S.I. Ltd Contract No: 5415

Client: Cairn Homes
Engineer: Waterman Moylan
Contractor: Site Investigations Ltd

Hollybank,
Swords, Co. Dublin
Site Investigation Report

Prepared by:

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Stephen Letch

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Appendices:

1. Introduction

On the instructions of Waterman Moylan, Site Investigations Ltd (SIL) was appointed to complete a ground investigation at Glen Ellan Road, Swords, County Dublin. The investigation was for a new residential development of the site, Hollybank, and was completed on behalf of the Client, Cairn Homes.

The fieldworks comprised a programme of cable percussive boreholes, trial pits, dynamic probes and California Bearing Ratio tests. All fieldwork was carried out in accordance with Eurocode 7: Geotechnical Design and the IEI Specification & Related Documents for Ground Investigation in Ireland (2006). Laboratory testing has been performed on representative soil samples recovered from the trial pits and these were completed in accordance of BS1377: 1990.

This report presents the factual geotechnical data obtained from the field and laboratory testing with interpretation of the ground conditions discussed.

2. Fieldwork

The geotechnical fieldworks were started and completed in September 2017 and comprised the following:

- 8 No. cable percussive boreholes
- 17 No. trial pits
- 17 No. dynamic probes
- 8 No. California Bearing Ratio tests

2.1. Cable Percussive Boreholes

Cable percussion boring was undertaken at 8 No. locations using a Dando 150 rig and constructed a 200mm diameter borehole. BH02 terminated at 3.00mbgl on a shallow obstruction but the remaining boreholes all terminated at 5.00mbgl or deeper. It was not possible to collect undisturbed samples due to the gravel and cobble content of the strata so bulk disturbed samples were recovered at regular intervals.

To test the strength of the stratum, Standard Penetration Tests (SPT's) were performed at 1.00m intervals in accordance with BS 1377 (1990). In soils with high gravel and cobble content it is appropriate to use a solid cone (60°) (CPT) instead of the split spoon and this was used throughout the testing. The test is completed over 450mm and the cone is driven 150mm into the stratum to ensure that the test is conducted over an undisturbed zone. The cone is then driven the remaining 300mm and the blows recorded to report the N-Value. The report shows the N-Value with the seating and test 75mm incremental blows listed in brackets

(e.g. BH01 at 1.00mbgl where N=17-(1,2/3,3,5,6)). Where refusal of 50 blows across the test zone was encountered was achieved during testing, the penetration depth is also reported (e.g. BH01 at 5.00mbgl where N=50-(25 for 10mm / 50 for 5mm)).

The logs are presented in Appendix 1.

2.2. Trial Pits and Dynamic Probes

17 No. trial pits were completed using a wheeled excavator and were logged by SIL geotechnical engineer. Representative disturbed bulk samples were recovered as the pits were excavated and they were returned to the laboratory for geotechnical testing.

Adjacent to the trial pits, dynamic probes were completed using a track mounted Competitor 130 machine. The testing complies with the requirements of BS1377: Part 9 (1990) and Eurocode 7: Part 3. The configuration utilised standard DPH (Heavy) probing method comprising a 50kg weight, 500mm drop height and a 43.7mm diameter (90°) cone. The number of blows required to drive the cone each 100mm increment into the sub soil is recorded in accordance with the standards. The dynamic probe provides no information regarding soil type or groundwater conditions.

The dynamic probe results can be used to analyse the strength of the soil strata encountered by the probe. 'Proceedings of the Trinity College Dublin Symposium of Field and Laboratory Testing of Soils for Foundations and Embankments' presents a paper by Foirbart that is most relevant to Irish soil conditions and within this paper the following equations were included:

Granular Soils: DPH N_{100} x 2.5 = SPT N value

Cohesive Soils: C_u = 15 x DPH N_{100} + 30 kN/m^2

These equations present a relationship between the probe N_{100} value and the SPT N value for granular soils and the undrained shear strength of cohesive soils.

The trial pit and dynamic probes results are presented on one log and are presented in Appendix 2 with the trial pit photographs.

2.3. California Bearing Ratio tests

At 8 No. locations, undisturbed cylindrical mould samples were taken to complete California Bearing Ratio tests in the laboratory. The results facilitate the designing of the access roads and associated areas. These tests were completed to BS1377: 1990: Part 4, Clause 7 ‘Determination of California Bearing Ratio’. The results are presented as part of Appendix 3 with the laboratory test data.

2.4. Surveying

Following the completion of the works, a survey of the exploratory hole locations was completed using a GeoMax GPS Rover. The data is supplied on each individual log and is provided along with a site plan in Appendix 4.

3. Laboratory Testing

Geotechnical laboratory testing is currently ongoing on representative soil samples in accordance with BS 1377 (1990). Testing included:

- 3 No. Moisture content
- 3 No. Atterberg limits
- 3 No. Particle size gradings
- 3 No. pH, sulphate and chloride content

Environmental testing was completed by ALS Environmental Ltd. and consisted of the following:

- 3 No. Rilta Analysis

The laboratory test results are presented in Appendix 4.

4. Ground Conditions

4.1. Overburden

A generalised summary of the ground profile at BH01 is shown below. Reference should be made to the individual borehole and trial pit records in Appendices 1 and 2 for the full strata information at specific locations.

- **0.00m:** TOPSOIL.
- **0.50m:** Stiff grey brown sandy slightly gravelly silty CLAY with low cobble content.
- **2.50m:** Very stiff black sandy slightly gravelly silty CLAY with low cobble content.
- **4.80m:** Obstruction - possible boulders.
- **5.00m:** Borehole terminated due to obstruction.

MADE GROUND was not recorded in the boreholes but was recorded to shallow depths at TP05 and TP14 (0.70mbgl) but was also recorded to greater depths in TP17 to 1.90mbgl. The MADE GROUND generally consists of cohesive soils with cobbles and boulders and timber, plastic, red brick and concrete fragments.

The natural overburden deposits are of glacial origin and the particle size gradings display characteristic poorly-graded 'straight-line' profiles for the glacial material. The trial pits did encounter some granular soils to the North of the site but was not recorded to the South.

4.2. Groundwater

Groundwater details in the boreholes and trial pits during the fieldworks are noted on the logs in Appendices 1 and 2. Groundwater was encountered in seven of the eight boreholes ranging in depth from 2.40mbgl to 5.80mbgl. Water was also recorded in TP01 and TP02 at 2.30mbgl and 2.70mbgl respectively.

5.0. Recommendations and Conclusions

Please note the following caveats:

The recommendations given and opinions expressed in this report are based on the findings as detailed in the exploratory hole records. Where an opinion is expressed on the material between the exploratory hole locations or below the final level of excavation, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for adjacent unexpected conditions that have not been revealed by the exploratory holes. It is further recommended that all bearing surfaces when excavated should be inspected by a suitably qualified Engineer to verify the information given in this report.

Excavated surfaces in clay strata should be kept dry to avoid softening prior to foundation placement. Foundations should always be taken to a minimum depth of 0.50mBGL to avoid the effects of frost action and possible seasonal shrinkage/swelling.

If it is intended that on-site materials are to be used as fill, then the necessary laboratory testing should be specified by the Client to confirm the suitability. Also, relevant lab testing should be specified where stability of side slopes to excavations is a concern, or where contamination may be an issue.

5.1. Shallow Foundations

Due to the unknown depth of foundation and no longer-term groundwater information, this analysis assumes the groundwater will not influence the construction or performance of these foundations.

The boreholes recorded firm brown or grey sandy gravelly silty CLAY with low cobble content at 1.00mbgl. The SPT test results are generally consistent with values between 10 and 12 recorded at 6 locations with BH01 (17) and BH03 (27) recording higher N-values. Therefore, for the analysis an N-value of 10 was chosen for the purposes of design in this stratum, in accordance with Eurocode 7 (EC 7).

Using an equation proposed by Stroud and Butler, the SPT N-value can be used to calculate the shear strength and this is Cu=5N. Therefore, using the value of 10, this indicates that the undrained shear strength of the CLAY is 50kN/m^2. This can be used to calculate the allowable bearing capacity (ABC) and using a factor of safety of 3 an ABC of 90kN/m^2 would be anticipated.

The trial pits and the probes show that the soil does strengthen between 1.00mbgl and 2.00mbgl and therefore, if these capacities are too low then the foundations could be placed on the stiffer soils between 1mbgl and 2mbgl.

The following assumptions were made as part of these analyses. If any of these assumptions are not in accordance with detailed design or observations made during construction these recommendations should be re-evaluated.

- The foundation is to be 1m wide.
- Foundations are to be constructed on a level formation of uniform material type (described above).
- All man-made or filled material is to be removed prior to construction.
- The bulk unit weight of the material in this stratum has a minimum density of 19kN/m^3.
- Based on groundwater observations this analysis assumes the groundwater will not influence the construction or performance of these foundations.
- All founding strata to be inspected by a suitably qualified Engineer prior to pouring the foundations.

The trial pits indicate that excavations in the cohesive soils should be stable for a short while at least. However, regular inspection of temporary excavations should be completed during construction to ensure that all slopes are stable. If granular soils are encountered then the stability any excavation wall will reduce and therefore temporary support should be used on any excavation that will be left open for an extended period.

5.2. Groundwater

The caveats below relating to interpretation of groundwater levels should be noted:
There is always considerable uncertainty as to the likely rates of water ingress into excavations in clayey soil sites due to the possibility of localised unforeseen sand and gravel lenses acting as permeable conduits for unknown volumes of water.

Furthermore, water levels noted on the borehole and trial pit logs do not generally give an accurate indication of the actual groundwater conditions as the borehole or trial pit is rarely left open for sufficient time for the water level to reach equilibrium.

Also, during boring procedures, a permeable stratum may have been sealed off by the borehole casing, or water may have been added to aid drilling. Therefore, an extended period of groundwater monitoring using any constructed standpipes is required to provide more accurate information regarding groundwater conditions. Finally, groundwater levels vary with time of year, rainfall, nearby construction and tides.

Pumping tests would be required to determine likely seepage rates and persistence into excavations taken below the groundwater level. Deep trial pits also aid estimation of seepage rates.

As discussed previously there were water strikes in seven of the boreholes and two of the trial pits. These strikes were all recorded at depth though with the shallowest water strike at 2.30mbgl in TP01 and this was recorded as a seepage. There is always considerable uncertainty as to the likely rates of water ingress into excavations in cohesive soil sites due to the possibility of localised unforeseen sand and gravel lenses acting as permeable conduits for unknown volumes of water. However, based on this information at the exploratory hole locations to date, it is considered likely that any seepages into excavations of the CLAY will be slow. If granular soils are encountered then the possibility of water ingressing into an excavation increases.

If groundwater is encountered during excavations then mechanical pumps will be required to remove the groundwater from sumps. Sumps should be carefully located and constructed to ensure that groundwater is efficiently removed from excavations and trenches.

5.3. Pavement Design

The summary of the CBR test results in Appendix 3 indicates values generally between 6.2% and 7.7%.

The CBR tests samples were collected at 0.60mbgl and inspection of the formation strata should be completed prior to construction of the pavement. Once the exact formation levels are finalised then additional in-situ testing could be completed to assist with the detailed pavement design.

5.4. Contamination

Environmental testing was carried out on three samples from the investigation and the results are shown in Appendix 3. For material to be removed from site, Rilta testing was carried out to determine whether the material on the site could be accepted as ‘inert material’ by an Irish landfill. The results were compared with the published waste acceptance limits of BS EN 12457-2.

The disposal suite results indicate that the material would generally be able to be treated as Inert Waste. However, discussions about the acceptance of the material must be undertaken with individual landfills before removal of any material from site.

Only three samples were tested for analysis and although no major contamination was noted at the fieldwork locations, any localised contamination may have been missed. Therefore, a testing regime designed by an environmental engineer should be designed on any material that is to be removed from site to ensure that the material stays within the landfill acceptance criteria.

5.5. Aggressive Ground Conditions

The chemical tests results in Appendix 3 indicate a general pH value between 8.30 and 8.47, which is close to neutral and below the level of 9, therefore no special precautions are required.

The maximum value obtained for water soluble sulphate was 126mg/l as SO_3. The BRE Special Digest 1:2005 – '*Concrete in Aggressive Ground'* guidelines require SO_4 values and after conversion ($SO_4 = SO_3 \times 1.2$), the maximum value of 151mg/l shows Class 1 conditions and no special precautions are required.

Appendix 1

Cable Percussive Borehole Logs

Contract No: 5415	**Cable Percussion Borehole Log**				Corehole No: **BH01**
Contract:	Hollybank	Easting:	717608.793	Date Started:	15/09/2017
Location:	Swords, Co. Dublin	Northing:	748363.439	Date Completed:	15/09/2017
Client:	Cairn Homes	Elevation:	7.25	Logged By:	S. Letch
Engineer:	Waterman Moylan	Rig Type:	Dando 150	Drilled By:	M. Cunniffe

Depth (m)		Stratum Description	Legend	Level (mOD)		Samples and Insitu Tests			Water Strike	Backfill
Scale	Depth			Scale	Depth	Depth	Type	Result		
		TOPSOIL.		7.0						
0.5	0.50				6.75					
1.0		Stiff grey brown sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.		6.5		1.00 1.00	C B	N=17 (1,2/3,3,5,6) MC08		
1.5				6.0						
2.0				5.5		2.00 2.00	C B	N=21 (2,2/3,5,6,7) MC09		
2.5	2.50			5.0	4.75					
3.0		Very stiff black sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.		4.5		3.00 3.00	C B	N=46 (3,7/10,11,13,12) MC10		
3.5				4.0						
4.0				3.5		4.00 4.00	C B	N=47 (5,9/10,12,12,13) MC11		
4.5				3.0						
	4.80			2.5	2.45					
5.0	5.00	Obstruction - possible boulder. End of Borehole at 5.00m		2.0	2.25	5.00	C	50 (25 for 10mm/50 for 5mm)		
5.5				1.5						
6.0				1.0						
6.5				0.5						
7.0				0.0						
7.5				-0.5						
8.0				-1.0						
8.5				-1.5						
9.0				-2.0						
9.5				-2.5						

Chiselling:			Water Strikes:			Water Details:			Installation:			Backfill:			Remarks:
From:	To:	Time:	Strike:	Rose:	Depth Sealed:	Date:	Hole Depth:	Water Depth:	From:	To:	Pipe:	From:	To:	Type:	
4.80	5.00	01:00	4.00	3.60	-	15/09	5.00	4.00				0.00	5.00	Arisings	Termination due to boulder obstruction.

Legend:
B: Bulk
D: Disturbed
U: Undisturbed
ES: Environmental
C: Cone SPT
S: Split spoon SPT

Contract No: 5415	**Cable Percussion Borehole Log**				Corehole No: **BH02**
Contract:	Hollybank	Easting:	717663.420	Date Started:	15/09/2017
Location:	Swords, Co. Dublin	Northing:	748294.172	Date Completed:	15/09/2017
Client:	Cairn Homes	Elevation:	9.42	Logged By:	S. Letch
Engineer:	Waterman Moylan	Rig Type:	Dando 150	Drilled By:	M. Cunniffe

Depth (m)		Stratum Description	Legend	Level (mOD)		Samples and Insitu Tests			Water Strike	Backfill
Scale	Depth			Scale	Depth	Depth	Type	Result		
		TOPSOIL.								
	0.50	Firm becoming stiff grey sandy gravelly clayey SILT with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.			8.92	1.00 1.00	C B	N=11 (1,1/2,2,3,4) MC05		
						2.00 2.00	C B	N=24 (2,2/4,5,7,8) MC06		
	2.70	Obstruction - possible boulder.			6.72	2.70	B	MC07		
	3.00	End of Borehole at 3.00m			6.42	3.00	C	50 (25 for 10mm/50 for 5mm)		

Chiselling:			Water Strikes:			Water Details:			Installation:			Backfill:			Remarks:	Legend:
From:	To:	Time:	Strike:	Rose:	Depth Sealed:	Date:	Hole Depth:	Water Depth:	From:	To:	Pipe:	From:	To:	Type:		B: Bulk D: Disturbed U: Undisturbed ES: Environmental C: Cone SPT S: Split spoon SPT
2.70	3.00	01:00				15/09	3.00	Dry				0.00	3.00	Arisings	Termination due to boulder obstruction.	

Contract No: 5415	**Cable Percussion Borehole Log**			Corehole No: **BH03**
Contract:	Hollybank	Easting:	717845.956	Date Started: 21/09/2017
Location:	Swords, Co. Dublin	Northing:	748256.318	Date Completed: 21/09/2017
Client:	Cairn Homes	Elevation:	5.94	Logged By:
Engineer:	Waterman Moylan	Rig Type:		Drilled By:

Depth (m) Scale	Depth	Stratum Description	Legend	Level (mOD) Scale	Depth	Samples and Insitu Tests Depth	Type	Result	Water Strike	Backfill
0.5	0.50	TOPSOIL.		5.5	5.44					
1.0		Stiff grey sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.		5.0		1.00 1.00	C B	N=27 (2,4/5,7,7,8) MC36		
1.5				4.5						
2.0	2.10			4.0	3.84	2.00 2.00	C B	N=30 (2,3/6,7,8,9) MC37		
2.5		Very stiff black sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.		3.5						
3.0				3.0		3.00 3.00	C B	N=34 (3,4/5,9,10,10) MC38		
3.5				2.5						
4.0				2.0		4.00 4.00	C B	N=41 (2,5/8,10,11,12) MC39		
4.5				1.5						
5.0	5.00	Obstruction - possible boulder.		1.0	0.94	5.00	C	50 (4,20/50 for 40mm)		
5.5	5.50	End of Borehole at 5.50m		0.5	0.44					
6.0				0.0						
6.5				-0.5						
7.0				-1.0						
7.5				-1.5						
8.0				-2.0						
8.5				-2.5						
9.0				-3.0						
9.5				-3.5						

Chiselling: From:	To:	Time:	Water Strikes: Strike:	Rose:	Depth Sealed:	Water Details: Date:	Hole Depth:	Water Depth:	Installation: From:	To:	Pipe:	Backfill: From:	To:	Type:	Remarks:
5.00	5.50	01:00	2.40	2.00	-	21/09	5.50	5.00				0.00	5.50	Arisings	Termination due to boulder obstruction.

Legend:
B: Bulk
D: Disturbed
U: Undisturbed
ES: Environmental
C: Cone SPT
S: Split spoon SPT

Contract No: 5415	**Cable Percussion Borehole Log**			Corehole No: **BH04**
Contract:	Hollybank	Easting:	717631.220	Date Started: 14/09/2017
Location:	Swords, Co. Dublin	Northing:	748202.211	Date Completed: 14/09/2017
Client:	Cairn Homes	Elevation:	9.92	Logged By: S. Letch
Engineer:	Waterman Moylan	Rig Type:	Dando 150	Drilled By: M. Cunniffe

Depth (m) Scale	Depth	Stratum Description	Legend	Level (mOD) Scale	Depth	Samples and Insitu Tests Depth	Type	Result	Water Strike	Backfill
		TOPSOIL.								
	0.50	Firm brown sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone.			9.42	1.00 1.00	C B	N=10 (1,1/1,2,3,4) MC01		
	1.50	Firm becoming stiff grey sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.			8.42	2.00 2.00	C B	N=13 (2,1/2,2,4,5) MC02		
						3.00 3.00	C B	N=23 (2,2/3,5,7,8) MC03		
	3.50	Very stiff black sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.			6.42	4.00 4.00	C B	N=33 (4,6/7,8,8,10) MC04		
	4.70	Obstruction - possible boulder.			5.22					
	5.00	End of Borehole at 5.00m			4.92	5.00	C	50 (25 for 10mm/50 for 10mm)		

Chiselling: From:	To:	Time:	Water Strikes: Strike:	Rose:	Depth Sealed:	Water Details: Date:	Hole Depth:	Water Depth:	Installation: From:	To:	Pipe:	Backfill: From:	To:	Type:	Remarks:
4.70	5.00	01:00	4.00	3.80	-	14/09	5.00	4.00				0.00	5.00	Arisings	Termination due to boulder obstruction.

Legend:
B: Bulk
D: Disturbed
U: Undisturbed
ES: Environmental
C: Cone SPT
S: Split spoon SPT

Contract No: 5415	**Cable Percussion Borehole Log**			Corehole No: **BH05**
Contract:	Hollybank	Easting:	717822.927	Date Started: 20/09/2017
Location:	Swords, Co. Dublin	Northing:	748206.474	Date Completed: 21/09/2017
Client:	Cairn Homes	Elevation:	7.67	Logged By:
Engineer:	Waterman Moylan	Rig Type:		Drilled By:

Depth (m) Scale	Depth	Stratum Description	Legend	Level (mOD) Scale	Depth	Samples and Insitu Tests Depth	Type	Result	Water Strike	Backfill
		TOPSOIL.								
	0.50	Firm becoming stiff grey sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.			7.17	1.00 1.00	C B	N=11 (1,1/2,2,3,4) MC30		
						2.00 2.00	C B	N=22 (1,3/4,5,6,7) MC31		
	2.40	Stiff becoming very stiff black sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.			5.27	3.00 3.00	C B	N=29 (2,4/5,7,8,9) MC32		
						4.00 4.00	C B	N=33 (3,4/6,8,9,10) MC33		
						5.00 5.00	C B	N=42 (2,5/8,10,12,12) MC34		
	6.00	End of Borehole at 6.00m			1.67	6.00 6.00	C B	N=53 (3,6/9,12,14,18) MC35		

Chiselling: From:	To:	Time:	Water Strikes: Strike:	Rose:	Depth Sealed:	Water Details: Date:	Hole Depth:	Water Depth:	Installation: From:	To:	Pipe:	Backfill: From:	To:	Type:	Remarks:
			3.00	2.80	-	20/09 21/09 21/09	3.00 3.00 6.00	3.00 2.50 5.00				0.00	6.00	Arisings	Terminated at scheduled depth.

Legend:
B: Bulk
D: Disturbed
U: Undisturbed
ES: Environmental
C: Cone SPT
S: Split spoon SPT

Contract No: 5415	**Cable Percussion Borehole Log**			Corehole No: **BH06**
Contract:	Hollybank	Easting:	717849.380	Date Started: 19/09/2017
Location:	Swords, Co. Dublin	Northing:	748120.667	Date Completed: 19/09/2017
Client:	Cairn Homes	Elevation:	13.46	Logged By:
Engineer:	Waterman Moylan	Rig Type:		Drilled By:

Depth (m) Scale	Depth	Stratum Description	Legend	Level (mOD) Scale	Depth	Samples and Insitu Tests Depth	Type	Result	Water Strike	Backfill
		TOPSOIL.								
	0.50	Firm grey sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.			12.96	1.00 1.00	C B	N=12 (1,1/2,3,3,4) MC18		
	2.20	Stiff brown sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.			11.26	2.00 2.00	C B	N=21 (2,2/4,6,5,6) MC19		
						3.00 3.00	C B	N=28 (2,3/5,6,8,9) MC20		
						4.00 4.00	C B	N=36 (3,5/7,9,10,10) MC21		
	4.50	Very stiff black sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.			8.96	5.00 5.00	C B	N=43 (2,6/8,10,12,13) MC22		
	6.00	End of Borehole at 6.00m			7.46	6.00 6.00	C B	N=58 (3,8/10,14,16,18) MC23		

Chiselling: From:	To:	Time:	Water Strikes: Strike:	Rose:	Depth Sealed:	Water Details: Date:	Hole Depth:	Water Depth:	Installation: From:	To:	Pipe:	Backfill: From:	To:	Type:	Remarks:
			5.50	5.40	-	19/09	6.00	5.50				0.00	6.00	Arisings	Terminated at scheduled depth.

Legend:
B: Bulk
D: Disturbed
U: Undisturbed
ES: Environmental
C: Cone SPT
S: Split spoon SPT

Contract No: 5415	**Cable Percussion Borehole Log**			Corehole No: **BH07**
Contract:	Hollybank	Easting:	717714.458	Date Started: 18/09/2017
Location:	Swords, Co. Dublin	Northing:	748040.428	Date Completed: 18/09/2017
Client:	Cairn Homes	Elevation:	13.32	Logged By: S. Letch
Engineer:	Waterman Moylan	Rig Type:	Dando 150	Drilled By: M. Cunniffe

Depth (m) Scale	Depth	Stratum Description	Legend	Level (mOD) Scale	Depth	Samples and Insitu Tests Depth	Type	Result	Water Strike	Backfill
0.5	0.50	TOPSOIL.		13.0	12.82	0.50	B	MC12		
1.0		Firm brown slightly sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.		12.5		1.00	C	N=12 (1,1/2,2,3,5)		
1.5				12.0		1.50	B	MC13		
2.0	2.00			11.5	11.32	2.00	C	N=19 (2,2/3,4,5,7)		
2.5		Stiff becoming very stiff black sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.		11.0		2.50	B	MC14		
3.0				10.5		3.00	C	N=35 (3,5/7,9,9,10)		
3.5				10.0						
4.0				9.5		4.00	C	N=42		
4.5				9.0		4.00	B	(4,6/8,10,12,12) MC15		
5.0				8.5		5.00	C	N=52		
5.5				8.0		5.00	B	(4,8/10,12,14,16) MC16		
6.0	6.00	End of Borehole at 6.00m		7.5	7.32	6.00	C	50 (3,18/50 for 25mm)		
6.5				7.0		6.00	B	MC17		
7.0				6.5						
7.5				6.0						
8.0				5.5						
8.5				5.0						
9.0				4.5						
9.5				4.0						
				3.5						

Chiselling: From:	To:	Time:	Water Strikes: Strike:	Rose:	Depth Sealed:	Water Details: Date:	Hole Depth:	Water Depth:	Installation: From:	To:	Pipe:	Backfill: From:	To:	Type:	Remarks:
5.90	6.00	01:00	5.50	5.20	-	18/09	6.00	5.50				0.00	6.00	Arisings	Terminated at scheduled depth.

Legend:
B: Bulk
D: Disturbed
U: Undisturbed
ES: Environmental
C: Cone SPT
S: Split spoon SPT

Contract No: 5415	**Cable Percussion Borehole Log**			Corehole No: **BH08**
Contract:	Hollybank	Easting:	717873.791	Date Started: 19/09/2017
Location:	Swords, Co. Dublin	Northing:	748077.087	Date Completed: 19/09/2017
Client:	Cairn Homes	Elevation:	12.51	Logged By:
Engineer:	Waterman Moylan	Rig Type:		Drilled By:

Depth (m) Scale	Depth	Stratum Description	Legend	Level (mOD) Scale	Depth	Samples and Insitu Tests Depth	Type	Result	Water Strike	Backfill
0.5	0.50	TOPSOIL.		12.0	12.01					
1.0		Firm grey sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.		11.5		1.00 1.00	C B	N=10 (1,2/2,3,2,3) MC24		
1.5				11.0						
2.0	2.00	Firm becoming stiff brown sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.		10.5	10.51	2.00 2.00	C B	N=12 (1,1/2,3,4,3) MC25		
2.5				10.0						
3.0				9.5		3.00 3.00	C B	N=19 (2,2/3,4,5,7) MC26		
3.5				9.0						
4.0	3.80	Very stiff brown black sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.		8.5	8.71	4.00 4.00	C B	N=33 (1,4/6,8,9,10) MC27		
4.5	4.60	Very stiff black sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.		8.0	7.91					
5.0				7.5		5.00 5.00	C B	N=44 (6,8/10,11,11,12) MC28		
5.5				7.0						
6.0	6.00	End of Borehole at 6.00m		6.5	6.51	6.00 6.00	C B	50 (9,14/50 for 210mm) MC29		
6.5				6.0						
7.0				5.5						
7.5				5.0						
8.0				4.5						
8.5				4.0						
9.0				3.5						
9.5				3.0						

Chiselling: From:	To:	Time:	Water Strikes: Strike:	Rose:	Depth Sealed:	Water Details: Date:	Hole Depth:	Water Depth:	Installation: From:	To:	Pipe:	Backfill: From:	To:	Type:	Remarks:	Legend: B: Bulk D: Disturbed U: Undisturbed ES: Environmental C: Cone SPT S: Split spoon SPT
			5.80	5.50	-	19/09	6.00	5.80				0.00	6.00	Arisings	Terminated at scheduled depth.	

Appendix 2

Trial Pit and Dynamic Probe Logs and Photographs

Contract No: 5415	**Trial Pit and Dynamic Probe Log**				Trial Pit No: **TP01**
Contract:	Hollybank	Easting:	717593.680	Date:	26/09/2017
Location:	Swords, Co. Dublin	Northing:	748316.185	Excavator:	JCB 3CX
Client:	Cairn Homes	Elevation:	8.51	Logged By:	M. Kaliski
Engineer:	Waterman Moylan	Dimensions (LxWxD) (m):	3.50 x 0.60 x 3.00	Scale:	1:25

Level (mbgl) Scale:	Depth	Stratum Description	Legend	Level (mOD) Scale:	Depth:	Samples Depth	Type	Probe	Water Strike
		TOPSOIL.						2	
	0.20	Firm light brown sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone.			8.31			3	
0.5				8.0				4	
	0.70	Grey brown silty sandy angular to rounded, fine to coarse GRAVEL of limestone with high cobble content. Sand is fine to coarse. Cobbles are subangular to subrounded of limestone.			7.81			4	
								5	
1.0				7.5		1.00	B	6	
								5	
								6	
								9	
								13	
1.5				7.0				15	
								17	
								17	
								17	
								17	
2.0				6.5		2.00	B	16	
								16	
								17	
								17	
								18	
								23	
2.5				6.0				35	
	2.50	Grey silty sandy angular to rounded, fine to coarse GRAVEL of limestone with high cobble content and some clay/silt bands. Sand is fine to coarse. Cobbles are subangular to rounded of limestone.			6.01				
						2.80	B		
3.0	3.00	**Pit terminated at 3.00m**		5.5	5.51				
3.5				5.0					
4.0				4.5					
4.5				4.0					

Termination:	Pit Wall Stability:	Groundwater Rate:	Remarks:	Key:
Scheduled depth.	Pit walls stable.	2.30 Seepage	-	B = Bulk disturbed D = Small disturbed CBR = Undisturbed CBR ES = Environmental

Contract No: 5415	**Trial Pit and Dynamic Probe Log**				Trial Pit No: **TP02**
Contract:	Hollybank	Easting:	717632.703	Date:	26/09/2017
Location:	Swords, Co. Dublin	Northing:	748256.648	Excavator:	JCB 3CX
Client:	Cairn Homes	Elevation:	9.31	Logged By:	M. Kaliski
Engineer:	Waterman Moylan	Dimensions (LxWxD) (m):	3.50 x 0.60 x 3.00	Scale:	1:25

Level (mbgl) Scale:	Depth	Stratum Description	Legend	Level (mOD) Scale:	Depth:	Samples Depth	Type	Probe	Water Strike
0.5	0.20	TOPSOIL.		9.0	9.11			1	
		Firm light brown sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone.						2	
								2	
								2	
								3	
								2	
								3	
								3	
				8.5				6	
1.0	0.90	Grey brown silty sandy subangular to rounded, fine to coarse GRAVEL of limestone with high cobble and low boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded of limestone (up to 500mm diameter).			8.41	1.00	B	12	
								16	
								23	
								26	
				8.0				28	
1.5								35	
				7.5					
2.0						2.00	B		
				7.0					
2.5									
	2.70	Grey brown silty sandy subangular to rounded, fine to coarse GRAVEL of limestone with high cobble and low boulder content and dark grey clay bands. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded of limestone (up to 500mm diameter).			6.61				▼
				6.5		2.90	B		
3.0	3.00	**Pit terminated at 3.00m**			6.31				
				6.0					
3.5									
				5.5					
4.0									
				5.0					
4.5									
				4.5					

Termination:	Pit Wall Stability:	Groundwater Rate:	Remarks:	Key:
Scheduled depth.	Pit walls stable.	2.70 Seepage	-	B = Bulk disturbed D = Small disturbed CBR = Undisturbed CBR ES = Environmental

Contract No: 5415	**Trial Pit and Dynamic Probe Log**				Trial Pit No: **TP03**
Contract:	Hollybank	Easting:	717726.797	Date:	27/09/2017
Location:	Swords, Co. Dublin	Northing:	748227.917	Excavator:	JCB 3CX
Client:	Cairn Homes	Elevation:	9.22	Logged By:	M. Kaliski
Engineer:	Waterman Moylan	Dimensions (LxWxD) (m):	3.50 x 0.60 x 3.00	Scale:	1:25

Level (mbgl) Scale:	Depth	Stratum Description	Legend	Level (mOD) Scale:	Depth:	Samples Depth	Type	Probe	Water Strike
0.5	0.20	TOPSOIL.		9.0	9.02			1	
1.0		Firm brown slightly sandy gravelly silty CLAY with high cobble and boulder content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles and boulders are angular to subangular of limestone (up to 400mm diameter).		8.5		1.00	B	2 3 12 15 24 23 18 20 26 28 35	
1.5	1.70	Firm brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone.		8.0					
2.0				7.5	7.52	2.00	B		
2.5	2.40	Grey brown silty sandy subangular to rounded, fine to coarse GRAVEL of limestone with high cobble content and frequent clay bands. Sand is fine to coarse. Cobbles are subangular to rounded of limestone.		7.0	6.82				
3.0	3.00	**Pit terminated at 3.00m**		6.5		2.80	B		
3.5				6.0	6.22				
4.0				5.5					
4.5				5.0					
				4.5					

Termination:	Pit Wall Stability:	Groundwater Rate:	Remarks:	Key:
Scheduled depth	Pit walls stable.	Dry	-	B = Bulk disturbed D = Small disturbed CBR = Undisturbed CBR ES = Environmental

Contract No: 5415	**Trial Pit and Dynamic Probe Log**				Trial Pit No: **TP04**
Contract:	Hollybank	Easting:	717802.210	Date:	27/09/2017
Location:	Swords, Co. Dublin	Northing:	748276.115	Excavator:	JCB 3CX
Client:	Cairn Homes	Elevation:	6.04	Logged By:	M. Kaliski
Engineer:	Waterman Moylan	Dimensions (LxWxD) (m):	3.50 x 0.60 x 3.00	Scale:	1:25

Level (mbgl) Scale:	Depth	Stratum Description	Legend	Level (mOD) Scale:	Depth:	Samples Depth	Type	Probe	Water Strike
		TOPSOIL.		6.0				1	
	0.20	Firm brown sandy silty CLAY. Sand is fine to coarse.			5.84			2	
0.5				5.5				3	
	0.80	Firm grey brown sandy slightly gravelly silty CLAY with low cobble content and frequent pockets of gravel. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subrounded to rounded of limestone.			5.24			7	
1.0				5.0		1.00	B	10	
	1.30	Stiff grey brown slightly sandy gravelly silty CLAY with high cobble and boulder content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles and boulders are angular to subrounded of limestone (up to 400mm diameter).			4.74			17	
1.5				4.5		1.50	B	17	
	1.80	Stiff becoming very stiff grey sandy slightly gravelly silty CLAY with high cobble and boulder content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles and boulders are angular to subrounded of limestone (up to 400mm diameter).			4.24			19	
2.0				4.0				25	
						2.20	B	35	
2.5				3.5					
3.0	3.00	**Pit terminated at 3.00m**		3.0	3.04				
3.5				2.5					
4.0				2.0					
4.5				1.5					

Termination:	Pit Wall Stability:	Groundwater Rate:	Remarks:	Key:
Scheduled depth	Pit walls stable.	Dry	-	B = Bulk disturbed D = Small disturbed CBR = Undisturbed CBR ES = Environmental

Contract No: 5415	**Trial Pit and Dynamic Probe Log**				Trial Pit No: **TP05**
Contract:	Hollybank	Easting:	717810.993	Date:	27/09/2017
Location:	Swords, Co. Dublin	Northing:	748222.897	Excavator:	JCB 3CX
Client:	Cairn Homes	Elevation:	7.45	Logged By:	M. Kaliski
Engineer:	Waterman Moylan	Dimensions (LxWxD) (m):	3.50 x 0.60 x 3.00	Scale:	1:25

Level (mbgl) Scale:	Depth	Stratum Description	Legend	Level (mOD) Scale:	Depth:	Samples Depth	Type	Probe	Water Strike
		TOPSOIL.			7.25			2	
	0.20	MADE GROUND: dark brown sandy gravelly silty clay with some pottery fragments.						2	
0.5				7.0				13	
	0.70	Grey brown silty sandy subangular to rounded, fine to coarse GRAVEL of limestone with high cobble and medium boulder content. Sand is fine to coarse. Cobbles and boulders are angular to subrounded of limestone (up to 400mm diameter).			6.75			20	
1.0				6.5		1.00	B	20	
1.5				6.0				22	
2.0				5.5		2.00	B	23	
	2.10	Stiff grey sandy slightly gravelly silty CLAY with high cobble and low boulder content. Sand is fine to coarse. Gravel is subangular to subrounded, fine to coarse of limestone. Cobbles and boulders are angular to subrounded of limestone (up to 400mm diameter).			5.35			24	
2.5				5.0		2.50	B	22	
3.0	3.00	**Pit terminated at 3.00m**		4.5	4.45			26	
3.5				4.0				28	
4.0				3.5				35	
4.5				3.0					
				2.5					

Termination:	Pit Wall Stability:	Groundwater Rate:	Remarks:	Key:
Scheduled depth	Pit walls stable.	Dry	-	B = Bulk disturbed D = Small disturbed CBR = Undisturbed CBR ES = Environmental

Contract No: 5415	**Trial Pit and Dynamic Probe Log**				Trial Pit No: **TP06**
Contract:	Hollybank	Easting:	717625.987	Date:	26/09/2017
Location:	Swords, Co. Dublin	Northing:	748161.701	Excavator:	JCB 3CX
Client:	Cairn Homes	Elevation:	10.93	Logged By:	M. Kaliski
Engineer:	Waterman Moylan	Dimensions (LxWxD) (m):	3.50 x 0.60 x 3.00	Scale:	1:25

Level (mbgl) Scale:	Depth	Stratum Description	Legend	Level (mOD) Scale:	Depth:	Samples Depth	Type	Probe	Water Strike
		TOPSOIL.						2	
	0.20	Firm brown slightly sandy gravelly silty CLAY with high cobble content. Sand is fine to coarse. Gravel is subangular to rounded, fine to coarse of limestone. Cobbles are subrounded to rounded of limestone.			10.73			4	
0.5				10.5				3	
	0.80	Firm becoming stiff light brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded, fine to coarse of limestone.			10.13			2	
1.0				10.0		1.00	B	2	
								2	
								3	
								5	
								6	
								9	
1.5	1.50	Stiff becoming very stiff brown sandy slightly gravelly silty CLAY with high cobble content. Sand is fine to coarse. Gravel is subangular to rounded, fine to coarse of limestone. Cobbles are subangular to rounded of limestone.		9.5	9.43			7	
								8	
								7	
								6	
								7	
2.0				9.0		2.00	B	11	
								11	
								13	
								16	
								12	
2.5				8.5				11	
								10	
								10	
								11	
								11	
3.0	3.00	**Pit terminated at 3.00m**		8.0	7.93			11	
								12	
								12	
								14	
								20	
3.5				7.5				35	
4.0				7.0					
4.5				6.5					
				6.0					

Termination:	Pit Wall Stability:	Groundwater Rate:	Remarks:	Key:
Scheduled depth.	Pit walls stable.	Dry	-	B = Bulk disturbed D = Small disturbed CBR = Undisturbed CBR ES = Environmental

Contract No: 5415	**Trial Pit and Dynamic Probe Log**				Trial Pit No: **TP07**
Contract:	Hollybank	Easting:	717663.978	Date:	26/09/2017
Location:	Swords, Co. Dublin	Northing:	748112.404	Excavator:	JCB 3CX
Client:	Cairn Homes	Elevation:	14.07	Logged By:	M. Kaliski
Engineer:	Waterman Moylan	Dimensions (LxWxD) (m):	3.50 x 0.60 x 3.00	Scale:	1:25

Level (mbgl) Scale:	Depth	Stratum Description	Legend	Level (mOD) Scale:	Depth:	Samples Depth	Samples Type	Probe	Water Strike
0	0.20	TOPSOIL.		14.0	13.87			1	
0.5		Firm light brown sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded, fine to coarse of limestone.		13.5				1 2 2 2 1 2 3 3	
1.0	0.90	Grey brown silty sandy subangular to rounded, fine to coarse GRAVEL of limestone with high cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded of limestone (up to 400mm diameter).		13.17		1.00	B	8 16 22 23 25 35	
1.5				13.0					
2.0				12.5					
2.5				12.0		2.50	B		
3.0	3.00	**Pit terminated at 3.00m**		11.5	11.07				
3.5				11.0					
4.0				10.5					
4.5				10.0					
				9.5					

Termination:	Pit Wall Stability:	Groundwater Rate:	Remarks:	Key:
Scheduled depth	Pit walls stable.	Dry	-	B = Bulk disturbed D = Small disturbed CBR = Undisturbed CBR ES = Environmental

Contract No: 5415	**Trial Pit and Dynamic Probe Log**				Trial Pit No: **TP08**
Contract:	Hollybank	Easting:	717698.097	Date:	26/09/2017
Location:	Swords, Co. Dublin	Northing:	748155.594	Excavator:	JCB 3CX
Client:	Cairn Homes	Elevation:	10.16	Logged By:	M. Kaliski
Engineer:	Waterman Moylan	Dimensions (LxWxD) (m):	3.50 x 0.60 x 3.00	Scale:	1:25

Level (mbgl) Scale:	Depth	Stratum Description	Legend	Level (mOD) Scale:	Depth:	Samples Depth	Type	Probe	Water Strike
		TOPSOIL.		10.0				1	
	0.30				9.86			1	
0.5		Firm light brown sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded, fine to coarse of limestone.		9.5				2	
								4	
								5	
								5	
								5	
								5	
								4	
1.0						1.00	B	4	
	1.10				9.06			4	
		Firm becoming stiff brown sandy slightly gravelly silty CLAY with high cobble content. Sand is fine to coarse. Gravel is subangular to rounded, fine to coarse of limestone. Cobbles are subangular to rounded of limestone.		9.0				6	
								8	
								5	
1.5								4	
								3	
				8.5				2	
								4	
								8	
								12	
2.0						2.00	B	18	
				8.0				12	
								11	
	2.40				7.76			15	
2.5		Grey brown silty sandy subangular to rounded, fine to coarse GRAVEL of limestone with high cobble content. Sand is fine to coarse. Cobbles are subangular to rounded of limestone.						9	
								10	
				7.5				8	
								7	
						2.80	B	7	
3.0	3.00	**Pit terminated at 3.00m**			7.16			15	
								15	
				7.0				17	
								20	
3.5								35	
				6.5					
4.0									
				6.0					
4.5									
				5.5					

Termination:	Pit Wall Stability:	Groundwater Rate:	Remarks:	Key:
Scheduled depth	Pit walls stable.	Dry	-	B = Bulk disturbed D = Small disturbed CBR = Undisturbed CBR ES = Environmental

Contract No: 5415	**Trial Pit and Dynamic Probe Log**				Trial Pit No: **TP09**
Contract:	Hollybank	Easting:	717785.379	Date:	27/09/2017
Location:	Swords, Co. Dublin	Northing:	748160.575	Excavator:	JCB 3CX
Client:	Cairn Homes	Elevation:	9.97	Logged By:	M. Kaliski
Engineer:	Waterman Moylan	Dimensions (LxWxD) (m):	3.50 x 0.60 x 3.00	Scale:	1:25

Level (mbgl) Scale:	Depth	Stratum Description	Legend	Level (mOD) Scale:	Depth:	Samples Depth	Type	Probe	Water Strike
0.5	0.20	TOPSOIL.		9.5	9.77			1, 1, 2, 2, 3, 5, 5, 5, 5	
1.0	0.90	Firm brown slightly sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subrounded to rounded of limestone.		9.0	9.07	1.00	B	4, 3, 3, 4, 3, 5, 4, 2, 2, 2, 4, 4, 5, 5, 5, 5	
1.5		Light brown very silty slightly gravelly fine to coarse SAND with frequent silt bands.		8.5					
2.0				8.0					
2.5				7.5		2.50	B	7, 13, 13, 12, 13, 12, 14, 25, 35	
3.0	3.00	**Pit terminated at 3.00m**		7.0	6.97				
3.5				6.5					
4.0				6.0					
4.5				5.5					

Termination:	Pit Wall Stability:	Groundwater Rate:	Remarks:	Key:
Scheduled depth	Pit walls stable.	Dry	-	B = Bulk disturbed D = Small disturbed CBR = Undisturbed CBR ES = Environmental

Contract No: 5415	**Trial Pit and Dynamic Probe Log**				Trial Pit No: **TP10**
Contract:	Hollybank	Easting:	717873.933	Date:	27/09/2017
Location:	Swords, Co. Dublin	Northing:	748147.926	Excavator:	JCB 3CX
Client:	Cairn Homes	Elevation:	12.44	Logged By:	M. Kaliski
Engineer:	Waterman Moylan	Dimensions (LxWxD) (m):	3.50 x 0.60 x 3.00	Scale:	1:25

Level (mbgl) Scale:	Depth	Stratum Description	Legend	Level (mOD) Scale:	Depth:	Samples Depth	Type	Probe	Water Strike
		TOPSOIL.						1	
	0.30	Firm brown sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to rounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.			12.14			2	
0.5				12.0				2	
	0.90	Stiff brown sandy slightly gravelly silty CLAY with high cobble content. Sand is fine to coarse. Gravel is subangular to rounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.			11.54			4	
1.0				11.5		1.00	B	6	
								8	
								12	
								12	
1.5				11.0				15	
								13	
								14	
								15	
								19	
	1.90	Very stiff grey brown sandy slightly gravelly silty CLAY with high cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are angular to subrounded of limestone.			10.54			16	
2.0				10.5		2.00	B	17	
								17	
								20	
2.5				10.0				21	
								24	
								35	
	3.00	**Pit terminated at 3.00m**		9.5	9.44				
3.0									
3.5				9.0					
				8.5					
4.0									
				8.0					
4.5									
				7.5					

Termination:	Pit Wall Stability:	Groundwater Rate:	Remarks:	Key:
Scheduled depth	Pit walls stable.	Dry	-	B = Bulk disturbed D = Small disturbed CBR = Undisturbed CBR ES = Environmental

Contract No: 5415	**Trial Pit and Dynamic Probe Log**				Trial Pit No: **TP11**
Contract:	Hollybank	Easting:	717743.796	Date:	26/09/2017
Location:	Swords, Co. Dublin	Northing:	748104.831	Excavator:	JCB 3CX
Client:	Cairn Homes	Elevation:	14.27	Logged By:	M. Kaliski
Engineer:	Waterman Moylan	Dimensions (LxWxD) (m):	3.50 x 0.60 x 3.00	Scale:	1:25

Level (mbgl) Scale:	Depth	Stratum Description	Legend	Level (mOD) Scale:	Depth:	Samples Depth	Type	Probe	Water Strike
		TOPSOIL.							
	0.20				14.07				
		Soft brown sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded, fine to coarse of limestone.		14.0					
	0.40				13.87				
0.5		Firm brown sandy slightly gravelly silty CLAY with high cobble content. Sand is fine to coarse. Gravel is subangular to subrounded, fine to coarse of limestone. Cobbles are subangular to rounded of limestone.		13.5					
1.0						1.00	B		
				13.0					
1.5	1.50				12.77				
		Firm becoming stiff grey sandy slightly gravelly silty CLAY with high cobble and medium boulder content. Sand is fine to coarse. Gravel is subangular to subrounded, fine to coarse of limestone. Cobbles and boulders are subangular to rounded of limestone (up to 400mm diameter).		12.5					
2.0						2.00	B		
				12.0					
2.5									
3.0	3.00	**Pit terminated at 3.00m**		11.5	11.27				
3.5				11.0					
				10.5					
4.0									
				10.0					
4.5									
				9.5					

Termination:	Pit Wall Stability:	Groundwater Rate:	Remarks:	Key:
Scheduled depth	Pit walls stable.	Dry	-	B = Bulk disturbed D = Small disturbed CBR = Undisturbed CBR ES = Environmental

Contract No: 5415	**Trial Pit and Dynamic Probe Log**				Trial Pit No: **TP12**
Contract:	Hollybank	Easting:	717812.038	Date:	27/09/2017
Location:	Swords, Co. Dublin	Northing:	748070.366	Excavator:	JCB 3CX
Client:	Cairn Homes	Elevation:	13.53	Logged By:	M. Kaliski
Engineer:	Waterman Moylan	Dimensions (LxWxD) (m):	3.50 x 0.60 x 3.00	Scale:	1:25

Level (mbgl) Scale:	Depth	Stratum Description	Legend	Level (mOD) Scale:	Depth:	Samples Depth	Type	Probe	Water Strike
		TOPSOIL.						2	
	0.20	Firm brown sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded, fine to coarse of limestone.			13.33			2	
0.5				13.0				2	
	0.80	Firm becoming stiff brown sandy slightly gravelly silty CLAY with high cobble content. Sand is fine to coarse. Gravel is subangular to subrounded, fine to coarse of limestone. Cobbles are subangular to subrounded of limestone.			12.73			3	
1.0				12.5		1.00	B	4	
								6	
1.5				12.0				4	
	1.70	Stiff becoming very stiff light brown slightly sandy gravelly silty CLAY with medium cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to rounded of limestone.			11.83			2	
2.0				11.5		2.00	B	4	
								3	
2.5				11.0				5	
								6	
3.0	3.00	**Pit terminated at 3.00m**		10.5	10.53			8	
								8	
3.5				10.0				10	
								20	
4.0				9.5				30	
								35	
4.5				9.0					

Termination:	Pit Wall Stability:	Groundwater Rate:	Remarks:	Key:
Scheduled depth	Pit walls stable.	Dry	-	B = Bulk disturbed D = Small disturbed CBR = Undisturbed CBR ES = Environmental

Contract No: 5415	**Trial Pit and Dynamic Probe Log**				Trial Pit No: **TP13**
Contract:	Hollybank	Easting:	717707.802	Date:	26/09/2017
Location:	Swords, Co. Dublin	Northing:	747999.822	Excavator:	JCB 3CX
Client:	Cairn Homes	Elevation:	13.70	Logged By:	M. Kaliski
Engineer:	Waterman Moylan	Dimensions (LxWxD) (m):	3.50 x 0.60 x 3.00	Scale:	1:25

Level (mbgl) Scale:	Depth	Stratum Description	Legend	Level (mOD) Scale:	Depth:	Samples Depth	Type	Probe	Water Strike
		TOPSOIL.						2	
	0.20	Firm brown sandy gravelly silty CLAY with high cobble content. Sand is fine to coarse. Gravel is subangular to rounded, fine to coarse of limestone. Cobbles are subrounded to rounded of limestone.		13.5	13.50			1 2 2 1 2 1 2 3	
0.5				13.0					
	0.90	Firm light brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded, fine to coarse of limestone.			12.80	1.00	B	2 3 2 2 3	
1.0				12.5					
1.5								1 1 2 3	
	1.80	Stiff grey brown sandy slightly gravelly silty CLAY with high cobble content and frequent gravel pockets. Sand is fine to coarse. Gravel is subangular to rounded, fine to coarse of limestone. Cobbles are subangular to rounded of limestone.		12.0	11.90	2.00	B	4 5 8 7 6 8 11 13 35	
2.0				11.5					
2.5				11.0					
3.0	3.00	**Pit terminated at 3.00m**			10.70				
				10.5					
3.5				10.0					
4.0				9.5					
4.5				9.0					

Termination:	Pit Wall Stability:	Groundwater Rate:	Remarks:	Key:
Scheduled depth	Pit walls stable.	Dry	-	B = Bulk disturbed D = Small disturbed CBR = Undisturbed CBR ES = Environmental

Contract No: 5415	**Trial Pit and Dynamic Probe Log**				Trial Pit No: **TP14**
Contract:	Hollybank	Easting:	717764.277	Date:	26/09/2017
Location:	Swords, Co. Dublin	Northing:	748021.529	Excavator:	JCB 3CX
Client:	Cairn Homes	Elevation:	13.61	Logged By:	M. Kaliski
Engineer:	Waterman Moylan	Dimensions (LxWxD) (m):	3.50 x 0.60 x 3.00	Scale:	1:25

Level (mbgl) Scale:	Depth	Stratum Description	Legend	Level (mOD) Scale:	Depth:	Samples Depth	Type	Probe	Water Strike
0	0.20	TOPSOIL.		13.5	13.41			2	
		MADE GROUND: grey brown slightly sandy gravelly silty clay with high cobble content.						3	
0.5								3	
								4	
								6	
								8	
	0.70			13.0	12.91			4	
		Firm becoming stiff brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to rounded, fine to coarse of limestone.						2	
								2	
1.0						1.00	B	1	
								1	
				12.5				1	
								3	
								2	
1.5								3	
								2	
				12.0				3	
								4	
								4	
2.0								4	
								6	
				11.5				7	
								7	
								7	
2.5						2.50	B	8	
								7	
				11.0				6	
								9	
								11	
3.0	3.00	**Pit terminated at 3.00m**			10.61			10	
								12	
				10.5				15	
								19	
3.5								35	
				10.0					
4.0									
				9.5					
4.5									
				9.0					

Termination:	Pit Wall Stability:	Groundwater Rate:	Remarks:	Key:
Scheduled depth	Pit walls stable.	Dry	-	B = Bulk disturbed D = Small disturbed CBR = Undisturbed CBR ES = Environmental

Contract No: 5415	**Trial Pit and Dynamic Probe Log**				Trial Pit No: **TP15**
Contract:	Hollybank	Easting:	717828.563	Date:	26/09/2017
Location:	Swords, Co. Dublin	Northing:	748028.279	Excavator:	JCB 3CX
Client:	Cairn Homes	Elevation:	13.12	Logged By:	M. Kaliski
Engineer:	Waterman Moylan	Dimensions (LxWxD) (m):	3.50 x 0.60 x 3.00	Scale:	1:25

Level (mbgl) Scale:	Depth	Stratum Description	Legend	Level (mOD) Scale:	Depth:	Samples Depth	Type	Probe	Water Strike
0.5	0.20	TOPSOIL.		13.0	12.92			1	
		Firm light brown sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone.		12.5		0.80	B	1 1 2 2 1 2 1 3	
1.0	0.90	Firm becoming stiff light brown sandy slightly gravelly silty CLAY with high cobble content. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of limestone. Cobbles are subangular to rounded of limestone.		12.0	12.22			3 2 2 3 4 4	
1.5						1.50	B	5 4 6 4 4 5	
2.0				11.5				7 8 9 12 15 13 11 12 12 14 15 13 19 24 35	
2.5				11.0					
3.0	3.00	**Pit terminated at 3.00m**		10.5	10.12	3.00	B		
3.5				10.0					
4.0				9.5					
4.5				9.0					
				8.5					

Termination:	Pit Wall Stability:	Groundwater Rate:	Remarks:	Key:
Scheduled depth.	Pit walls stable.	Dry	-	B = Bulk disturbed D = Small disturbed CBR = Undisturbed CBR ES = Environmental

Contract No: 5415	**Trial Pit and Dynamic Probe Log**				Trial Pit No: **TP16**
Contract:	Hollybank	Easting:	717879.885	Date:	25/09/2017
Location:	Swords, Co. Dublin	Northing:	748022.537	Excavator:	JCB 3CX
Client:	Cairn Homes	Elevation:	12.57	Logged By:	M. Kaliski
Engineer:	Waterman Moylan	Dimensions (LxWxD) (m):	3.50 x 0.60 x 3.00	Scale:	1:25

Level (mbgl) Scale:	Depth	Stratum Description	Legend	Level (mOD) Scale:	Depth:	Samples Depth	Type	Probe	Water Strike
0	0.20	TOPSOIL.		12.5	12.37			2	
0.5		Firm light brown sandy slightly gravelly silty CLAY with high cobble content. Sand is fine to coarse. Gravel is subangular to rounded, fine to coarse of limestone. Cobbles are subrounded to rounded of limestone.		12.0				2 1 1 1 2 2 1 2	
1.0				11.5		1.00	B	3 3 3 2	
	1.30	Firm becoming stiff light brown sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to rounded, fine to coarse of limestone. Cobbles are subangular to rounded of limestone.		11.27				3	
1.5				11.0		1.50	B	4 3 5 5 4	
2.0				10.5				6 7 6	
	2.20	Stiff brown sandy slightly gravelly silty CLAY with medium cobble content. Sand is fine to coarse. Gravel is angular to rounded, fine to coarse of limestone. Cobbles are subangular to rounded of limestone.		10.37				8 10 17	
2.5				10.0		2.50	B	35	
3.0	3.00	**Pit terminated at 3.00m**		9.57					
3.5				9.5					
4.0				9.0					
4.5				8.5					
				8.0					

Termination:	Pit Wall Stability:	Groundwater Rate:	Remarks:	Key:
Scheduled depth	Pit walls stable.	Dry	-	B = Bulk disturbed D = Small disturbed CBR = Undisturbed CBR ES = Environmental

Contract No: 5415	**Trial Pit and Dynamic Probe Log**				Trial Pit No: **TP17**
Contract:	Hollybank	Easting:	717851.855	Date:	25/09/2017
Location:	Swords, Co. Dublin	Northing:	747971.646	Excavator:	JCB 3CX
Client:	Cairn Homes	Elevation:	15.23	Logged By:	M. Kaliski
Engineer:	Waterman Moylan	Dimensions (LxWxD) (m):	3.50 x 0.60 x 3.00	Scale:	1:25

Level (mbgl) Scale:	Depth	Stratum Description	Legend	Level (mOD) Scale:	Depth:	Samples Depth	Type	Probe	Water Strike
	0.10	TOPSOIL.			15.13			3	
	0.30	MADE GROUND: brown slightly sandy gravelly silty clay with high cobble content, pockets of gravel and some timber fragments.		15.0	14.93			4	
0.5		MADE GROUND: brown slightly sandy gravelly silty clay with medium cobble content, pockets of gravel and some concrete and red brick fragments.						5	
								8	
								9	
								11	
				14.5				9	
								8	
								12	
1.0						1.00	B	15	
								10	
				14.0				8	
								9	
								11	
1.5	1.50	MADE GROUND: grey slightly sandy gravelly silty clay with some timber fragments.			13.73			15	
								17	
				13.5		1.70	B	25	
	1.90				13.33			35	
2.0		Firm becoming stiff grey sandy slightly gravelly silty CLAY with high cobble content. Sand is fine to coarse. Gravel is subangular to rounded, fine to coarse of limestone. Cobbles are subangular to rounded of limestone.							
				13.0					
2.5						2.40	B		
				12.5					
3.0	3.00	**Pit terminated at 3.00m**			12.23				
				12.0					
3.5									
				11.5					
4.0									
				11.0					
4.5									
				10.5					

Termination:	Pit Wall Stability:	Groundwater Rate:	Remarks:	Key:
Scheduled depth	Pit walls stable.	Dry	-	B = Bulk disturbed D = Small disturbed CBR = Undisturbed CBR ES = Environmental

TP01 Pit

TP01 Sidewall

TP01 Spoil

TP02 Pit

TP02 Sidewall

TP02 Spoil

TP03 Pit

TP03 Sidewall

TP03 Spoil

TP04 Pit

TP04 Sidewall

TP04 Spoil

TP05 Pit

TP05 Sidewall

TP05 Spoil

TP06 Pit

TP06 Sidewall

TP06 Spoil

TP07 Pit

TP07 Sidewall

TP07 Spoil

TP08 Pit

TP08 Sidewall

TP08 Spoil

TP09 Pit

TP09 Sidewall

TP09 Spoil

TP10 Pit

TP10 Sidewall

TP10 Spoil

TP11 Pit

TP11 Sidewall

TP11 Spoil

TP12 Pit

TP12 Sidewall

TP12 Spoil

TP13 Pit

TP13 Sidewall

TP13 Spoil

TP14 Pit

TP14 Sidewall

TP14 Spoil

TP15 Pit

TP15 Sidewall

TP15 Spoil

TP16 Pit

TP16 Sidewall

TP16 Spoil

TP17 Pit

TP17 Sidewall

TP17 Spoil

Appendix 3
Laboratory Test Results

Classification Tests

Client	Cairn Homes
Site	Hollybank, Swords
S.I. File No	5415 / 17
Test Lab	Site Investigations Ltd., Carhugar The Grange, 12th Lock Rd., Lucan Co. Dublin. Tel (01) 6108768 Email:info@siteinvestigations.ie
Report Date	11th October 2017

Hole ID	Depth	Sample No	Lab Ref No.	Sample Type	Natural Moisture Content %	Liquid Limit %	Plastic Limit %	Plastic Index %	Min. Dry Density Mg/m^3	Particle Density Mg/m^3	% passing 425um	Comments	**Remarks** **C**=Clay; **M**=Silt **Plasticity**: **L**=Low; **I**=Intermediate; **H**=High; **V**=Very High; **E**=Extremely High
BH02	1.00	MC04	17/1823	B	11.8	28	23	5			49.0		ML
BH05	1.00	MC06	17/1824	B	21.9	36	22	14			72.1		CI
BH07	0.50	MC08	17/1825	B	16.9	34	22	12			84.3		CL

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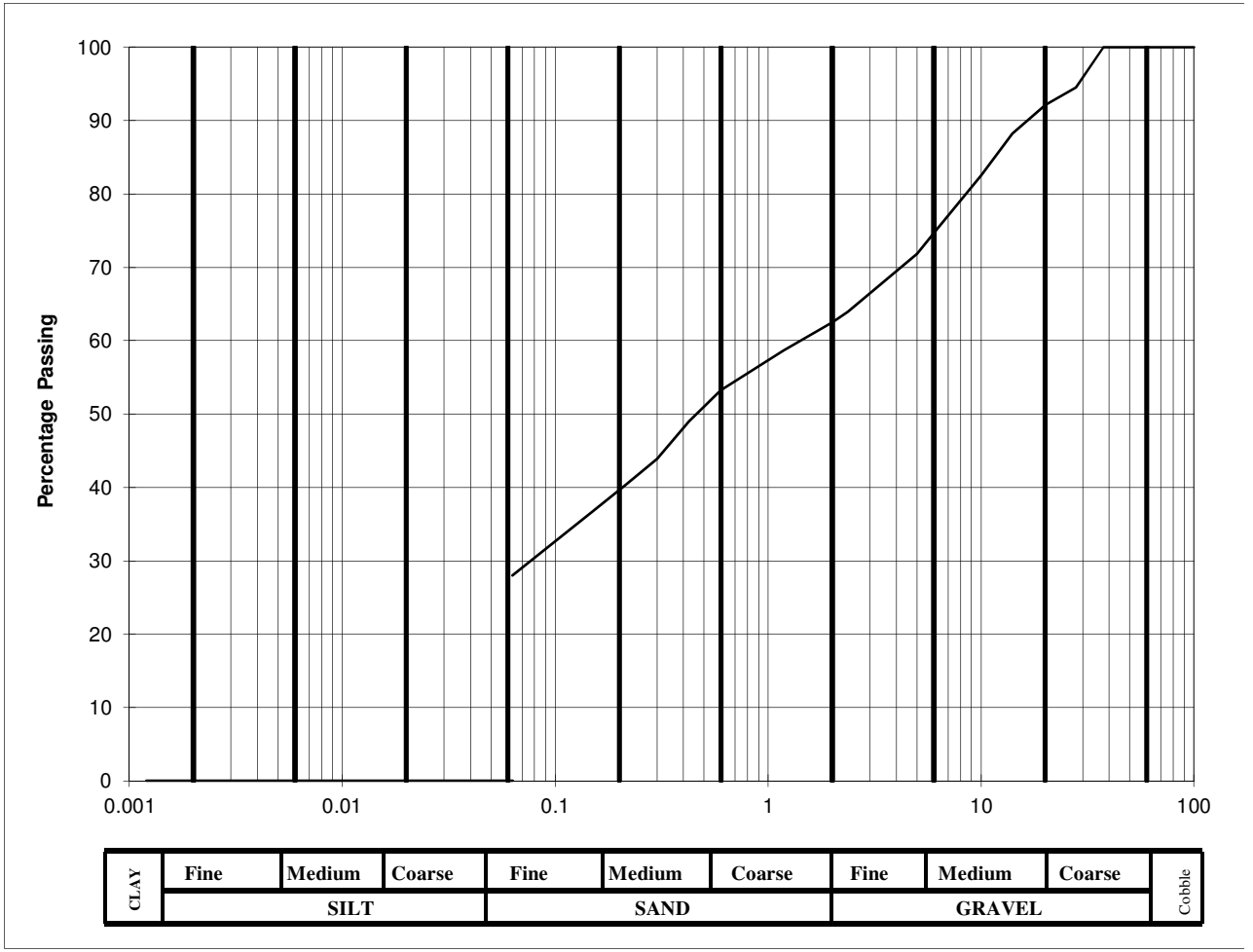
BS 1377 Particle Size Analysis

Site Investigations Limited

BS Sieve size, mm	Percent passing	Hydrometer analysis	
		Diameter, mm	% passing
100	100	**0.0630**	
90	100	**0.0200**	
75	100	**0.0060**	
63	100	**0.0020**	
50	100		
37.5	100		
28	94.5		
20	92.1		
14	88.2		
10	82.5		
6.3	75.4		
5.0	71.8		
2.36	63.9		
2.00	62.5		
1.18	58.7		
0.600	53.2		
0.425	49		
0.300	43.9		
0.212	40.2		
0.150	36.8		
0.063	28		

Cobbles, %	0
Gravel, %	38
Sand, %	35
Clay / Silt, %	28



Client :	Cairn Homes
Project :	Hollybank, Swords

Lab. No :	17/1823
Sample No :	MC04

Hole ID :	BH 02
Depth, m :	1.00

Material description :	sandy gravelly clayey SILT
Remarks :	Soils with clay or silt content between 15% - 35% can be classified as clay or silt depending on the field Engineers assessment of in-situ behaviour. Where material is for re-use and therefore disturbed, only soils with clay or silt >35% are classified as clay or silt

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Printed 12/10/2017

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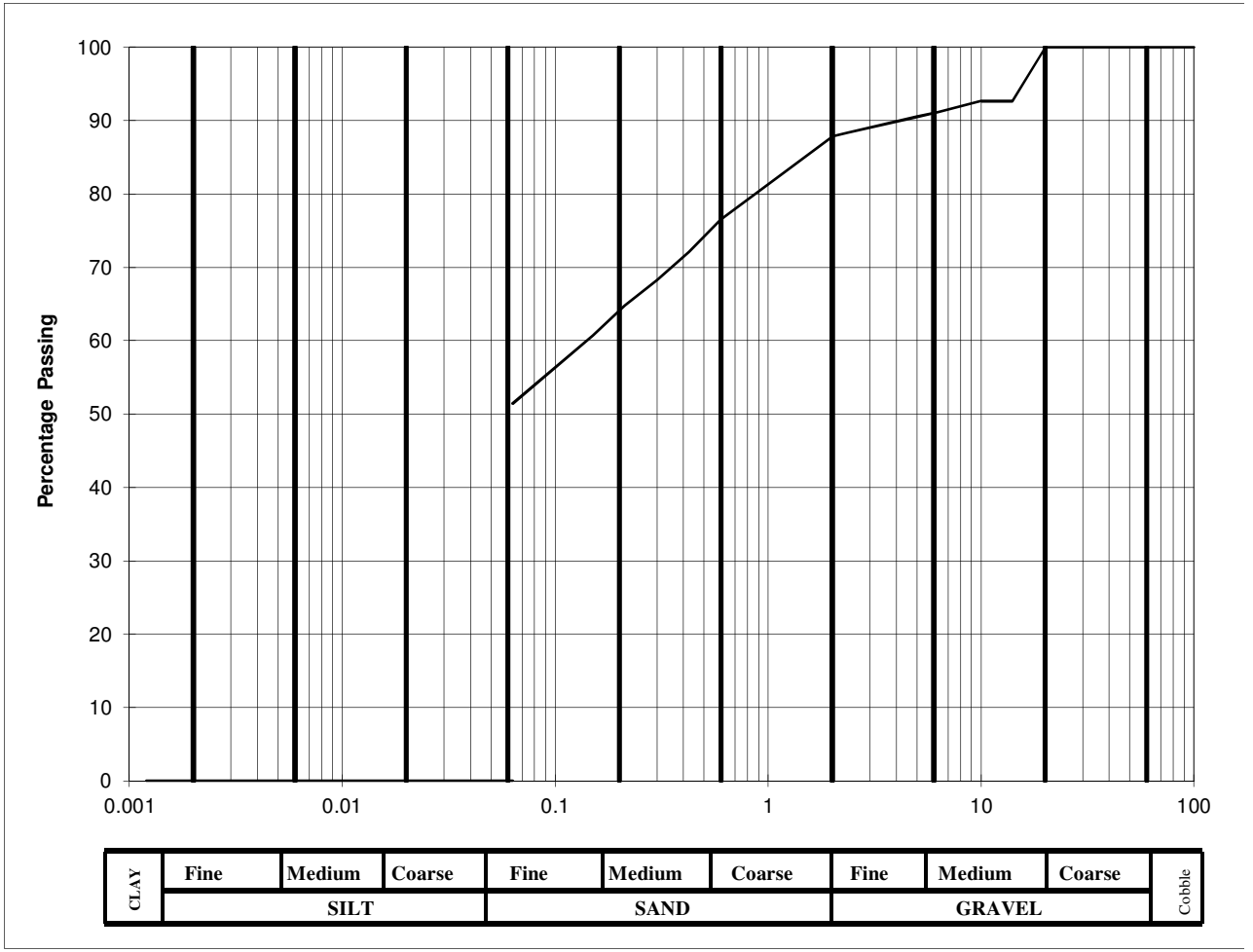
BS 1377 Particle Size Analysis

Site Investigations Limited

BS Sieve size, mm	Percent passing	Hydrometer analysis	
		Diameter, mm	% passing
100	100	**0.0630**	
90	100	**0.0200**	
75	100	**0.0060**	
63	100	**0.0020**	
50	100		
37.5	100		
28	100		
20	100		
14	92.6		
10	92.6		
6.3	91.1		
5.0	90.5		
2.36	88.3		
2.00	87.8		
1.18	82.9		
0.600	76.5		
0.425	72.1		
0.300	68.3		
0.212	64.8		
0.150	60.7		
0.063	51		

Cobbles, %	0
Gravel, %	12
Sand, %	37
Clay / Silt, %	51



Client :	Cairn Homes
Project :	Hollybank, Swords

Lab. No :	17/1824
Sample No :	MC06

Hole ID :	BH 05
Depth, m :	1.00

Material description :	slightly gravelly sandy silty CLAY
Remarks :	Soils with clay or silt content between 15% - 35% can be classified as clay or silt depending on the field Engineers assessment of in-situ behaviour. Where material is for re-use and therefore disturbed, only soils with clay or silt >35% are classified as clay or silt

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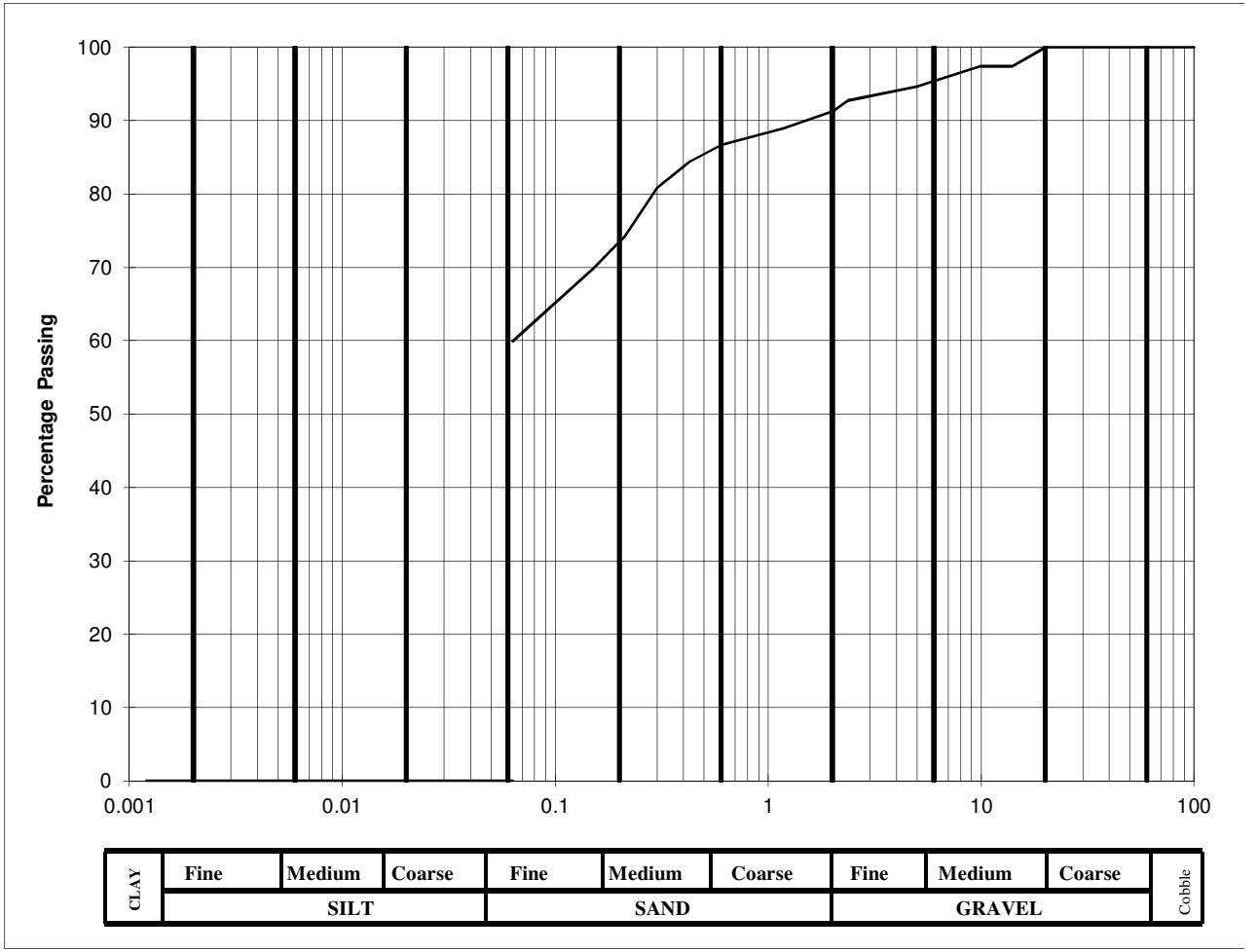
BS 1377 Particle Size Analysis

Site Investigations Limited

BS Sieve size, mm	Percent passing	Hydrometer analysis	
		Diameter, mm	% passing
100	100	**0.0630**	
90	100	**0.0200**	
75	100	**0.0060**	
63	100	**0.0020**	
50	100		
37.5	100		
28	100		
20	100		
14	97.4		
10	97.4		
6.3	95.5		
5.0	94.6		
2.36	92.7		
2.00	91.2		
1.18	88.9		
0.600	86.6		
0.425	84.3		
0.300	80.8		
0.212	74.2		
0.150	69.8		
0.063	60		

Cobbles, %	0
Gravel, %	9
Sand, %	31
Clay / Silt, %	60



Client :	Cairn Homes
Project :	Hollybank, Swords

Lab. No :	17/1825
Sample No :	MC08

Hole ID :	BH 07
Depth, m :	0.50

Material description :	slightly gravelly slightly sandy silty CLAY
Remarks :	Soils with clay or silt content between 15% - 35% can be classified as clay or silt depending on the field Engineers assessment of in-situ behaviour. Where material is for re-use and therefore disturbed, only soils with clay or silt >35% are classified as clay or silt

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California Bearing Ratio (CBR) In accordance with BS1377: Part 4: Method 7

Client	Cairn Homes
Site	Hollybank, Swords
S.I. File No	5415 / 17
Test Lab	Site Investigations Ltd., Carhugar The Grange, 12th Lock Rd., Lucan Co. Dublin. Tel (01) 6108768 Email info@siteinvestigations.ie
Report Date	11th October 2017

CBR No	Depth (mBGL)	Sample No	Sample Type	Lab Ref	Moisture Content (%)	CBR Value (%)	Location / Remarks
CBR01	0.60	MK01	CBR	17/1826	16.3	6.6	
CBR02	0.60	MK02	CBR	17/1827	12.8	6.8	
CBR03	0.60	MK03	CBR	17/1828	6.8	7.3	
CBR04	0.60	MK04	CBR	17/1829	12.8	6.6	
CBR05	0.60	MK05	CBR	17/1830	9.0	7.7	
CBR06	0.60	MK06	CBR	17/1831	17.5	6.9	
CBR07	0.60	MK07	CBR	17/1832	12.0	6.2	
CBR08	0.60	MK08	CBR	17/1833	13.4	7.0	

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Chemical Testing
In accordance with BS 1377: Part 3

Client	Cairn Homes
Site	Hollybank, Swords
S.I. File No	5415 / 17
Test Lab	Site Investigations Ltd., Carhugar The Grange, 12th Lock Rd., Lucan Co. Dublin. Tel (01) 6108768 Email:info@siteinvestigations.ie
Report Date	11th October 2017

Hole Id	Depth (mBGL)	Sample No	Lab Ref	pH Value	Water Soluble Sulphate Content (2:1 Water-soil extract) (SO_3) g/L	Water Soluble Sulphate Content (2:1 Water-soil extract) (SO_3) %	Organic Content **%**	Chloride ion Content (water:soil ratio 2:1) **%**	% passing 2mm	Remarks
BH02	1.00	MC04	17/1823	8.43	0.119	0.074		0.19	62.5	
BH05	1.00	MC06	17/1824	8.30	0.126	0.110		0.24	87.8	
BH07	0.50	MC08	17/1825	8.47	0.116	0.106		0.26	91.2	

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Site Investigations Ltd
The Grange
Carhugar
12th Lock Road
Lucan
Co. Dublin

Attention: Stephen Letch

CERTIFICATE OF ANALYSIS

Date:	10 October 2017
Customer:	D_SITEINV_NCS
Sample Delivery Group (SDG):	170930-79
Your Reference:	5415
Location:	Hollybank, Swords
Report No:	427686

We received 3 samples on Saturday September 30, 2017 and 3 of these samples were scheduled for analysis which was completed on Tuesday October 10, 2017. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).

Approved By:

Sonia McWhan

Operations Manager

Validated

CERTIFICATE OF ANALYSIS

SDG:	170930-79	**Client Reference:**	5415	**Report Number:**	427686
Location:	Hollybank, Swords	**Order Number:**	73/B/17	**Superseded Report:**	

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
16282588	BH02		1.00 - 1.00	27/09/2017
16282590	BH05		1.00 - 1.00	27/09/2017
16282591	BH07		0.50 - 0.50	27/09/2017

Maximum Sample/Coolbox Temperature (°C) :

ISO5667-3 Water quality - Sampling - Part3 -

During Transportation samples shall be stored in a cooling device capable of maintaining a temperature of (5±3)°C.

16.2

ALS have data which show that a cool box with 4 frozen icepacks is capable of maintaining pre-chilled samples at a temperature of (5±3)°C for a period of up to 24hrs.

Only received samples which have had analysis scheduled will be shown on the following pages.

Validated

CERTIFICATE OF ANALYSIS

SDG:	170930-79	**Client Reference:**	5415	**Report Number:**	427686
Location:	Hollybank, Swords	**Order Number:**	73/B/17	**Superseded Report:**	

Results Legend

X Test

N No Determination Possible

Sample Types -
S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)			16282588			16282590			16282591		
Customer Sample Reference			BH02			BH05			BH07		
AGS Reference											
Depth (m)			1.00 - 1.00			1.00 - 1.00			0.50 - 0.50		
Container			1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)
Sample Type			S	S	S	S	S	S	S	S	S
Anions by Kone (w)	All	NDPs: 0 Tests: 3	X			X			X		
CEN Readings	All	NDPs: 0 Tests: 3	X			X			X		
Chromium III	All	NDPs: 0 Tests: 3		X			X			X	
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 3	X			X			X		
Dissolved Organic/Inorganic Carbon	All	NDPs: 0 Tests: 3	X			X			X		
EPH CWG (Aliphatic) GC (S)	All	NDPs: 0 Tests: 3		X			X			X	
EPH CWG (Aromatic) GC (S)	All	NDPs: 0 Tests: 3		X			X			X	
Fluoride	All	NDPs: 0 Tests: 3	X			X			X		
GRO by GC-FID (S)	All	NDPs: 0 Tests: 3			X			X			X
Hexavalent Chromium (s)	All	NDPs: 0 Tests: 3		X			X			X	
Loss on Ignition in soils	All	NDPs: 0 Tests: 3		X			X			X	
Mercury Dissolved	All	NDPs: 0 Tests: 3	X			X			X		
Metals in solid samples by OES	All	NDPs: 0 Tests: 3		X			X			X	
Mineral Oil	All	NDPs: 0 Tests: 3		X			X			X	
PAH by GCMS	All	NDPs: 0 Tests: 3		X			X			X	

Validated

CERTIFICATE OF ANALYSIS

SDG:	170930-79	**Client Reference:**	5415	**Report Number:**	427686
Location:	Hollybank, Swords	**Order Number:**	73/B/17	**Superseded Report:**	

Results Legend

X Test

N No Determination Possible

Sample Types -

S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)			16282588			16282590			16282591		
Customer Sample Reference			BH02			BH05			BH07		
AGS Reference											
Depth (m)			1.00 - 1.00			1.00 - 1.00			0.50 - 0.50		
Container			1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)
Sample Type			S	S	S	S	S	S	S	S	S
PCBs by GCMS	All	NDPs: 0 Tests: 3		X			X			X	
Phenols by HPLC (W)	All	NDPs: 0 Tests: 3	X			X			X		
Sample description	All	NDPs: 0 Tests: 3		X			X			X	
Total Dissolved Solids on Leachates	All	NDPs: 0 Tests: 3	X			X			X		
Total Organic Carbon	All	NDPs: 0 Tests: 3		X			X			X	
TPH CWG GC (S)	All	NDPs: 0 Tests: 3		X			X			X	

CERTIFICATE OF ANALYSIS

SDG:	170930-79	**Client Reference:**	5415	**Report Number:**	427686
Location:	Hollybank, Swords	**Order Number:**	73/B/17	**Superseded Report:**	

Sample Descriptions

Grain Sizes

very fine	<0.063mm	fine	0.063mm - 0.1mm	medium	0.1mm - 2mm	coarse	2mm - 10mm	very coarse	>10mm

Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Inclusions	Inclusions 2
16282588	BH02	1.00 - 1.00	Dark Brown	Sandy Clay Loam	Stones	N/A
16282590	BH05	1.00 - 1.00	Dark Brown	Sandy Clay Loam	Stones	Glass & Stones
16282591	BH07	0.50 - 0.50	Dark Brown	Sandy Clay Loam	Stones	None

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally ocurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

Validated

CERTIFICATE OF ANALYSIS

SDG:	170930-79	**Client Reference:**	5415	**Report Number:**	427686
Location:	Hollybank, Swords	**Order Number:**	73/B/17	**Superseded Report:**	

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	BH02	BH05	BH07			
			Depth (m)	1.00 - 1.00	1.00 - 1.00	0.50 - 0.50			
			Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)			
			Date Sampled	27/09/2017	27/09/2017	27/09/2017			
			Sample Time	.	.	.			
			Date Received	30/09/2017	30/09/2017	30/09/2017			
			SDG Ref	170930-79	170930-79	170930-79			
			Lab Sample No.(s)	16282588	16282590	16282591			
			AGS Reference						
Moisture Content Ratio (% of as received sample)	%	PM024		10	19	14			
Loss on ignition	<0.7 %	TM018		1.4 M	3.06 M	3.52 M			
Mineral oil >C10-C40	<1 mg/kg	TM061		22.9	15.3	25.6			
Organic Carbon, Total	<0.2 %	TM132		0.231 M	0.509 M	0.654 M			
Chromium, Hexavalent	<0.6 mg/kg	TM151		<0.6 #	<0.6 #	<0.6 #			
PCB congener 28	<3 µg/kg	TM168		<3 M	<3 M	<3 M			
PCB congener 52	<3 µg/kg	TM168		<3 M	<3 M	<3 M			
PCB congener 101	<3 µg/kg	TM168		<3 M	<3 M	<3 M			
PCB congener 118	<3 µg/kg	TM168		<3 M	<3 M	<3 M			
PCB congener 138	<3 µg/kg	TM168		<3 M	<3 M	<3 M			
PCB congener 153	<3 µg/kg	TM168		<3 M	<3 M	<3 M			
PCB congener 180	<3 µg/kg	TM168		<3 M	<3 M	<3 M			
Sum of detected PCB 7 Congeners	<21 µg/kg	TM168		<21	<21	<21			
Chromium, Trivalent	<0.9 mg/kg	TM181		10.1	11.1	15.7			
Antimony	<0.6 mg/kg	TM181		<0.6 #	1.01 #	<0.6 #			
Arsenic	<0.6 mg/kg	TM181		7.74 M	13.5 M	11.5 M			
Barium	<0.6 mg/kg	TM181		48.8 #	67.5 #	104 #			
Cadmium	<0.02 mg/kg	TM181		0.983 M	2.28 M	1.28 M			
Chromium	<0.9 mg/kg	TM181		10.1 M	11.1 M	15.7 M			
Copper	<1.4 mg/kg	TM181		14.6 M	33.2 M	21.3 M			
Lead	<0.7 mg/kg	TM181		10.8 M	23.4 M	32.8 M			
Mercury	<0.14 mg/kg	TM181		0.295 M	0.425 M	0.301 M			
Molybdenum	<0.1 mg/kg	TM181		1.67 #	3.18 #	2.65 #			
Nickel	<0.2 mg/kg	TM181		24.1 M	50.9 M	30.4 M			
Selenium	<1 mg/kg	TM181		<1 #	<1 #	<1 #			
Zinc	<1.9 mg/kg	TM181		49.5 M	85.9 M	72.8 M			

Validated

CERTIFICATE OF ANALYSIS

SDG:	170930-79	**Client Reference:**	5415	**Report Number:**	427686
Location:	Hollybank, Swords	**Order Number:**	73/B/17	**Superseded Report:**	

PAH by GCMS

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	BH02	BH05	BH07			
			Depth (m)	1.00 - 1.00	1.00 - 1.00	0.50 - 0.50			
			Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)			
			Date Sampled	27/09/2017	27/09/2017	27/09/2017			
			Sample Time	.	.	.			
			Date Received	30/09/2017	30/09/2017	30/09/2017			
			SDG Ref	170930-79	170930-79	170930-79			
			Lab Sample No.(s)	16282588	16282590	16282591			
			AGS Reference						
Naphthalene	<9 µg/kg	TM218		<9 M	<9 M	23.3 M			
Acenaphthylene	<12 µg/kg	TM218		<12 M	<12 M	<12 M			
Acenaphthene	<8 µg/kg	TM218		<8 M	<8 M	130 M			
Fluorene	<10 µg/kg	TM218		<10 M	<10 M	101 M			
Phenanthrene	<15 µg/kg	TM218		<15 M	<15 M	929 M			
Anthracene	<16 µg/kg	TM218		<16 M	<16 M	86.9 M			
Fluoranthene	<17 µg/kg	TM218		<17 M	<17 M	642 M			
Pyrene	<15 µg/kg	TM218		<15 M	<15 M	521 M			
Benz(a)anthracene	<14 µg/kg	TM218		<14 M	<14 M	214 M			
Chrysene	<10 µg/kg	TM218		<10 M	<10 M	194 M			
Benzo(b)fluoranthene	<15 µg/kg	TM218		<15 M	<15 M	204 M			
Benzo(k)fluoranthene	<14 µg/kg	TM218		<14 M	<14 M	72.6 M			
Benzo(a)pyrene	<15 µg/kg	TM218		<15 M	<15 M	112 M			
Indeno(1,2,3-cd)pyrene	<18 µg/kg	TM218		<18 M	<18 M	42.8 M			
Dibenzo(a,h)anthracene	<23 µg/kg	TM218		<23 M	<23 M	<23 M			
Benzo(g,h,i)perylene	<24 µg/kg	TM218		<24 M	<24 M	65.5 M			
Coronene	<200 µg/kg	TM218		<200	<200	<200			
PAH, Total Detected USEPA 16	<118 µg/kg	TM218		<118	<118	3340			

CERTIFICATE OF ANALYSIS

SDG:	170930-79	**Client Reference:**	5415	**Report Number:**	427686
Location:	Hollybank, Swords	**Order Number:**	73/B/17	**Superseded Report:**	

TPH CWG (S)

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	BH02	BH05	BH07			
			Depth (m)	1.00 - 1.00	1.00 - 1.00	0.50 - 0.50			
			Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)			
			Date Sampled	27/09/2017	27/09/2017	27/09/2017			
			Sample Time	.	.	.			
			Date Received	30/09/2017	30/09/2017	30/09/2017			
			SDG Ref	170930-79	170930-79	170930-79			
			Lab Sample No.(s)	16282588	16282590	16282591			
			AGS Reference						
GRO Surrogate % recovery**	%	TM089		66	65	102			
GRO TOT (Moisture Corrected)	<44 µg/kg	TM089		488 M	<44 M	<44 M			
Methyl tertiary butyl ether (MTBE)	<5 µg/kg	TM089		<5 #	<5 #	<5 #			
Benzene	<10 µg/kg	TM089		<10 M	<10 M	<10 M			
Toluene	<2 µg/kg	TM089		<2 M	<2 M	<2 M			
Ethylbenzene	<3 µg/kg	TM089		<3 M	<3 M	<3 M			
m,p-Xylene	<6 µg/kg	TM089		<6 M	<6 M	<6 M			
o-Xylene	<3 µg/kg	TM089		<3 M	<3 M	<3 M			
sum of detected mpo xylene by GC	<9 µg/kg	TM089		<9	<9	<9			
sum of detected BTEX by GC	<24 µg/kg	TM089		<24	<24	<24			
Aliphatics >C5-C6	<10 µg/kg	TM089		<10	<10	<10			
Aliphatics >C6-C8	<10 µg/kg	TM089		15.5	<10	<10			
Aliphatics >C8-C10	<10 µg/kg	TM089		72.2	<10	<10			
Aliphatics >C10-C12	<10 µg/kg	TM089		205	<10	<10			
Aliphatics >C12-C16	<100 µg/kg	TM173		798	1050	<100			
Aliphatics >C16-C21	<100 µg/kg	TM173		<100	776	<100			
Aliphatics >C21-C35	<100 µg/kg	TM173		6120	141	11000			
Aliphatics >C35-C44	<100 µg/kg	TM173		<100	<100	583			
Total Aliphatics >C12-C44	<100 µg/kg	TM173		6920	1970	11600			
Aromatics >EC5-EC7	<10 µg/kg	TM089		<10	<10	<10			
Aromatics >EC7-EC8	<10 µg/kg	TM089		<10	<10	<10			
Aromatics >EC8-EC10	<10 µg/kg	TM089		47.7	<10	<10			
Aromatics >EC10-EC12	<10 µg/kg	TM089		137	<10	<10			
Aromatics >EC12-EC16	<100 µg/kg	TM173		<100	<100	<100			
Aromatics >EC16-EC21	<100 µg/kg	TM173		<100	<100	1750			
Aromatics >EC21-EC35	<100 µg/kg	TM173		1530	1030	4860			
Aromatics >EC35-EC44	<100 µg/kg	TM173		5630	3610	1230			
Aromatics >EC40-EC44	<100 µg/kg	TM173		3330	2190	212			
Total Aromatics >EC12-EC44	<100 µg/kg	TM173		7160	4640	7830			
Total Aliphatics & Aromatics >C5-C44	<100 µg/kg	TM173		14600	6610	19400			
GRO >C5-C6	<10 µg/kg	TM089		<10	<10	<10			
GRO >C6-C7	<10 µg/kg	TM089		<10	<10	<10			
GRO >C7-C8	<10 µg/kg	TM089		<10	<10	<10			

Validated

CERTIFICATE OF ANALYSIS

SDG:	170930-79	**Client Reference:**	5415	**Report Number:**	427686
Location:	Hollybank, Swords	**Order Number:**	73/B/17	**Superseded Report:**	

TPH CWG (S)

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	BH02	BH05	BH07			
			Depth (m)	1.00 - 1.00	1.00 - 1.00	0.50 - 0.50			
			Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)			
			Date Sampled	27/09/2017	27/09/2017	27/09/2017			
			Sample Time	-	-	-			
			Date Received	30/09/2017	30/09/2017	30/09/2017			
			SDG Ref	170930-79	170930-79	170930-79			
			Lab Sample No.(s)	16282588	16282590	16282591			
			AGS Reference						
GRO >C8-C10	<10 µg/kg	TM089		121	<10	<10			
GRO >C10-C12	<10 µg/kg	TM089		342	<10	<10			

Validated

CERTIFICATE OF ANALYSIS

SDG:	170930-79	**Client Reference:**	5415	**Report Number:**	427686
Location:	Hollybank, Swords	**Order Number:**	73/B/17	**Superseded Report:**	

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Hollybank, Swords
Mass Sample taken (kg)	0.103	**Natural Moisture Content (%)**	14.5
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	87.4
Particle Size <4mm	>95%		

Case	
SDG	170930-79
Lab Sample Number(s)	16282588
Sampled Date	27-Sep-2017
Customer Sample Ref.	BH02
Depth (m)	1.00 - 1.00

Solid Waste Analysis	**Result**	**Landfill Waste Acceptance Criteria Limits**		
		Inert Waste Landfill	**Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon (%)	0.231	3	5	6
Loss on Ignition (%)	1.4	-	-	10
Sum of BTEX (mg/kg)	<0.024	6	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg)	22.9	500	-	-
PAH Sum of 17 (mg/kg)	-	-	-	-
pH (pH Units)	-	-	-	-
ANC to pH 6 (mol/kg)	-	-	-	-
ANC to pH 4 (mol/kg)	-	-	-	-

Eluate Analysis	**C_2** Concⁿ in 10:1 eluate (mg/l)		**A_2** 10:1 concⁿ leached (mg/kg)		**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
	Result	**Limit of Detection**	**Result**	**Limit of Detection**			
Arsenic	<0.0005	<0.0005	<0.005	<0.005	0.5	2	25
Barium	0.00397	<0.0002	0.0397	<0.002	20	100	300
Cadmium	<0.00008	<0.00008	<0.0008	<0.0008	0.04	1	5
Chromium	<0.001	<0.001	<0.01	<0.01	0.5	10	70
Copper	<0.0003	<0.0003	<0.003	<0.003	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	0.00333	<0.0005	0.0333	<0.005	0.5	10	30
Nickel	<0.0004	<0.0004	<0.004	<0.004	0.4	10	40
Lead	<0.0002	<0.0002	<0.002	<0.002	0.5	10	50
Antimony	0.000229	<0.0001	0.00229	<0.001	0.06	0.7	5
Selenium	<0.0005	<0.0005	<0.005	<0.005	0.1	0.5	7
Zinc	<0.001	<0.001	<0.01	<0.01	4	50	200
Chloride	<2	<2	<20	<20	800	15000	25000
Fluoride	<0.5	<0.5	<5	<5	10	150	500
Sulphate (soluble)	<2	<2	<20	<20	1000	20000	50000
Total Dissolved Solids	60	<10	600	<100	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	<3	<3	<30	<30	500	800	1000

Leach Test Information

Date Prepared	04-Oct-2017
pH (pH Units)	8.79
Conductivity (µS/cm)	62.50
Temperature (°C)	18.10
Volume Leachant (Litres)	0.887

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and ALS Environmental cannot be held responsible for any discrepancies with current legislation
Mcerts Certification does not apply to leachates

10/10/2017 16:09:01

16:08:51 10/10/2017

Validated

CERTIFICATE OF ANALYSIS

SDG:	170930-79	**Client Reference:**	5415	**Report Number:**	427686
Location:	Hollybank, Swords	**Order Number:**	73/B/17	**Superseded Report:**	

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Hollybank, Swords
Mass Sample taken (kg)	0.114	**Natural Moisture Content (%)**	26.6
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	79
Particle Size <4mm	>95%		

Case	
SDG	170930-79
Lab Sample Number(s)	16282590
Sampled Date	27-Sep-2017
Customer Sample Ref.	BH05
Depth (m)	1.00 - 1.00

Solid Waste Analysis	**Result**	**Landfill Waste Acceptance Criteria Limits**		
		Inert Waste Landfill	**Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon (%)	0.509	3	5	6
Loss on Ignition (%)	3.06	-	-	10
Sum of BTEX (mg/kg)	<0.024	6	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg)	15.3	500	-	-
PAH Sum of 17 (mg/kg)	-	-	-	-
pH (pH Units)	-	-	-	-
ANC to pH 6 (mol/kg)	-	-	-	-
ANC to pH 4 (mol/kg)	-	-	-	-

Eluate Analysis	**C_2** Concⁿ in 10:1 eluate (mg/l)		**A_2** 10:1 concⁿ leached (mg/kg)		**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
	Result	**Limit of Detection**	**Result**	**Limit of Detection**			
Arsenic	<0.0005	<0.0005	<0.005	<0.005	0.5	2	25
Barium	0.00454	<0.0002	0.0454	<0.002	20	100	300
Cadmium	<0.00008	<0.00008	<0.0008	<0.0008	0.04	1	5
Chromium	<0.001	<0.001	<0.01	<0.01	0.5	10	70
Copper	<0.0003	<0.0003	<0.003	<0.003	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	0.00368	<0.0005	0.0368	<0.005	0.5	10	30
Nickel	<0.0004	<0.0004	<0.004	<0.004	0.4	10	40
Lead	<0.0002	<0.0002	<0.002	<0.002	0.5	10	50
Antimony	0.000178	<0.0001	0.00178	<0.001	0.06	0.7	5
Selenium	<0.0005	<0.0005	<0.005	<0.005	0.1	0.5	7
Zinc	<0.001	<0.001	<0.01	<0.01	4	50	200
Chloride	<2	<2	<20	<20	800	15000	25000
Fluoride	<0.5	<0.5	<5	<5	10	150	500
Sulphate (soluble)	<2	<2	<20	<20	1000	20000	50000
Total Dissolved Solids	79.9	<10	799	<100	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	<3	<3	<30	<30	500	800	1000

Leach Test Information

Date Prepared	04-Oct-2017
pH (pH Units)	8.11
Conductivity (µS/cm)	98.00
Temperature (°C)	18.30
Volume Leachant (Litres)	0.876

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and ALS Environmental cannot be held responsible for any discrepancies with current legislation
Mcerts Certification does not apply to leachates

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Validated

CERTIFICATE OF ANALYSIS

SDG:	170930-79	**Client Reference:**	5415	**Report Number:**	427686
Location:	Hollybank, Swords	**Order Number:**	73/B/17	**Superseded Report:**	

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Hollybank, Swords
Mass Sample taken (kg)	0.109	**Natural Moisture Content (%)**	21.1
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	82.6
Particle Size <4mm	>95%		

Case	
SDG	170930-79
Lab Sample Number(s)	16282591
Sampled Date	27-Sep-2017
Customer Sample Ref.	BH07
Depth (m)	0.50 - 0.50

Solid Waste Analysis	**Result**	**Landfill Waste Acceptance Criteria Limits**		
		Inert Waste Landfill	**Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon (%)	0.654	3	5	6
Loss on Ignition (%)	3.52	-	-	10
Sum of BTEX (mg/kg)	<0.024	6	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg)	25.6	500	-	-
PAH Sum of 17 (mg/kg)	-	-	-	-
pH (pH Units)	-	-	-	-
ANC to pH 6 (mol/kg)	-	-	-	-
ANC to pH 4 (mol/kg)	-	-	-	-

Eluate Analysis	**C_2 Conc^n in 10:1 eluate (mg/l)**		**A_2 10:1 conc^n leached (mg/kg)**		**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
	Result	**Limit of Detection**	**Result**	**Limit of Detection**			
Arsenic	<0.0005	<0.0005	<0.005	<0.005	0.5	2	25
Barium	0.00348	<0.0002	0.0348	<0.002	20	100	300
Cadmium	<0.00008	<0.00008	<0.0008	<0.0008	0.04	1	5
Chromium	<0.001	<0.001	<0.01	<0.01	0.5	10	70
Copper	0.000656	<0.0003	0.00656	<0.003	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	0.00116	<0.0005	0.0116	<0.005	0.5	10	30
Nickel	0.000527	<0.0004	0.00527	<0.004	0.4	10	40
Lead	<0.0002	<0.0002	<0.002	<0.002	0.5	10	50
Antimony	0.000282	<0.0001	0.00282	<0.001	0.06	0.7	5
Selenium	<0.0005	<0.0005	<0.005	<0.005	0.1	0.5	7
Zinc	0.00124	<0.001	0.0124	<0.01	4	50	200
Chloride	<2	<2	<20	<20	800	15000	25000
Fluoride	<0.5	<0.5	<5	<5	10	150	500
Sulphate (soluble)	<2	<2	<20	<20	1000	20000	50000
Total Dissolved Solids	41.3	<10	413	<100	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	<3	<3	<30	<30	500	800	1000

Leach Test Information

Date Prepared	04-Oct-2017
pH (pH Units)	8.65
Conductivity (µS/cm)	48.90
Temperature (°C)	16.50
Volume Leachant (Litres)	0.881

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and ALS Environmental cannot be held responsible for any discrepancies with current legislation
Mcerts Certification does not apply to leachates
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CERTIFICATE OF ANALYSIS

SDG:	170930-79	**Client Reference:**	5415	**Report Number:**	427686
Location:	Hollybank, Swords	**Order Number:**	73/B/17	**Superseded Report:**	

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample [1]	Surrogate Corrected
PM001		Preparation of Samples for Metals Analysis		
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material		
PM115		Leaching Procedure for CEN One Stage Leach Test 2:1 & 10:1 1 Step		
TM018	BS 1377: Part 3 1990	Determination of Loss on Ignition		
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)		
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)		
TM090	Method 5310, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 415.1 & 9060	Determination of Total Organic Carbon/Total Inorganic Carbon in Water and Waste Water		
TM104	Method 4500F, AWWA/APHA, 20th Ed., 1999	Determination of Fluoride using the Kone Analyser		
TM123	BS 2690: Part 121:1981	The Determination of Total Dissolved Solids in Water		
TM132	In - house Method	ELTRA CS800 Operators Guide		
TM151	Method 3500D, AWWA/APHA, 20th Ed., 1999	Determination of Hexavalent Chromium using Kone analyser		
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS		
TM168	EPA Method 8082, Polychlorinated Biphenyls by Gas Chromatography	Determination of WHO12 and EC7 Polychlorinated Biphenyl Congeners by GC-MS in Soils		
TM173	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Soils by GC-FID		
TM181	US EPA Method 6010B	Determination of Routine Metals in Soil by iCap 6500 Duo ICP-OES		
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry		
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers		
TM218	Determination of PAH by GCMS Microwave extraction	The determination of PAH in soil samples by microwave extraction and GC-MS		
TM259	by HPLC	Determination of Phenols in Waters and Leachates by HPLC		

[1] Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).

CERTIFICATE OF ANALYSIS

SDG:	170930-79	**Client Reference:**	5415	**Report Number:**	427686
Location:	Hollybank, Swords	**Order Number:**	73/B/17	**Superseded Report:**	

Test Completion Dates

Lab Sample No(s)	16282588	16282590	16282591
Customer Sample Ref.	BH02	BH05	BH07
AGS Ref.			
Depth	1.00 - 1.00	1.00 - 1.00	0.50 - 0.50
Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
Anions by Kone (w)	10-Oct-2017	10-Oct-2017	10-Oct-2017
CEN 10:1 Leachate (1 Stage)	04-Oct-2017	04-Oct-2017	04-Oct-2017
CEN Readings	05-Oct-2017	05-Oct-2017	05-Oct-2017
Chromium III	10-Oct-2017	10-Oct-2017	10-Oct-2017
Dissolved Metals by ICP-MS	10-Oct-2017	10-Oct-2017	10-Oct-2017
Dissolved Organic/Inorganic Carbon	06-Oct-2017	06-Oct-2017	06-Oct-2017
EPH CWG (Aliphatic) GC (S)	09-Oct-2017	09-Oct-2017	09-Oct-2017
EPH CWG (Aromatic) GC (S)	09-Oct-2017	09-Oct-2017	09-Oct-2017
Fluoride	06-Oct-2017	06-Oct-2017	06-Oct-2017
GRO by GC-FID (S)	10-Oct-2017	10-Oct-2017	10-Oct-2017
Hexavalent Chromium (s)	09-Oct-2017	09-Oct-2017	09-Oct-2017
Loss on Ignition in soils	10-Oct-2017	10-Oct-2017	10-Oct-2017
Mercury Dissolved	09-Oct-2017	09-Oct-2017	09-Oct-2017
Metals in solid samples by OES	10-Oct-2017	10-Oct-2017	10-Oct-2017
Mineral Oil	10-Oct-2017	10-Oct-2017	10-Oct-2017
PAH by GCMS	10-Oct-2017	10-Oct-2017	10-Oct-2017
PCBs by GCMS	09-Oct-2017	09-Oct-2017	09-Oct-2017
Phenols by HPLC (W)	09-Oct-2017	09-Oct-2017	09-Oct-2017
Sample description	03-Oct-2017	03-Oct-2017	03-Oct-2017
Total Dissolved Solids on Leachates	06-Oct-2017	06-Oct-2017	06-Oct-2017
Total Organic Carbon	10-Oct-2017	10-Oct-2017	10-Oct-2017
TPH CWG GC (S)	10-Oct-2017	10-Oct-2017	10-Oct-2017

Appendix

General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as “Not detected”. If no asbestos fibre types are found all will be reported as “Not detected” and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP - No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals - total metals must be requested separately.

11. Results relate only to the items tested.

12. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%, they are generally wider for volatiles analysis, 50-150%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

14. **Product analyses** - Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethyphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

21. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

24. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as “mixed hydrocarbons”. Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

Sample Deviations

If a sample is classed as deviated then the associated results may be compromised.

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
4	**Holding time exceeded before sample received**
5	**Samples exceeded holding time before presevation was performed**
§	**Sampled on date not provided**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to sampled on date**
&	**Sample Holding Time exceeded - Late arrival of instructions.**

Asbestos

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

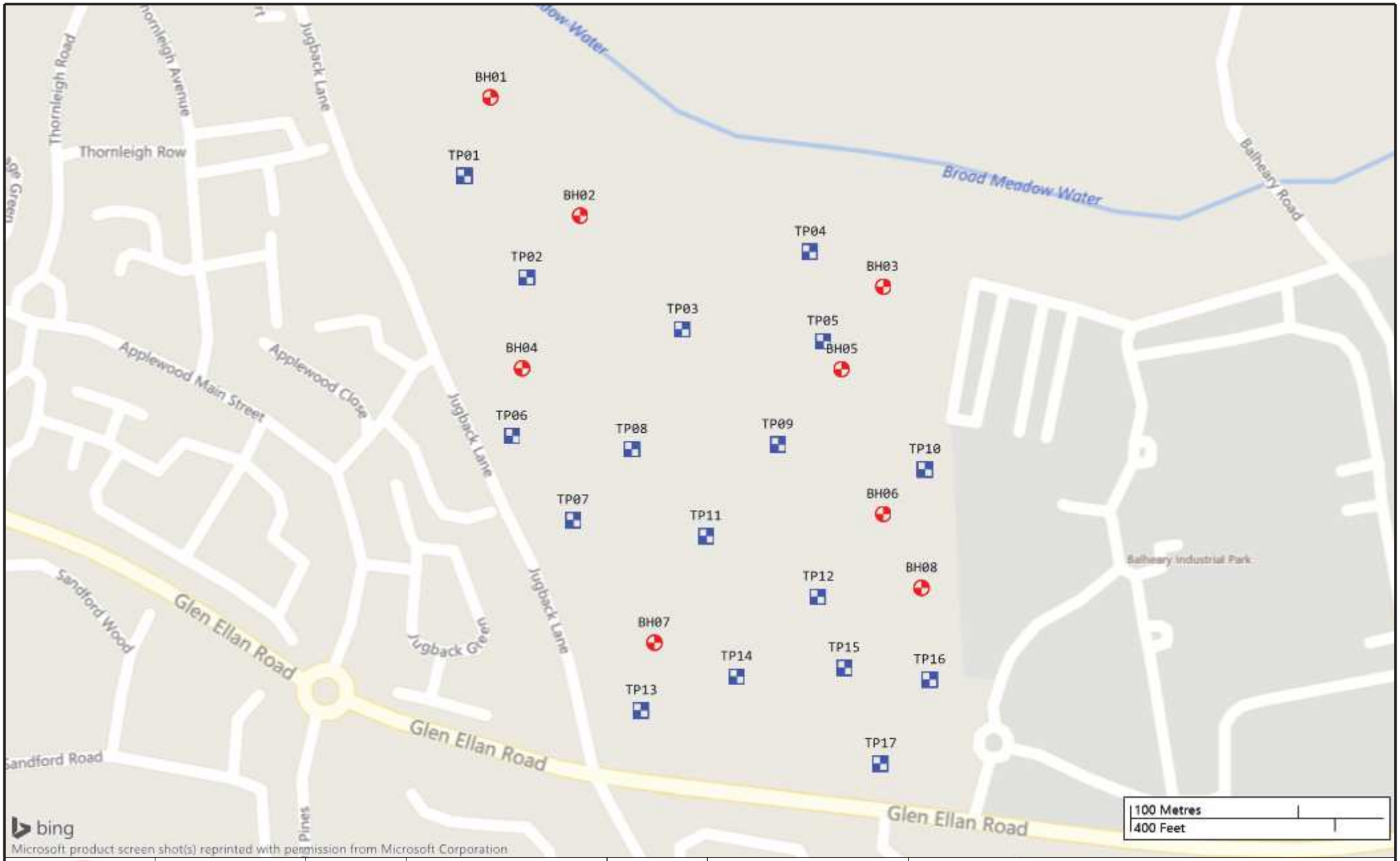
The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

Appendix 4

Survey Data

Site Survey

Location	Irish National Grid		Level	Irish Transverse Mercator	
	Easting	Northing		Easting	Northing
Cable Percussion Boreholes					
BH01	717608.793	748363.439	7.25	317683.411	248340.257
BH02	717663.420	748294.172	9.42	317738.050	248270.975
BH03	717845.956	748256.318	5.94	317920.625	248233.114
BH04	717631.220	748202.211	9.92	317705.844	248178.994
BH05	717822.927	748206.474	7.67	317897.592	248183.259
BH06	717849.380	748120.667	13.46	317924.052	248097.434
BH07	717714.458	748040.428	13.32	317789.102	248017.177
BH08	717873.791	748077.087	12.51	317948.468	248053.845
Trial Pits					
TP01	717593.680	748316.185	8.51	317668.295	248292.992
TP02	717750.929	748074.592	14.54	317825.580	248051.348
TP03	717726.797	748227.917	9.22	317801.441	248204.706
TP04	717802.210	748276.115	6.04	317876.870	248252.915
TP05	717810.993	748222.897	7.45	317885.655	248199.686
TP06	717625.987	748161.701	10.93	317700.611	248138.475
TP07	717663.978	748112.404	14.07	317738.610	248089.168
TP08	717698.097	748155.594	10.16	317772.736	248132.367
TP09	717785.379	748160.575	9.97	317860.037	248137.350
TP10	717873.933	748147.926	12.44	317948.610	248124.699
TP11	717743.796	748104.831	14.27	317818.445	248081.594
TP12	717812.038	748070.366	13.53	317886.702	248047.122
TP13	717707.802	747999.822	13.70	317782.445	247976.562
TP14	717764.277	748021.529	13.61	317838.931	247998.274
TP15	717828.563	748028.279	13.12	317903.231	248005.026
TP16	717879.885	748022.537	12.57	317954.564	247999.283
TP17	717851.855	747971.646	15.23	317926.529	247948.381



Site Investigations Ltd The Grange 12th Lock Road Lucan Co. Dublin T: 01 6108768 e: info@siteinvestigations.ie	Contract No:	5415	Client:	Cairn Homes	Legend Key Locations By Type - CP Locations By Type - TP
	Contract Name:	Hollybank	Engineer:	Waterman Moylan	
	Location:	Swords, Co. Dublin	Scale:	1:3000	
	Title:	Site Plan	Drawn By:	SL	

Site Investigations Ltd The Grange 12th Lock Road Lucan Co. Dublin T: 01 6108768 e: info@siteinvestigations.ie	Contract No:	5415	Client:	Cairn Homes	Legend Key Locations By Type - CP Locations By Type - TP
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	Title:	Site Plan	Drawn By:	SL	