GEO-ENVIRONMENTAL ASSESSMENT
NORTHFLEET CEMENT WORKS
THE SHORE, NORTHFLEET, GRAVESEND, KENT DA11 9HD
BELLWAY HOMES LIMITED
GEA-17855CZ-23-153
APRIL 2023

IDOM

GEO-ENVIRONMENTAL ASSESSMENT
NORTHFLEET CEMENT WORKS
THE SHORE, NORTHFLEET, GRAVESEND, KENT DA11 9HD
BELLWAY HOMES LIMITED
GEA-17855CZ-23-153
APRIL 2023

Document Issue Record

Status	Final	Date of Issue	28/04/23

Prepared by	Approved by
Ben Alexander	Rob Glavin MSc, BSc, FGS

Rev	Prepared	Approved	Date of Issue	Reason(s) for Revision

TABLE OF CONTENTS

EXECUTIVE SUMMARY I

SECTION 1 INTRODUCTION 1
SECTION 2 BACKGROUND AND SITE SETTING 2
2.1 SITE LOCATION AND SETTING 2
2.2 GEOLOGY 2
2.3 HYDROGEOLOGY 2
2.4 HYDROLOGY 2
2.5 PREVIOUS INVESTIGATIONS 2
SECTION 3 SITE INVESTIGATION RATIONALE 2
3.1 INTRODUCTION 2
3.2 SITE INVESTIGATION METHODS 2
SECTION 4 GROUND CONDITIONS 3
4.1 SURFACE GROUND CONDITIONS 3
4.2 SUB-SURFACE GROUND CONDITIONS 3
4.3 HAZARDOUS GAS 3
SECTION 5 ENVIRONMENTAL ASSESSMENT 4
5.1 SOIL QUALITY 4
SECTION 6 RISK ASSESSMENT 6
SECTION 7 UPDATED CONCEPTUAL MODEL 8
SECTION 8 PRELIMINARY REMEDIATION STRATEGY 9
SECTION 9 CONCLUSIONS 10

APPENDIX 1
- Drawing 1 – Site Plan
- Drawing 2 – Exploratory Hole Locations

APPENDIX 2
- Soil Chemistry
- Summary Spreadsheet
- Laboratory Analysis Certificates

APPENDIX 3
- Hazardous Ground Gas Assessment

EXECUTIVE SUMMARY

A Geo-Environmental Assessment was requested by Bellway Homes Limited. The purpose of the assessment was to identify any contaminative issues associated with former land use at *Northfleet Cement Works, The Shore, Northfleet, Gravesend, Kent DA11 9HD* which might impact on the redevelopment.

SITE DETAILS	
Current use / historic use	The site was undeveloped from 1865 to 1932. The site was partially incorporated in a residential garden from 1932 and formed part of the wider cement works, but was undeveloped.
Proposed use	Three residential dwellings with associated soft landscaped areas and parking.

PHASE 2 EXPLORATORY INVESTIGATION	
Ground Conditions	Made ground over Boyn Hill Gravel Member
Contamination	No pollutant linkages were found to be present.

RECOMMENDATIONS	
Remediation	Follow remediation strategy for the wider Northfleet Embankment site set out in IDOM Merebrook Remediation Implementation plan - RIP-17855cz-20-474. For all development areas, a clean soil cover system will be required to form private gardens, managed landscaped areas and public open space. For private gardens this should include a minimum of 600 mm of suitably workable and clean soils overlying a robust marker and no dig layer.

SECTION 1 INTRODUCTION

1.1 Bellway Homes Limited proposes to purchase/develop an area of land located at Northfleet Cement Works, The Shore, Northfleet, Gravesend, Kent DA11 9HD for residential development purposes. The proposed development comprises erection of three dwellings including hard and soft landscaping, car parking and associated infrastructure.

1.2 IDOM Merebrook Limited (IDOM) has been commissioned by Bellway Homes Limited to undertake preliminary site investigation works and to advise on the geo-environmental implications of the redevelopment of the site for the proposed end use.

1.3 The objectives of the investigation are to:

i. Assess surface and sub-surface ground conditions present at the site;

ii. Identify hazards associated with ground contamination which may place constraints on the site and the proposed development;

iii. Evaluate the risks associated with any identified hazards; and

iv. Provide preliminary recommendations for the mitigation of any significant risks identified,

1.4 A Phase 2a (Preliminary Exploratory Investigation) have been undertaken for the subject site.

1.5 This report presents the findings of the geo-environmental investigation and provides an interpretation of the geo-environmental conditions that exist at the site. The contaminative status of the site and the implications with respect to development have been interpreted in accordance with the current government guidance on source-pathway-receptor risk assessment. This report uses a Tier 1 risk assessment to ascribe a conservative qualitative appraisal of the hazards associated with the site.

1.6 This report has been prepared for Bellway Homes Limited for the sole purpose described above and no extended duty of care to any third party is implied or offered. Third parties making reference to the report should consult Bellway Homes Limited and IDOM as to the extent to which the findings may be appropriate for their use.

SECTION 2 BACKGROUND AND SITE SETTING

2.1 SITE LOCATION AND SETTING

2.1.1 The site is located north of Warwick Place at the Former Northfleet Cement Works, The Shore, Northfleet, Gravesend, Kent.

2.1.2 The site is located at National Grid Reference TQ 61845 74665 and indicated on drawing 1, presented in Appendix 1 of this report.

2.2 GEOLOGY

2.2.1 The published geological map indicates the presence of superficial drift deposits of the Boyn Hill Gravel Member.

2.2.2 The underlying bedrock geology comprises the White Chalk Subgroup.

2.3 HYDROGEOLOGY

2.3.1 The Boyn Hill Gravel Member is classified by the Environment Agency (EA) as a Secondary A Aquifer. The White Chalk Subgroup is classified as a Principal Aquifer

2.4 HYDROLOGY

2.4.1 Robins Creek is located 120m to the north of site, unnamed river 200m to the south of site and the River Thames is located 210m to the north of site.

2.5 PREVIOUS INVESTIGATIONS

2.5.1 A hazardous gas risk assessment has been carried out for this site which is presented in IDOM Merebrook letter report L-17855cz-2.4.2-23-26-MB.

2.5.2 Previous site investigation shave bee undertaken across the wider site, but did not specifically target the three units to be constructed.

SECTION 3 SITE INVESTIGATION RATIONALE

3.1 INTRODUCTION

3.1.1 A site investigation was carried out to prove the thickness of the made ground on site and test the made ground for any possible contamination.

3.2 SITE INVESTIGATION METHODS

3.2.1 An intrusive investigation was carried out by IDOM between the 8th and 9th March 2023 and comprised the following scope of work:

i. Three hand-dug trial holes (HP01 to HP03) to a depth of 0.5 to 1.0m bgl.

3.2.2 Exploratory hole locations are indicated on drawing 2 in Appendix 1. Logging of exploratory holes was undertaken by an IDOM Officer.

SECTION 4 GROUND CONDITIONS

4.1 SURFACE GROUND CONDITIONS

4.1.1 No surface treatment was present

4.2 SUB-SURFACE GROUND CONDITIONS

4.2.1 The investigation showed the site to be underlain by made ground overlying the Boyn Hill Gravel Member. The base of the Boyn Hill Gravel Member was not proven and the White Chalk Subgroup was not encountered.

4.2.2 A summary of the ground conditions encountered is presented in Table 1, whilst a more detailed assessment of the strata is contained in the following sections of the report.

Table 1: Summary of Sub-surface Ground Conditions

Strata	Depth to Top of Range (m bgl)	Thickness Range (m)
Made Ground	0.0	0.4 – 0.8
Boyn Hill Gravel Member	0.4 - 0.8	Base Not Proven

4.2.3 Made Ground

4.2.3.1 Made ground consisted of a brown slightly gravelly sandy clay with gravels of brick and clinker. In HP02 the made ground consisted of a slightly gravelly clayey sand with gravels of brick and concrete.

4.2.3.2 There was no visual or olfactory evidence of contamination

4.2.3.3 No perched water was encountered

4.2.4 Boyn Hill Gravel Member

4.2.4.1 The Boyn Hill Gravel member consisted of a Firm yellowish brown slightly sandy slightly gravelly clay with gravels of flint.

4.2.4.2 There was no visual or olfactory evidence of contamination and no groundwater was encountered.

4.3 HAZARDOUS GAS

4.3.1 Gas monitoring has been undertaken on three occasions from 30 August 2022 to 16 January 2023 across the wider site, with location in proximity to the scheme and located within the same development platform. Levels of methane, carbon dioxide and oxygen were recorded in each standpipe, together with associated parameters including borehole flow and ambient air pressure. The results of these gas monitoring rounds are contained in Appendix 3.

4.3.2 The monitoring was undertaken at barometric pressures ranging from 983 to 1023. No positive flow was detected, and no methane was recorded. The maximum recorded concentration of carbon dioxide was 0.8 % by volume (% v/v) with corresponding depleted oxygen concentrations.

SECTION 5 ENVIRONMENTAL ASSESSMENT

5.1 SOIL QUALITY

5.1.1 A total of three soil samples from the made ground were submitted to the laboratory for chemical analysis. The laboratory chemical analysis certificates are contained in Appendix 2. The results of the analysis are summarised in Table 2.

5.1.2 An initial screening exercise has been undertaken whereby contaminant concentrations recorded in soils have been assessed against *Suitable for Use Levels* (S4ULs) published in 2015 by LQM/CIEH[1]. These precautionary screening levels are designed to be representative of minimal risk to human health in a number of land use scenarios. In this report S4ULs have been selected for a residential land use where the possibility of consumption of homegrown produce exists and assuming a soil organic matter of 1 %. For lead the DEFRA Category 4 Screening Level[2] has been used as this is based on updated toxicological data and a low risk to human health.

5.1.3 An additional set of phytotoxin screening levels have been adopted from 'The Code of Agricultural Practice for the Protection of Soil' Ministry of Agriculture, Fisheries and Food (MAFF), 1993, which are protective of healthy plant growth.

Table 2: Summary of Soils Chemical Analysis Results

CONTAMINANT	No of Tests	MAX ($mg.kg^{-1}$)	MEAN ($mg.kg^{-1}$)	SCREENING LEVEL (SL) ($mg.kg^{-1}$)	No > SL*
HUMAN HEALTH RISK ASSESSMENT					
Asbestos in soil	3	Nd	Nd	Detected	0
pH	3	10.1	9.1	5 – 9	2
Arsenic	3	12.0	10.2	37	0
Barium	3	73.0	68.0	1300	0
Cadmium	3	1.1	0.8	11	0
Chromium (III)	3	50.0	30.3	910	0
Hexavalent Chromium	3	0.0	-	6	0
Lead	3	56.0	47.3	200	0
Mercury	3	0.0	-	40	0

[1] Nathanail, C. P., McCaffrey, C., Gillett, A. G., Ogden, R. C. and Nathanail, J. F. 2015. *The LQM/CIEH S4ULs for Human Health Risk Assessment*. Land Quality Press, Nottingham. Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3100. All rights reserved. Including August 2015 nickel update.
[2] SP1010 *Development of Category 4 Screening Levels Main Report* (Dec 2013) and SP1010 *Policy Companion Document* (Mar 2014).

CONTAMINANT	No of Tests	MAX ($mg.kg^{-1}$)	MEAN ($mg.kg^{-1}$)	SCREENING LEVEL (SL) ($mg.kg^{-1}$)	No > SL*
Nickel	3	19.0	17.0	130	0
Selenium	3	0.0	-	250	0
Vanadium	3	44.0	37.3	410	0
TPH Aliphatic >EC_5 - EC_6	3	0.000	-	42	0
TPH Aliphatic >EC_6 - EC_8	3	0.000	-	100	0
TPH Aliphatic >EC_8 - EC_{10}	3	0.000	-	27	0
TPH Aliphatic >EC_{10} - EC_{12}	3	0.00	-	130	0
TPH Aliphatic >EC_{12} - EC_{16}	3	0.00	-	1100	0
TPH Aliphatic >EC_{16} - EC_{21}	3	8.90	8.90	65000	0
TPH Aliphatic >EC_{21} - EC_{35}	3	51.00	34.00	65000	0
TPH Aromatic >EC_5 - EC_7	3	0.000	-	70	0
TPH Aromatic >EC_7 - EC_8	3	0.000	-	130	0
TPH Aromatic >EC_8 - EC_{10}	3	0.000	-	34	0
TPH Aromatic >EC_{10} - EC_{12}	3	0.00	-	74	0
TPH Aromatic >EC_{12} - EC_{16}	3	0.00	-	140	0
TPH Aromatic >EC_{16} - EC_{21}	3	0.00	-	260	0
TPH Aromatic >EC_{21} - EC_{35}	3	0.00	-	1100	0
Benzene	0	0.00	-	0.087	0
Toluene	0	0.00	-	130	0
Ethylbenzene	0	0.00	-	47	0
Xylene	0	0.000	-	56	0
Naphthalene	3	0.00	-	2.3	0
Acenaphthylene	3	0.00	-	170	0
Acenaphthene	3	0.00	-	210	0
Fluorene	3	0.00	-	170	0
Phenanthrene	3	0.21	0.14	95	0
Anthracene	3	0.00	-	2400	0
Fluoranthene	3	0.32	0.18	280	0
Pyrene	3	0.28	0.17	620	0
Benzo(a)anthracene	3	0.00	-	7.2	0
Chrysene	3	0.00	-	15	0
Benzo(b)fluoranthene	3	0.00	-	2.6	0
Benzo(k)fluoranthene	3	0.00	-	77	0
Benzo(a)pyrene	3	0.00	-	2.2	0
Indeno(1,2,3-c,d)pyrene	3	0.00	-	27	0
Dibenzo(a,h)anthracene	3	0.00	-	0.24	0
Benzo(g,h,i)perylene	3	0.00	-	320	0
Phenol	3	0.0	-	120	0
PHYTOTOXICITY RISK ASSESSMENT					
Copper	3	70.0	48.0	200	0

CONTAMINANT	No of Tests	MAX ($mg.kg^{-1}$)	MEAN ($mg.kg^{-1}$)	SCREENING LEVEL (SL) ($mg.kg^{-1}$)	No > SL*
Nickel	3	19.0	17.0	110	0
Zinc	3	89.0	66.3	300	0

Notes: * Number of samples exceeding screening level nd = not detected

5.1.4 Zootoxic Metals (harmful to human health)

5.1.4.1 No samples exceeded the screening levels.

5.1.5 Phytotoxic Metals (harmful to plant health)

5.1.5.1 No samples exceeded the screening levels.

5.1.6 Organic Contaminants

5.1.6.1 No samples exceeded the screening levels.

5.1.7 Inorganic Contaminants

5.1.7.1 No samples exceeded the screening levels.

5.1.7.2 pH levels exceeded the screening criteria in two samples, this is considered likely to be associated with inclusions of concrete reported within the soils sampled.

5.1.8 Summary

5.1.8.1 pH levels exceeded the screening criteria in two samples, this is considered likely to be associated with inclusions of concrete reported within the soils sampled.

5.1.8.2 There were no other contaminants detected at concentrations above screening values in the made ground.

SECTION 6 RISK ASSESSMENT

6.1 The potential sources of contamination at the site and the implications with respect to development have been interpreted in accordance with the current government guidance on source-pathway-receptor risk assessment.

6.2 The investigations demonstrate that the former uses of the site have resulted in no contaminants at concentrations above screening values.

6.3 The potential impacts of contamination sources have been considered with respect to the following receptors:

i. The general public and present site users,

ii. Residents of future development,

iii. Groundwater,

iv. Surface water,

v. Construction workers,

vi. Adjacent land, and

vii. Infrastructure.

6.4 In each case the existence of a pollutant linkage requires a pathway by which the receptor could be exposed to the source. A qualitative assessment of risk is thus considered in the first instance with respect to the site in its current condition and is summarised in the sections below.

6.5 **The general public and present site users**

6.5.1 The site is currently used as residential gardens and an unused part of the cement works, with no contaminants detected at concentrations above screening values the risk to the public and current site users is considered negligible.

6.6 **Residents of future development**

6.6.1 Soil contamination (chemical)

6.6.2 The proposed development is for use of residential homes with areas of soft landscaping.

6.6.3 Other than pH associated with inclusions of concrete in the made ground, no contaminants were detected at concentrations above screening values. Therefore the risks to future users from soil contamination is considered to be low.

6.6.4 Soils are unlikely to provide amenity value and suitable topsoil and subsoil will be required in areas of soft landscaping.

6.6.5 Asbestos

6.6.5.1 No asbestos was detected in the made ground and there have been no historical buildings on site so the risk from asbestos is considered to be low.

6.6.6 Hazardous Soil Gas/Vapours (including hydrocarbon vapours/radon)

6.6.7 Both CIRIA 665 and NHBC guidance has been followed to assess the recorded soil gas and flow conditions from monitoring undertaken during this investigation. Calculations are appended which suggest that a ‘Characteristic Situation 1’ or NHBC class ‘Green’. These indicate a negligible gas risk and that gas protection measures are not required for this phase of the development

6.7 **Controlled waters**

6.7.1 Groundwater was not encountered in the investigation and no contaminants were detected at concentrations likely to represent a potential risk to controlled waters. As a result, the risk to controlled waters is considered to be low.

6.8 **Construction workers**

6.8.1 Potentially, construction workers are initially at the greatest risk from exposure to hazardous contamination due to excavation works and during the handling of materials including imported soils. Providing that dust levels are kept within statutory limits and appropriate health and safety procedures are adhered to during the construction phase, the levels of chemical contamination recorded to date are not considered to present an acute risk to human.

6.9 **Adjacent land**

6.9.1 No contaminants were detected at concentrations above screening values therefore the risks to adjacent land is considered to be low.

6.9.2 There are no nearby land uses that could present a risk to site from offsite contamination. The adjacent land is undergoing redevelopment, with an approved remediation strategy in place.

6.10 **Infrastructure**

6.10.1 No contaminants were detected at concentrations above screening values therefore the risk to plant growth is considered to be low.

6.10.2 No contamination with the potential to permeate polymeric services has been identified by this investigation, however it is recommended that the utility provider is consulted with respect to their requirements for water supply pipes.

6.10.3 Utility companies apply strict guideline levels on use of polymeric pipes and may consider all made ground unsuitable for typical plastic pipe materials to be used.

SECTION 7 UPDATED CONCEPTUAL MODEL

7.1 Following completion of phases 1 and 2 of the investigation and a qualitative risk assessment, the conceptual model for the site, with relation to pollutant linkages, has been updated. The revised model is presented in Table 3 below.

Table 3: Revised Conceptual Model

POSSIBLE POLLUTANT LINKAGE			RISK CHARACTERISATION
POTENTIAL SOURCES	PATHWAYS	RECEPTORS	
Heavy metals and hydrocarbons (made ground)	Contact with contaminated soil	Human health (current users)	**Low risk identified** Heavy metals and hydrocarbons were detected at concentrations below screening values.
	Ingestion and inhalation of contaminated soil and dust	Human health (current users)	

POSSIBLE POLLUTANT LINKAGE			RISK CHARACTERISATION
POTENTIAL SOURCES	PATHWAYS	RECEPTORS	
Heavy metals and hydrocarbons (made ground)	Contact with contaminated soil	Human health (future residents and construction workers)	**Low risk identified** Heavy metals and hydrocarbons were detected at concentrations below screening values.
	Ingestion and inhalation of contaminated soil and dust	Human health (future residents and construction workers)	
Asbestos (made ground)	Ingestion and inhalation of contaminated soil and dust	Human health (future residents and construction workers)	**Low risk identified** No asbestos was detected in the made ground.
Contamination (all forms)	Vertical migration to aquifer	Controlled waters	**Low risk identified** Contaminants were detected at concentrations below screening values.
Contamination (all forms)	Horizontal migration to surface water	Controlled waters	**Low risk identified** No surface waters in the vicinity
Hydrocarbons	Direct contact	Plastic water pipes	**Low risk identified** Heavy metals and hydrocarbons were detected at concentrations below screening values
Hazardous Gas/Vapours In soil	Ingress into buildings and voids	Human health (future residents and construction workers)	**Low risk identified** Potential for made ground which could act as source of hazardous gas.

SECTION 8 PRELIMINARY REMEDIATION STRATEGY

8.1 The identified risks at the site can be mitigated by removal of either the source, pathway or receptor. With reference to the conceptual model for the site a remediation strategy, based on source or pathway removal, has been designed.

8.2 The investigation has found no contamination sources to be present.

8.3 It is recommended that the IDOM Merebrook Remediation Implementation plan (RIP-17855cz-20-474) for the wider Northfleet Embankment site is followed with regards to remediation of this site. This will mitigate the risks of any unforeseen contamination.

8.4 For all development areas, a clean soil cover system will be required to form private gardens, managed landscaped areas and public open space. For private gardens this should include a minimum of 600 mm of suitably workable and clean soils overlying a robust marker and no dig layer.

8.5 Material imported for the formation of domestic gardens and landscaped areas should be obtained from a validated source. The validation should incorporate an assessment of the provenance of the material and chemical analysis.

8.6 Potential risks to construction workers have been identified and the adoption of appropriate Health and Safety procedures will ensure that risks to operatives from hazardous materials at the site are minimised. Operatives should not be allowed to eat, drink or smoke on site except in designated areas and should be required to wash all exposed skin at the end of each shift. Operatives should be informed of the potential hazards at the site and should be required to report any observations of suspect material.

8.7 Materials, including waste soils which are not to be retained on site, should be removed and disposed of in accordance with all relevant statues including the *Environmental Protection Act 1990* (as amended), *The Controlled Waste Regulations 2012* (as amended), *The Waste (England and Wales) Regulations 2011* (as amended) , *The Hazardous Waste (England and Wales), Regulations 2005* as amended, *The Waste Management (England and Wales) Regulations 2006*, and *The Environmental Permitting (England and Wales) Regulations 2016* (as amended).

8.8 It is recommended that this report is submitted to the regulators (Local Authority EHO and Planners, Environment Agency Planning Liaison and NHBC) for approval prior to commencement of the works.

8.9 Any observations of ground conditions atypical of those already described should be reported to IDOM immediately so that an assessment of appropriate action can be made. The Remediation Implementation Plan (RIP-17855cz-20-474) should be followed in the case of any unforeseen contamination.

SECTION 9 CONCLUSIONS

9.1 The investigation showed the site to be underlain by made ground overlying the Boyn Hill Gravel Member. The base of the Boyn Hill Gravel Member was not proven.

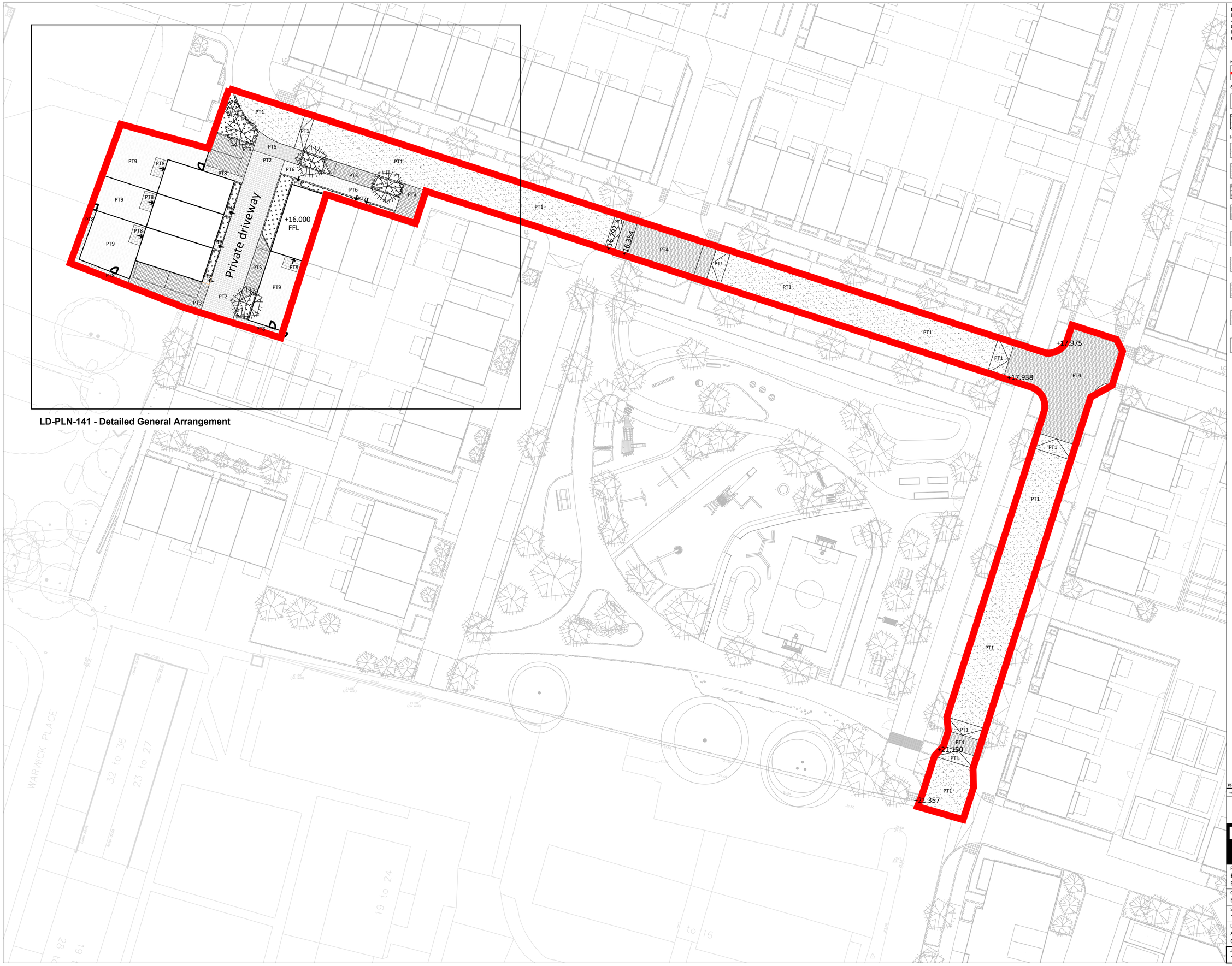
9.2 No pollutant linkages were found to be present in respect to this site.

9.3 The development should follow the Remediation Implementation plan (RIP-17855cz-20-474) that has been in place for the wider Northfleet Embankment site.

9.4 For all development areas, a clean soil cover system will be required to form private gardens, managed landscaped areas and public open space. For private gardens this should include a minimum of 600 mm of suitably workable and clean soils.

APPENDIX 1

- Drawing 1 – Site Plan
- Drawing 2 – Exploratory Hole Locations



LD-PLN-141 - Detailed General Arrangement

Notes
Do not scale from this drawing.
All dimensions are drawn in millimetres.
Drawing & design copyright LUC.
Reproduction of this drawing in whole or in part is prohibited without prior permission.

Key

Site Boundary

Soft Landscape

Proposed Tree Planting
2m Min clear stem - refer to soft landscape plans

Proposed perennial and shrub planting to communal amenity spaces - refer to soft landscape plans

Hard Landscape

PT1 - Asphalt surface
Colour: Black. To Engineers Specification

PT2 - Concrete Block Paving to Type 4 Roads
Size: 240x160mm & 160x160mm
Colour: Pennant Grey, Bond: Random stagger (1/3 lap)

PT3 - Concrete Block Paving to Type 3 & 4 Street Parking & Driveways
Size: 160x120mm, Colour: Charcoal
Bond: Stretcher (1/2 lap)

PT4 - Concrete Block Paving to Raised Tables
Size: 200x100mm
Colour: Twilight (60%), Morning Light (40%)
Bond: Stretcher (1/2 lap)

PT5 - Concrete Block Paving to Ramps & Thresholds
Size: 160x160x160mm
Colour: Charcoal
Bond: Stack Bond

PT6 - Concrete Paving to Type 3 & 4 Footpaths
Size: 600x300mm
Colour: Textured Natural
Bond: Stretcher (1/2 lap)

PT7- Concrete Paving to Housing Paths
Size: 450x450mm
Colour: French Grey
Bond: Stretcher (1/2 lap)

PT8 - Concrete Paver to Patio & Private Footpaths
Size: 450x450mm
Colour: Linen
Bond: Stack Bond

PT9 - Private Gardens

Iss	Date	Description	Drn	Chk
P01	07.07.22	For Coordination	AWa	JLo

0 4 8 12m

LUC London
250 Waterloo Road, London SE1 8RD
+44 (0)20 7383 5784
london@landuse.co.uk
www.landuse.co.uk

Project
Harbour Village at Ebbsfleet Garden City
Phase 1C Section 96a Application

Client
Bellway Homes Ltd (Thames Gateway)

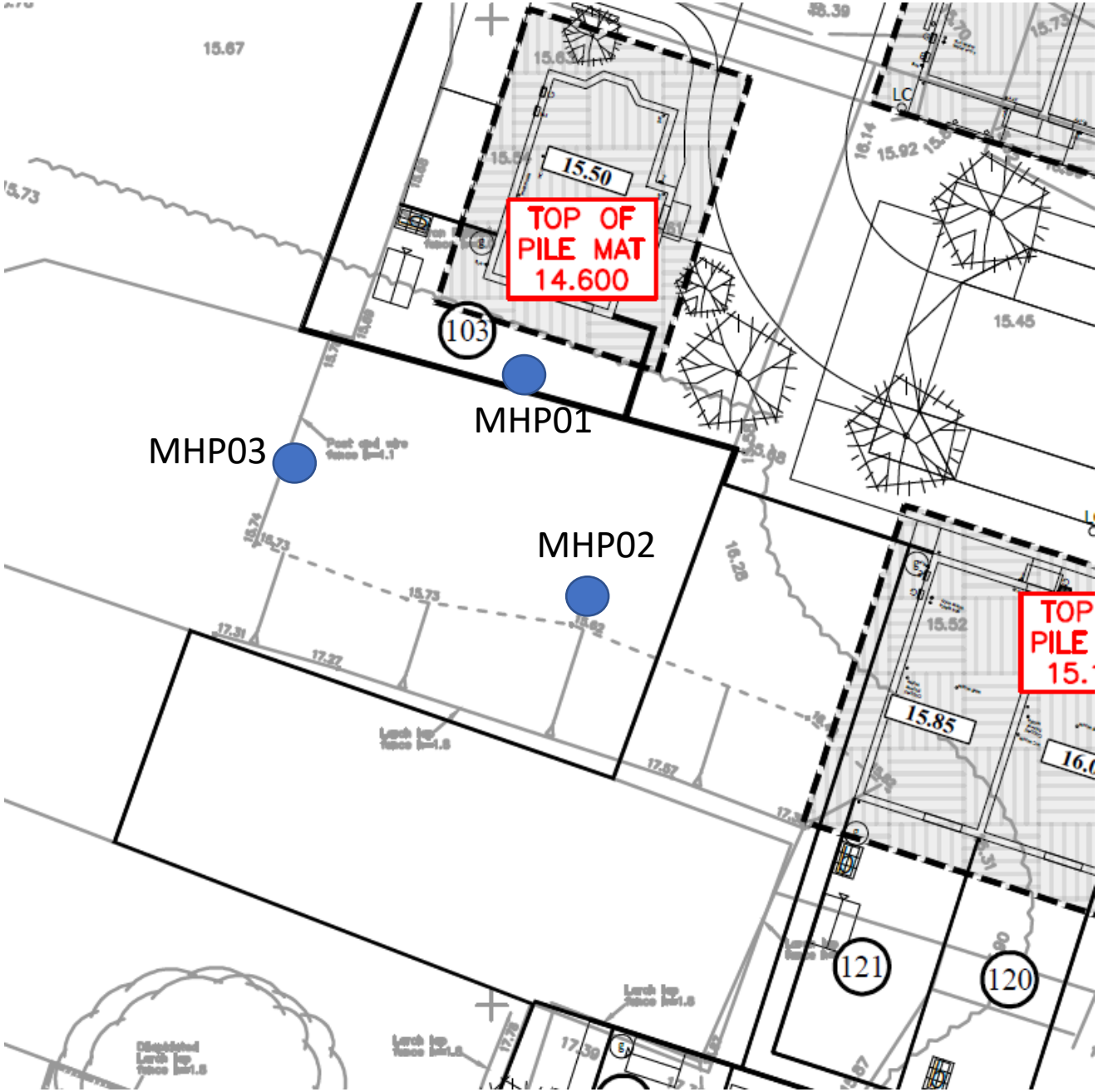
Scale @A1	Status
1:250	FOR COORDINATION

Drawing Title
Additional 3 Dwellings
General Arrangement

Job Nr	Drawing Nr	Issue
10986	LD-PLN-140	P01

17855cz

Validation plots



APPENDIX 2

- Soil Chemistry
- Summary Spreadsheet
- Laboratory Analysis Certificates

Matthew Balyis
Merebrook
First Floor
1 Leonard Place
Westerham Road
Keston
BR2 6HQ

t: 01689 889980
f: 01689 889981
e: mbaylis@idom.com

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

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

Analytical Report Number : 23-21996

Project / Site name:	Northfleet Embankment	**Samples received on:**	09/03/2023
Your job number:	17855CZ	**Samples instructed on/ Analysis started on:**	09/03/2023
Your order number:	23-2-FDO-LABS	**Analysis completed by:**	16/03/2023
Report Issue Number:	1	**Report issued on:**	16/03/2023
Samples Analysed:	2 soil samples		

Signed:

Anna Goc
Junior Reporting 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.

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number: 23-21996
Project / Site name: Northfleet Embankment
Your Order No: 23-2-FDO-LABS

Lab Sample Number				2611193	2611194
Sample Reference				MHP01_ES	MHP02_ES
Sample Number				None Supplied	None Supplied
Depth (m)				0.20	0.60
Date Sampled				08/03/2023	08/03/2023
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	15	9
Total mass of sample received	kg	0.001	NONE	0.5	0.5

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	WEM	WEM

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	9.2	10.1
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	1.7	0.9
Organic Matter (automated)	%	0.1	MCERTS	1.3	1.2
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	0.7	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	0.21	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.32	0.13
Pyrene	mg/kg	0.05	MCERTS	0.28	0.12
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	ISO 17025	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	< 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	ISO 17025	0.81	< 0.80

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	12	9.3
Barium (aqua regia extractable)	mg/kg	1	MCERTS	73	59
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	1.1	0.5
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8
Chromium (III)	mg/kg	1	NONE	50	25
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	50	25
Copper (aqua regia extractable)	mg/kg	1	MCERTS	25	49
Lead (aqua regia extractable)	mg/kg	1	MCERTS	56	39
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	19	15
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	44	33
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	89	65

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number: 23-21996
Project / Site name: Northfleet Embankment
Your Order No: 23-2-FDO-LABS

Lab Sample Number				2611193	2611194
Sample Reference				MHP01_ES	MHP02_ES
Sample Number				None Supplied	None Supplied
Depth (m)				0.20	0.60
Date Sampled				08/03/2023	08/03/2023
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
Monoaromatics & Oxygenates					
Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0
Toluene	µg/kg	5	MCERTS	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0
p & m-xylene	µg/kg	5	MCERTS	< 5.0	< 5.0
o-xylene	µg/kg	5	MCERTS	< 5.0	< 5.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	< 5.0
Petroleum Hydrocarbons					
TPH-CWG - Aliphatic >EC5 - EC6 $_{HS_1D_AL}$	mg/kg	0.001	NONE	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8 $_{HS_1D_AL}$	mg/kg	0.001	NONE	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10 $_{HS_1D_AL}$	mg/kg	0.001	NONE	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12 $_{EH_CU_1D_AL}$	mg/kg	1	MCERTS	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16 $_{EH_CU_1D_AL}$	mg/kg	2	MCERTS	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21 $_{EH_CU_1D_AL}$	mg/kg	8	MCERTS	8.9	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35 $_{EH_CU_1D_AL}$	mg/kg	8	MCERTS	51	17
TPH-CWG - Aliphatic >EC35 - EC40 $_{EH_CU_1D_AL}$	mg/kg	10	NONE	32	< 10
TPH-CWG - Aliphatic (EC5 - EC35) $_{EH_CU+HS_1D_AL}$	mg/kg	10	NONE	60	19
TPH-CWG - Aromatic >EC5 - EC7 $_{HS_1D_AR}$	mg/kg	0.001	NONE	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8 $_{HS_1D_AR}$	mg/kg	0.001	NONE	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10 $_{HS_1D_AR}$	mg/kg	0.001	NONE	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12 $_{EH_CU_1D_AR}$	mg/kg	1	MCERTS	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16 $_{EH_CU_1D_AR}$	mg/kg	2	MCERTS	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21 $_{EH_CU_1D_AR}$	mg/kg	10	MCERTS	< 10	< 10
TPH-CWG - Aromatic >EC21 - EC35 $_{EH_CU_1D_AR}$	mg/kg	10	MCERTS	< 10	< 10
TPH-CWG - Aromatic >EC35 - EC40 $_{EH_CU_1D_AR}$	mg/kg	10	NONE	< 10	< 10
TPH-CWG - Aromatic (EC5 - EC35) $_{EH_CU+HS_1D_AR}$	mg/kg	10	NONE	< 10	< 10
TPH Total C5 - C40 $_{EH_CU+HS_1D_TOTAL}$	mg/kg	10	NONE	92	26

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number : 23-21996
Project / Site name: Northfleet Embankment

* 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 *
2611193	MHP01_ES	None Supplied	0.2	Brown loam and sand with gravel and vegetation.
2611194	MHP02_ES	None Supplied	0.6	Brown loam and sand with gravel and vegetation.

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number : 23-21996
Project / Site name: Northfleet Embankment

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

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 dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
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
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
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 and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS. Individual components MCERTS accredited	In-house method based on USEPA8260	L073B-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
Cr (III) in soil	In-house method by calculation from total Cr and Cr VI.	In-house method by calculation	L080-PL	W	NONE
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
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

Analytical Report Number : 23-21996
Project / Site name: Northfleet Embankment

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL or B' 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.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number : 23-21996
Project / Site name: Northfleet Embankment

This deviation report indicates the sample and test deviations that apply to the samples submitted for analysis.Please note that the associated result(s) may be unreliable and should be interpreted with care.

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

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
MHP01_ES	None Supplied	S	2611193	b	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
MHP01_ES	None Supplied	S	2611193	b	TPHCWG (Soil)	L088/76-PL	b

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report relate only to the sample(s) submitted for testing.

Matthew Balyis
Merebrook
First Floor
1 Leonard Place
Westerham Road
Keston
BR2 6HQ

t: 01689 889980
f: 01689 889981
e: mbaylis@idom.com

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

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

Analytical Report Number : 23-22252

Project / Site name:	Northfleet Embankment	**Samples received on:**	10/03/2023
Your job number:	17855CZ	**Samples instructed on/ Analysis started on:**	10/03/2023
Your order number:	23-2-FDO-LABS	**Analysis completed by:**	17/03/2023
Report Issue Number:	1	**Report issued on:**	17/03/2023
Samples Analysed:	1 soil sample		

Signed:

Elżbieta Suchy
Junior Reporting 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.

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number: 23-22252
Project / Site name: Northfleet Embankment
Your Order No: 23-2-FDO-LABS

Lab Sample Number				2612400
Sample Reference				MHP03_ES
Sample Number				None Supplied
Depth (m)				0.30
Date Sampled				09/03/2023
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	0.5

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	WEM

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.1
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.068
Organic Matter (automated)	%	0.1	MCERTS	1
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	0.6

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	0.07
Anthracene	mg/kg	0.05	MCERTS	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.09
Pyrene	mg/kg	0.05	MCERTS	0.12
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	ISO 17025	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	< 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	ISO 17025	< 0.80

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	9.3
Barium (aqua regia extractable)	mg/kg	1	MCERTS	72
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8
Chromium (III)	mg/kg	1	NONE	16
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	16
Copper (aqua regia extractable)	mg/kg	1	MCERTS	70
Lead (aqua regia extractable)	mg/kg	1	MCERTS	47
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	17
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	35
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	45

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number: 23-22252
Project / Site name: Northfleet Embankment
Your Order No: 23-2-FDO-LABS

Lab Sample Number				2612400
Sample Reference				MHP03_ES
Sample Number				None Supplied
Depth (m)				0.30
Date Sampled				09/03/2023
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**	
Monoaromatics & Oxygenates				
Benzene	µg/kg	5	MCERTS	< 5.0
Toluene	µg/kg	5	MCERTS	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0
p & m-xylene	µg/kg	5	MCERTS	< 5.0
o-xylene	µg/kg	5	MCERTS	< 5.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0
Petroleum Hydrocarbons				
TPH-CWG - Aliphatic >EC5 - EC6 $_{HS_1D_AL}$	mg/kg	0.001	NONE	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8 $_{HS_1D_AL}$	mg/kg	0.001	NONE	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10 $_{HS_1D_AL}$	mg/kg	0.001	NONE	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12 $_{EH_CU_1D_AL}$	mg/kg	1	MCERTS	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16 $_{EH_CU_1D_AL}$	mg/kg	2	MCERTS	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21 $_{EH_CU_1D_AL}$	mg/kg	8	MCERTS	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35 $_{EH_CU_1D_AL}$	mg/kg	8	MCERTS	< 8.0
TPH-CWG - Aliphatic >EC35 - EC40 $_{EH_CU_1D_AL}$	mg/kg	10	NONE	< 10
TPH-CWG - Aliphatic (EC5 - EC35) $_{EH_CU+HS_1D_AL}$	mg/kg	10	NONE	< 10
TPH-CWG - Aromatic >EC5 - EC7 $_{HS_1D_AR}$	mg/kg	0.001	NONE	< 0.001
TPH-CWG - Aromatic >EC7 - EC8 $_{HS_1D_AR}$	mg/kg	0.001	NONE	< 0.001
TPH-CWG - Aromatic >EC8 - EC10 $_{HS_1D_AR}$	mg/kg	0.001	NONE	< 0.001
TPH-CWG - Aromatic >EC10 - EC12 $_{EH_CU_1D_AR}$	mg/kg	1	MCERTS	< 1.0
TPH-CWG - Aromatic >EC12 - EC16 $_{EH_CU_1D_AR}$	mg/kg	2	MCERTS	< 2.0
TPH-CWG - Aromatic >EC16 - EC21 $_{EH_CU_1D_AR}$	mg/kg	10	MCERTS	< 10
TPH-CWG - Aromatic >EC21 - EC35 $_{EH_CU_1D_AR}$	mg/kg	10	MCERTS	< 10
TPH-CWG - Aromatic >EC35 - EC40 $_{EH_CU_1D_AR}$	mg/kg	10	NONE	< 10
TPH-CWG - Aromatic (EC5 - EC35) $_{EH_CU+HS_1D_AR}$	mg/kg	10	NONE	< 10
TPH Total C5 - C40 $_{EH_CU+HS_1D_TOTAL}$	mg/kg	10	NONE	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number : 23-22252
Project / Site name: Northfleet Embankment

* 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 *
2612400	MHP03_ES	None Supplied	0.3	Brown loam with gravel.

Analytical Report Number : 23-22252
Project / Site name: Northfleet Embankment

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

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 dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
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
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
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 and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS. Individual components MCERTS accredited	In-house method based on USEPA8260	L073B-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
Cr (III) in soil	In-house method by calculation from total Cr and Cr VI.	In-house method by calculation	L080-PL	W	NONE
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
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
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL or B' 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 : 23-22252
Project / Site name: Northfleet Embankment

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

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

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.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

idom merebrook

Site Name: Northfleet Cement Works					Home screening level from phytotoxicity	Residential with homegrown produce			
Project Number: 21-0-0-0									
Sample Location NWW11_ NWW12_01 NWW12_01 NWW12_01									
Depth 0.2 0.8 0.1									
Determrand					Number of Tests	Maximum (mg kg^{-1})	Mean (mg kg^{-1})	Screening Level (mg kg^{-1})	No. > SL
Arsenic	12	9.2	9.3		3	12	10.200	37	0
Barium	12	9.8	9.7		3	12	10.500	1300	0
Cadmium	1.1	0.5	<0.3		3	1.1	0.800	15	0
Hexavalent Chromium	<1.8	<1.8	<1.8		3	0	-	6	0
Chromium III	50	25	36		3	50	37.333	910	0
Chromium (total)	50	25	36		3	50	36.333	-	-
Copper	26	88	70		3	70	48.000	2400	0
Lead	56	45	47		3	56	47.333	200	0
Mercury	<0.3	<0.3	<0.3		3	0	-	40	0
Nickel	19	15	17		3	19	17.000	130	0
Selenium	<1.0	<1.0	<1.0		3	0	-	250	0
Vanadium	44	33	35		3	44	37.333	410	0
Zinc	130	110	110		3	130	116.667	40000	0
pH	9.2	10.1	8.1		3	10.1	9.133	9	1
Water Soluble SOX (BRE SD 2:1 Leach Equivalent) g l^{-1}	1.7	0.9	0.068		3	1.7	0.889	-	-
% Organic matter	5.7	5.7	6		3	6.0	5.567	-	-
Total Cyanide	0.7	0.7	0.5		3	0.7	0.667	-	-
Aliphatic C5-C6	<0.001	<0.001	<0.001		3	0	-	42	0
Aliphatic C6-C8	<0.001	<0.001	<0.001		3	0	-	100	0
Aliphatic C8-C10	<0.001	<0.001	<0.001		3	0	-	27	0
Aliphatic C10-C12	<0.001	<0.001	<0.001		3	0	-	130	0
Aliphatic C12-C16	<1.0	<1.0	<1.0		3	0	-	1100	0
Aliphatic C16-C21	8.9	<8.0	<8.0		3	8.9	8.900	65000	0
Aliphatic C21-C35	51	17	<8.0		3	51	34.000	65000	0
Aromatic C5-C7	10	<10	<10		3	10	10.000	-	-
Aromatic C7-C8	<10	<10	<10		3	0	-	-	-
Aromatic C8-C10	50	26	<10		3	50	35.667	-	-
TPH Total C5 - C40	60	28	<10		3	60	39.500	-	-
Benzene	<5.0	<5.0	<5.0		-	-	-	-	-
Toluene	<5.0	<5.0	<5.0		-	-	-	-	-
Ethylbenzene	<5.0	<5.0	<5.0		-	-	-	-	-
m & p Xylene	<5.0	<5.0	<5.0		-	-	-	-	-
o-Xylene	<5.0	<5.0	<5.0		-	-	-	-	-
MTBE	<5.0	<5.0	<5.0		-	-	-	-	-
Benzene	#VALUE!	#VALUE!	#VALUE!		0	#VALUE!	-	0.087	0
Toluene	#VALUE!	#VALUE!	#VALUE!		0	#VALUE!	-	130	0
Ethylbenzene	#VALUE!	#VALUE!	#VALUE!		0	#VALUE!	-	47	0
Total xylene	-	-	-		0	0	-	56	0
MTBE	#VALUE!	#VALUE!	#VALUE!		0	#VALUE!	-	-	-
Naphthalene	<0.05	<0.05	<0.05		3	0	-	2.3	0
Acenaphthylene	<0.05	<0.05	<0.05		3	0	-	170	0
Acenaphthene	<0.05	<0.05	<0.05		3	0	-	210	0
Fluorene	<0.05	<0.05	<0.05		3	0	-	170	0
Phenanthrene	0.21	<0.05	0.07		3	0.21	0.140	95	0
Anthracene	<0.05	<0.05	<0.05		3	0	-	2400	0
Fluoranthene	0.36	0.12	0.15		3	0.36	0.182	280	0
Pyrene	0.34	0.12	0.15		3	0.34	0.173	620	0
Benzo(a)anthracene	<0.05	<0.05	<0.05		3	0	-	7.2	0
Chrysene	<0.05	<0.05	<0.05		3	0	-	15	0
Benzo(b)fluoranthene	<0.05	<0.05	<0.05		3	0	-	2.6	0
Benzo(k)fluoranthene	<0.05	<0.05	<0.05		3	0	-	77	0
Benzo(a)pyrene	<0.05	<0.05	<0.05		3	0	-	2.2	0
Indeno(1,2,3-c,d)pyrene	<0.05	<0.05	<0.05		3	0	-	27	0
Dibenz(a,h)anthracene	<0.05	<0.05	<0.05		3	0	-	0.241	0
Benzo(g,h,i)perylene	<0.05	<0.05	<0.05		3	0	-	320	0
Total PAH (USEPA 16)	0.81	<0.40	<0.40		3	0.81	0.810	-	-
Phenol - Monohydric	<1.0	<1.0	<1.0		3	0	-	120	0

APPENDIX 3

- Hazardous Ground Gas Assessment

1 Leonard Place
Westerham Road
Keston
Kent BR2 6HQ
T: +44 1689 889 980
info.kent@idom.com
idom.com

IDOM

Bellway Homes Limited (Thames Gateway)
Bellway House
Anchor Boulevard
Crossways Business Park
Dartford
Kent
DA2 6QH

Mr. Andy Jessop
andy.jessop@bellway.co.uk

03 February 2023

Subject: Harbour Village, Phase 2 and 3 – Hazardous Ground Gas Monitoring
Our ref: L-17855cz-2.4.2-23-26-MB

Dear Mr. Jessop,

IDOM Merebrook (IDOM) has been commissioned by Bellway Homes Limited (Thames Gateway) (Bellway) to undertake an assessment of hazardous ground gas in an area known as Phase 2 and 3 at the proposed Harbour Village development in Northfleet. The proposed development delivery phasing plan is enclosed.

IDOM produced an Earthworks and Materials Specification, reference ES-17855CZ-19-271, dated December 2020. Following the ongoing completion of earthworks across Phase 2 and 3 and once sufficient compliance testing in accordance with the Earthworks Specification (ES-17855CX-19-271, dated December 2020) had been undertaken, IDOM commenced a hazardous ground gas risk assessment.

On 21 December 2021, six windowless sample boreholes were advanced to a maximum depth of three metres below ground level, across the completed areas of Phase 2 and 3, as indicated on drawing 17855cz/SK01. Boreholes were each installed with ground gas and groundwater monitoring wells.

HAZARDOUS GROUND GAS

Three rounds of gas monitoring were undertaken from 30 August 2022 to 16 January 2023. During the monitoring programme, a number of the boreholes were damaged and could not be monitored for all of the rounds.

Levels of methane, carbon dioxide and oxygen were recorded in each standpipe, together with associated parameters including borehole flow and ambient air pressure. Field monitoring records are enclosed.

The monitoring was undertaken at barometric pressures ranging from 983 to 1023. No positive flow was detected, and no methane was recorded. The maximum recorded concentration of carbon dioxide was 0.8 % by volume (% v/v) with corresponding depleted oxygen concentrations.

Both CIRIA 665 and NHBC guidance has been followed to assess the recorded soil gas and flow conditions from monitoring undertaken during this investigation. Calculations are appended which suggest that a 'Characteristic Situation 1' or NHBC class 'Green' would be applicable to the site. These indicate a negligible gas risk and that gas protection measures are not required for this phase of the development.

I trust the above and attached are suitable for your current requirements. If you have any queries, please do not hesitate to contact me.

Yours sincerely,

Matt Baylis

For IDOM Merebrook Limited

Encs. Proposed development delivery phasing plan

17855cz/SK01

Field monitoring records

Modified Wilson and Card gas characteristic situation risk assessment

NHBC traffic light gas characteristic situation risk assessment

Boundary Key

- Approved Site Wide Boundary of Permission EDC/16/0004
- Land within Bellway's Ownership
- Release of Protected Strip*

  *The land hatched black is owned by Bellway but is subject to a covenant (imposed prior to grant of the outline consent) that it cannot be used for residential use.
- Protected Strip
- Gatehouse Area

  This land currently comprises part of the access to the Employment Land.
- Stopping-up Land

  The stopping up land is currently highway but an application to stop up such land is in progress. The transfer to Bellway included such land subject to the highway rights.

*Best estimate based on the approved **Mixed Use Planning Application Boundary**, Ref: LAF00-052 Rev S (David Lock Associates, 2015, PDF)

Building Programme Key

- Residential Phase 1A – Factory Road
- Residential Phase 1B – The Hive
- Residential Phase 2 – College Road and Central
- Residential Phase 2A – Bus Road West
- Residential Phase 2B – Playing pitch/ Bevan's Park
- Residential Phase 2C – Robin Creek SUD
- Residential Phase 3 – The Riverside
- Employment land
- MU2*

*Riverside Food and Drink Uses comprising up to 500 sqm of Public House or Food and Drink Uses (A3/A4) as per description of development on outline planning permission (ref: EDC/16/0004)

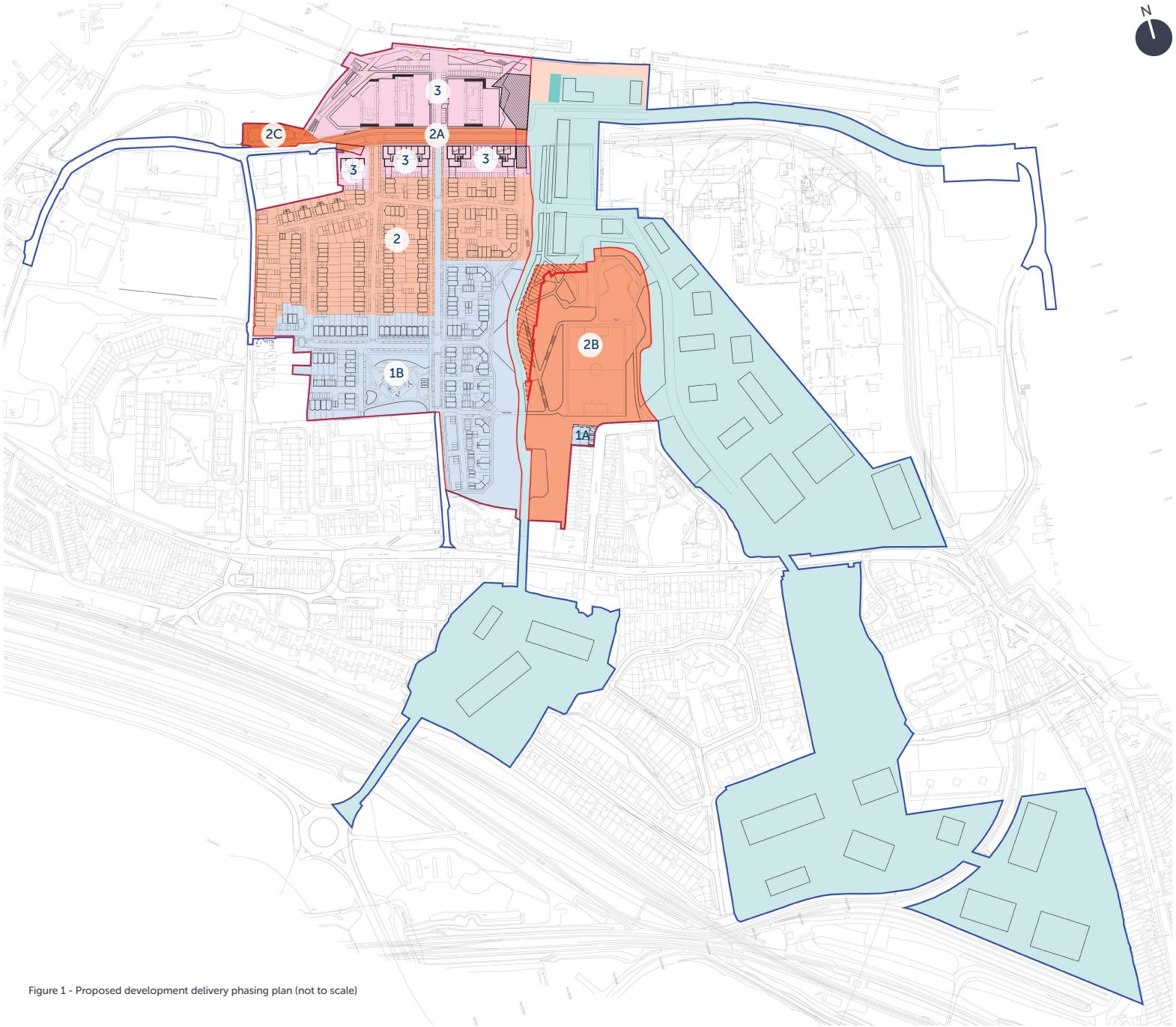
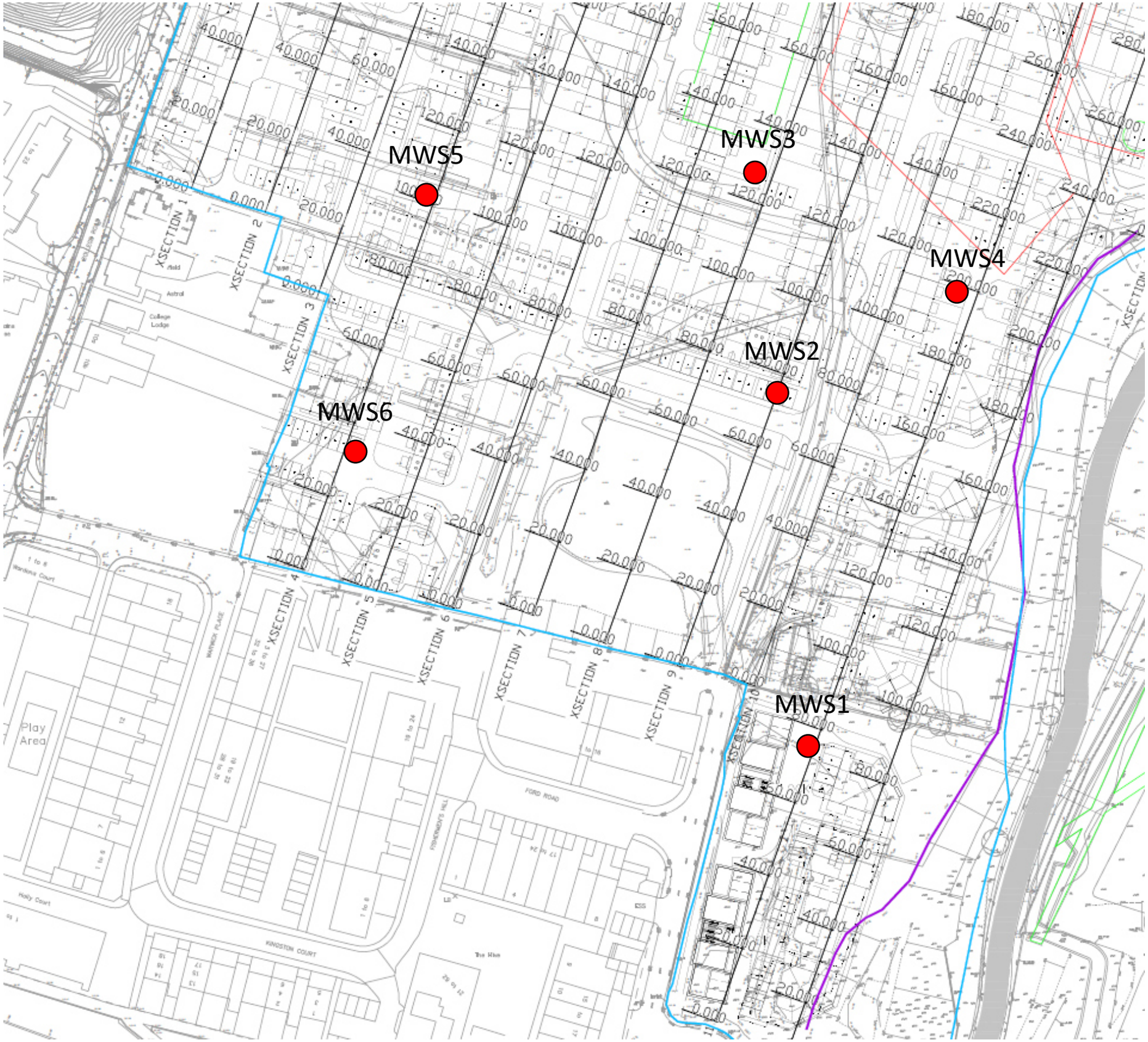


Figure 1 - Proposed development delivery phasing plan (not to scale)



Gas monitoring borehole

Exploratory hole location plan – 17855cz/SK01

GAS MONITORING RECORD ROUND 1

Location Reference	Time	Flow and Pressure Measurements				Gas Measurements						VOC Measurements		Dip Measurements		Comments
		Flow		Atmospheric Pressure	Differential Pressure	Methane	Methane LEL	Carbon Dioxide	Oxygen	Carbon Monoxide	Hydrogen Sulphide	Hexane	PID	Depth to Water	Depth to Base	
		max	steady													
		l hr^{-1}		mb	Pa	%	%	%	%	ppm	ppm	%	ppm	m	m	
MWS101	10:00	0	0	1023	0	0	0	0	13.2	0	0	0.049	nr	DRY	-	-
MWS102	10:15	0	0	-	-	-	-	-	-	-	nr	-	nr	-	-	Standpipe destroyed and non-functioning.
MWS103	10:30	0	0	1022	0	0	0	0	10.6	0	0	0.053	nr	DRY	-	-
MWS104	10:45	0	0	1022	0	0	0	0.4	20.2	0	0	0.053	nr	DRY	-	-
MWS105	11:00	0	0	1020	0	0	0	0	19.7	0	0	0.058	nr	DRY	-	-
MWS106	11:15	0	0	1022	0	0	0	0.8	18.6	0	0	0.048	nr	DRY	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Weather:	Sunny with partial cloud. Dry.	nr = not recorded	Gas Analyser	PID	Site:	Northfleet Embankment
		Model:	GFM 436-1	-	Project Number:	17855cz
		Serial Number:	12228	-	Monitored By:	Joe Bertram
		Date of Last Calibration:	30/09/2021	-	Date:	30/08/2022

GAS MONITORING RECORD ROUND 2

Location Reference	Time	Flow and Pressure Measurements				Gas Measurements						VOC Measurements		Dip Measurements		Comments
		Flow		Atmospheric Pressure	Differential Pressure	Methane	Methane LEL	Carbon Dioxide	Oxygen	Carbon Monoxide	Hydrogen Sulphide	Hexane	PID	Depth to Water	Depth to Base	
		max	steady													
		l hr^{-1}		mb	Pa	%	%	%	%	ppm	ppm	%	ppm	m	m	
MWS101	13:00	0	0	1011	0	0	0	0.1	20	0	0	0.000	0	2.85	0.00	-
MWS102	-	-	-	-	-	-	-	-	-	-	nr	-	nr	-	0.00	Standpipe destroyed and non-functioning.
MWS103	-	-	-	-	-	-	-	-	-	-	nr	-	nr	-	0.00	Unable to locate
MWS104	13:15	0	0	1010	0	0	0	0.3	19.9	0	0	0.000	0	DRY	0.00	-
MWS105	13:30	0	0	1009	0	0	0	0.1	20.1	0	0	0.000	0	3.24	0.00	-
MWS106	-	-	-	-	-	-	-	-	-	-	nr	-	nr	-	-	Unable to locate
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Weather:	Sunny with partial cloud. Wet	nr = not recorded	Gas Analyser	PID	Site:	Northfleet Embankment
		Model:	GFM 436-1	MiniRAE 3000	Project Number:	17855cz
		Serial Number:	2633/2518	592-920925	Monitored By:	Joe Bertram
		Date of Last Calibration:	24/05/2022	28/10/2021	Date:	09/01/2023

GAS MONITORING RECORD ROUND 3

Location Reference	Time	Flow and Pressure Measurements				Gas Measurements						VOC Measurements		Dip Measurements		Comments
		Flow		Atmospheric Pressure	Differential Pressure	Methane	Methane LEL	Carbon Dioxide	Oxygen	Carbon Monoxide	Hydrogen Sulphide	Hexane	PID	Depth to Water	Depth to Base	
		max	steady													
		l hr^{-1}		mb	Pa	%	%	%	%	ppm	ppm	%	ppm	m	m	
MWS101	12:45	0	0	983	0	0	0	0.3	20	0	0	0.000	0	3.00	-	-
MWS102	-	-	-	-	-	-	-	-	-	-	nr	-	nr	-	-	Standpipe destroyed and non-functioning.
MWS103	-	-	-	-	-	-	-	-	-	-	nr	-	nr	-	-	Unable to locate
MWS104	13:00	0	0	984	0	0	0	0.1	20.2	0	0	0.000	0	2.12	-	-
MWS105	13:15	0	0	984	0	0	0	0.5	15.7	0	0	0.000	0	2.90	-	-
MWS106	-	-	-	-	-	-	-	-	-	-	nr	-	nr	-	-	Unable to located
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Weather:	Partially cloudy. Wet.	nr = not recorded	Gas Analyser	PID	Site: Northfleet Embankment
		Model:	GFM 436-1	MiniRAE 3000	Project Number: 17855cz
		Serial Number:	2633/2518	592-920925	Monitored By: Finn Leahy
		Date of Last Calibration:	24/05/2022	28/10/2021	Date: 16/01/2023

IDOM

MODIFIED WILSON AND CARD GAS CHARACTERISTIC SITUATION

SITE: Northfleet Embankment JOB NUMBER: 17855cz 17/01/2023

Carbon Dioxide			Methane		
Maximum Gas Concentration	0.80	%	Maximum Gas Concentration	0.10	%
Maximum Measured Steady Flow	0.10	L hr^{-1}	Maximum Measured Peak Flow	0.10	L hr^{-1}
Gas Screening Value	0.00	L hr^{-1}	Gas Screening Value	0.00	L hr^{-1}
Characteristic Situation	1		Characteristic Situation	1	

if measured values are zero then resolution limit of instrument is used for calculation of GSV
worst case carbon dioxide or methane characteristic situation value defines overall characterstic situation for the site

Modified Wilson and Card Classification

					BS 8485:2015+A1:2019 Gas Protection Scores - refer to standard for full guidance			
					Minimum Gas Protection Score Required			
Characteristic Situation	Risk Classification	Gas Screening Value Threshold (L hr^{-1})	Additional Factors	Typical Source of Generation	Type A Building	Type B Building	Type C Building	Type D Building
1	very low risk	<0.07	typically methane not to exceed 1% and/or carbon dioxide 5% otherwise consider increase to situation 2	natural soils with low organic content; 'typical' made ground	0	0	0	0
2	low risk	0.07 to <0.7	borehole air flow rate not to exceed 70 L hr^{-1} otherwise consider increase to situation 3	natural soils with high peat/organic content; 'typical' made ground	3.5	3.5	2.5	1.5
3	moderate risk	0.7 to <3.5		old landfill, inert waste, mineworking flooded	4.5	4	3	2.5
4	moderate to high risk	3.5 to <15	quantitative risk assessment required to evaluate scope of protective measures	mineworking susceptible to flooding, completed landfill	6.5 A)	5.5 A)	4.5	3.5
5	high risk	15 to <70		mineworking unflooded inactive with shallow workings near surface	hazard too high for this method to define protection measures	6 A)	5.5	4.5
6	very high risk	>70		recent landfill site	hazard too high for this method to define protection measures	hazard too high for this method to define protection measures	hazard too high for this method to define protection measures	6

BS 8485:2015+A1:2019 Gas Protection Measures - refer to standard for full guidance
Select two or more elements from the following three types of protection to achieve score (only one element per type permitted)

Structural Barrier	Score A)	Ventilation Measures		Score	Gas Resistant Membrane	Score
Precast suspended segmental subfloor (i.e. beam and block)	0	Pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building)		0.5	Gas resistant membrane meeting all of the following criteria: 1. sufficiently impervious, both in the sheet material and in the sealing of sheets and sealing around sheet penetrations, to prevent any significant passage of methane and/or carbon dioxide through the membrane. *A membrane with a methane gas transmission rate <40.0 ml/day/m2/atm (average) for sheets and joints (tested in accordance with BS ISO 15105-1:2007 manometric method) is regarded as sufficiently impervious.* 2. sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions 3. sufficiently strong* to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc) and to withstand in-service stresses (e.g. settlement if placed below a floor slab) 5. capable, after installation, of providing a complete barrier to the entry of the relevant gas 6. verified in accordance with CIRIA C735 * For example, reinforced LDPE (virgin polymer) membranes having a minimum mass per unit area of 370 g/m2 and not significantly less than 0.4 mm thickness between the reinforcement scrim (tested in accordance with Procedure D (2 mm diameter tip) of BS EN ISO 9863-1:2016) installed above floor slabs are considered sufficiently strong to meet the performance criteria (see also C.3). Thicker and more robust membranes or an additional membrane protection layer should be installed directly beneath cast-in-situ floor slabs	2
Cast in situ ground-bearing floor slab (with only nominal mesh reinforcement)	0.5	Passive sub floor dispersal layer	Very good performance E)	2.5		
			Good performance E)	1.5		
Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations	1 or 1.5 B)	Active dispersal layer, usually comprising fans with active abstraction (suction) from a subfloor dilution layer, with roof level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers E)		1.5 to 2.5		
Basement floor and walls conforming to BS 8102:2009, Grade 2 waterproofing C) D)	2	Active positive pressurization by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket E)		1.5 to 2.5		
Basement floor and walls conforming to BS 8102:2009, Grade 3 waterproofing C) D)	2.5	Ventilated car park (floor slab of occupied part of the building under consideration is underlain by a basement or undercroft car park) F)		4		

Notes

A) The scores are conditional on breaches of floor slabs, etc., being effectively sealed

B) To achieve a score of 1.5 the raft or suspended slab should be well reinforced to control cracking and have minimal penetrations cast in

C) The score is conditional on the waterproofing being provided by a suitable structural barrier with the design and detailing of the walls and floor meeting the requirements for Type B protection. The score cannot be assigned for Type A (waterproof membrane) or Type C (drained cavity wall).

D) If a membrane is installed beneath and around the basement to provide Type A waterproofing (BS 8102:2009), it can be assigned a gas protection score in accordance with Table 7, if it meets all the criteria for a gas resistant membrane in that table

E) Refer to BS 8485:2015 Annex B to determine performance and assign score

F) Assumes that the car park is vented to deal with car exhaust fumes, designed to Buildings Regulations 2000, Approved Document F

Building Types

Type A
Private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms present. Probably conventional building construction (rather than civil engineering). Examples include private housing and some retail premises.

FOR TYPE A BUILDINGS ACTIVE VENTILATION MEASURES ARE INAPPROPRIATE

Type B
Private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium size rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels.

Type C
Commercial building with central building management control of any alterations to the building or its uses and central building management control of the maintenance of the building, including the gas protection measures. Single occupancy of ground floor and basement areas. Small to large size rooms with active ventilation or good passive ventilation of all rooms and other internal spaces throughout ground floor and basement areas. Probably civil engineering construction. Examples include offices, some retail premises, and parts of some public buildings (such as schools, hospitals, leisure centres and parts of hotels).

Type D
Industrial style building having large volume internal space(s) that are well ventilated. Corporate ownership with building management controls on alterations to the ground floor and basement areas of the building and on maintenance of ground gas protective measures. Probably civil engineering construction. Examples are retail park sales buildings, factory shop floor areas, warehouses. (Small rooms within these style buildings should be separately categorized as Type B or Type C).

IDOM

NHBC TRAFFIC LIGHT GAS CHARACTERISTIC SITUATION

SITE: Northfleet Embankment JOB NUMBER: 17855cz 17/01/2023

Carbon Dioxide			Methane		
Maximum Gas Concentration	0.80	%	Maximum Gas Concentration	0.10	%
Maximum Measured Steady Flow	0.10	L hr^{-1}	Maximum Measured Peak Flow	0.10	L hr^{-1}
Gas Screening Value	0.00	L hr^{-1}	Gas Screening Value	0.00	L hr^{-1}
Characteristic Situation	Green		Characteristic Situation	Green	

if measured values are zero then resolution limit of instrument is used for calculation of GSV
worst case carbon dioxide or methane characteristic situation value defines overall characterstic situation for the site

NHBC Classification **Protection Measures**

Characteristic Situation	Carbon Dioxide		Methane		Identified Gas Regime	Protection Measures Required
	Typical Maximum Concentration (%v/v)	Gas Screening Value (L hr^{-1})	Typical Maximum Concentration (%v/v)	Gas Screening Value (L hr^{-1})		
Green					negligible	Ground gas protection measures are not required
	5	0.78	1	0.16		
Amber 1					low to intermediate	Low-level ground gas protection measures are required, using a membrane and ventilated sub-floor void that creates a permeability contrast to limit the ingress of gas into buildings. Gas protection measures are to be installed as prescribed in BRE 414. Ventilation of the sub-floor void should be designed to provide a minimum of one complete volume change per 24 hours
	10	1.56	5	0.63		
Amber 2					intermediate to high	High-level ground gas protection measures are required, creating a permeability contrast to prevent ingress of gas into buildings. Gas protection measures are to be installed as prescribed in BRE 414. Membranes used should always be fitted by a specialist contractor and should be fully certified (see Appendix E). As with Amber 1, ventilation of the sub-floor void should be designed to provide a minimum of one complete volume change per 24 hours.
	30	3.10	20	1.56		
Red					high	Standard residential housing is not normally acceptable without further Ground Gas Risk Assessment and/or possible remedial mitigation measures to reduce/remove the source of the ground gases. In certain circumstances, active protection methods could be applied, but only when there is a legal agreement assuring the management and maintenance of the system for the life of the property.

IDOM

IDOM Cromford Mills, Mill Lane, Matlock, Derbyshire DE4 3RQ
t +44 (0)1773 829 988 **e** info.derbyshire@idom.com **idom.com**
Registered in England No. 02740216 Registered office: as above