DC3_BH05	DC3_BH07
Sample Number				1	1	1	1
Depth (m)				2.37	3.38	2.20	4.72
Date Sampled				17/02/2021	17/02/2021	17/02/2021	17/02/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**				
Glycols							
1,2-Butanediol	mg/l	10	NONE	< 10	< 10	< 10	< 10
1,2-Propanediol	mg/l	10	NONE	< 10	< 10	< 10	< 10
1,3-Butanediol	mg/l	10	NONE	< 10	< 10	< 10	< 10
1,3-Propanediol	mg/l	10	NONE	< 10	< 10	< 10	< 10
1,4-Butanediol	mg/l	10	NONE	< 10	< 10	< 10	< 10
1,5-Pentanediol	mg/l	10	NONE	< 10	< 10	< 10	< 10
Diethylene Glycol	mg/l	10	NONE	< 10	< 10	< 10	< 10
Ethylene Glycol	mg/l	10	NONE	< 10	< 10	< 10	< 10
Triethylene Glycol	mg/l	10	NONE	< 10	< 10	< 10	< 10
Thiourea							
Thiourea	µg/l	50	NONE	< 50	< 50	< 50	< 50

U/S = Unsuitable Sample   I/S = Insufficient Sample

Analytical Report Number : 21-57610
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Boron in water	Determination of boron in water by acidification followed by ICP-OES. Accredited matrices: SW PW GW	In-house method based on MEWAM	L039-PL	W	ISO 17025
Free cyanide in water	Determination of free cyanide by distillation followed by colorimetry.Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
PCB's By GC-MS in water	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L028-PL	W	NONE
Sulphide in water	Determination of sulphide in water by ion selective electrode.	In-house method	L029-PL	W	NONE
Sulphate in water	Determination of sulphate in water by acidification followed by ICP-OES. Accredited matrices: SW PW GW, PrW.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
TPH1 (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS.	In-house method	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Total organic carbon in water	Determination of dissolved organic carbon in water by TOC/DOC NDIR analyser. Accredited matrices: SW PW GW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Ammonia as NH3 in water	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In house method.	L099-PL	W	ISO 17025

Analytical Report Number : 21-57610
Project / Site name: DC3 Imperial Park

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Determination of glycols in water by GC-MS.	Determination of glycols in water by GC-MS.	In-house method	L059B-PL	W	NONE
TPH in (Water)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L070-PL	W	NONE
Chloride in water	Determination of Chloride colorimetrically by discrete analyser.	In house based on MEWAM Method ISBN 0117516260. Accredited matrices: SW, PW, GW.	L082-PL	W	ISO 17025
TO - Thiourea in water	Determination of alkylthioureas by LC-UV/LC-MS	In-house method		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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Analytical Report Number : 21-60122

Project / Site name:	Newport	**Samples received on:**	03/03/2021
Your job number:	36253	**Samples instructed on/ Analysis started on:**	03/03/2021
Your order number:	36253 MH	**Analysis completed by:**	10/03/2021
Report Issue Number:	1	**Report issued on:**	10/03/2021
Samples Analysed:	4 water samples		

Signed:

Joanna Wawrzeczko
Technical Reviewer (Reporting Team)
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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Environmental Science

Analytical Report Number: 21-60122
Project / Site name: Newport

Your Order No: 36253 MH

Lab Sample Number				1790066	1790067	1790068	1790069
Sample Reference				DC3-BH01	DC3-BH03	DC3-BH05	DC3-BH07
Sample Number				2	2	2	2
Depth (m)				2.95-3.00	3.60-3.71	2.75-2.75	4.86-4.91
Date Sampled				03/03/2021	03/03/2021	03/03/2021	03/03/2021
Time Taken				0950	0920	1010	0900
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**				
General Inorganics							
pH	pH Units	N/A	ISO 17025	7	7.1	7.1	7.1
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10
Free Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10
Sulphate as SO4	mg/l	0.045	ISO 17025	39.1	36.8	10.7	44.3
Sulphide	µg/l	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0
Chloride	mg/l	0.15	ISO 17025	17	8.9	7.5	13
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	71	17	< 15	< 15
Ammoniacal Nitrogen as NH3	µg/l	15	ISO 17025	87	20	17	< 15
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	1.46	1.07	1.63	1.01
Total Organic Carbon (TOC)	mg/l	0.1	ISO 17025	2.91	1.64	2.76	1.95
Total Phenols							
Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10
Speciated PAHs							
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Total PAH							
Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16
Heavy Metals / Metalloids							
Boron (dissolved)	µg/l	10	ISO 17025	44	78	36	47
Arsenic (dissolved)	µg/l	0.15	ISO 17025	0.83	0.17	0.33	< 0.15
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.02	0.07	< 0.02	0.04
Chromium (dissolved)	µg/l	0.2	ISO 17025	2	3.1	2	1.3
Copper (dissolved)	µg/l	0.5	ISO 17025	4.4	5.1	6.1	5
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	< 0.2	< 0.2
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	6.2	1.1	3.7	1.9
Selenium (dissolved)	µg/l	0.6	ISO 17025	1.4	1.9	1	2
Zinc (dissolved)	µg/l	0.5	ISO 17025	1	12	< 0.5	0.8

UKAS TESTING 4041

Analytical Environmental Science

Analytical Report Number: 21-60122
Project / Site name: Newport

Your Order No: 36253 MH

Lab Sample Number				1790066	1790067	1790068	1790069
Sample Reference				DC3-BH01	DC3-BH03	DC3-BH05	DC3-BH07
Sample Number				2	2	2	2
Depth (m)				2.95-3.00	3.60-3.71	2.75-2.75	4.86-4.91
Date Sampled				03/03/2021	03/03/2021	03/03/2021	03/03/2021
Time Taken				0950	0920	1010	0900
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**				
Monoaromatics & Oxygenates							
Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
Petroleum Hydrocarbons							
TPH1 (C10 - C40)	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10	< 10
PCBs by GC-MS							
PCB Congener 28	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02	< 0.02
PCB Congener 52	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02	< 0.02
PCB Congener 101	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02	< 0.02
PCB Congener 118	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02	< 0.02
PCB Congener 138	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02	< 0.02
PCB Congener 153	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02	< 0.02
PCB Congener 180	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02	< 0.02
PCBs by GC-MS							
Total PCBs	µg/l	0.14	NONE	< 0.14	< 0.14	< 0.14	< 0.14

Analytical Report Number: 21-60122
Project / Site name: Newport

Your Order No: 36253 MH

Lab Sample Number				1790066	1790067	1790068	1790069
Sample Reference				DC3-BH01	DC3-BH03	DC3-BH05	DC3-BH07
Sample Number				2	2	2	2
Depth (m)				2.95-3.00	3.60-3.71	2.75-2.75	4.86-4.91
Date Sampled				03/03/2021	03/03/2021	03/03/2021	03/03/2021
Time Taken				0950	0920	1010	0900
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**				
Glycols							
1,2-Butanediol	mg/l	10	NONE	< 10	< 10	< 10	< 10
1,2-Propanediol	mg/l	10	NONE	< 10	< 10	< 10	< 10
1,3-Butanediol	mg/l	10	NONE	< 10	< 10	< 10	< 10
1,3-Propanediol	mg/l	10	NONE	< 10	< 10	< 10	< 10
1,4-Butanediol	mg/l	10	NONE	< 10	< 10	< 10	< 10
1,5-Pentanediol	mg/l	10	NONE	< 10	< 10	< 10	< 10
Diethylene Glycol	mg/l	10	NONE	< 10	< 10	< 10	< 10
Ethylene Glycol	mg/l	10	NONE	< 10	< 10	< 10	< 10
Triethylene Glycol	mg/l	10	NONE	< 10	< 10	< 10	< 10
Thiourea							
Thiourea	µg/l	50	NONE	< 50	< 50	< 50	< 50

U/S = Unsuitable Sample   I/S = Insufficient Sample

UKAS TESTING 4041

Analytical Environmental Science

Analytical Report Number : 21-60122
Project / Site name: Newport

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Boron in water	Determination of boron in water by acidification followed by ICP-OES. Accredited matrices: SW PW GW	In-house method based on MEWAM	L039-PL	W	ISO 17025
Free cyanide in water	Determination of free cyanide by distillation followed by colorimetry.Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
PCB's By GC-MS in water	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L028-PL	W	NONE
Sulphide in water	Determination of sulphide in water by ion selective electrode.	In-house method	L029-PL	W	NONE
Sulphate in water	Determination of sulphate in water by acidification followed by ICP-OES. Accredited matrices: SW PW GW, PrW.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
TPH1 (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS.	In-house method	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Total organic carbon in water	Determination of dissolved organic carbon in water by TOC/DOC NDIR analyser. Accredited matrices: SW PW GW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Ammonia as NH3 in water	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In house method.	L099-PL	W	ISO 17025

Analytical Report Number : 21-60122
Project / Site name: Newport

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Determination of glycols in water by GC-MS.	Determination of glycols in water by GC-MS.	In-house method	L059B-PL	W	NONE
TPH in (Water)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L070-PL	W	NONE
Chloride in water	Determination of Chloride colorimetrically by discrete analyser.	In house based on MEWAM Method ISBN 0117516260. Accredited matrices: SW, PW, GW.	L082-PL	W	ISO 17025
TO - Thiourea in water	Determination of alkylthioureas by LC-UV/LC-MS	In-house method		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.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Appendix C. Minimum and maximum concentrations of each contaminant recorded

Maximum and Minimum Soil Contaminant Concentrations

Constituent	Unit	Number of Samples	Minimum Value	Maximum Value
Asbestos in Soil	Type	10	NAD	NAD
General Inorganics				
pH	pH Units	10	8.3	11.6
Total Cyanide	mg/kg	10	<1	<1
Free Cyanide	mg/kg	10	<1	<1
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	g/l	10	0.0046	1.2
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/kg	10	9.2	2400
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	10	4.6	1180
Sulphide	mg/kg	10	<1	2400
Ammoniacal Nitrogen as N	mg/kg	10	<0.5	<0.5
Ammoniacal Nitrogen as NH3	mg/kg	10	<0.5	<0.5
Organic Matter	%	10	<0.1	1.4
Total Organic Carbon (TOC)	%	10	<0.1	0.8
Total Phenols (monohydric)	mg/kg	10	<1	<1
Speciated PAHs				
Naphthalene	mg/kg	10	<0.05	<0.05
Acenaphthylene	mg/kg	10	<0.05	<0.05
Acenaphthene	mg/kg	10	<0.05	<0.05
Fluorene	mg/kg	10	<0.05	<0.05
Phenanthrene	mg/kg	10	<0.05	<0.05
Anthracene	mg/kg	10	<0.05	<0.05
Fluoranthene	mg/kg	10	<0.05	<0.05
Pyrene	mg/kg	10	<0.05	<0.05
Benzo(a)anthracene	mg/kg	10	<0.05	<0.05
Chrysene	mg/kg	10	<0.05	<0.05
Benzo(b)fluoranthene	mg/kg	10	<0.05	<0.05
Benzo(k)fluoranthene	mg/kg	10	<0.05	<0.05
Benzo(a)pyrene	mg/kg	10	<0.05	<0.05
Indeno(1,2,3-cd)pyrene	mg/kg	10	<0.05	<0.05
Dibenz(a,h)anthracene	mg/kg	10	<0.05	<0.05
Benzo(ghi)perylene	mg/kg	10	<0.05	<0.05
Speciated Total EPA-16 PAHs	mg/kg	10	<0.8	<0.8
Heavy Metals / Metalloids				
Arsenic (aqua regia extractable)	mg/kg	10	3	13
Boron (water soluble)	mg/kg	10	<0.2	7.8
Cadmium (aqua regia extractable)	mg/kg	10	<0.2	13
Chromium (aqua regia extractable)	mg/kg	10	8	22
Copper (aqua regia extractable)	mg/kg	10	7.1	36

Lead (aqua regia extractable)	mg/kg	10	13	270
Mercury, elemental	mg/kg	10	<0.3	<0.3
Nickel (aqua regia extractable)	mg/kg	10	2.5	33
Selenium (aqua regia extractable)	mg/kg	10	<1	4.8
Zinc (aqua regia extractable)	mg/kg	10	52	600
Monoaromatics & Oxygenates				
Benzene	mg/kg	10	<0.001	<1
Toluene	mg/kg	10	<0.001	<1
Ethylbenzene	mg/kg	10	<0.001	<1
p & m-xylene	mg/kg	10	<0.001	<1
o-xylene	mg/kg	10	<0.001	<1
MTBE (Methyl Tertiary Butyl Ether)	mg/kg	10	<0.001	<1
Petroleum Hydrocarbons				
TPH C10 - C40	mg/kg	10	<10	1100
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	10	<0.001	<0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	10	<0.001	<0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	10	<0.001	<0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	10	<1	8.2
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	10	<2	11
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	10	<8	16
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	10	<8	130
TPH-CWG - Aliphatic > EC35 - EC44	mg/kg	10	<8.4	120
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	<10	170
TPH-CWG - Aliphatic (EC5 - EC44)	mg/kg	10	<10	290
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	10	<0.001	<0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	10	<0.001	<0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	10	<0.001	<0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	10	<1	<1
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	10	<2	<2
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	<10	12
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	<10	330
TPH-CWG - Aromatic > EC35 - EC44	mg/kg	10	<8.4	570
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	<10	340
TPH-CWG - Aromatic (EC5 - EC44)	mg/kg	10	<10	910
PCBs by GC-MS				
PCB Congener 28	mg/kg	6	<0.001	<0.001
PCB Congener 52	mg/kg	6	<0.001	<0.001
PCB Congener 101	mg/kg	6	<0.001	<0.001
PCB Congener 118	mg/kg	6	<0.001	<0.001
PCB Congener 138	mg/kg	6	<0.001	<0.001
PCB Congener 153	mg/kg	6	<0.001	<0.001
PCB Congener 180	mg/kg	6	<0.001	<0.001
Total PCBs by GC-MS				

Total PCBs	mg/kg	6	<0.007	<0.007
Glycols				
1,2-Butanediol	mg/kg	6	<10	<10
1,2-Propanediol	mg/kg	6	<10	<10
1,3-Butanediol	mg/kg	6	<10	<10
1,3-Propanediol	mg/kg	6	<10	<10
1,4-Butanediol	mg/kg	6	<10	<10
1,5-Pentanediol	mg/kg	6	<10	<10
Diethylene Glycol	mg/kg	6	<10	<10
Ethylene Glycol	mg/kg	6	<10	<10
Triethylene Glycol	mg/kg	6	<10	<10
Urea				
Thiourea	mg/kg	9	<0.05	<0.05

Maximum and Minimum Waters Contaminant Concentrations

Constituents	Unit	Number of Samples	Minimum Value	Maximum Value
pH	pH Units	6	6.7	7.5
Total Cyanide	mg/l	6	<0.01	<0.01
Free Cyanide	mg/l	6	<0.01	<0.01
Sulphate as SO4	mg/l	6	10.7	54.1
Sulphide	mg/l	6	<0.005	<0.005
Chloride	mg/l	6	7.5	17
Ammoniacal Nitrogen as N	mg/l	6	<0.015	0.071
Ammoniacal Nitrogen as NH3	mg/l	6	<0.015	0.087
Dissolved Organic Carbon (DOC)	mg/l	6	0.7	2.57
Total Organic Carbon (TOC)	mg/l	6	1.64	7.21
Total Phenols				
Total Phenols (monohydric)	mg/l	6	<0.01	<0.01
Speciated PAHs				
Naphthalene	mg/l	6	<0.00001	<0.00001
Acenaphthylene	mg/l	6	<0.00001	<0.00001
Acenaphthene	mg/l	6	<0.00001	<0.00001
Fluorene	mg/l	6	<0.00001	<0.00001
Phenanthrene	mg/l	6	<0.00001	<0.00001
Anthracene	mg/l	6	<0.00001	<0.00001
Fluoranthene	mg/l	6	<0.00001	<0.00001
Pyrene	mg/l	6	<0.00001	<0.00001
Benzo(a)anthracene	mg/l	6	<0.00001	<0.00001
Chrysene	mg/l	6	<0.00001	<0.00001
Benzo(b)fluoranthene	mg/l	6	<0.00001	<0.00001
Benzo(k)fluoranthene	mg/l	6	<0.00001	<0.00001
Benzo(a)pyrene	mg/l	6	<0.00001	<0.00001
Indeno(1,2,3-cd)pyrene	mg/l	6	<0.00001	<0.00001
Dibenz(a,h)anthracene	mg/l	6	<0.00001	<0.00001
Benzo(ghi)perylene	mg/l	6	<0.00001	<0.00001
Total PAH				
Total EPA-16 PAHs	mg/l	6	<0.00016	<0.00016
Heavy Metals / Metalloids				
Boron (dissolved)	mg/l	6	0.036	0.081
Arsenic (dissolved)	mg/l	6	<0.00015	0.00083
Cadmium (dissolved)	mg/l	6	0.00002	<0.02
Chromium (dissolved)	mg/l	6	0.0012	0.0031
Copper (dissolved)	mg/l	6	0.0008	0.0061
Lead (dissolved)	mg/l	6	<0.0002	0.0003
Mercury (dissolved)	mg/l	6	<0.00005	<0.00005
Nickel (dissolved)	mg/l	6	0.0011	0.0084
Selenium (dissolved)	mg/l	6	0.001	0.0035
Zinc (dissolved)	mg/l	6	<0.00005	0.012
Monoaromatics & Oxygenates				

Benzene	mg/l	6	<0.001	<0.001
Toluene	mg/l	6	<0.001	<0.001
Ethylbenzene	mg/l	6	<0.001	<0.001
p & m-xylene	mg/l	6	<0.001	<0.001
o-xylene	mg/l	6	<0.001	<0.001
MTBE (Methyl Tertiary Butyl Ether)	mg/l	6	<0.001	<0.001
Petroleum Hydrocarbons				
TPH1 (C10 - C40)	mg/l	6	<0.01	<0.01
TPH-CWG - Aliphatic >C5 - C6	mg/l	6	<0.001	<0.001
TPH-CWG - Aliphatic >C6 - C8	mg/l	6	<0.001	<0.001
TPH-CWG - Aliphatic >C8 - C10	mg/l	6	<0.001	<0.001
TPH-CWG - Aliphatic >C10 - C12	mg/l	6	<0.01	<0.01
TPH-CWG - Aliphatic >C12 - C16	mg/l	6	<0.01	<0.01
TPH-CWG - Aliphatic >C16 - C21	mg/l	6	<0.01	<0.01
TPH-CWG - Aliphatic >C21 - C35	mg/l	6	<0.01	<0.01
TPH-CWG - Aliphatic >C35 - C44	mg/l	6	<0.01	<0.01
TPH-CWG - Aliphatic (C5 - C35)	mg/l	6	<0.01	<0.01
TPH-CWG - Aliphatic (C5 - C44)	mg/l	6	<0.01	<0.01
TPH-CWG - Aromatic >C5 - C7	mg/l	6	<0.001	<0.001
TPH-CWG - Aromatic >C7 - C8	mg/l	6	<0.001	<0.001
TPH-CWG - Aromatic >C8 - C10	mg/l	6	<0.001	<0.001
TPH-CWG - Aromatic >C10 - C12	mg/l	6	<0.01	<0.01
TPH-CWG - Aromatic >C12 - C16	mg/l	6	<0.01	<0.01
TPH-CWG - Aromatic >C16 - C21	mg/l	6	<0.01	<0.01
TPH-CWG - Aromatic >C21 - C35	mg/l	6	<0.01	<0.01
TPH-CWG - Aromatic >C35 - C44	mg/l	6	<0.01	<0.01
TPH-CWG - Aromatic (C5 - C35)	mg/l	6	<0.01	<0.01
TPH-CWG - Aromatic (C5 - C44)	mg/l	6	<0.01	<0.01
PCBs by GC-MS				
PCB Congener 28	mg/l	6	<0.00002	<0.00002
PCB Congener 52	mg/l	6	<0.00002	<0.00002
PCB Congener 101	mg/l	6	<0.00002	<0.00002
PCB Congener 118	mg/l	6	<0.00002	<0.00002
PCB Congener 138	mg/l	6	<0.00002	<0.00002
PCB Congener 153	mg/l	6	<0.00002	<0.00002
PCB Congener 180	mg/l	6	<0.00002	<0.00002
PCBs by GC-MS				
Total PCBs	mg/l	6	<0.00014	<0.00014
Glycols				
1,2-Butanediol	mg/l	6	<10	<10
1,2-Propanediol	mg/l	6	<10	<10
1,3-Butanediol	mg/l	6	<10	<10
1,3-Propanediol	mg/l	6	<10	<10
1,4-Butanediol	mg/l	6	<10	<10
1,5-Pentanediol	mg/l	6	<10	<10
Diethylene Glycol	mg/l	6	<10	<10
Ethylene Glycol	mg/l	6	<10	<10
Triethylene Glycol	mg/l	6	<10	<10
Thiourea				
Thiourea	mg/l	6	<0.05	<0.05

Appendix D. Landscape Softworks and Hardworks plans

Millimetres 100 10 0

HARDWORKS KEY

Red Line Boundary - Application Site

Red Line Boundary - Client ownership (where differs from application site)

PERMEABLE PAVING TO VEHICULAR AREAS
Product Reference:
Permeable block paving
Refer to Engineers' specification.

PERMEABLE PAVING TO PEDESTRIAN AREAS
Product Reference:
Permeable block paving
Refer to Engineers' specification.

VEHICULAR TARMAC
Product Reference:
Vehicular macadam
Refer to Engineers' specification.

PAVING TO PEDESTRIAN AREAS
Product Reference:
Marshalls - Keyblok paving
200x100x60mm (Natural) or similar approved.
NBS Clause: Q24/10.

CONCRETE PAD FOUNDATIONS TO SECURITY LODGE & GENERATORS
Refer to Engineers' specification.

TACTILE BLISTER PAVING TO ROAD CROSSINGS
Product Reference:
Marshalls - Tactile Paving Flags.
400x400x50mm pre-cast concrete (buff), or similar approved.
Refer to Engineers' specification / NBS Clause*: Q25/320.*

THERMOPLASTIC ROAD MARKINGS TO VEHICULAR AREAS. *Refer to Engineers' specification*

STEPS
Contractor to design and install

HAZARD WARNING CORDUROY PAVING TO TOP AND BOTTOM OF STEPS
Product Reference:
Marshalls - Hazard Warning Paving.
400x400x50mm pre-cast concrete (buff), or similar approved.
Refer to Engineers' specification / NBS Clause: Q25/320A.

SuDS drainage channels*

*For SuDS details see engineers' drawings

+(15.85) Existing Levels

+15.50 Proposed Levels
(tok) top of kerb
(tob) top of bank
(tos) top of steps
(bos) bottom of steps

KERBS

FLUSH KERB TO ROADWAY / RAIN GARDENS
Refer to Engineers' specification.

KERB - UPSTAND OF VARYING HEIGHTS
Where kerb interfaces with road or site boundary line *refer to Engineers' specification*.

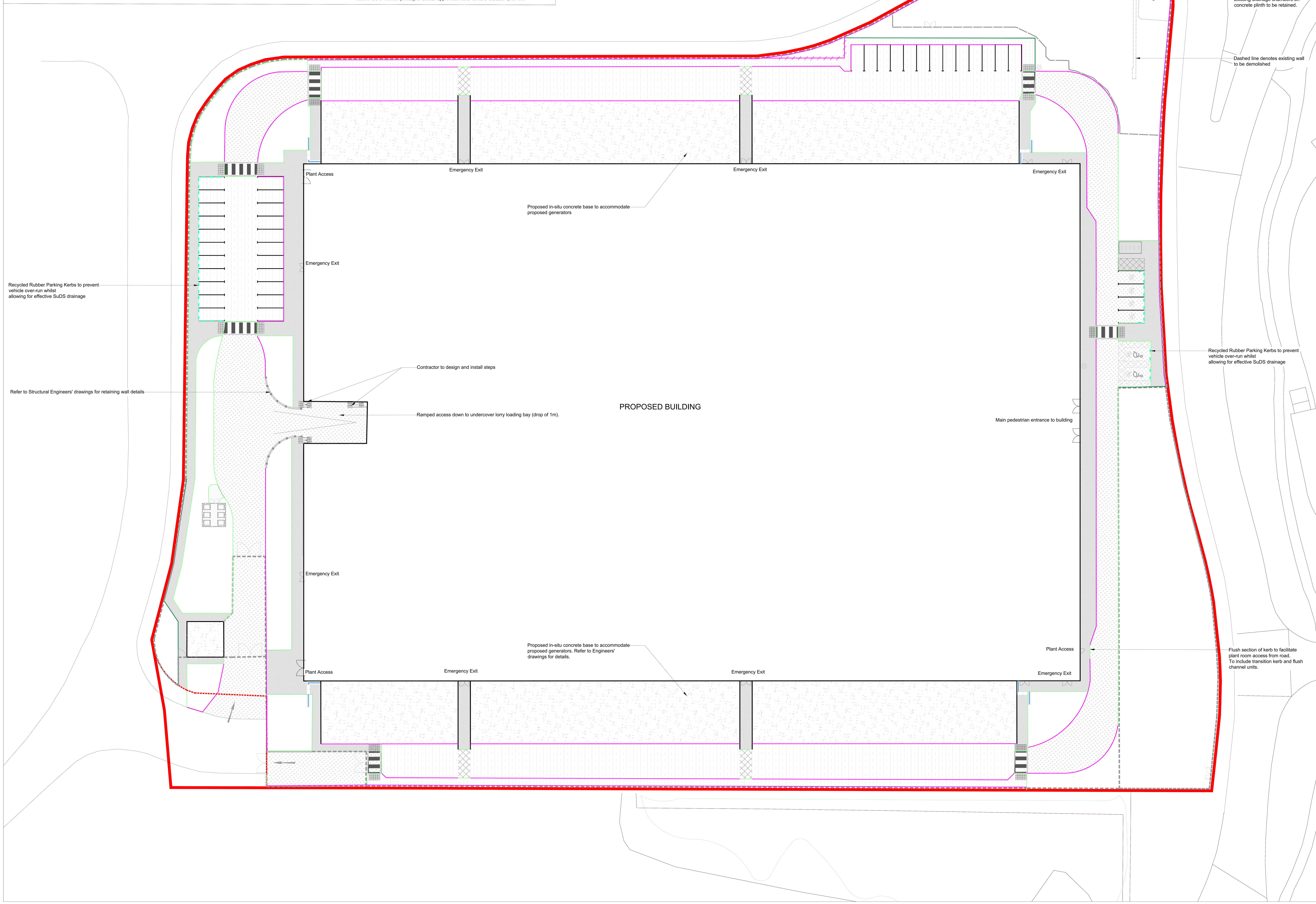
KERB - UPSTAND WHERE KERB INTERFACES WITH FOOTPATH AND SHRUB PLANTING:
Marshalls Half Battered Concrete Kerb
125mm x 255mm x 915mm pre-cast concrete (natural), or similar approved.
Refer to NBS Clause Q10/110B.

PIN KERB LAID FLUSH TO FOOTPATH EDGINGS AND GRASSED AREAS
Product Reference:
Marshalls - Pin Kerb ED500015.
50 x 150 x 915 mm pre-cast concrete (natural), or similar approved.
Refer to NBS Clause Q10/110.

RECYCLED RUBBER PARKING KERB
Product Reference:
Pittman Traffic - P-756551 Park It 1800mm Rubber Wheel Stops.
1800 x 150 x 100mm (white), or similar approved. Refer to NBS Clause: *Q10/160.*

NORTH

DO NOT SCALE



SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

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

CONSTRUCTION

Refer to Designers Risk Assessment

MAINTENANCE/CLEANING

Refer to Designers Risk Assessment

DECOMMISSIONING/DEMOLITION

Refer to Designers Risk Assessment

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

To be read in conjunction with drawings:

CWL13-ATK-XX-XX-DR-LA-401100 - General Arrangement Plan
CWL13-ATK-XX-XX-DR-LA-424200 - Hardworks Details
CWL13-ATK-XX-XX-DR-LA-431300 - Softworks Plan
CWL13-ATK-XX-XX-DR-LA-434300 - Planting Details
CWL13-ATK-XX-XX-DR-LA-411400 - Detailed Levels Plan
CWL13-ATK-XX-XX-DR-LA-461500 - Fencing & Furniture Plan
CWL13-ATK-XX-XX-DR-LA-401600 - Topsoil Plan
CWL13-ATK-XX-XX-DR-LA-481800 - Tree Protection Plan
CWL13-ATK-XX-XX-DR-LA-435300 - Softworks Schedule
CWL13-ATK-XX-XX-RP-LA-405800 - External Works Specification

5197838-ATK-GHM-ARB001 - Tree Protection Drawing

CWL13-ATK-01-XX-DR-EE-641030 to 641035 - Electrical Engineering External lighting
CWL13-ATK-01-XX-DR-EE-661030 to 661035 - Electrical Engineering External Security Services

CWL13--ATK-XX-XX-DR-CE-281001 - Drainage Layout Plan
CWL13--ATK-XX-XX-DR-CE-284013, 284014, 284015 - Bioretention Systems
CWL13--ATK-XX-XX-DR-CE-284020 - Permeable pavements
CWL13--ATK-XX-XX-DR-CE-284021 - Basin details
CWL13--ATK-XX-XX-DR-CE-284051 - Civils pavement and kerb details
CWL13-ATK-XX-XX-SP-CE-280051 - Civils Specification

RIBA STAGE 4a DEFINITION
Design Intent Riba Stage 4a = Key details and General Arrangement information developed for Contractor to produce Riba Stage 4b and conclude Construction issue against Design Intent for Client or Client comment. Review of documents submitted is for general compliance with the contract and design development responsibility remains with the main Contractor.

Rev.	Date	Description	By	Chk'd	App'd
C01	15/04/2021	STAGE 4a FOR ISSUE	CMS	MP/MB	WR

Drawing Status: APPROVED AND ACCEPTED
Suitability: A4a

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Client: VANTAGE DATA CENTERS

Project Title: CWL13

Drawing Title: LANDSCAPE HARDWORKS PLAN

Scale	Designed	Drawn	Checked	Authorised
1:250	AB	CMS	MP/MB	WR
Original Size: A0	Date: 01/03/2021	Date: 01/03/2021	Date: 09/04/2021	Date: 15/04/2021

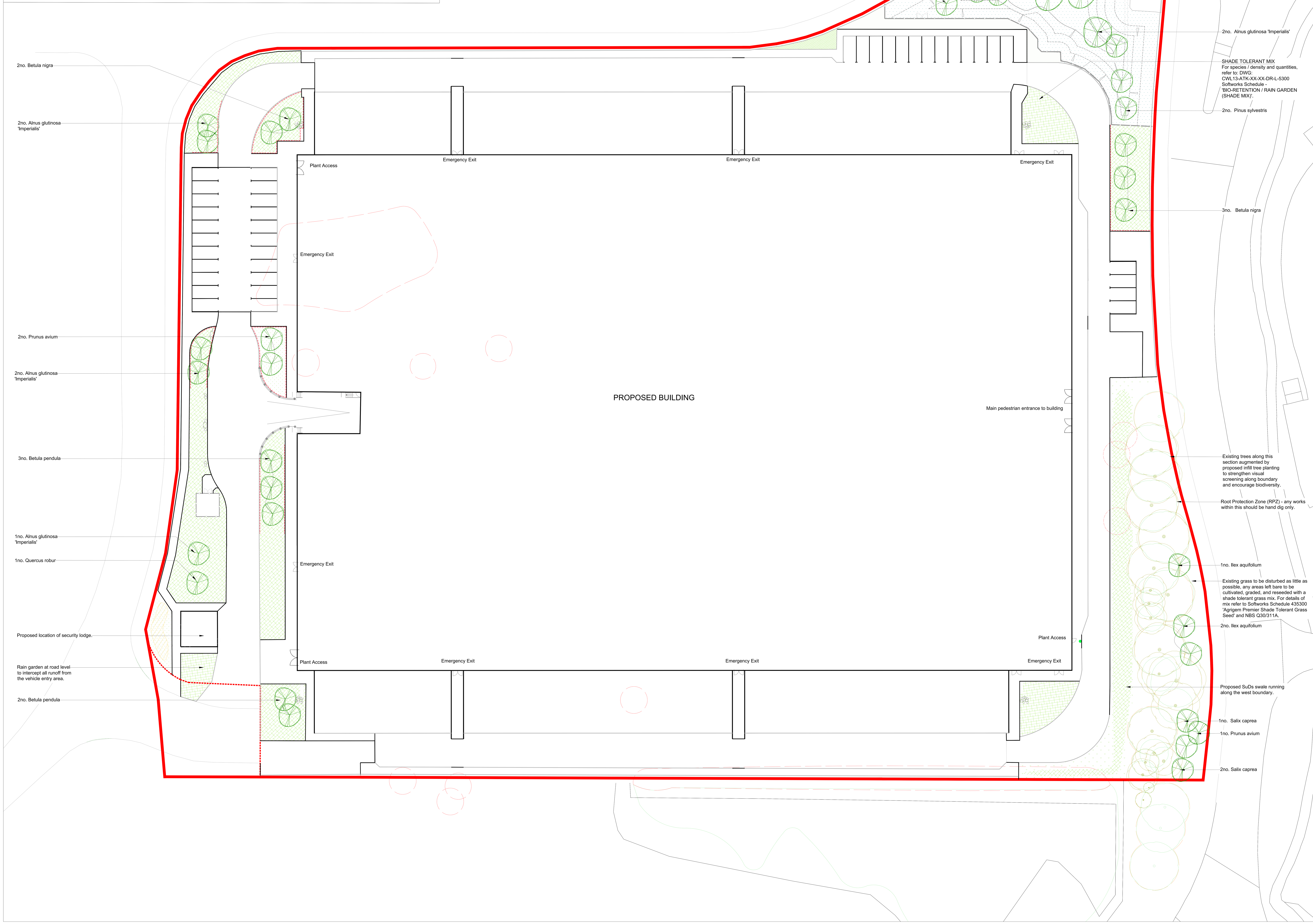
Drawing Number: CWL13-ATK-XX-XX-DR-LA-421200
Revision: C01

SOFTWORKS KEY

- Red Line Boundary - Application Site
- Red Line Boundary - Client ownership (where differs from application site)
- PROPOSED CONTOURS
- PROPOSED NATIVE SHRUB PLANTING
- PROPOSED RAIN GARDEN PLANTING *Refer to NBS Clause: Q28/315A and Engineers drawings for details*
- PROPOSED SPECIES-RICH GRASSLAND TO DETENTION AREA **Product reference:** Emorsgate - EM8 Meadow mixture for wetlands, or similar approved. *Refer to NBS Clause: Q30/312.*
- PROPOSED SPECIES-RICH GRASSLAND **Product reference:** Emorsgate - EM5 Meadow mixture for Loamy soils, or similar approved. *Refer to NBS Clause: Q30/312A.*
- PROPOSED BULB PLANTING
- EXISTING TREES RETAINED*
- PROPOSED TREES *Refer to Planting details drawing for tree pits*
- ROOT PROTECTION AREAS*
- EXISTING TREES TO BE REMOVED
- Proposed Amenity Grassland **Product reference:** Germinal - A19 All Purpose Landscaping, or similar approved. *Refer to NBS Clause: Q30/311.*
- Root barrier to proposed trees in confined locations *Refer to Planting Details drawing for tree pit details*

*Locations based on Arboricultural Survey Drawing number: 5197838-ATK-BHM-ARB001

Millimetres 100 10 0



DO NOT SCALE

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

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

CONSTRUCTION

Refer to Designers Risk Assessment

MAINTENANCE/CLEANING

Refer to Designers Risk Assessment

DECOMMISSIONING/DEMOLITION

Refer to Designers Risk Assessment

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

To be read in conjunction with drawings:

CWL13-ATK-XX-XX-DR-LA-401100 - General Arrangement Plan
CWL13-ATK-XX-XX-DR-LA-421200 - Hardworks Plan
CWL13-ATK-XX-XX-DR-LA-424200 - Hardworks Details
CWL13-ATK-XX-XX-DR-LA-434300 - Planting Details
CWL13-ATK-XX-XX-DR-LA-411400 - Detailed Levels Plan
CWL13-ATK-XX-XX-DR-LA-461500 - Fencing & Furniture Plan
CWL13-ATK-XX-XX-DR-LA-401600 - Topsoil Plan
CWL13-ATK-XX-XX-DR-LA-481800 - Tree Protection Plan
CWL13-ATK-XX-XX-DR-LA-435300 - Softworks Schedule
CWL13-ATK-XX-XX-RP-LA-405800 - External Works Specification

5197838-ATK-GHM-ARB001 - Tree Protection Drawing

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CWL13--ATK-XX-XX-DR-CE-284020 - Permeable pavements
CWL13--ATK-XX-XX-DR-CE-284021 - Basin details
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CWL13--ATK-XX-XX-SP-CE-280051 - Civils Specification

RIBA STAGE 4a DEFINITION
Design Intent Riba Stage 4a = Key details and General Arrangement information developed for Contractor to produce Riba Stage 4b and conclude Construction issue against Design Intent for Client or Client comment. Review of documents submitted is for general compliance with the contract and design development responsibility remains with the main Contractor.

Rev.	Date	Description	By	Chk'd	App'd
C01	15/04/2021	STAGE 4a ISSUE	CMS	MP/ MB	WR

Drawing Status: APPROVED AND ACCEPTED
Suitability: A4a

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Client: VANTAGE DATA CENTERS

Project Title: CWL13

Drawing Title: SOFTWORKS PLAN

Scale	Designed	Drawn	Checked	Authorised
1:250	CMS	CMS	MP/MB	WR
Original Size	Date	Date	Date	Date
A0	01/03/2021	01/03/2021	09/04/2021	15/04/2021

Drawing Number: CWL13-ATK-XX-XX-DR-LA-431300
Revision: C01

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Appendix G. Site Condition Report

Appendix H. MCP Information for Form B3, Appendix 8

This Appendix provides the information required by Appendix 8 of Application Form B3 (specific questions for Medium Combustion Plant (MCP)) for the proposed new engines.

The following information applies to all of the engines at the proposed CWL13 Vantage facility n:

- Type of engine:
  All of the engines are diesel engines.
- Fuel use:
  HVO, with diesel as a backup fuel
- Operating hours:
  Each engine is expected to operate for less than 50 hours per year (in reality operation will be lower than this, planned testing and maintenance is approx. 5 hrs per engine per year).
- Load:
  The load when in use will be 100%.
- Make and manufacturer:
  The engines are manufactured by Kohler, Model KD45V20-5DES.
- Thermal input:
  Each engine has a thermal input of 2.987 MWth, the aggregated thermal input for the 60 new engines is 179 MWth.
- Start Date:
  None of the engines are operational at time of writing. The engines are due to be installed progressively, in a modular fashion, with the first engines being ready to come on line in October 2022.
- NACE code:
  The sector of activity for the facility is J63.1.1 - Data processing, hosting and related activities.
- MCPD Exemption:
  Yes, I/We confirm that where the option of exemption under article 6(3) or article 6(8) of the medium combustion plant directive is used, the medium combustion plant will not be operated more than the number of hours referred to in those paragraphs".
- Confirmation of operator name and address:
  Yes, I/We confirm that the operator name, registered office address and in the case of stationary medium combustion plants, the address where the plant is located is as stated in Form Part A and Form Part B1.

The following table provides the remainder of information required by Appendix 8 of Application Form B3.

MCPD Identifier(1)	Data Hall	Engine ID	X coordinate	Y coordinate
A1	9	DH9_1	328417.3	184495.3
A2	9	DH9_2	328420.4	184497.9
A3	9	DH9_3	328423.4	184500.3
A4	9	DH9_4	328426.7	184502.7
A5	9	DH9_5	328429.9	184505.0
A6	9	DH9_6	328433.0	184507.4
A7	7	DH7_1	328439.4	184512.4

MCPD Identifier(1)	Data Hall	Engine ID	X coordinate	Y coordinate
A8	7	DH7_2	328442.9	184514.7
A9	7	DH7_3	328445.7	184517.3
A10	7	DH7_4	328449.2	184519.8
A11	7	DH7_5	328452.0	184521.8
A12	7	DH7_6	328455.1	184524.5
A13	5	DH5_1	328458.3	184526.8
A14	5	DH5_2	328461.3	184529.3
A15	5	DH5_3	328464.5	184531.8
A16	5	DH5_4	328467.7	184534.3
A17	5	DH5_5	328470.7	184536.6
A18	5	DH5_6	328473.5	184539.2
A19	3	DH3_1	328479.9	184543.9
A20	3	DH3_2	328482.9	184546.2
A21	3	DH3_3	328486.0	184548.8
A22	3	DH3_4	328489.3	184551.2
A23	3	DH3_5	328492.4	184553.4
A24	3	DH3_6	328495.4	184556.1
A25	1	DH1_1	328498.3	184558.3
A26	1	DH1_2	328501.4	184560.9
A27	1	DH1_3	328504.6	184563.5
A28	1	DH1_4	328507.6	184566.1
A29	1	DH1_5	328510.7	184568.5
A30	1	DH1_6	328513.9	184571.1
A31	10	DH10_1	328478.9	184416.8
A32	10	DH10_2	328482.1	184418.9
A33	10	DH10_3	328485.5	184421.5
A34	10	DH10_4	328488.5	184423.9
A35	10	DH10_5	328491.5	184426.6
A36	10	DH10_6	328494.6	184428.9
A37	8	DH8_1	328501.3	184434.2
A38	8	DH8_2	328504.7	184436.1
A39	8	DH8_3	328507.5	184438.5
A40	8	DH8_4	328510.9	184441.6
A41	8	DH8_5	328513.6	184443.8
A42	8	DH8_6	328516.7	184446.1
A43	6	DH6_1	328520.0	184448.7

MCPD Identifier(1)	Data Hall	Engine ID	X coordinate	Y coordinate
A44	6	DH6_2	328522.9	184450.8
A45	6	DH6_3	328526.4	184453.5
A46	6	DH6_4	328529.3	184455.9
A47	6	DH6_5	328532.5	184458.5
A48	6	DH6_6	328535.5	184460.8
A49	4	DH4_1	328541.6	184465.7
A50	4	DH4_2	328544.6	184468.0
A51	4	DH4_3	328547.4	184470.4
A52	4	DH4_4	328550.9	184472.8
A53	4	DH4_5	328553.8	184475.5
A54	4	DH4_6	328557.2	184477.8
A55	2	DH2_1	328560.2	184480.2
A56	2	DH2_2	328563.0	184482.9
A57	2	DH2_3	328566.2	184485.3
A58	2	DH2_4	328569.4	184487.6
A59	2	DH2_5	328572.5	184490.1
A60	2	DH2_6	328575.4	184492.4

Table Notes:
(1) This is the identifier for the location of the engines as shown on the Installation Boundary and Emission Points site plan.

Appendix I. Checklist for Form F1 - Q6, Table 2

This Appendix provides the information required by Application Form F1, Question 6, Table 2 (application checklist).

Table 2 Application Checklist

Question Reference	Document title / reference	Document Section
Part A - Q5a	Supporting Information Document	Appendix C: Company Information / Change of Name
Part B2 - Q1a	Supporting Information Document	Appendix B: Pre-Application Discussions and Advice
Part B2 - Q3d3	Supporting Information Document	Section 3.10: Environmental Management System
Part B2 - Q5a	Supporting Information Document	Appendix A: Figure A.3
Part B2 - Q5b	Supporting Information Document	Appendix G: Site Condition Report
Part B2 - Q5c	Supporting Information Document	Section 1 - NTS
Part B2 - Q6	Supporting Information Document	Section 5 - Impact on the Environment
Part B3 - Q2	Supporting Information Document	Section 5 - Impact on the Environment
Part B3 - Q3a	Supporting Information Document	Section 3 - Techniques for Process and Emissions Control and BAT Assessment
Part B3 - Q3b	Supporting Information Document	Section 3 - Techniques for Process and Emissions Control and BAT Assessment
Part B3 - Q3c	Supporting Information Document	Section 2.8: Materials Use, Handling and Storage
Part B3 - Q4a	Supporting Information Document	Section 4: Proposed Emissions, Monitoring and Reporting
Part B3 - Q4b	Supporting Information Document	Section 4: Proposed Emissions, Monitoring and Reporting
Part B3 - Q6a	Supporting Information Document	Section 3.13: Energy Efficiency
Part B3 - Q6b	Supporting Information Document	Section 3.13: Energy Efficiency
Part B3 - Q6c	Supporting Information Document	Section 3.13: Energy Efficiency
Part B3 - Q6d	Supporting Information Document	Section 3.11: Raw and Auxiliary Materials
Part B3 - Q6e	Supporting Information Document	Section 3.12: Avoidance, Recovery and Disposal of Waste
Part B3 - Q7a	Supporting Information Document	Section 2.10: Applicable Legislation and Section 4.1: Emissions to Air

Table 2 Application Checklist

Question Reference	Document title / reference	Document Section
Part B3 - Appendix 1 - Q1	Supporting Information Document	Section 3.2: Selection and Arrangement of Engines and Fuel
Part B3 - Appendix 8 (all questions)	Supporting Information Document	Appendix H: MCP Information for Form B3, Appendix 8
Form F1	Vantage CWL13 OPRA 1Aug22	(2 spreadsheets, one 'xls' and one macro-enabled)

In addition, the following files have been submitted:

- Air quality modelling files;
- Noise modelling files; and
- A standalone version of the Installation Boundary and Emission Points (Figure A.3 in Appendix A of the Supporting Information Document).

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