Volume 3 Part D

Appendix G. Ground Investigation

Appendix H. Flood Risk Assessment

Appendix G. Land, Soils and Geology

G.1. Proposed Residential Development Blackrock, Dundalk, Co. Louth, Ground Investigation - Factual and Interpretative Report – Report No. 002/ROI/18, July 2018 (Geotechnical Environmental Services Ltd., 2018)

GEOTECHNICAL
ENVIRONMENTAL SERVICES
LIMITED

PROPOSED RESIDENTIAL DEVELOPMENT
BLACKROCK
DUNDALK
COUNTY LOUTH

GROUND INVESTIGATION

FACTUAL AND INTERPRETATIVE REPORT

REPORT No. 002/ROI/18

JULY 2018

CLIENT: KINGSBRIDGE CONSULTANCY LIMITED

ENGINEER: FINN DESIGN PARTNERSHIP

DOCUMENT CONTROL SHEET

CLIENT	KINGSBRIDGE CONSULTANCY LIMITED
PROJECT TITLE	PROPOSED RESIDENTIAL DEVELOPMENT BLACKROCK, DUNDALK, COUNTY LOUTH GROUND INVESTIGATION
CONSULTING ENGINEER	FINN DESIGN PARTNERSHIP
REPORT No.	002/ROI/18

REV.	STATUS	AUTHOR(S)	REVIEWED & APPROVED BY	ISSUE DATE
1	FINAL	 ROBERT BARRY BSc, MSc, C. Eng, C. Geol, FGS, MIMMM	 JOE GERVIN BSc.	27/07/2018

CONTENTS

APPENDICES

1.0 INTRODUCTION

On the instruction of Finn Design Partnership (the Engineer), acting on behalf of Kingsbridge Consultancy Limited (the Client), Geotechnical Environmental Services Limited (GES) were appointed to undertake a ground investigation contract in connection with a proposed residential development to be located on lands at Blackrock, Dundalk, County Louth (Appendix 1).

The ground investigation comprised the following:

- 5 No. boreholes excavated to a maximum depth of 5.37m below existing ground level (begl), with associated in-situ testing and sampling;
- The installation of combined gas/groundwater monitoring standpipes in selected boreholes;
- 20 No. trial pits excavated to a maximum depth of 3.1m begl, with associated sampling;
- Geotechnical, geochemical and environmental laboratory testing;
- Factual and interpretative reporting.

The Specification for the investigation was the "Specification and Related Documents for Ground Investigation in Ireland" published by Engineers Ireland (2016), with information, amendments and additions as advised by the Engineer.

Soil and rock descriptions were undertaken in accordance with British Standard BS5930:2015, Code of Practice for Site Investigations which incorporates guidance presented in BS EN ISO 14688-1:2002+A1:2013, BS EN ISO 14688-2:2004+A1:2013 and and BS EN ISO 14689-1:2003.

The following provides additional clarification of the terminology that has been used:

- Silty CLAY/clayey SILT – used where it is considered that the secondary fraction is important and hence significantly modifies the appearance and/or behaviour of the principal;
- Fine grained (clays/silts) soils plotting on or just below the A-line on a plasticity chart are classified as clays;
- Fine grained soils with less than 35% sand and/or gravel sized particles are classified as slightly sandy and/or slightly gravelly;
- Fine grained soils with between 35% and 65% sand or gravel sized particles are classified as sandy or gravelly ("and" only in theory);
- Fine grained soils with greater than 65% sand or gravel sized particles are classified as very sandy or very gravelly;
- Coarse soils (sands/gravels) with less than 5% clay or silt and/or less than 5% sand or gravel are classified as slightly clayey or slightly silty and/or slightly sandy or slightly gravelly;
- Coarse soils with between 5% and 20% clay or silt and/or between 5% and 20% sand or gravel are classified as clayey or silty and/or sandy or gravelly;
- Coarse soils with greater than 20% clay or silt or greater than 20% sand or gravel are classified as very clayey or very silty and/or very sandy or very gravelly;

As noted in BS5930:2015 Clause 33.4.4.2, Table 15, the classification of very coarse soils (cobbles and boulders) requires a very large sample (circa 1000kg). Accordingly, it is not possible to recover representative samples from boreholes and conventional trial pits to quantify cobble and boulder content. Therefore, the exploratory hole logs presented in this report simply make reference to the presence or otherwise of cobble and boulders with no attempt to classify the % content.

2.0 AIMS AND OBJECTIVES OF THE INVESTIGATION

The investigation was designed with the objective of obtaining the following information:

- An overview of the ground and groundwater conditions present in relation to foundation design;
- The potential aggressiveness of the soils encountered toward buried concrete;
- An assessment as to the presence, or otherwise, of contaminants within the soil;
- An assessment as to the presence, or otherwise, of ground gases.

This report provides a factual and interpretative account of the ground and groundwater conditions encountered and the laboratory test results obtained in relation to geotechnical and geochemical design. The interpretation of the findings of the investigation is based on the assumption that the ground and groundwater conditions encountered and laboratory test results obtained are representative of the site area as a whole.

Issues relating to a contamination assessment of the site, i.e. the preparation of Preliminary Risk Assessment (PRA) and Generic Quantitative Risk Assessment (GQRA) reports have been addressed, on behalf of GES, by specialist environmental consultant Cove Environmental Consulting and are included in Appendix 5.

3.0 SITE WORKS

3.1 Introduction

Site works were undertaken during the period 11th-14th June 2018, under the supervision of a geotechnical engineer from GES.

An exploratory hole location plan is included in Appendix 1.

3.2 Boreholes

5 No. boreholes (BH1–BH5) were excavated, to a maximum depth of 4.37m begl and at a diameter of 101mm, by means of a Geoprobe 6620DT drill rig using percussion sampling techniques.

In-situ testing took the form of the standard penetration test (SPT), using a split barrel sampler, to allow measurement of the soil penetration resistance 'N' to be determined under dynamic loading.

Details of groundwater strikes (if applicable), as encountered during boring operations, are presented on individual exploratory hole logs together with details of water levels as recorded upon completion of each borehole.

Exploratory hole logs are included in Appendix 2.

3.5 Standpipes

Combined gas/groundwater monitoring standpipes were installed in boreholes BH1, BH4 and BH5.

Each standpipe comprised 50mm (HDPE) i.d. well casing and well screen sections with associated gravel filter pack, bentonite pellet seal, push fit base cap, geotextile filter sock, gas bung, cement/bentonite grout seals and flush lockable steel head cover.

Specific details of each standpipe installation are presented on an instrumentation log that accompanies the relevant exploratory hole log as included in Appendix 2.

3.3 Trial Pits

20 No. trial pits (TP1-TP20) were excavated to a maximum depth of 3.1m begl by means of a 13T tracked excavator.

Details of the ground conditions encountered, groundwater strikes (if applicable) and pit sidewall stability are noted on exploratory hole logs as included in Appendix 3.

Photographs of the trial pit excavations, resulting spoil and reinstatement are also included in Appendix 3.

3.4 Soil Sampling

Soil samples for detailed geotechnical description, geotechnical, geochemical and environmental laboratory testing were collected in the following containers:

- PVC "jar bags" of approximately 1kg capacity;
- Open tube samplers;
- 400g capacity plastic tub;
- 250g capacity amber glass jar;
- 60g capacity amber glass vial.

Environmental soil sampling was undertaken with reference to guidance presented in British Standard BS10175:2011+A2:2017, British Standard Code of Practice for Investigation of Potentially Contaminated Sites.

4.0 GROUND AND GROUNDWATER CONDITIONS ENCOUNTERED

4.1 Superficial and Solid Geology

Preliminary information on the anticipated site superficial and solid geology was obtained through reference to the Geological Survey of Ireland, Bedrock Geology: 1:100000 Scale Map Series, Geology of Monaghan and Carlingford: Sheet 8 and part of sheet 9 (1996) and the Geological Survey of Ireland, Quaternary Sediments and Geomorphology: Quaternary Sediments Merged Datasets (2013).

The above publications indicate that the natural strata in the vicinity of the site area comprise glacial till overlying sedimentary mudstone and greywacke bedrock of the Ordovician period Inishkeen Formation.

Examination of the exploratory hole logs as included in Appendices 2 and 3 reveals that the general ground conditions encountered comprise the following:

- TOPSOIL;
- Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets;
- Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY;
- Light grey brown silty sandy fine to coarse GRAVEL (localised);
- Firm to stiff medium to high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content;
- Highly weathered destructured GREYWACKE: Recovered as grey brown angular fine to coarse GRAVEL sized fragments in a silty clay matrix.

The above description represents the general order of occurrence of the strata below the ground surface. However, it should be noted that at specific locations one or more strata may be absent.

Localised made ground of soft grey brown slightly sandy slightly gravelly silty CLAY with cobble content and containing glass and ceramic remnants was encountered in trial pit TP19.

4.2 Groundwater

Minimal groundwater was encountered during the excavation of the individual exploratory holes.

Post fieldwork monitoring of the standpipes as installed in boreholes BH1, BH4 and BH5 revealed minimal groundwater.

5.0 LABORATORY TESTING

5.1 Geotechnical and Geochemical Laboratory Testing

Selected soil samples obtained as part of the investigation were tested at the laboratories of Queen's University, Belfast and Exova Jones Environmental, Deeside, Wales.

Laboratory testing comprised the following:

- Moisture content;
- Atterberg limits;
- UU Triaxial (Single Stage);
- Water soluble sulfate (SO_4);
- pH.

Laboratory testing was undertaken in accordance with guidance presented in British Standard BS1377:1990, Methods of Test for Soils for Civil Engineering Purposes and Building Research Establishment (BRE) Special Digest 1 (2005).

5.2 Environmental Laboratory Testing

All environmental soil samples obtained as part of the investigation were transported to the laboratory of Exova Jones Environmental, Deeside, Wales.

The testing scheduled and results obtained, along with a discussion and interpretation of the same, are included in Appendix 5 as a GQRA report detailing the contaminative status of the site (compiled on behalf of GES by specialist environmental consultant Cove Environmental Consulting).

6.0 GEOTECHNICAL AND GEOCHEMICAL DESIGN CONSIDERATIONS

6.1 Introduction

At the time of preparation of this report it was our understanding that the proposed development will involve the construction of housing with associated access roads, car parking and soft landscaping. A proposed site layout plan is included in Appendix 3.

No specific details regarding the final site levels or potential foundation loadings were available at the time of preparation of this report. Given the above we have provided comments on geotechnical and geochemical design considerations assuming minimal alterations to existing site levels.

6.2 Foundation and Floor Design

It is our opinion that strip foundations and ground bearing floor slabs can be designed for in respect of individual housing units.

A safe bearing capacity of circa 125kN/m^2 can be designed for in respect of foundations bearing on the strata encountered within 0.75m of existing ground level.

The friable nature of the clay strata should be noted. If exposed to excess water (rainfall/groundwater inflow) softening will occur and a reduction in cohesive strength and hence bearing capacity.

6.3 Trench Excavation

Given the findings of the exploratory holes, and in particular the trial pit excavations (see excavation photographs as included in Appendix 3), it is our opinion the foundation and/or service trench excavations will experience minimal side wall instability or groundwater inflow.

The presence of rock at shallow depth should be noted. Locally there may be a requirement to use a rock hammer attachment to facilitate excavation, particularly if drainage service runs are required to be located at depths of greater than 2.0m to 2.5m begl.

6.4 Soil Sub-Grade Strength

No specific assessment of pavement sub-grade strength was requested as part of this investigation. However, given the ground conditions encountered it is our assumption that the sub-grade will primarily comprise firm to stiff friable sandy gravelly clay strata. Given the above, we recommend that a conservative design California Bearing Ratio (CBR) of 4% be adopted.

The friable nature of the clay strata should be noted. If exposed to excess water (rainfall/groundwater inflow) softening will occur and a reduction in cohesive strength and hence CBR value.

Should localised 'soft spots' be encountered during development we would recommend their removal and replacement with compacted granular fill. Consideration may also be given to the use of a geotextile layer at the interface between the sub-grade and sub-base layers.

A more detailed assessment of the anticipated sub-grade could be undertaken by means of plate load tests and the determination of equivalent CBR values.

6.5 Resistance of Buried Concrete to Sulfate Attack

An assessment of the Aggressive Chemical Environment for Concrete (ACEC) was undertaken through reference to the Building Research Establishment (BRE) Special Digest 1 (2005).

As noted by BRE Special Digest 1, sulfates in the soil and groundwater are the chemical agents most likely to attack concrete. The extent to which sulfates affect concrete is linked to their concentrations, the type of ground, the presence of groundwater, the type of concrete and the form of construction in which concrete is used.

BRE Special Digest 1 identifies four different categories of site which require specific procedures for investigation for aggressive ground conditions:

- Sites not subjected to previous development and not perceived as containing pyrite;
- Sites not subjected to previous development and perceived as containing pyrite;
- Brownfield sites not perceived as containing pyrite;
- Brownfield sites perceived as containing pyrite.

For the purposes of this report the site was classified as not having been subject to previous development and not perceived as containing pyrite.

The sulfate results, as reported in Appendix 4, refer to water soluble sulfate in 2:1 water soil extract (SO_4) as per BRE Special Digest 1.

As 15 No. results were available the mean of the highest 20% of the results was taken as the characteristic site value, i.e. 0.04g/l (SO_4).

The characteristic site value of soil pH was taken as the lowest result obtained, i.e. 7.9.

Based on the above, and a mobile groundwater table, the Design Sulfate Class for the site should be taken as DS-1 and the ACEC Class as AC-1. The above should be used in conjunction with guidance presented in Part D of BRE Special Digest 1 to specify the concrete type for the site.

REFERENCES

1. Specification and Related Documentation for Ground Investigation in Ireland (Part I Guidance Notes, Part II Technical Specification and Bill of Quantities). The Institute of Engineers of Ireland. Second Edition; 2016.

2. British Standard BS5930:2015. Code of Practice for Site Investigations. British Standards Institution, London.

3. BS EN ISO 14688-1, 2002. Geotechnical Investigation and Testing - Identification and classification of soil. Part 1: Identification and description. British Standards Institution, London.

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5. BS EN ISO 14689-1, 2003. Geotechnical Investigation and Testing – Identification and classification of rock. Part 1: Identification and description. British Standards Institution, London.

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7. Geological Survey of Ireland, 1996. Bedrock Geology: 1:100000 Scale Map Series, Geology of Monaghan and Carlingford: Sheet 8 and part of sheet 9. Geological Survey of Ireland, Dublin.

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10. Construction Industry Research and Information Association (CIRIA). 1993. Research Project 369. The Standard Penetration Test (SPT): Methods and Use. CIRIA. London.

11. Stroud, M.A. 1989. The Standard Penetration Test – Its application and Interpretation. Proc. I.C.E. conference on Penetration Testing in the UK. Thomas Telford. London.

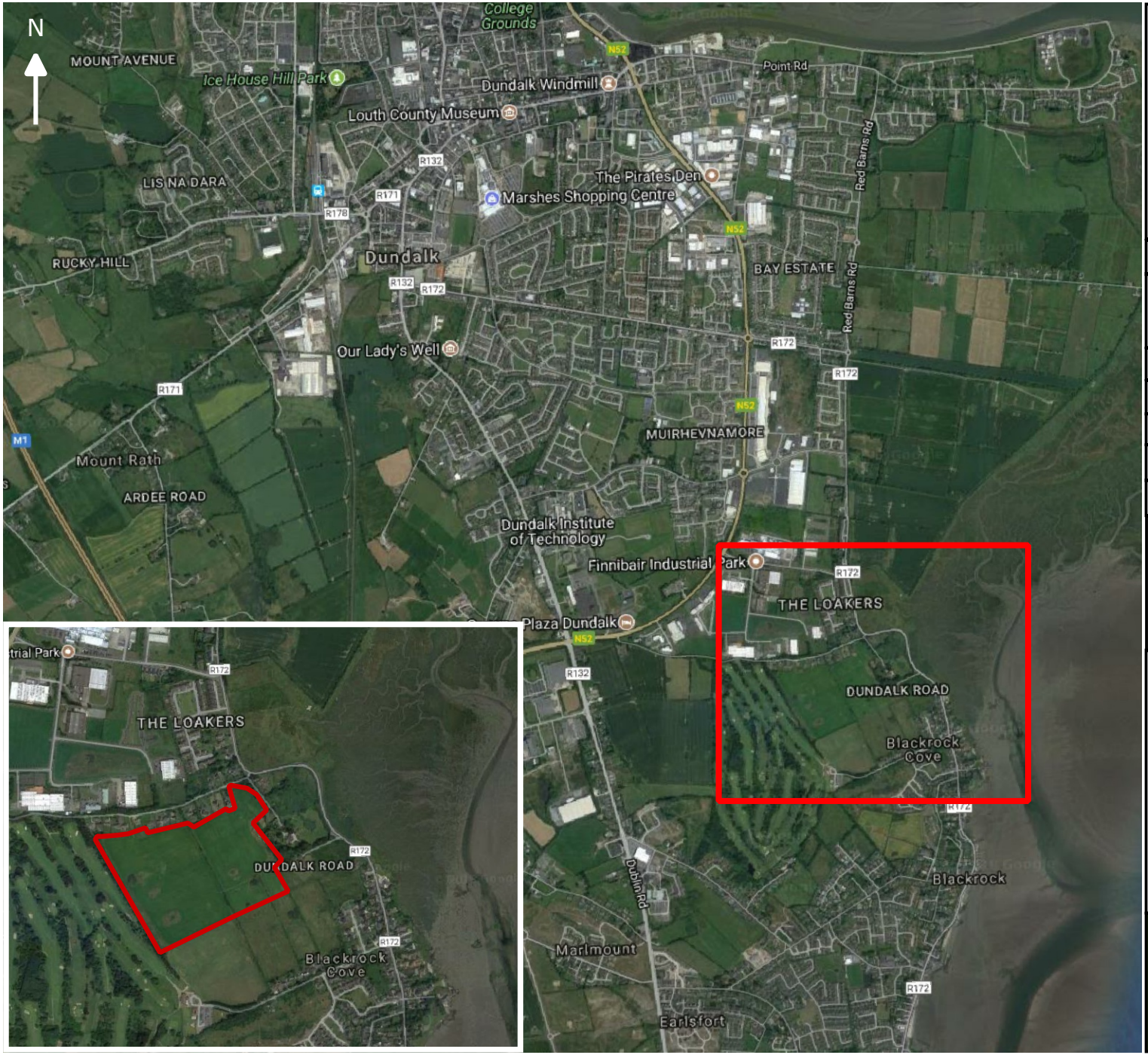
12. Simons, N. & Menzies, B. 2005. A Short Course in Foundation Engineering; Second Edition. Thomas Telford. London.

13. British Research Establishment Special Digest 1. Concrete in Aggressive Ground; Third Edition 2005. BRE Bookshop. Garston.

GEOTECHNICAL
ENVIRONMENTAL SERVICES
LIMITED

APPENDIX 1

SITE AND EXPLORATORY HOLE LOCATION PLANS; PROPOSED DEVELOPMENT LAYOUT PLAN



GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Title: Site Location Plan	
Project Name: Proposed Residential Development, Blackrock, Dundalk, County Louth	
Figure: 1	Report No: 002/ROI/18
Client: Kingsbridge Consultancy Limited	
Engineer: Finn Design Partnership	
Drawn: TS	Date: 18/7/2018
Reviewed: RB	Date: 18/7/2018

Symbol/Key:

Approximate Site Location/Boundary

Notes:

Geotechnical Environmental Services Limited

The Old Mill,
22A Kilmoyle Road,
Ballybogey,
Co Antrim.
BT53 6NR.

Tel: 0044 (0)28 2074 2066
Fax: 0044 (0)28 2074 2829
info@geospecialists.co.uk

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Title: Exploratory Hole Location Plan.

Project Name:
Proposed Residential Development, Blackrock, Dundalk, County Louth.

Figure: 2	Report No: 002/ROI/18
Client: Kingsbridge Consultancy Limited	
Engineer: Finn Design Partnership	
Drawn: TS	Date: 18/7/2018
Reviewed: RB	Date: 18/7/2018

Symbol/Key:

Approximate Borehole Location

Approximate Trial Pit Location

Notes:

Geotechnical Environmental Services Limited

The Old Mill,
22A Kilmoyle Road,
Ballybogey,
Co Antrim.
BT53 6NR.

Tel: 0044 (0)28 2074 2066
Fax: 0044 (0)28 2074 2829
info@geospecialists.co.uk

01 SOIL POERMEABILITY SOIL TESTS
003 SCALE 1:1000

REV. NO.	DESCRIPTION	DATE	INITIALS

finn DESIGN PARTNERSHIP
CREATIVE ● INNOVATIVE

30 Fair Street, Drogheda, Co. Louth, Ireland
t 041 9877100 f 041 9877200 e info@finn.ie w www.finn.ie

DRAWING. NO: 003
REV. NO: -

ENG

TITLE: Soil Permeability Tests
-

PROJECT: Residential Development @ Haggardstown
Blackrock, Dundalk, Co Louth

CLIENT: Kingsbridge Consultancy Ltd
1st Floor, Block 1, Quayside Business Park,
Dundalk Co Louth

SCALE: As Shown	DRAWN: T.Finn
DATE: June 2018	CHECKED: -

STATUS: Scheme Design

JOB NO: 1703

NOTES
1. Copyright Reserved 2003 ©
2. Work to figured dimensions only. Do not scale drawing.
3. The contractor is responsible for checking all levels and dimensions on site and shall refer all discrepancies to the Architect
4. Where appropriate, for details of r.c. structure, or mechanical and electrical details, see Engineers drawings
5. Proprietary items shall be fixed in strict accordance with manufacturers instructions.
6. Sizes of proprietary items shall be checked with manufacturer.
7. The contractor shall be responsible for the coordination of structure, finishes and services.

ARCHITECTURE ● LANDSCAPE ARCHITECTURE ● CIVIL - STRUCTURAL ENGINEERING ● PROJECT MANAGEMENT

GEOTECHNICAL
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APPENDIX 2

BOREHOLE LOGS

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site
Proposed Residential Development, Blackrock, Dundalk, County Louth.

Borehole Number
BH1

Boring Method
Geoprobe 6620DT Drill Rig. Percussion sampling to 3.60m depth.

Casing Diameter
Borehole diam. 101mm to 3.60m

Ground Level (mOD)
16.98

Client
Kingsbridge Consultancy Limited

Job Number
02.ROI18

Location (Handheld GPS)
306654.9 E 304337.21 N

Dates
14/06/2018

Engineer
Finn Design Partnership

Sheet
1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(0.25)	TOPSOIL.			
0.25	D1				16.73	0.25	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.			
0.50	ES1					(0.55)				
0.80	D2				16.18	0.80	Firm to stiff medium to high strength friable light grey brown slightly sandy slightly gravelly CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.			
1.00 1.00-1.45	ES2 U1		DRY	72 blows						
1.45	D3					(1.20)				
2.00-2.45 2.00 2.00 2.00-2.45	SPT N=19 D5 ES3 D4		DRY	3,3/3,6,5,5	14.98	2.00	Firm to stiff friable light brown grey slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.			
						(0.80)				
2.80	D6				14.18	2.80	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular GRAVEL sized fragments in a silt matrix.			
3.00-3.45 3.00 3.00-3.45	SPT N=22 ES4 D7		DRY	3,7/6,3,5,8						
						(0.94)				
3.60-3.74 3.60-3.74	SPT 25*/50 50/90 D8		3.64	25/43,7 Steady(1) at 3.64m. 14/06/2018:3.64m	13.24	3.74	Complete at 3.74m		▽1	

Remarks
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)
1:25

Logged By
TS

Figure No.
02.ROI18.BH1

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site
Proposed Residential Development, Blackrock, Dundalk, County Louth.

Borehole Number
BH1

Installation Type
Standpipe

Dimensions
Internal Diameter of Tube [A] = 50 mm
Diameter of Filter Zone = 101 mm

Client
Kingsbridge Consultancy Limited

Job Number
02.ROI18

Location
306654.9 E 304337.21 N

Ground Level (mOD)
16.98

Engineer
Finn Design Partnership

Sheet
1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
			16.88	0.10	Concrete
					Bentonite Seal
			16.48	0.50	
					Slotted Standpipe
	▽1		13.24	3.74	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings				Depth Sealed (m)
					5 min	10 min	15 min	20 min	
14/06/18		3.64		Steady					

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
14/06/18							3.74		3.64	13.34

Instrument Groundwater Observations

Inst. [A] Type : Standpipe

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	
19/06/18		3.59	13.39	Insufficient water to sample
25/06/18		3.62	13.36	Insufficient water to sample
28/06/18		3.62	13.36	Insufficient water to sample

Remarks
Flush lockable cover.
Gas bung.
Geotextile filter sock surround to well screen section.

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site
Proposed Residential Development, Blackrock, Dundalk, County Louth.

Borehole Number
BH2

Boring Method
Geoprobe 6620DT Drill Rig. Percussion sampling to 4.0m depth.

Casing Diameter
Borehole diam. 101mm to 4.00m

Ground Level (mOD)
21.20

Client
Kingsbridge Consultancy Limited

Job Number
02.ROI18

Location (Handheld GPS)
306780.67 E 304123.71 N

Dates
13/06/2018

Engineer
Finn Design Partnership

Sheet
1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(0.30)	TOPSOIL.			
0.30	D1				20.90	0.30	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.			
0.50	ES1					(0.70)				
1.00	D2				20.20	1.00	Firm to stiff medium to high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.			
1.00	ES2									
1.00-1.45	U1		DRY	46 blows						
1.45	D3									
2.00-2.45	SPT N=27		DRY	2,4/4,4,4,15		(2.00)				
2.00	ES3									
2.00-2.45	D4									
3.00	D5				18.20	3.00	Firm to stiff medium to high strength friable brown grey slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.			
3.00	ES4									
3.00-3.45	U2		DRY	66 blows		(0.60)				
3.45	D6									
3.60	D7				17.60	3.60	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to course GRAVEL sized fragments in a silty clay matrix.			
4.00-4.37	SPT 50/220		DRY	1,5/10,13,23,4		(0.77)				
4.00-4.37	D8									
				13/06/2018:DRY	16.83	4.37	Complete at 4.37m			

Remarks
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)
1:25

Logged By
TS

Figure No.
02.ROI18.BH2

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site
Proposed Residential Development, Blackrock, Dundalk, County Louth.

Borehole Number
BH2

Installation Type
Standpipe

Dimensions
Internal Diameter of Tube [A] = 50 mm
Diameter of Filter Zone = 101 mm

Client
Kingsbridge Consultancy Limited

Job Number
02.ROI18

Location
306780.67 E 304123.71 N

Ground Level (mOD)
21.20

Engineer
Finn Design Partnership

Sheet
1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
			21.10	0.10	Concrete
					Bentonite Seal
			20.70	0.50	
					Slotted Standpipe
			17.20	4.00	Bentonite Seal
			16.83	4.37	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings				Depth Sealed (m)
					5 min	10 min	15 min	20 min	

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
13/06/18							4.37		DRY	

Instrument Groundwater Observations

Inst. [A] Type : Standpipe

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	
19/06/18		DRY		
25/06/18		DRY		
28/06/18		DRY		

Remarks
Flush lockable cover.
Gas bung.
Geotextile filter sock surround to well screen section.

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site
Proposed Residential Development, Blackrock, Dundalk, County Louth.

Borehole Number
BH3

Boring Method
Geoprobe 6620DT Drill Rig. Percussion sampling to 3.0m depth.

Casing Diameter
Borehole diam. 101mm to 3.00m

Ground Level (mOD)
12.60

Client
Kingsbridge Consultancy Limited

Job Number
02.ROI18

Location (Handheld GPS)
306842.78 E 304306.16 N

Dates
13/06/2018

Engineer
Finn Design Partnership

Sheet
1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.25)	TOPSOIL.		
0.25	D1				12.35	0.25	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.		
						(0.30)			
0.50	ES1				12.05	0.55	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.55	D2								
						(0.45)			
1.00-1.45	SPT N=17		DRY	3,5/7,4,3,3	11.60	1.00	Medium dense brown grey silty sandy fine to medium GRAVEL. Gravel is sub-angular to sub-rounded.		
1.00	D3								
1.00	ES2					(0.30)			
1.00-1.45	D4								
1.30	D5				11.30	1.30	Firm medium strength friable grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Also containing lenses of silty sandy fine to medium GRAVEL. Gravel is sub-angular to sub-rounded.		
1.50-1.95	U1		DRY	53 blows					
						(1.35)			
1.95	D6								
2.00	ES3								
2.10-2.55	SPT N=13		DRY	2,2/3,3,3,4					
2.10-2.55	D7								
2.65	D8				9.95	2.65	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to course GRAVEL sized fragments in a silty clay matrix.		
3.00-3.40	SPT 50/250		DRY	6,7/8,13,16,13		(0.75)			
3.00-3.40	D9								
				13/06/2018:DRY	9.20	3.40	Complete at 3.40m		

Remarks
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)
1:25

Logged By
TS

Figure No.
02.ROI18.BH3

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site
Proposed Residential Development, Blackrock, Dundalk, County Louth.

Borehole Number
BH4

Boring Method
Geoprobe 6620DT Drill Rig. Percussion sampling to 2.0m depth.

Casing Diameter
Borehole diam. 101mm to 2.00m

Ground Level (mOD)
9.88

Client
Kingsbridge Consultancy Limited

Job Number
02.ROI18

Location (Handheld GPS)
306941.38 E 304407.86 N

Dates
13/06/2018

Engineer
Finn Design Partnership

Sheet
1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(0.35)	TOPSOIL.			
0.35	D1				9.53	0.35	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.			
0.50	ES1					(0.55)				
0.90	D2				8.98	0.90	Stiff high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.			
1.00-1.45	SPT N=21		DRY	2,2/3,5,6,7						
1.00	ES2									
1.00-1.45	U1		DRY	56 blows		(0.80)				
1.45	D3									
1.70	D4				8.18	1.70	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to course GRAVEL sized fragments in a silty clay matrix.			
2.00-2.23	SPT 25*/100 50/130		DRY	18,7/30,20		(0.53)				
2.00-2.23	D5				7.65	2.23	Complete at 2.23m			
				13/06/2018:DRY						

Remarks
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)
1:25

Logged By
TS

Figure No.
02.ROI18.BH4

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Borehole Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	BH4

Installation Type	Dimensions	Client	Job Number
Single Installation	Internal Diameter of Tube [A] = 50 mm Diameter of Filter Zone = 101 mm	Kingsbridge Consultancy Limited	02.ROI18

Location	Ground Level (mOD)	Engineer	Sheet
306941.38 E 304407.86 N	9.88	Finn Design Partnership	1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
			9.78	0.10	Concrete
					Bentonite Seal
			9.38	0.50	
					Slotted Standpipe
			7.88	2.00	
					Bentonite Seal
			7.65	2.23	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings				Depth Sealed (m)
					5 min	10 min	15 min	20 min	

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
13/06/18							2.23		DRY	

Instrument Groundwater Observations

Inst. [A] Type : Standpipe

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	
19/06/18		DRY		
25/06/18		DRY		
28/06/18		DRY		

Remarks
Flush lockable cover.
Gas bung.
Geotextile filter sock surround to well screen section.

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site
Proposed Residential Development, Blackrock, Dundalk, County Louth.

Borehole Number
BH5

Boring Method
Geoprobe 6620DT Drill Rig. Percussion sampling to 3.0m depth.

Casing Diameter
Borehole diam. 101mm to 3.00m

Ground Level (mOD)
13.86

Client
Kingsbridge Consultancy Limited

Job Number
02.ROI18

Location (Handheld GPS)
307041.54 E 304224.64 N

Dates
13/06/2018

Engineer
Finn Design Partnership

Sheet
1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.30)	TOPSOIL.		
0.30	D1				13.56	0.30	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.50	ES1					(0.40)			
0.70	D2				13.16	0.70	Stiff high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2								
1.00-1.45	U1		DRY	60 blows					
1.45	D3					(1.85)			
2.00-2.45	SPT N=28		DRY	2,3/3,4,6,15					
2.00	ES3								
2.00-2.45	D4								
2.55	D5				11.31	2.55	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to course GRAVEL sized fragments in a silty clay matrix.		
						(0.72)			
3.00-3.27	SPT 25*/100 50/170		DRY	19,6/23,22,5					
3.00-3.27	D6								
				13/06/2018:DRY	10.59	3.27	Complete at 3.27m		

Remarks
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)
1:25

Logged By
TS

Figure No.
02.ROI18.BH5

GEOTECHNICAL
ENVIRONMENTAL SERVICES
LIMITED

APPENDIX 3

TRIAL PIT LOGS; PHOTOGRAPHS OF TRIAL PITS, RESULTING SPOIL AND REINSTATEMENT

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP1

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T tracked excavator.		15.20	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306579.21 E 304369.05 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.40)	TOPSOIL.		
0.40	D1			14.80	0.40			
0.50	ES1				(0.25)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.65	D2			14.55	0.65			
1.00	ES2					Stiff friable light grey brown slightly sandy slightly gravelly with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.60	D3				(2.25)			
2.00	ES3							
2.50	D4							
2.50	ES4							
2.90	D5		Pit terminated due to encountering suspected bedrock. 12/06/2018:DRY	12.30	2.90	Complete at 2.90m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP1

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP2

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		16.78	Kingsbridge Consultancy Limited	02.ROI18
	Location	**Dates**	**Engineer**	**Sheet**
	306626.56 E 304279.76 N	11/06/2018	Finn Design Partnership	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL.		
0.30	D1			16.48	0.30	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.50	ES1				(0.60)			
0.90	D2			15.88	0.90	Firm friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2				(0.50)			
1.40	D3			15.38	1.40	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to coarse GRAVEL sized fragments.		
					(0.20)			
			11/06/2018:DRY	15.18	1.60	Complete at 1.60m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP2

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP3

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		18.61	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306693.33 E 304174.95 N	**Dates** 11/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL.		
0.30	D1			18.31	0.30	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.50	ES1				(0.40)			
0.70	D2			17.91	0.70	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2				(0.90)			
1.60	D3			17.01	1.60	Firm to stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
2.00	ES3				(0.80)			
2.40	D4			16.21	2.40	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to coarse GRAVEL sized fragments.		
			11/06/2018:DRY		(0.20)			
				16.01	2.60	Complete at 2.60m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP3

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP4

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		21.22	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306756.22 E 304072.47 N	**Dates** 11/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20)	TOPSOIL.		
0.20	D1			21.02	0.20			
					(0.20)	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.40	D2			20.82	0.40			
0.50	ES1					Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
					(0.50)			
0.90	D3			20.32	0.90			
1.00	ES2					Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
					(0.60)			
1.50	D4			19.72	1.50	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to coarse GRAVEL sized fragments in a silty clay matrix.		
					(0.90)			
			11/06/2018:DRY	18.82	2.40	Complete at 2.40m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP4

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP5

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		20.52	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306843.17 E 304112.07 N	**Dates** 11/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20)	TOPSOIL.		
0.20	D1			20.32	0.20	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.50	ES1				(0.70)			
0.90	D2			19.62	0.90	Stiff friable light grey brown with dark brown mottling slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2				(0.60)			
1.50	D3			19.02	1.50	Firm to stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
2.00	ES3				(0.90)			
2.40	D4			18.12	2.40	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
					(0.70)			
			Pit terminated due to encountering suspected bedrock. 11/06/2018:DRY	17.42	3.10	Complete at 3.10m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP5

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP6

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		19.24	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306793.48 E 304211.44 N	**Dates** 11/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.25)	TOPSOIL.		
0.25	D1			18.99	0.25	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble content. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.50	ES1				(0.65)			
0.90	D2			18.34	0.90	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to coarse GRAVEL sized fragments in a silty clay matrix.		
1.00	ES2							
					(1.10)			
2.00	D3		11/06/2018:DRY	17.24	2.00	Complete at 2.00m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP6

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP7

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator.		17.63	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306747.77 E 304299.49 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL.		
0.30	D1		12/06/2018:DRY	17.33 17.23	0.30 (0.10) 0.40	Highly weathered GREYWACKE: Recovered as grey angular fine to coarse GRAVEL sized fragments.		
						Complete at 0.40m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP7

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP8

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		15.28	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306693.09 E 304384.08 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL.		
0.30	D1			14.98	0.30			
0.50	ES1				(0.40)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.70	D2			14.58	0.70			
					(0.40)	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2			14.18	1.10			
1.10	D3					Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
2.00	ES3				(2.00)			
2.50	D4							
3.00	ES4			12.18	3.10			
			Pit terminated due to encountering suspected bedrock. 12/06/2018:DRY			Complete at 3.10m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP8

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP9

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		11.61	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306787.66 E 304405.92 N	**Dates** 11/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.25)	TOPSOIL.		
0.25	D1			11.36	0.25 (0.10)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.35	D2			11.26	0.35	Light grey brown clayey silty sandy fine to coarse GRAVEL with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
					(0.95)			
1.30	D3			10.31	1.30	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble content. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.30	ES1							
					(1.20)			
2.50	D4			9.11	2.50	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
2.50	ES2				(0.30)			
			Pit terminated due to encountering suspected bedrock. 11/06/2018:DRY	8.81	2.80	Complete at 2.80m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP9

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP10

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T tracked excavator.		8.72	Kingsbridge Consultancy Limited	02.ROI18
	Location	**Dates**	**Engineer**	**Sheet**
	307019.8 E 304421.84 N	12/06/2018	Finn Design Partnership	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.35)	TOPSOIL.		
0.35	D1			8.37	0.35	Damp light grey brown silty sandy fine to coarse GRAVEL (damp). Gravel is sub-angular to sub-rounded.		
0.50	ES1							
1.00	ES2							
					(2.45)			
2.00	ES3							
2.80	D2			5.92	2.80			
					(0.30)	Firm to stiff friable light brown grey slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
3.00	ES4		Pit terminated due to encountering suspected bedrock. 12/06/2018:DRY	5.62	3.10	Complete at 3.10m		

Plan

Remarks

Pit side walls slightly unstable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:50	TS	02.ROI18.TP10

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP11

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator.		15.38	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306876.56 E 304239.78 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL.		
0.30	D1			15.08	0.30			
0.50	ES1				(0.30)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.60	D2			14.78	0.60			
1.00	ES2				(0.80)	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.40	D3			13.98	1.40			
2.00	ES3				(1.00)	Firm to stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
2.40	D4			12.98	2.40			
					(0.30)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
			Pit terminated due to encountering suspected bedrock. 12/06/2018:DRY	12.68	2.70	Complete at 2.70m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP11

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP12

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		16.07	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306922.36 E 304148.94 N	**Dates** 11/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20)	TOPSOIL.		
				15.87	0.20			
0.20	D1			15.77	0.30	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.30	D2							
0.50	ES1							
					(1.30)	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2							
				14.47	1.60			
						Firm to stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
2.00	ES3				(1.00)			
				13.47	2.60			
2.60	D3							
					(0.50)	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
			Pit terminated due to encountering suspected bedrock. 11/06/2018:DRY	12.97	3.10	Complete at 3.10m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:50	TS	02.ROI18.TP12

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP13

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		15.28	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306999.22 E 304199.02 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL.		
0.30	D1			14.98	0.30			
					(0.20)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.50	D2			14.78	0.50			
0.50	ES1					Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2				(1.10)			
1.60	D3			13.68	1.60	Firm to stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
2.00	ES3				(1.00)			
2.60	D4			12.68	2.60			
					(0.20)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
			Pit terminated due to encountering suspected bedrock. 12/06/2018:DRY	12.48	2.80	Complete at 2.80m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP13

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP14

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		14.06	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306940.76 E 304293.7 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.35)	TOPSOIL.		
0.35	D1			13.71	0.35	Highly weathered destructured GREYWACKE: Recovered as grey and light grey brown angular fine to coarse GRAVEL sized fragments in a silty clay matrix.		
					(0.70)			
			12/06/2018:DRY	13.01	1.05	Complete at 1.05m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP14

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP15

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T tracked excavator.		10.82	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306885.87 E 304404.37 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL.		
0.30	D1			10.52	0.30			
					(0.20)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Also containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.50	D2			10.32	0.50			
0.50	ES1					Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2				(1.30)			
1.80	D3			9.02	1.80			
2.00	ES3					Firm to stiff friable light brown grey slightly sandy slightly gravelly silty CLAY with cobble content. Gravel is fine to coarse, sub-angular to sub-rounded.		
					(1.20)			
3.00	ES4		Pit terminated due to encountering suspected bedrock. 12/06/2018:DRY	7.82	3.00	Complete at 3.00m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP15

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP16

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T tracked excavator.		10.01	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306950.41 E 304436.51 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.30	D1		12/06/2018:DRY	9.71	0.30 (0.30)	TOPSOIL.		
0.30	ES1					Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing roots and rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.40	D2			9.61	0.40 (0.10)			
						Highly weathered destructured GREYWACKE: Recovered as light grey and grey brown angular fine to coarse GRAVEL sized fragments.		
				9.41	0.60 (0.20)	Complete at 0.60m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP16

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP17

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		9.38	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306996.72 E 304498.59 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.35)	TOPSOIL.		
0.35	D1			9.03	0.35	Light grey brown silty fine SAND.		
0.50	ES1				(0.25)			
0.60	D2			8.78	0.60	Light grey brown silty fine SAND (damp).		
0.75	D3				(0.15)			
				8.63	0.75	Firm friable brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
					(0.25)			
1.00	D4			8.38	1.00	Grey brown silty sandy fine to coarse GRAVEL with cobble content (damp). Gravel is sub-angular to sub-rounded.		
1.00	ES2							
					(1.60)			
2.00	ES3							
				6.78	2.60	Firm to stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
2.60	D5							
					(0.50)			
3.00	ES4			6.28	3.10	Complete at 3.10m		
			Pit terminated due to encountering suspected bedrock. 12/06/2018:DRY					

Plan

Remarks

Pit side walls unstable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP17

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP18

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		9.09	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306950.73 E 304370.25 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.35)	TOPSOIL.		
				8.74	0.35			
0.35	D1				(0.25)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.50	ES1			8.49	0.60			
0.60	D2					Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2				(1.50)			
2.00	ES3							
2.10	D3			6.99	2.10			
					(0.20)	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to coarse GRAVEL sized fragments in a silty clay matrix.		
			12/06/2018:DRY	6.79	2.30			
						Complete at 2.30m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP18

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP19

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		10.12	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 307025.23 E 304317.03 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL.		
0.30	D1			9.82	0.30 (0.15)	MADE GROUND: Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.45	D2			9.67	0.45 (0.15)			
0.50	ES1					MADE GROUND: Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.60	D3			9.52	0.60 (0.50)	MADE GROUND: Soft grey brown slightly sandy slightly gravelly silty CLAY with cobble content. Also containing glass and ceramic remnants. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2			9.02	1.10 (0.70)	Soft to firm light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded. Becomes very stiff below 1.60m depth.		
1.10	D4							
1.80	D5			8.32	1.80 (0.60)	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to coarse GRAVEL in a silty clay matrix.		
2.00	ES3							
			12/06/2018:DRY	7.72	2.40	Complete at 2.40m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP19

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP20

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		13.06	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 307104.8 E 304241.59 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.35)	TOPSOIL.		
0.35	D1			12.71	0.35			
0.50	ES1				(0.50)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.85	D2			12.21	0.85			
1.00	ES2				(0.25)	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble content. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.10	D3			11.96	1.10			
					(0.30)	Highly weathered destructured GREYWACKE: Recovered as grey brown angular fine to coarse GRAVEL sized fragments in a silty clay matrix.		
			12/06/2018:DRY	11.66	1.40			
						Complete at 1.40m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP20

TP1

TP1 Sidewall

TP1 Spoil

TP1 Reinstatement

TP2

TP2 Sidewall

TP2 Spoil

TP2 Reinstatement

TP3

TP3 Sidewall

TP3 Spoil

TP3 Reinstatement

TP4

TP4 Sidewall

TP4 Spoil

TP4 Reinstatement

TP5

TP5 Sidewall

TP5 Spoil

TP5 Reinstatement

TP6

TP6 Sidewall

TP6 Spoil

TP6 Reinstatement

TP7

TP7 Sidewall

TP7 Spoil

TP7 Reinstatement

TP8

TP8 Sidewall

TP8 Spoil

TP8 Reinstatement

TP9

TP9 Sidewall

TP9 Spoil

TP9 Reinstatement

TP10

TP10 Sidewall

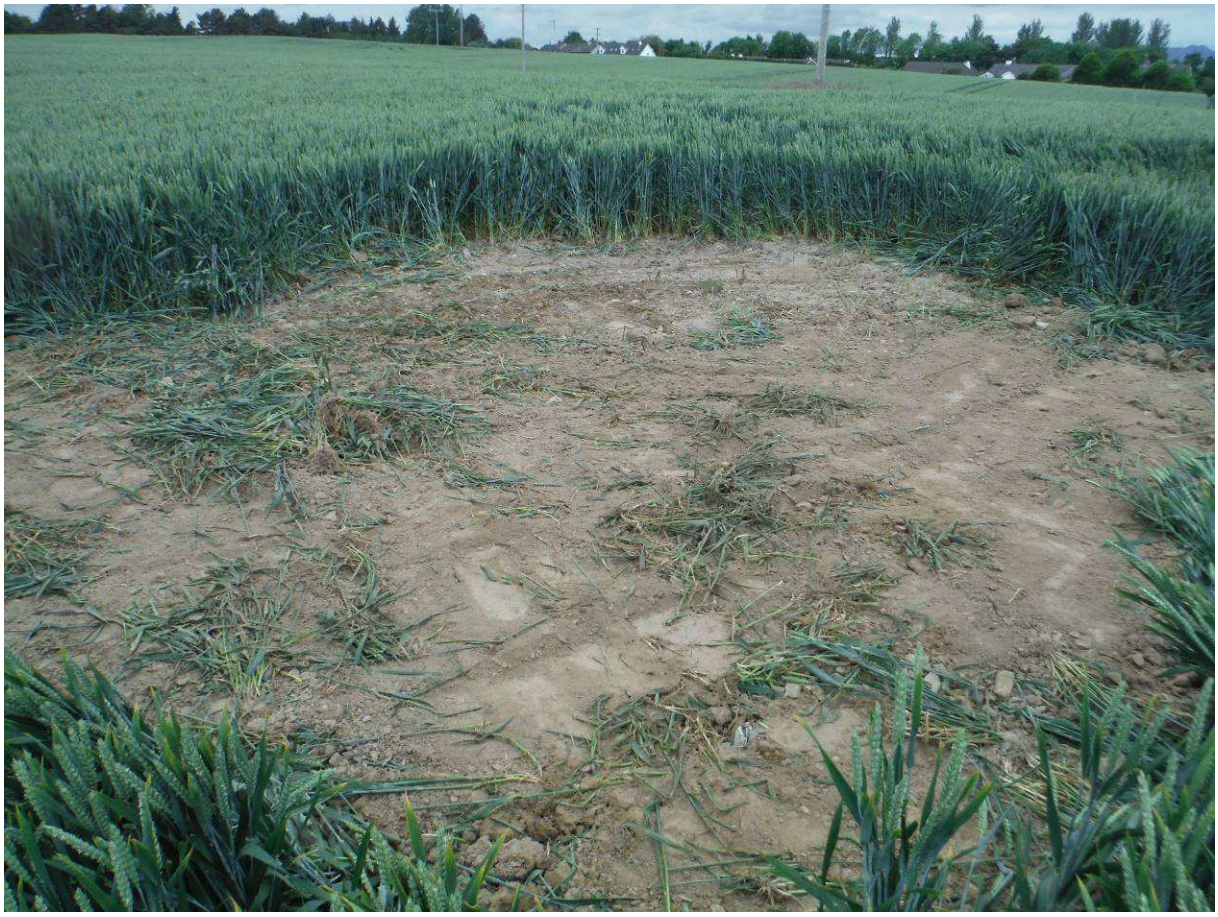
TP10 Spoil

TP10 Reinstatement

TP11

TP11 Sidewall

TP11 Spoil



TP11 Reinstatement

TP12

TP12 Sidewall

TP12 Spoil

TP12 Reinstatement

TP13

TP13 Sidewall

TP13 Spoil

TP13 Reinstatement

TP14

TP14 Sidewall

TP14 Spoil

TP14 Reinstatement

TP15

TP15 Sidewall

TP15 Spoil

TP15 Reinstatement

TP16

TP16 Sidewall

TP16 Spoil

TP16 Reinstatement

TP17

TP17 Sidewall

TP17 Spoil

TP17 Reinstatement

TP18

TP18 Sidewall

TP18 Spoil

TP18 Reinstatement

TP19

TP19 Sidewall

TP19 Spoil

TP19 Reinstatement

TP20

TP20 Sidewall

TP20 Spoil

TP20 Reinstatement

GEOTECHNICAL
ENVIRONMENTAL SERVICES
LIMITED

APPENDIX 4

GEOTECHNICAL AND GEOCHEMICAL LABORATORY RESULTS

GEOTECHNICAL
ENVIRONMENTAL SERVICES
LIMITED

Laboratory Test Results

Site : Proposed Residential Development, Blackrock, Dundalk, County Louth.

Client : Kingsbridge Consultancy Limited

Engineer : Finn Design Partnership

Job Number 02.ROI18

Sheet 1 / 1

DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY AND LIQUIDITY INDEX

Borehole/ Trial Pit	Depth (m)	Sample	Natural Moisture Content %	Sample Passing 425µm Sieve		Liquid Limit %	Plastic Limit %	Plasticity Index %	Liquidity Index	Modified Liquidity Index	Group Symbol	Laboratory Description
				Percentage %	Moisture Content %							
BH1	0.25	D1	10	56.7	18	34	17	17	0.06	-0.41	CL	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.
BH1	1.00	U1	11	49.5	22	31	14	17	0.47	-0.18	CL	Firm to stiff medium to high strength friable light grey brown slightly sandy slightly gravelly CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.
BH1	2.00	D4	10	51.4	19	33	13	20	0.30	-0.17	CL	Firm to stiff friable light brown grey slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.
BH2	1.00	U1	14	52.5	27	29	15	14	0.86	-0.07	CL	Firm to stiff medium to high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.
BH2	2.00	D4	12	52.5	23	30	15	15	0.53	-0.20	CL	Firm to stiff medium to high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.
BH2	3.00	U2	11	57.3	19	32	16	16	0.19	-0.31	CL	Firm to stiff medium to high strength friable brown grey slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.
BH3	0.25	D1	9	65.7	14	33	16	17	-0.12	-0.42	CL	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.
BH3	1.50	U1	11	59.3	19	30	14	16	0.31	-0.19	CL	Firm medium strength friable grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Also containing lenses of silty sandy fine to medium GRAVEL. Gravel is sub-angular to sub-rounded.
BH3	2.10	D7	10	56.8	17	32	15	17	0.12	-0.31	CL	Firm medium strength friable grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Also containing lenses of silty sandy fine to medium GRAVEL. Gravel is sub-angular to sub-rounded.
BH4	0.35	D1	10	63.5	16	35	17	18	-0.06	-0.39	CL/CI	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.
BH4	1.00	U1	11	61.4	18	33	17	16	0.06	-0.38	CL	Stiff high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.
BH5	0.30	D1	10	65.4	15	35	17	18	-0.11	-0.39	CL/CI	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.
BH5	1.00	U1	10	61.4	16	34	18	16	-0.13	-0.53	CL	Stiff high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.
BH5	2.00	D4	9	61.3	15	32	16	16	-0.06	-0.44	CL	Stiff high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.

Method of Preparation : BS 1377:PART 1:1990:7.4 Preparation of samples for classification tests BS 1377:PART 2:1990:4.2 & 5.2 Sample preparations

Method of Test : BS 1377:PART 2:1990:3 Determination of moisture content 1990:4 Determination of the liquid limit BS 1377:PART 2:1990:5 Determination of the plastic limit and plasticity index. Modified liquidity index based on natural moisture content

Remarks :

GEOTECHNICAL
ENVIRONMENTAL SERVICES
LIMITED

Laboratory Test Results

Site : Proposed Residential Development, Blackrock, Dundalk, County Louth.

Client : Kingsbridge Consultancy Limited

Engineer : Finn Design Partnership

Job Number 02.ROI18

Sheet 1 / 1

DETERMINATION OF DENSITY, MOISTURE CONTENT AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Trial Pit	Depth (m)	Sample	Moisture Content %	Bulk Density (Mg/m^3)	Dry Density (Mg/m^3)	Cell Pressure (kN/m^2)	Deviator Stress (kN/m^2)	Apparent Cohesion (kN/m^2)	Angle of Shearing Resistance (degrees)	Laboratory Description
BH1	1.00	U1	11	2.11	1.90	20	144	72		Firm to stiff medium to high strength friable light grey brown slightly sandy slightly gravelly CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.
BH2	1.00	U1	14	2.02	1.78	20	136	68		Firm to stiff medium to high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.
BH2	3.00	U2	11	2.14	1.93	60	146	73		Firm to stiff medium to high strength friable brown grey slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.
BH3	1.50	U1	11	2.05	1.86	30	112	56		Firm medium strength friable grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Also containing lenses of silty sandy fine to medium GRAVEL. Gravel is sub-angular to sub-rounded.
BH4	1.00	U1	11	2.10	1.89	20	168	84		Stiff high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.
BH5	1.00	U1	9.6	2.24	1.95	20	154	79		Stiff high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.

Method of Preparation : BS 1377:PART 1:1990:7.4.2 Moisture content 1990: Preparation of undisturbed samples for testing BS 1377:PART 2:1990:7.2

Method of Test : BS 1377:PART 2:1990:3 Determination of moisture content 1990:7 Determination of density BS 1377:PART 7:1990:8 Undrained shear strength 1990:8 Single stage loading

Remarks :

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Laboratory Test Results

Site : Proposed Residential Development, Blackrock, Dundalk, County Louth.

Client : Kingsbridge Consultancy Limited

Engineer : Finn Design Partnership

Job Number 02.ROI18

Sheet 1 / 1

DETERMINATION OF THE pH VALUE AND THE SULPHATE CONTENT OF SOIL AND GROUNDWATER

Borehole/ Trial Pit	Depth (m)	Sample	Concentration of Soluble Sulphate			Percentage of sample passing 2mm Sieve %	pH	Classification	Laboratory Description
			Soil		Groundwater g /l				
			Total S03 %	S04 in 2:1 water:soil g /l					
BH1	0.25	D1		0.04			8.1	DS-1	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.
BH1	0.80	D2		0.00			8.0	DS-1	Firm to stiff medium to high strength friable light grey brown slightly sandy slightly gravelly CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.
BH1	2.00	D4		0.00			8.0	DS-1	Firm to stiff friable light brown grey slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.
BH2	0.30	D1		0.03			8.0	DS-1	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.
BH2	1.45	D3		0.02			7.9	DS-1	Firm to stiff medium to high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.
BH2	3.60	D7		0.01			8.2	DS-1	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to course GRAVEL sized fragments in a silty clay matrix.
BH3	0.55	D2		0.04			7.9	DS-1	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.
BH3	1.00	D3		0.01			8.1	DS-1	Medium dense brown grey silty sandy fine to medium GRAVEL. Gravel is sub-angular to sub-rounded.
BH3	2.65	D8		0.01			8.5	DS-1	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to course GRAVEL sized fragments in a silty clay matrix.
BH4	0.90	D2		0.05			8.0	DS-1	Stiff high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.
BH4	1.45	D3		0.03			8.1	DS-1	Stiff high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.
BH4	1.70	D4		0.01			8.0	DS-1	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to course GRAVEL sized fragments in a silty clay matrix.
BH5	0.70	D2		0.03			8.1	DS-1	Stiff high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.
BH5	1.45	D3		0.02			8.0	DS-1	Stiff high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.
BH5	2.55	D5		0.04			8.2	DS-1	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to course GRAVEL sized fragments in a silty clay matrix.

Method of Preparation : BS 1377:PART 1:1990:7.5 Preparation of soil for chemical tests BS 1377:PART 3:1990:5.2, 5.3, 5.4 & 9.4

Method of Test : Laboratory in-house methods based on BS1377: Part 3 for contents of water soluble sulphate, total sulphate and pH.

Remarks : Classification relates to Design Sulphate Class of BRE Special Digest 1 (2005)

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APPENDIX 5

PRELIMINARY RISK ASSESSMENT (PRA) AND GENERIC QUANTITATIVE RISK ASSESSMENT (GQRA) REPORTS

Project

Proposed Residential Development

Lands at Blackrock, Dundalk

Combined Preliminary (PRA) and Generic Quantitative Risk Assessment (GQRA)

Client

GES Ltd

Date

July 2018

Prepared By

Simon Wood

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Site Location Plan

Proposed Site Development Plan

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APPENDIX A – Borehole Logs

APPENDIX B – Lab Analysis

APPENDIX C – Standpipe Monitoring Data

1.0 INTRODUCTION

1.1 REPORT BRIEF

Cove Environmental Consulting were appointed by GES Ltd on behalf of their client, Kingsbridge Consultancy Ltd to undertake a preliminary risk assessment of lands in relation to a residential development on lands at Blackrock, Dundalk, Co. Louth.

This assessment will determine the presence of contamination, migration pathways and form an assessment of hazards and risks associated with these and the extent of any environmental liability.

The process is based on making a qualitative Risk Assessment using the source-pathway-receptor model.

This report is prepared in accordance with current industry standard practice and existing legislation at the time of writing particularly the DEFRA / Environment Agency guidance document *"CLR 11 – Model Procedures for the Management of Land Contamination".*

Guidance documents used which refer UK / European documents also relevant to Republic of Ireland sites and are in compliance with Environmental Protection Agency standards.

2.0 PRELIMINARY RISK ASSESSMENT (PRA)

The desk top Preliminary Risk Assessment was completed using researches into available documentary evidence for the site and surrounding area.

The main sources used to compile the information in this risk assessment are listed below:

- Current and historical Ordnance Survey of Ireland maps;
- Current and historical geological information held by Geological Survey of Ireland;
- Information made available by Environmental Protection Agency;
- Other sources as appropriate.

2.1 SITE DETAILS

The environmental setting of the site is illustrated below:

Photo 1: Location of Site

Address	Lands to South of Bothar Maol, Blackrock, Dundalk
Council Area	Louth County Council
Current Use of Site	Agricultural Lands
Approximate Area of Site	Approximately 9 hectares

The main land uses in the immediate surrounding area are as described below:

North	Residential, Industrial beyond
South	Agricultural, residential beyond
East	Some residential, undeveloped land.

West	Golf course, agricultural beyond

2.2 Environmental Setting Of Site

2.2.1 Site Description And Current Use

The site is currently used for agricultural purposes. At the time of writing the fields were used for the growing of barley. There is a hedgerow running down the (approximate) centreline of the site.

Photo 2: Aerial View of Site Looking towards the North

Photos 3 & 4: View of Site Looking towards East (from NW and N of site)

Photos 5 & 6: View of Site showing Central Hedgerow (5) and Looking South (6)

Photo 7: Entrance to Site from Bothar Maol (looking South)

There is a small disused pumping station in the northwestern corner of the site.

The site is rises towards the south from the Bothar Maol along the northern boundary before cresting in the centre of the site and falling again slightly towards the south. Overall there is a general fall in levels towards the west with other local undulations across the site area.

The lands to the immediate north of the site are residential dwellings along the south side of the Bothar Maol. Beyond that there are a number of industrial premises within the Finnibair Industrial Park. The lands to the west are a golf course with agricultural lands beyond that.

To the east there are a few scattered residential properties within generally undeveloped lands towards the coast – the high water mark for the Irish Sea is approximately 250 / 300m to the east of the site boundary.

To the south there are agricultural fields with the village of Blackrock beyond.

2.2.2 GEOLOGY

Published geological maps for the area indicate that the general sequence of geology is expected to be:

Superficial Deposits

- Glacial Till (Boulder Clay) underlying the site

Bedrock

- Greywacke

A review of geological maps for the site would suggest that the drift geology beneath the site comprises glacial till (boulder clay) derived from Lower Palaeozoic sandstones and shales.

The solid geology underlying the area comprises a greywacke which is described as being green-grey, medium to thickly bedded, coarse and very fine grained Tae greywackes, with dark grey, thinly bedded, poorly graded, quartzose fine sandstone to siltstone units. Both lithologies contain distinctive brown-red coloured biotite. There are noted to be possible outcrops of bedrock to the north and south of the site.

2.3 HYDROLOGY AND HYDROGEOLOGY OF AREA

2.3.1 HYDROLOGY

No water courses are present within the boundary of the site. There are a number of small streams and field drains around the site to the east and south together with some small water features within the golf course itself to the west. There is a small drainage ditch which runs along the northern side of Bothar Maol.

The main drainage feature within the locality is the sea itself located to the east of the site.

2.3.2 GROUNDWATER CLASSIFICATION

Published data from Geological Survey Ireland indicates that the groundwater vulnerability of the immediate area is Class "E" Extreme. This map also highlights the areas of bedrock outcrop near the surface.

The aquifer itself is categorized as PI - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones.

2.3.3 HISTORICAL SITE USES

In order to determine the site's history of use, a site walkover was undertaken and the following sources consulted:

- Information contained in the Land Quality Database held by NIEA;
- Historical Ordnance Survey maps.

The information obtained from the historical searches is presented following:

Table 1: Historical Land Uses

Date	Historical Land Uses
1837	 *Site Area:* Undeveloped *Surrounding Area:* Area generally undeveloped and only a few small farm dwelling present in local area

1888-1913	 *Site Area*: Undeveloped *Surrounding Area*: Area still generally undeveloped. Road network shown clearly to the west of the site. Dundalk town beginning to expand to the north and the village of Blackrock appearing to the south
1995	 *Site:* No change – fields shown in agriculture *Surrounding Area:* Golf course now present to west, residential dwellings along Bothar Maol to the north and the beginnings of the industrial development beyond these shown.

2000	 *Site:* No significant changes *Surrounding Area:* No significant changes
Present Day (recent)	 *Site:* No changes on the site *Surrounding Area:* Increased industrial development to north and increase in size of Blackrock village to the south. No other significant changes

3.0 PRELIMINARY CONCEPTUAL SITE MODEL

The Preliminary Risk Assessment has identified the following source-pathway-receptor linkages in relation to the site.

3.1 POTENTIAL SOURCES

The research has indicated that the site has always been used for agricultural purposes and therefore there are no sources of potential contamination linked to the site itself. There is no evidence of any significant quantities of made ground within the site area (localised area around TP19 only).

The surrounding area is a mix of residential (north & south), golf course (west), agricultural / undeveloped (east) and industrial (north). As such, the identified sources of potential contamination are:

- Potential for hydrocarbons to be present in the shallow soils as a result of historic spills / leakages from residential heating oils - hydrocarbons
- Potential spillages and leakages from the industrial activities to the north of the site – hydrocarbons, metals

3.2 POTENTIAL RECEPTORS AND PATHWAYS

There are a number of potential receptors identified:

HUMAN HEALTH

There may be a potential risk to future site residents and construction workers through direct exposure, including:

- dermal absorption
- inhalation of soil / dust or volatilised compounds (vapours) / ground gases
- soil ingestion
- plant uptake of contaminants followed by human consumption e.g. vegetables grown within gardens.

BUILDINGS AND SERVICES

Any proposed on-site buildings / development may be at risk from ingress of ground gas released from any degradable material within the infilled made ground (if present). In addition, contaminants within

the soil could potentially impact upon the integrity of concrete, metal, rubber and plastic building fabrics with which they come in contact.

Environmental Receptors and Off Site Migration

Given the nature of the ground (both the soil type and the topography of the site) it is considered unlikely that significant lateral or vertical migration would occur therefore there is not considered to be a risk to surface water courses in the area or the groundwaters within the underlying low quality aquifer.

4.0 PRELIMINARY RISK ASSESSMENT CONCLUSIONS

The desk study concludes that there may be a potential for a contamination linkage to be present at this site:

- The site itself has always been undeveloped lands. Historical mapping and aerial photographs show the site to have been used for agricultural purposes. The site (at time of writing) was being used for the growing of barley;

- There is the potential for spillages / leaks of fuels etc resulting from the storage of residential heating / fuel oils in the vicinity of the site however the likelihood is low that there would be significant lateral migration towards the site;

- Similarly, there is the potential for spillages / leaks of fuels from the industrial activities to the north of the site. Again, however, the likelihood is low that there would be significant lateral migration towards the site;

- There is the potential for low quality made ground to be present below the ground in localized areas of the site, however given the history of the site and the topography of the area it is considered to be of a low likelihood and risk.

The Preliminary Risk Assessment indicated a very low potential for contamination to be present at the site however an intrusive investigation was undertaken for geotechnical purposes and therefore sampling was included to confirm the conclusions of the PRA.

5.0 SITE INVESTIGATIONS

An intrusive investigation was undertaken on the site in June 2018. This investigations comprised of 5 boreholes within the proposed development area to a maximum depth of 4.37mbgl and 20 No. trial pits to a maximum depth of 3.9mbgl. The intrusive works were undertaken by GES Ltd.

3 No. of the boreholes were installed with HDPE pipe, gravel pack and bentonite seal to allow for subsequent groundwater sampling and gas monitoring.

These boreholes confirmed that the ground conditions were as largely as anticipated within the PRA, namely:

- Topsoil;
- Glacial Till (Clay);
- Greywacke Bedrock generally at shallow depth.

Full details of the ground conditions encountered are contained within the borehole logs appended to this report.

Note that a small quantity of made ground was noted in TP19 to the eastern boundary of the site. This appears to be a small isolated area of rubble and not a significant quantity of made ground.

5.1 GROUNDWATER

No groundwater was noted during the drilling and the wells were also dry on subsequent site visits.

6.0 GENERIC QUANTITATIVE RISK ASSESSMENT (GQRA)

6.1 LABORATORY ANALYSIS ON SOIL SAMPLES

Chemical testing was scheduled in samples recovered from the boreholes during drilling. The results of the chemical testing of soil samples are contained within the Appendices and are summarised in Table 2.

The CLEA v1.04 model published by DEFRA and the UK Environment Agency (EA) in August 2008, sets a framework for the appropriate assessment of risks to human health from contaminated land. As part of this framework, generic Soil Guideline Values (SGV's) have currently been derived for a number of contaminants to be used as “intervention values”. These values should not be considered as remedial targets but values above which further detailed assessment should be considered.

Three sets of CLEA SGV’s have recently (March 2009) been produced for three different land uses, namely residential, allotments and commercial/industrial. It should be noted that the CLEA SGV’s relate to assessing chronic (long-term) risks to Human Health and do not apply to the potential short-term exposure risk to ground workers, or other potential receptors such as groundwater, buildings, plants or other ecosystems. The CLEA SGV’s are not directly applicable to a site completely covered in hardstanding as there is no direct exposure route to contaminated soils.

To date, 11 SGV’s have been published for the following: arsenic, nickel, cadmium, phenol, mercury, selenium, benzene, toluene, ethylbenzene, xylenes and dioxins. The SGV for mercury was derived for 3 mercury compounds. This detail of analysis was not undertaken during the investigation works and therefore the *ATRISK*^{SOIL} value for mercury has been utilised.

Where published CLEA soil guideline values were not yet available for individual contaminants, guidelines established using the *LQM/CIEH 'Suitable 4 Use Levels'* were used together with the *ATRISK*^{SOIL} values.

The Water Regulations Advisory Scheme (WRAS) was used in the absence of *ATRISK*^{SOIL} values.

For this assessment the guideline values used were those for a residential end use with plant uptake.

Table 2: Exceedance of Guideline Levels (Residential End-Use with Gardens)

Contaminant	Effect	Measured Exceedance Concentrations (mg/kg)		SGV/GSV/ SSV (mg/kg)	Source
		Number of Exceedences	Location of Exceedences		
Arsenic	Toxic	0	-	37	LQM/CIEH S4ULs (2015)
Mercury (Inorganic)	Toxic	0	-	40	LQM/CIEH S4ULs (2015)
Chromium III	Toxic	0	-	910	LQM/CIEH S4ULs (2015)
Lead	Toxic	0	-	200	ATRISK (2015)
Cadmium	Toxic	0	-	11	LQM/CIEH S4ULs (2015)
Selenium	Toxic	0	-	250	LQM/CIEH S4ULs (2015)
Nickel	Toxic	0	-	180	LQM/CIEH S4ULs (2015)
Copper	Toxic	0	-	2400	LQM/CIEH S4ULs (2015)
Zinc	Toxic	0	-	410	LQM/CIEH S4ULs (2015)
Petroleum Hydrocarbons					
Aliphatic C5-C6	Toxic	0	-	42	LQM/CIEH S4ULs (2015)
Aliphatic C6-C8	Toxic	0	-	100	LQM/CIEH S4ULs (2015)
Aliphatic C8-C10	Toxic	0	-	27	LQM/CIEH S4ULs (2015)
Aliphatic C10-C12	Toxic	0	-	130	LQM/CIEH S4ULs (2015)
Aliphatic C12-C16	Toxic	0	-	1100	LQM/CIEH S4ULs (2015)
Aliphatic C16-C35	Toxic	0	-	65,000	LQM/CIEH S4ULs (2015)
Aromatic C5-C7 (Benzene)	Toxic	0	-	70	LQM/CIEH S4ULs (2015)
Aromatic C7-C8 (Toluene)	Toxic	0	-	130	LQM/CIEH S4ULs (2015)
Aromatic C8-C10	Toxic	0	-	34	LQM/CIEH S4ULs (2015)
Aromatic C10-C12	Toxic	0	-	74	LQM/CIEH S4ULs (2015)
Aromatic C12-C16	Toxic	0	-	140	LQM/CIEH S4ULs (2015)
Aromatic C16-C21	Toxic	0	-	260	LQM/CIEH S4ULs (2015)
Aromatic C21-C35	Toxic	0	-	1100	LQM/CIEH S4ULs (2015)
PAHs					
Acenaphthene	Toxic	0	-	210	LQM/CIEH S4ULs (2015)
Acenaphthylene	Toxic	0	-	170	LQM/CIEH S4ULs (2015)
Anthracene	Toxic	0	-	2400	LQM/CIEH S4ULs (2015)
Benz(a)anthracene	Toxic	0	-	7.2	LQM/CIEH S4ULs (2015)
Benzo(a)pyrene	Toxic	0	-	2.2	LQM/CIEH S4ULs (2015)
Benzo(b)fluoranthene	Toxic	0	-	2.6	LQM/CIEH S4ULs (2015)
Benzo(g,h,i)perylene	Toxic	0	-	320	LQM/CIEH S4ULs (2015)
Benzo(k)fluoranthene	Toxic	0	-	77	LQM/CIEH S4ULs (2015)
Chrysene	Toxic	0	-	15	LQM/CIEH S4ULs (2015)
Dibenz(a,h)anthracene	Toxic	0	-	0.24	LQM/CIEH S4ULs (2015)
Fluoranthene	Toxic	0	-	280	LQM/CIEH S4ULs (2015)
Fluorene	Toxic	0	-	170	LQM/CIEH S4ULs (2015)
Indeno(1,2,3-CD) Pyrene	Toxic	0	-	27	LQM/CIEH S4ULs (2015)
Naphthalene	Toxic	0	-	2.3	LQM/CIEH S4ULs (2015)
Phenanthrene	Toxic	0	-	95	LQM/CIEH S4ULs (2015)
Pyrene	Toxic	0	-	620	LQM/CIEH S4ULs (2015)

* Based on SOM of 1%. Phytotoxic values based on pH of 6.0 – 7.0.

As noted, the threshold values for residential with homegrown produce have been used.

Of the samples analysed, generally, all potential contaminants were found to be below the respective threshold values used. The majority were also found to be below the lab detection limits.

6.2 LABORATORY ANALYSIS OF GROUNDWATER SAMPLES

Insufficient quantities of groundwaters were found to be present during the monitoring rounds.

6.3 GROUND GAS EMISSIONS

6.3.1 METHANE AND CARBON DIOXIDE

Gas generation was monitored from the installed boreholes.

The complete listing of gas results can be found within the Appendices to this report and are summarised in Table 4 following:

Table 4: Summary of Gas Monitoring Results (Max Values Used)

	CH_4 (Max) (%vol/vol)	CO_2 (Max) (%vol/vol)	Max Flow (l/hr)	Gas Screening Value CH_4	Gas Screening Value / CO_2	Risk Classification (after CIRIA 665 Table 8.5)
BH1	0.0	0.6	0.1 [1]	0.0	0.0	1 Very Low Risk
BH2	0.0	0.2	0.1 [1]	0.0	0.0001	1 Very Low Risk
BH4	0.0	2.8	0.1 [1]	0.0	0.0028	1 Very Low Risk

Note: [1] When zero flow is detected the meter detection limit is used (i.e. 0.1)

The gas monitoring results were classified according to the Characteristic Situations outlined in the CIRIA C665 documentation *"Assessing risks posed by hazardous ground gases to Buildings"* with the relevant table extracted and shown in Table 5 following:

Table 5: Classification System for Gassing Sites (after CARD Geotechnics)

Characteristic Situation	Limiting Volume Flow CH4/CO2 (l/hr)	Additional Limiting Factors	Source of Gas Generation
1	<0.07	Methane <1% and Carbon Dioxide <5%	Natural soils with low organic content
2	<0.7	Borehole air flow rate >70l/hr increase to Characteristic Situation 4	Natural soil, high peat/organic content

3	<3.5	Borehole air flow rate >70l/hr increase to Characteristic Situation 4	Old landfill, inert waste, mine working flooded
4	<15	Quantitative risk assessment required to evaluate scope of protection measures	Mine working susceptible to flooding, completed landfill, inert waste (WMP 26B criteria)
5	<70		Mine working unflooded inactive
6	>70		Recent landfill site

It is considered that the site will fall into the low risk situation (Situation 1).

6.3.2 RADON

The site is not located in an area of high radon generation based on the Environmental Protection Agency published mapping. The site is in an area where 5-10% of homes may be above the reference level and a radon barrier is not considered to be required.

7.0 CONCLUSIONS

The level of risk has been assessed using the data obtained from the site investigation and the potential source-pathway-linkages indentified within the Preliminary Risk Assessment.

7.1 HUMAN HEALTH

The levels of contaminants were generally all detected below the relevant human health guideline values used and thus there is not considered any significant risk to human health from this site.

7.2 BUILDINGS AND SERVICES

Levels of gas generation within the ground were recorded as low with the site falling into the Low Risk category.

7.3 ENVIRONMENT AND THIRD PARTY SITES

Very low quantities of water were detected within the boreholes (with many being dry). As a result it is considered that there is no significant movement of groundwater (or any contaminants) either laterally or vertically and thus the potential for transfer of contaminants to the groundwater, surface waters or third party sites is considered insignificant.

8.0 REMEDIATION RECOMMENDATIONS

Based on the findings of the site assessment, no remedial measures are considered to be required at this site.

In accordance with good site practice construction personnel involved in the excavation of service trenches should be notified of the nature of the materials which may be present. Vigilance should be maintained during the works for evidence of any ground conditions, which may be at variance with those discussed in this report. This is in accordance with current Health & Safety Legislation. Any other measures deemed necessary should be implemented in conjunction with the provision of a detailed site works risk assessment which should include a COSHH risk assessment.

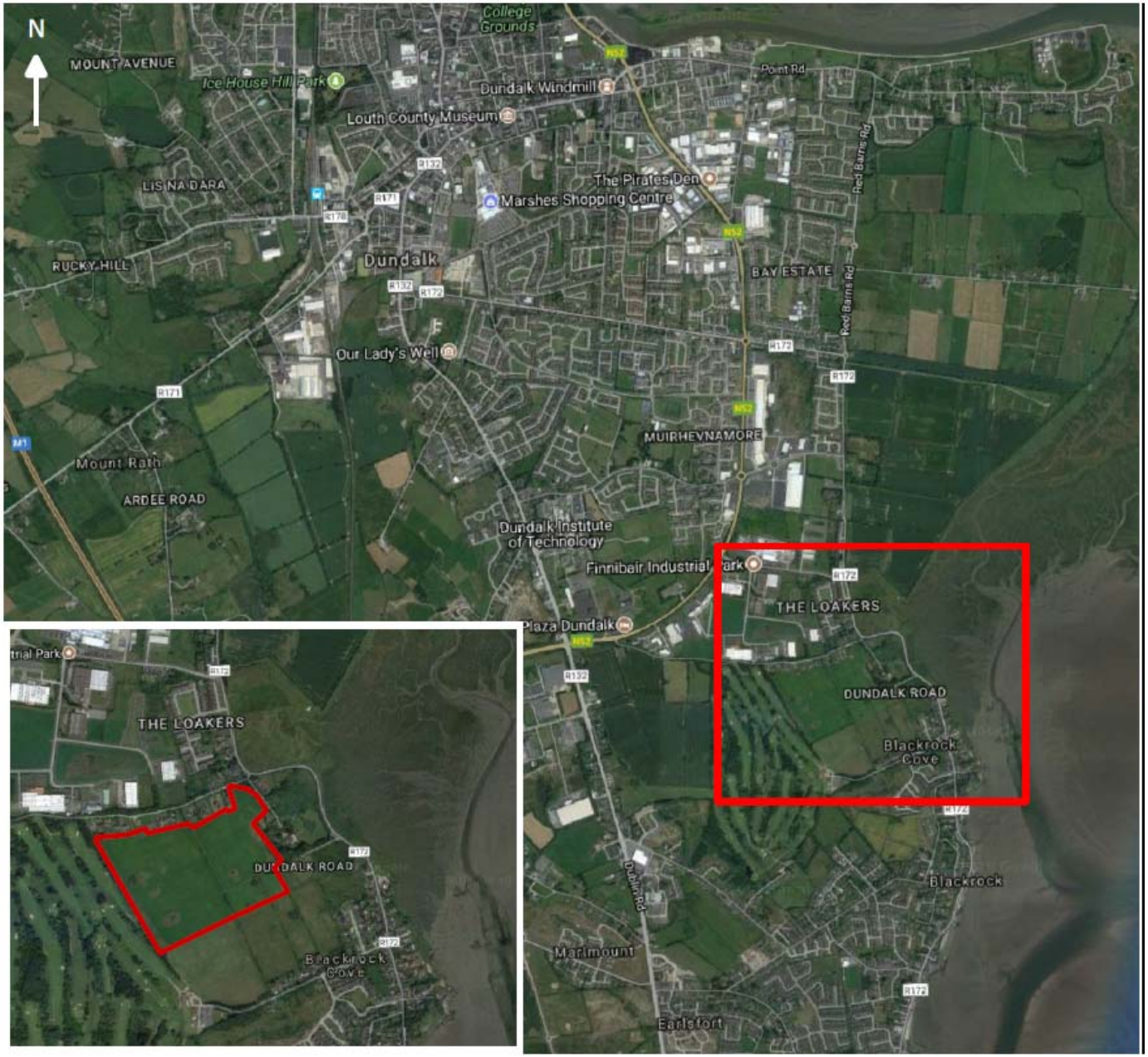
In the event that material, uncharacteristic to that which has been previously identified within the site is encountered in excavations, we would recommend that a suitably qualified engineer/scientist is engaged to obtain samples of the suspect material for chemical analysis, to determine how the material should be managed.

For off-site material disposal it will be necessary for the developer to provide the EPA and receiving landfill with approximate volumes for materials arising from foundation excavations and service trenches, with supporting chemical analyses. This should be used to identify an appropriately licensed landfill facility that is permitted to receive the contaminated soil materials, based on its classification as inert, non-hazardous or hazardous material in accordance with the conditions listed in current waste acceptance criteria.

Formal notification should be made to the Environmental Protection Agency prior to the movement of any waste materials offsite, and a system of consignment notes and tip receipts should be used to protect the developer.

FIGURES

SITE LOCATION PLAN



COVE ENVIRONMENTAL CONSULTANCY

Site Location Plan

Proposed Residential Development – Blackrock, Dundalk

Client: GES Ltd

Date: July 2018

Key:

Approximate Borehole Location

Approximate Trial Pit Location

Figure: CEC-1

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COVE ENVIRONMENTAL CONSULTANCY

Trial Pit & Borehole Location Plan

Proposed Residential Development – Blackrock, Dundalk

Client: GES Ltd

Date: July 2018

Key:

Approximate Borehole Location

Approximate Trial Pit Location

Figure: CEC-2

COVE ENVIRONMENTAL CONSULTING

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APPENDIX A

BOREHOLE LOGS

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site
Proposed Residential Development, Blackrock, Dundalk, County Louth.

Borehole Number
BH1

Boring Method
Geoprobe 6620DT Drill Rig. Percussion sampling to 3.60m depth.

Casing Diameter
Borehole diam. 101mm to 3.60m

Ground Level (mOD)
16.98

Client
Kingsbridge Consultancy Limited

Job Number
02.ROI18

Location (Handheld GPS)
306654.9 E 304337.21 N

Dates
14/06/2018

Engineer
Finn Design Partnership

Sheet
1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(0.25)	TOPSOIL.			
0.25	D1				16.73	0.25	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.			
0.50	ES1					(0.55)				
0.80	D2				16.18	0.80	Firm to stiff medium to high strength friable light grey brown slightly sandy slightly gravelly CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.			
1.00 1.00-1.45	ES2 U1		DRY	72 blows						
1.45	D3					(1.20)				
2.00-2.45 2.00 2.00 2.00-2.45	SPT N=19 D5 ES3 D4		DRY	3,3/3,6,5,5	14.98	2.00	Firm to stiff friable light brown grey slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.			
						(0.80)				
2.80	D6				14.18	2.80	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular GRAVEL sized fragments in a silt matrix.			
3.00-3.45 3.00 3.00-3.45	SPT N=22 ES4 D7		DRY	3,7/6,3,5,8						
						(0.94)				
3.60-3.74 3.60-3.74	SPT 25*/50 50/90 D8		3.64	25/43,7 Steady(1) at 3.64m. 14/06/2018:3.64m	13.24	3.74	Complete at 3.74m		▽1	

Remarks
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)
1:25

Logged By
TS

Figure No.
02.ROI18.BH1

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site
Proposed Residential Development, Blackrock, Dundalk, County Louth.

Borehole Number
BH1

Installation Type
Standpipe

Dimensions
Internal Diameter of Tube [A] = 50 mm
Diameter of Filter Zone = 101 mm

Client
Kingsbridge Consultancy Limited

Job Number
02.ROI18

Location
306654.9 E 304337.21 N

Ground Level (mOD)
16.98

Engineer
Finn Design Partnership

Sheet
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Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
			16.88	0.10	Concrete
					Bentonite Seal
			16.48	0.50	
					Slotted Standpipe
	▽1		13.24	3.74	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings				Depth Sealed (m)
					5 min	10 min	15 min	20 min	
14/06/18		3.64		Steady					

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
14/06/18							3.74		3.64	13.34

Instrument Groundwater Observations

Inst. [A] Type : Standpipe

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	
19/06/18		3.59	13.39	Insufficient water to sample
25/06/18		3.62	13.36	Insufficient water to sample
28/06/18		3.62	13.36	Insufficient water to sample

Remarks
Flush lockable cover.
Gas bung.
Geotextile filter sock surround to well screen section.

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site
Proposed Residential Development, Blackrock, Dundalk, County Louth.

Borehole Number
BH2

Boring Method
Geoprobe 6620DT Drill Rig. Percussion sampling to 4.0m depth.

Casing Diameter
Borehole diam. 101mm to 4.00m

Ground Level (mOD)
21.20

Client
Kingsbridge Consultancy Limited

Job Number
02.ROI18

Location (Handheld GPS)
306780.67 E 304123.71 N

Dates
13/06/2018

Engineer
Finn Design Partnership

Sheet
1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(0.30)	TOPSOIL.			
0.30	D1				20.90	0.30	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.			
0.50	ES1					(0.70)				
1.00	D2				20.20	1.00	Firm to stiff medium to high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.			
1.00	ES2									
1.00-1.45	U1		DRY	46 blows						
1.45	D3									
2.00-2.45	SPT N=27		DRY	2,4/4,4,4,15		(2.00)				
2.00	ES3									
2.00-2.45	D4									
3.00	D5				18.20	3.00	Firm to stiff medium to high strength friable brown grey slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.			
3.00	ES4									
3.00-3.45	U2		DRY	66 blows		(0.60)				
3.45	D6									
3.60	D7				17.60	3.60	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to course GRAVEL sized fragments in a silty clay matrix.			
4.00-4.37	SPT 50/220		DRY	1,5/10,13,23,4		(0.77)				
4.00-4.37	D8									
				13/06/2018:DRY	16.83	4.37	Complete at 4.37m			

Remarks
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)
1:25

Logged By
TS

Figure No.
02.ROI18.BH2

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site
Proposed Residential Development, Blackrock, Dundalk, County Louth.

Borehole Number
BH2

Installation Type
Standpipe

Dimensions
Internal Diameter of Tube [A] = 50 mm
Diameter of Filter Zone = 101 mm

Client
Kingsbridge Consultancy Limited

Job Number
02.ROI18

Location
306780.67 E 304123.71 N

Ground Level (mOD)
21.20

Engineer
Finn Design Partnership

Sheet
1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
			21.10	0.10	Concrete
					Bentonite Seal
			20.70	0.50	
					Slotted Standpipe
			17.20	4.00	Bentonite Seal
			16.83	4.37	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings				Depth Sealed (m)
					5 min	10 min	15 min	20 min	

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
13/06/18							4.37		DRY	

Instrument Groundwater Observations

Inst. [A] Type : Standpipe

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	
19/06/18		DRY		
25/06/18		DRY		
28/06/18		DRY		

Remarks
Flush lockable cover.
Gas bung.
Geotextile filter sock surround to well screen section.

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site
Proposed Residential Development, Blackrock, Dundalk, County Louth.

Borehole Number
BH3

Boring Method
Geoprobe 6620DT Drill Rig. Percussion sampling to 3.0m depth.

Casing Diameter
Borehole diam. 101mm to 3.00m

Ground Level (mOD)
12.60

Client
Kingsbridge Consultancy Limited

Job Number
02.ROI18

Location (Handheld GPS)
306842.78 E 304306.16 N

Dates
13/06/2018

Engineer
Finn Design Partnership

Sheet
1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.25)	TOPSOIL.		
0.25	D1				12.35	0.25	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.		
						(0.30)			
0.50	ES1				12.05	0.55	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.55	D2								
						(0.45)			
1.00-1.45	SPT N=17		DRY	3,5/7,4,3,3	11.60	1.00	Medium dense brown grey silty sandy fine to medium GRAVEL. Gravel is sub-angular to sub-rounded.		
1.00	D3								
1.00	ES2					(0.30)			
1.00-1.45	D4								
1.30	D5				11.30	1.30	Firm medium strength friable grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Also containing lenses of silty sandy fine to medium GRAVEL. Gravel is sub-angular to sub-rounded.		
1.50-1.95	U1		DRY	53 blows					
						(1.35)			
1.95	D6								
2.00	ES3								
2.10-2.55	SPT N=13		DRY	2,2/3,3,3,4					
2.10-2.55	D7								
2.65	D8				9.95	2.65	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to course GRAVEL sized fragments in a silty clay matrix.		
3.00-3.40	SPT 50/250		DRY	6,7/8,13,16,13		(0.75)			
3.00-3.40	D9								
				13/06/2018:DRY	9.20	3.40	Complete at 3.40m		

Remarks
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)
1:25

Logged By
TS

Figure No.
02.ROI18.BH3

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site
Proposed Residential Development, Blackrock, Dundalk, County Louth.

Borehole Number
BH4

Boring Method
Geoprobe 6620DT Drill Rig. Percussion sampling to 2.0m depth.

Casing Diameter
Borehole diam. 101mm to 2.00m

Ground Level (mOD)
9.88

Client
Kingsbridge Consultancy Limited

Job Number
02.ROI18

Location (Handheld GPS)
306941.38 E 304407.86 N

Dates
13/06/2018

Engineer
Finn Design Partnership

Sheet
1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(0.35)	TOPSOIL.			
0.35	D1				9.53	0.35	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.			
0.50	ES1					(0.55)				
0.90	D2				8.98	0.90	Stiff high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.			
1.00-1.45	SPT N=21		DRY	2,2/3,5,6,7						
1.00	ES2									
1.00-1.45	U1		DRY	56 blows		(0.80)				
1.45	D3									
1.70	D4				8.18	1.70	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to course GRAVEL sized fragments in a silty clay matrix.			
2.00-2.23	SPT 25*/100 50/130		DRY	18,7/30,20		(0.53)				
2.00-2.23	D5				7.65	2.23	Complete at 2.23m			
				13/06/2018:DRY						

Remarks
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)
1:25

Logged By
TS

Figure No.
02.ROI18.BH4

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Borehole Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	BH4

Installation Type	Dimensions	Client	Job Number
Single Installation	Internal Diameter of Tube [A] = 50 mm Diameter of Filter Zone = 101 mm	Kingsbridge Consultancy Limited	02.ROI18

Location	Ground Level (mOD)	Engineer	Sheet
306941.38 E 304407.86 N	9.88	Finn Design Partnership	1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
			9.78	0.10	Concrete
					Bentonite Seal
			9.38	0.50	
					Slotted Standpipe
			7.88	2.00	
					Bentonite Seal
			7.65	2.23	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings				Depth Sealed (m)
					5 min	10 min	15 min	20 min	

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
13/06/18							2.23		DRY	

Instrument Groundwater Observations

Inst. [A] Type : Standpipe

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	
19/06/18		DRY		
25/06/18		DRY		
28/06/18		DRY		

Remarks
Flush lockable cover.
Gas bung.
Geotextile filter sock surround to well screen section.

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site
Proposed Residential Development, Blackrock, Dundalk, County Louth.

Borehole Number
BH5

Boring Method
Geoprobe 6620DT Drill Rig. Percussion sampling to 3.0m depth.

Casing Diameter
Borehole diam. 101mm to 3.00m

Ground Level (mOD)
13.86

Client
Kingsbridge Consultancy Limited

Job Number
02.ROI18

Location (Handheld GPS)
307041.54 E 304224.64 N

Dates
13/06/2018

Engineer
Finn Design Partnership

Sheet
1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.30)	TOPSOIL.		
0.30	D1				13.56	0.30	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.50	ES1					(0.40)			
0.70	D2				13.16	0.70	Stiff high strength friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2								
1.00-1.45	U1		DRY	60 blows					
1.45	D3					(1.85)			
2.00-2.45	SPT N=28		DRY	2,3/3,4,6,15					
2.00	ES3								
2.00-2.45	D4								
2.55	D5				11.31	2.55	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to course GRAVEL sized fragments in a silty clay matrix.		
						(0.72)			
3.00-3.27	SPT 25*/100 50/170		DRY	19,6/23,22,5					
3.00-3.27	D6								
				13/06/2018:DRY	10.59	3.27	Complete at 3.27m		

Remarks
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)
1:25

Logged By
TS

Figure No.
02.ROI18.BH5

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP1

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T tracked excavator.		15.20	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306579.21 E 304369.05 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.40)	TOPSOIL.		
0.40	D1			14.80	0.40			
0.50	ES1				(0.25)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.65	D2			14.55	0.65			
1.00	ES2					Stiff friable light grey brown slightly sandy slightly gravelly with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.60	D3				(2.25)			
2.00	ES3							
2.50	D4							
2.50	ES4							
2.90	D5		Pit terminated due to encountering suspected bedrock. 12/06/2018:DRY	12.30	2.90	Complete at 2.90m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP1

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP2

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		16.78	Kingsbridge Consultancy Limited	02.ROI18
	Location	**Dates**	**Engineer**	**Sheet**
	306626.56 E 304279.76 N	11/06/2018	Finn Design Partnership	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL.		
0.30	D1			16.48	0.30	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.50	ES1				(0.60)			
0.90	D2			15.88	0.90	Firm friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2				(0.50)			
1.40	D3			15.38	1.40	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to coarse GRAVEL sized fragments.		
					(0.20)			
			11/06/2018:DRY	15.18	1.60	Complete at 1.60m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP2

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP3

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		18.61	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306693.33 E 304174.95 N	**Dates** 11/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL.		
0.30	D1			18.31	0.30	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.50	ES1				(0.40)			
0.70	D2			17.91	0.70	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2				(0.90)			
1.60	D3			17.01	1.60	Firm to stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
2.00	ES3				(0.80)			
2.40	D4			16.21	2.40	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to coarse GRAVEL sized fragments.		
			11/06/2018:DRY		(0.20)			
				16.01	2.60	Complete at 2.60m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP3

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP4

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		21.22	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306756.22 E 304072.47 N	**Dates** 11/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20)	TOPSOIL.		
0.20	D1			21.02	0.20			
					(0.20)	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.40	D2			20.82	0.40			
0.50	ES1					Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
					(0.50)			
0.90	D3			20.32	0.90			
1.00	ES2					Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
					(0.60)			
1.50	D4			19.72	1.50	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to coarse GRAVEL sized fragments in a silty clay matrix.		
					(0.90)			
			11/06/2018:DRY	18.82	2.40	Complete at 2.40m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP4

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP5

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		20.52	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306843.17 E 304112.07 N	**Dates** 11/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20)	TOPSOIL.		
0.20	D1			20.32	0.20	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.50	ES1				(0.70)			
0.90	D2			19.62	0.90	Stiff friable light grey brown with dark brown mottling slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2				(0.60)			
1.50	D3			19.02	1.50	Firm to stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
2.00	ES3				(0.90)			
2.40	D4			18.12	2.40	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
					(0.70)			
			Pit terminated due to encountering suspected bedrock. 11/06/2018:DRY	17.42	3.10	Complete at 3.10m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP5

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP6

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		19.24	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306793.48 E 304211.44 N	**Dates** 11/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.25)	TOPSOIL.		
0.25	D1			18.99	0.25	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble content. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.50	ES1				(0.65)			
0.90	D2			18.34	0.90	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to coarse GRAVEL sized fragments in a silty clay matrix.		
1.00	ES2							
					(1.10)			
2.00	D3		11/06/2018:DRY	17.24	2.00	Complete at 2.00m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP6

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP7

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator.		17.63	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306747.77 E 304299.49 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL.		
0.30	D1		12/06/2018:DRY	17.33 17.23	0.30 (0.10) 0.40	Highly weathered GREYWACKE: Recovered as grey angular fine to coarse GRAVEL sized fragments.		
						Complete at 0.40m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP7

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP8

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		15.28	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306693.09 E 304384.08 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL.		
0.30	D1			14.98	0.30			
0.50	ES1				(0.40)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.70	D2			14.58	0.70			
					(0.40)	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2			14.18	1.10			
1.10	D3					Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
2.00	ES3				(2.00)			
2.50	D4							
3.00	ES4			12.18	3.10			
			Pit terminated due to encountering suspected bedrock. 12/06/2018:DRY			Complete at 3.10m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP8

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP9

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		11.61	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306787.66 E 304405.92 N	**Dates** 11/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.25)	TOPSOIL.		
0.25	D1			11.36	0.25 (0.10)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.35	D2			11.26	0.35	Light grey brown clayey silty sandy fine to coarse GRAVEL with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
					(0.95)			
1.30	D3			10.31	1.30	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble content. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.30	ES1							
					(1.20)			
2.50	D4			9.11	2.50	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
2.50	ES2				(0.30)			
			Pit terminated due to encountering suspected bedrock. 11/06/2018:DRY	8.81	2.80	Complete at 2.80m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP9

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP10

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T tracked excavator.		8.72	Kingsbridge Consultancy Limited	02.ROI18
	Location	**Dates**	**Engineer**	**Sheet**
	307019.8 E 304421.84 N	12/06/2018	Finn Design Partnership	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.35)	TOPSOIL.		
0.35	D1			8.37	0.35	Damp light grey brown silty sandy fine to coarse GRAVEL (damp). Gravel is sub-angular to sub-rounded.		
0.50	ES1							
1.00	ES2							
					(2.45)			
2.00	ES3							
2.80	D2			5.92	2.80			
					(0.30)	Firm to stiff friable light brown grey slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
3.00	ES4		Pit terminated due to encountering suspected bedrock. 12/06/2018:DRY	5.62	3.10	Complete at 3.10m		

Plan

Remarks

Pit side walls slightly unstable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:50	TS	02.ROI18.TP10

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP11

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator.		15.38	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306876.56 E 304239.78 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL.		
0.30	D1			15.08	0.30			
0.50	ES1				(0.30)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.60	D2			14.78	0.60			
1.00	ES2				(0.80)	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.40	D3			13.98	1.40			
2.00	ES3				(1.00)	Firm to stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
2.40	D4			12.98	2.40			
					(0.30)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
			Pit terminated due to encountering suspected bedrock. 12/06/2018:DRY	12.68	2.70	Complete at 2.70m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP11

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP12

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		16.07	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306922.36 E 304148.94 N	**Dates** 11/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20)	TOPSOIL.		
				15.87	0.20			
0.20	D1			15.77	0.30	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.30	D2							
0.50	ES1							
					(1.30)	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2							
				14.47	1.60			
						Firm to stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
2.00	ES3				(1.00)			
				13.47	2.60			
2.60	D3							
					(0.50)	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
			Pit terminated due to encountering suspected bedrock. 11/06/2018:DRY	12.97	3.10	Complete at 3.10m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:50	TS	02.ROI18.TP12

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP13

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		15.28	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306999.22 E 304199.02 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL.		
0.30	D1			14.98	0.30			
					(0.20)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.50	D2			14.78	0.50			
0.50	ES1					Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2				(1.10)			
1.60	D3			13.68	1.60	Firm to stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
2.00	ES3				(1.00)			
2.60	D4			12.68	2.60			
					(0.20)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
			Pit terminated due to encountering suspected bedrock. 12/06/2018:DRY	12.48	2.80	Complete at 2.80m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP13

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP14

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		14.06	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306940.76 E 304293.7 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.35)	TOPSOIL.		
0.35	D1			13.71	0.35	Highly weathered destructured GREYWACKE: Recovered as grey and light grey brown angular fine to coarse GRAVEL sized fragments in a silty clay matrix.		
					(0.70)			
			12/06/2018:DRY	13.01	1.05	Complete at 1.05m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP14

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP15

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T tracked excavator.		10.82	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306885.87 E 304404.37 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL.		
0.30	D1			10.52	0.30			
					(0.20)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Also containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.50	D2			10.32	0.50			
0.50	ES1					Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2				(1.30)			
1.80	D3			9.02	1.80			
2.00	ES3					Firm to stiff friable light brown grey slightly sandy slightly gravelly silty CLAY with cobble content. Gravel is fine to coarse, sub-angular to sub-rounded.		
					(1.20)			
3.00	ES4		Pit terminated due to encountering suspected bedrock. 12/06/2018:DRY	7.82	3.00	Complete at 3.00m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP15

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP16

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T tracked excavator.		10.01	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306950.41 E 304436.51 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.30	D1		12/06/2018:DRY	9.71	0.30 (0.30)	TOPSOIL.		
0.30	ES1					Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing roots and rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.40	D2			9.61	0.40 (0.10)			
						Highly weathered destructured GREYWACKE: Recovered as light grey and grey brown angular fine to coarse GRAVEL sized fragments.		
				9.41	0.60 (0.20)	Complete at 0.60m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP16

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP17

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		9.38	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306996.72 E 304498.59 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.35)	TOPSOIL.		
0.35	D1			9.03	0.35	Light grey brown silty fine SAND.		
0.50	ES1				(0.25)			
0.60	D2			8.78	0.60	Light grey brown silty fine SAND (damp).		
0.75	D3				(0.15)			
				8.63	0.75	Firm friable brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
					(0.25)			
1.00	D4			8.38	1.00	Grey brown silty sandy fine to coarse GRAVEL with cobble content (damp). Gravel is sub-angular to sub-rounded.		
1.00	ES2							
					(1.60)			
2.00	ES3							
				6.78	2.60	Firm to stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
2.60	D5							
					(0.50)			
3.00	ES4			6.28	3.10	Complete at 3.10m		
			Pit terminated due to encountering suspected bedrock. 12/06/2018:DRY					

Plan

Remarks

Pit side walls unstable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP17

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP18

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		9.09	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 306950.73 E 304370.25 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.35)	TOPSOIL.		
				8.74	0.35			
0.35	D1				(0.25)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.50	ES1			8.49	0.60			
0.60	D2					Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2				(1.50)			
2.00	ES3							
2.10	D3			6.99	2.10			
					(0.20)	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to coarse GRAVEL sized fragments in a silty clay matrix.		
			12/06/2018:DRY	6.79	2.30			
						Complete at 2.30m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP18

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP19

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		10.12	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 307025.23 E 304317.03 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL.		
0.30	D1			9.82	0.30 (0.15)	MADE GROUND: Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.45	D2			9.67	0.45 (0.15)			
0.50	ES1					MADE GROUND: Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.60	D3			9.52	0.60 (0.50)	MADE GROUND: Soft grey brown slightly sandy slightly gravelly silty CLAY with cobble content. Also containing glass and ceramic remnants. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.00	ES2			9.02	1.10 (0.70)	Soft to firm light grey brown slightly sandy slightly gravelly silty CLAY with cobble and boulder content. Gravel is fine to coarse, sub-angular to sub-rounded. Becomes very stiff below 1.60m depth.		
1.10	D4							
1.80	D5			8.32	1.80 (0.60)	Highly weathered destructured GREYWACKE: Recovered as light grey brown angular fine to coarse GRAVEL in a silty clay matrix.		
2.00	ES3							
			12/06/2018:DRY	7.72	2.40	Complete at 2.40m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP19

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED

Site	Trial Pit Number
Proposed Residential Development, Blackrock, Dundalk, County Louth.	TP20

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
13T Tracked Excavator		13.06	Kingsbridge Consultancy Limited	02.ROI18
	Location (Handheld GPS) 307104.8 E 304241.59 N	**Dates** 12/06/2018	**Engineer** Finn Design Partnership	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.35)	TOPSOIL.		
0.35	D1			12.71	0.35			
0.50	ES1				(0.50)	Very stiff friable light grey brown slightly sandy slightly gravelly silty CLAY containing rootlets. Gravel is fine to coarse, sub-angular to sub-rounded.		
0.85	D2			12.21	0.85			
1.00	ES2				(0.25)	Stiff friable light grey brown slightly sandy slightly gravelly silty CLAY with cobble content. Gravel is fine to coarse, sub-angular to sub-rounded.		
1.10	D3			11.96	1.10			
					(0.30)	Highly weathered destructured GREYWACKE: Recovered as grey brown angular fine to coarse GRAVEL sized fragments in a silty clay matrix.		
			12/06/2018:DRY	11.66	1.40			
						Complete at 1.40m		

Plan

Remarks

Pit side walls stable.
No obvious visual or olfactory evidence of contamination.
ES=Environmental soil sample comprising 1x400g capacity plastic tub, 1x250g capacity amber glass jar and 1x60g capacity amber glass vial.

Scale (approx)	Logged By	Figure No.
1:25	TS	02.ROI18.TP20

APPENDIX B

LAB ANALYSIS

Exova Jones Environmental

Registered Address : Exova (UK) Ltd, Lochend Industrial Estate, Newbridge, Midlothian, EH28 8PL

Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

Tel: +44 (0) 1244 833780
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Geotechnical Environmental Services Limited
The Old Mill
22A Kilmoyle Road
Ballybogey
Co Antrim
Northern Ireland
BT53 6NR

4225

Attention :	Tom Salway
Date :	3rd July, 2018
Your reference :	002/ROI/18
Our reference :	Test Report 18/9453 Batch 1
Location :	Proposed Residential Development, Blackrock,
Date samples received :	18th June, 2018
Status :	Final report
Issue :	1

Sixty eight samples were received for analysis on 18th June, 2018 of which ten were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:

Bruce Leslie
Project Co-ordinator

Client Name: Geotechnical Environmental Services Limited **Report : Solid**
Reference: 002/ROI/18
Location: Proposed Residential Development, Blackrock, Dundalk, Coun **Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub
Contact: Tom Salway
JE Job No.: 18/9453

J E Sample No.	1-3	4-6	13-15	16-18	25-27	28-30	34-36	37-39	40-42	43-45	LOD/LOR	Units	Method No.
Sample ID	BH1	BH1	BH2	BH2	BH3	BH3	BH4	BH4	BH5	BH5			
Depth	0.50	1.00	0.50	1.00	0.50	1.00	0.50	1.00	0.50	1.00			
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	14/06/2018	14/06/2018	13/06/2018	13/06/2018	13/06/2018	13/06/2018	13/06/2018	13/06/2018	13/06/2018	13/06/2018			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	18/06/2018	18/06/2018	18/06/2018	18/06/2018	18/06/2018	18/06/2018	18/06/2018	18/06/2018	18/06/2018	18/06/2018			
Arsenic #	6.0	6.1	4.4	6.8	4.2	1.8	5.1	6.4	4.4	5.1	<0.5	mg/kg	TM30/PM15
Cadmium #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM30/PM15
Chromium #	80.6	79.0	70.2	81.3	77.6	88.9	81.9	77.6	81.1	78.4	<0.5	mg/kg	TM30/PM15
Copper #	31	39	7	37	10	45	30	34	22	49	<1	mg/kg	TM30/PM15
Lead #	8	21	9	11	13	<5	9	10	6	8	<5	mg/kg	TM30/PM15
Mercury #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM30/PM15
Nickel #	73.6	72.0	42.3	76.6	41.6	82.4	66.0	67.7	70.2	68.1	<0.7	mg/kg	TM30/PM15
Selenium #	1	1	1	1	1	1	2	1	1	<1	<1	mg/kg	TM30/PM15
Zinc #	80	81	73	91	77	88	72	76	78	78	<5	mg/kg	TM30/PM15
PAH MS													
Naphthalene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM4/PM8
Fluorene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Phenanthrene #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM4/PM8
Anthracene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Fluoranthene #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM4/PM8
Pyrene #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	mg/kg	TM4/PM8
Chrysene #	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
PAH 16 Total	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	mg/kg	TM4/PM8
Benzo(b)fluoranthene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	93	96	92	93	81	91	92	92	91	92	<0	%	TM4/PM8
Methyl Tertiary Butyl Ether #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/kg	TM15/PM10
Benzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Toluene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Ethylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
p/m-Xylene #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM15/PM10
o-Xylene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Surrogate Recovery Toluene D8	98	101	101	103	98	105	103	106	105	104	<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	110	105	100	101	88	104	102	106	104	103	<0	%	TM15/PM10

Please see attached notes for all abbreviations and acronyms

Client Name: Geotechnical Environmental Services Limited **Report : Solid**
Reference: 002/ROI/18
Location: Proposed Residential Development, Blackrock, Dundalk, Coun **Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub
Contact: Tom Salway
JE Job No.: 18/9453

J E Sample No.	1-3	4-6	13-15	16-18	25-27	28-30	34-36	37-39	40-42	43-45	LOD/LOR	Units	Method No.
Sample ID	BH1	BH1	BH2	BH2	BH3	BH3	BH4	BH4	BH5	BH5			
Depth	0.50	1.00	0.50	1.00	0.50	1.00	0.50	1.00	0.50	1.00			
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	14/06/2018	14/06/2018	13/06/2018	13/06/2018	13/06/2018	13/06/2018	13/06/2018	13/06/2018	13/06/2018	13/06/2018			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	18/06/2018	18/06/2018	18/06/2018	18/06/2018	18/06/2018	18/06/2018	18/06/2018	18/06/2018	18/06/2018	18/06/2018			
TPH CWG													
Aliphatics													
>C5-C6 #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>C6-C8 #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>C8-C10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>C10-C12 #	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	mg/kg	TM5/PM8/PM16
>C12-C16 #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	mg/kg	TM5/PM8/PM16
>C16-C21 #	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	mg/kg	TM5/PM8/PM16
>C21-C35 #	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	mg/kg	TM5/PM8/PM16
Total aliphatics C5-35	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	mg/kg	TM5/TM36/PM8/PM12/PM16
Aromatics													
>C5-EC7 #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>EC7-EC8 #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>EC8-EC10 #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>EC10-EC12 #	<0.2	6.7	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	mg/kg	TM5/PM8/PM16
>EC12-EC16 #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	mg/kg	TM5/PM8/PM16
>EC16-EC21 #	<7	18	<7	<7	<7	<7	<7	<7	<7	<7	<7	mg/kg	TM5/PM8/PM16
>EC21-EC35 #	<7	24	<7	<7	<7	<7	<7	<7	<7	<7	<7	mg/kg	TM5/PM8/PM16
Total aromatics C5-35 #	<19	49	<19	<19	<19	<19	<19	<19	<19	<19	<19	mg/kg	TM5/TM36/PM8/PM12/PM16
Total aliphatics and aromatics(C5-35)	<38	49	<38	<38	<38	<38	<38	<38	<38	<38	<38	mg/kg	TM5/TM36/PM8/PM12/PM16
Natural Moisture Content	7.5	13.8	13.9	16.3	10.6	6.3	8.7	13.5	5.8	11.4	<0.1	%	PM4/PM0

Please see attached notes for all abbreviations and acronyms

Client Name: Geotechnical Environmental Services Limited **VOC Report :** **Solid**
Reference: 002/ROI/18
Location: Proposed Residential Development, Blackrock, Dundalk, Coun
Contact: Tom Salway
JE Job No.: 18/9453

J E Sample No.	1-3	4-6	13-15	16-18	25-27	28-30	34-36	37-39	40-42	43-45	LOD/LOR	Units	Method No.
Sample ID	BH1	BH1	BH2	BH2	BH3	BH3	BH4	BH4	BH5	BH5			
Depth	0.50	1.00	0.50	1.00	0.50	1.00	0.50	1.00	0.50	1.00			
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	14/06/2018	14/06/2018	13/06/2018	13/06/2018	13/06/2018	13/06/2018	13/06/2018	13/06/2018	13/06/2018	13/06/2018			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	18/06/2018	18/06/2018	18/06/2018	18/06/2018	18/06/2018	18/06/2018	18/06/2018	18/06/2018	18/06/2018	18/06/2018			
VOC MS													
Dichlorodifluoromethane	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/kg	TM15/PM10
Methyl Tertiary Butyl Ether #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/kg	TM15/PM10
Chloromethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Vinyl Chloride	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/kg	TM15_A/PM10
Bromomethane	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	ug/kg	TM15/PM10
Chloroethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/kg	TM15/PM10
Trichlorofluoromethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/kg	TM15/PM10
1,1-Dichloroethene (1,1 DCE) #	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	ug/kg	TM15/PM10
Dichloromethane (DCM) #	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	ug/kg	TM15/PM10
trans-1-2-Dichloroethene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
1,1-Dichloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
cis-1-2-Dichloroethene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
2,2-Dichloropropane	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
Bromochloromethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Chloroform #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
1,1,1-Trichloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
1,1-Dichloropropene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Carbon tetrachloride #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
1,2-Dichloroethane #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
Benzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Trichloroethene (TCE) #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
1,2-Dichloropropane #	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	ug/kg	TM15/PM10
Dibromomethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Bromodichloromethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
cis-1-3-Dichloropropene	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
Toluene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
trans-1-3-Dichloropropene	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
1,1,2-Trichloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Tetrachloroethene (PCE) #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
1,3-Dichloropropane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Dibromochloromethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
1,2-Dibromoethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Chlorobenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
1,1,1,2-Tetrachloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Ethylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
p/m-Xylene #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM15/PM10
o-Xylene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Styrene	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15_A/PM10
Bromoform	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Isopropylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
1,1,2,2-Tetrachloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
Bromobenzene	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/kg	TM15/PM10
1,2,3-Trichloropropane #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
Propylbenzene #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
2-Chlorotoluene	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
1,3,5-Trimethylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
4-Chlorotoluene	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/kg	TM15/PM10
tert-Butylbenzene #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM15/PM10
1,2,4-Trimethylbenzene #	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	ug/kg	TM15/PM10
sec-Butylbenzene #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
4-Isopropyltoluene #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
1,3-Dichlorobenzene #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
1,4-Dichlorobenzene #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
n-Butylbenzene #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
1,2-Dichlorobenzene #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
1,2-Dibromo-3-chloropropane #	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
1,2,4-Trichlorobenzene #	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	ug/kg	TM15/PM10
Hexachlorobutadiene	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/kg	TM15/PM10
Naphthalene	<27	<27	<27	<27	<27	<27	<27	<27	<27	<27	<27	ug/kg	TM15/PM10
1,2,3-Trichlorobenzene #	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	ug/kg	TM15/PM10
Surrogate Recovery Toluene D8	98	101	101	103	98	105	103	106	105	104	<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	110	105	100	101	88	104	102	106	104	103	<0	%	TM15/PM10

Please see attached notes for all abbreviations and acronyms

All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Geotechnical Environmental Services Limited

Matrix : Solid

Reference: 002/ROI/18

Location: Proposed Residential Development, Blackrock, Dundalk, County Louth

Contact: Tom Salway

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Analysis	Reason
18/9453	1	BH1	0.50	1-3	GRO, VOC	Solid Samples were received at a temperature above 9°C.
18/9453	1	BH1	1.00	4-6	GRO, VOC	Solid Samples were received at a temperature above 9°C.
18/9453	1	BH2	0.50	13-15	GRO	Sample holding time exceeded
18/9453	1	BH2	0.50	13-15	GRO, VOC	Solid Samples were received at a temperature above 9°C.
18/9453	1	BH2	1.00	16-18	GRO	Sample holding time exceeded
18/9453	1	BH2	1.00	16-18	GRO, VOC	Solid Samples were received at a temperature above 9°C.
18/9453	1	BH3	0.50	25-27	GRO	Sample holding time exceeded
18/9453	1	BH3	0.50	25-27	GRO, VOC	Solid Samples were received at a temperature above 9°C.
18/9453	1	BH3	1.00	28-30	GRO	Sample holding time exceeded
18/9453	1	BH3	1.00	28-30	GRO, VOC	Solid Samples were received at a temperature above 9°C.
18/9453	1	BH4	0.50	34-36	GRO	Sample holding time exceeded
18/9453	1	BH4	0.50	34-36	GRO, VOC	Solid Samples were received at a temperature above 9°C.
18/9453	1	BH4	1.00	37-39	GRO	Sample holding time exceeded
18/9453	1	BH4	1.00	37-39	GRO, VOC	Solid Samples were received at a temperature above 9°C.
18/9453	1	BH5	0.50	40-42	GRO	Sample holding time exceeded
18/9453	1	BH5	0.50	40-42	GRO, VOC	Solid Samples were received at a temperature above 9°C.
18/9453	1	BH5	1.00	43-45	GRO	Sample holding time exceeded
18/9453	1	BH5	1.00	43-45	GRO, VOC	Solid Samples were received at a temperature above 9°C.

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.

Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 18/9453

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to an Exova Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

JE Job No: 18/9453

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.			AR	
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.	Yes		AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details			AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details	Yes		AR	Yes
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes		AD	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes

JE Job No: 18/9453

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM15_A	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds, Vinyl Chloride & Styrene by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes

APPENDIX C

STANDPIPE MONITORING DATA

BLACKROCK, DUNDALK
GAS MONITORING DATA

Monitoring Date and Weather		Atmos. Pressure (mb)		Flow Rate (l/hr)	CH_4 %	CO_2 %	O_2 %	Groundwater Levels (mbgl)
19th June 2018	**BH1**	1001	**Steady**	0.0	0.0	0.6	19.4	3.59
			Max	0.0	0.0	0.6	19.6	
Overcast: Cool, Rain Showers	**BH2**	1001	**Steady**	0.0	0.0	0.1	20.1	Dry
			Max	0.0	0.0	0.2	20.2	
	BH4	1001	**Steady**	0.0	0.0	2.2	17.7	Dry
			Max	0.0	0.0	2.2	18.3	
25th June 2018	**BH1**	1034	**Steady**	0.0	0.0	0.3	19.5	3.62
			Max	0.0	0.0	0.5	20.0	
Bright: Dry, Warm	**BH2**	1034	**Steady**	0.0	0.0	0.0	20.0	Dry
			Max	0.0	0.0	0.2	20.1	
	BH4	1034	**Steady**	0.0	0.0	2.5	18.8	Dry
			Max	0.0	0.0	2.8	19.9	
28th June 2018	**BH1**	1030	**Steady**	0.0	0.0	0.2	19.4	3.62
			Max	0.0	0.0	0.4	21.1	
Bright: Dry, Very Warm	**BH2**	1030	**Steady**	0.0	0.0	0.1	19.8	Dry
			Max	0.0	0.0	0.2	20.2	
	BH4	1030	**Steady**	0.0	0.0	2.4	18.9	Dry
			Max	0.0	0.0	2.7	19.8	

GEOTECHNICAL ENVIRONMENTAL SERVICES LIMITED
THE OLD MILL | 22A KILMOYLE ROAD | BALLYBOGEY | CO. ANTRIM | BT53 6NR
TEL: 0044 (0)28 2074 2066 | EMAIL: info@geospecialists.co.uk | WEB: www.geospecialists.co.uk

Appendix H. Water

H.1. Flood Risk Assessment (Finn Design Partnership, 2019)

Kingsbridge Consultancy Ltd.

Proposed Strategic Housing Development

@

Haggardstown, Blackrock, Dundalk, Co. Louth

Flood Risk Assessment

Appendix E

KINGSBRIDGE CONSULTANCY LTD

PROPOSED DEVELOPMENT SITE AT

HAGGARDSTOWN, BLACKROCK, CO. LOUTH

HYDRAULIC ASSESSMENT & ANALYSIS OF CONVEYANCE CHANNELS

& HYDROLOGICAL IMPACT ASSESSMENT OF PROPOSED ACCESS ROAD

IE CONSULTING

WATER-ENVIRONMENTAL-CIVIL

Integrated Engineering Consulting

IE CONSULTING
WATER-ENVIRONMENTAL-CIVIL

KINGSBRIDGE CONSULTANCY LTD

PROPOSED DEVELOPMENT SITE AT

HAGGARDSTOWN, BLACKROCK, CO. LOUTH

HYDRAULIC ASSESSMENT & ANALYSIS OF CONVEYANCE CHANNELS

& HYDROLOGICAL IMPACT ASSESSMENT OF PROPOSED ACCESS ROAD

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Client :-
Finn Design Partnership
30 Fair Street
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Co. Louth

Document No:	IE1723-2931
Issue No:	03-ISSUE
Project No:	IE1723
Date:	30th April 2019
Revision:	6.0
Prepared By:	Logan McMillan BEng(Hons)
Checked By:	P McShane BEng(Hons) MIEI

Table of Contents

1 Executive Summary

IE Consulting was requested by Finn Design Partnership, on behalf of Kingsbridge Consultancy Ltd, to undertake hydraulic modelling, assessment and analysis of the existing surface water conveyance channels in the vicinity of the proposed development site. Permission is sought to construct a new residential development at Haggardstown, Blackrock, Dundalk, Co. Louth and all associated site works.

The purpose of the hydraulic assessment is to predict the effects of an attenuated surface water of 0.106m^3/s discharging to an existing nearby drainage channel and a seperate attenuated surface water of 0.0021m^3/s discharging to the existing nearby wetlands system and associated conveyance channels.

Using the methodology detailed in the Flood Studies Report (FSR) and Flood Studies Supplementary Reports (FSSR) and the Institute of Hydrology Report (IH) No. 124 'Flood Estimation for Small Catchments' the mean annual flood volume in the northern conveyance channel and the eastern conveyance channel associated with the wetlands system was estimated. The 1 in 100 year (1% AEP) and 1 in 1000 year (0.1% AEP) flood volumes in the eastern and northern conveyance channels were then estimated using the index flood methodology.

A detailed hydraulic model was constructed for the eastern and northern conveyance channels over reach lengths of approximately 273.19m and 124.02m respectively. The model was run for the existing scenario to form a baseline and again incorporating the additional attenuated discharge from the proposed development site.

The results of the simulation indicate that the maximum attenuated surface water discharges from the proposed development site would not result in an increase in flood water levels in the conveyance channels due to the occurrence of a 10% AEP (1 in 10 year) or 2% AEP (1 in 50 year) flood event in the catchment area upstream of the conveyance channels.

In the context of the occurrence of a 1% AEP (1 in 100 year) or a 0.1% AEP (1 in 1000 year) fluvial flood event these small predictive increases in flood levels in the northern drainage conveyance channel are imperceptible and immeasurable and would not result in an adverse impact to the existing hydrological regime or result in an increased flood risk to adjacent lands or properties or result in an adverse impact to the existing hydrological regime of the area.

The input of attenuated surface water discharge from the proposed new access road to the eastern drainage channels at a maximum discharge rate of 0.0021m^3/s is not predicted to result in any measurable increase in current scenario fluvial flood levels within these drainage channel or the existing wetland areas.

Development of the new access road as proposed is not predicted to result in any adverse impact to the existing hydrological regime of the area or to result in an increased flood risk elsewhere and is considered to be appropriate from a hydrological and flood risk perspective.

2 Introduction

IE Consulting was requested by Finn Design Partnership, on behalf of Kingsbridge Consultancy Ltd, to undertake hydraulic modelling, assessment and analysis of the existing surface water conveyance channels in the vicinity of the proposed development site. Permission is sought to construct a new residential development at Haggardstown, Blackrock, Dundalk, Co. Louth and all associated site works.

A Stage 1/ Stage 2 Flood Risk Assessment undertaken by Finn Design Partnership Ltd for the proposed development site identified potential flood risks associated with the discharge of attenuated surface water from the site to the nearby existing northern drainage channel and from the proposed new access road to the existing wetlands. The purpose of this hydraulic assessment is to assess the impact that the maximum volume of attenuated surface water discharge from the site and from the access road may or may not have on receiving watercourses.

It is proposed to discharge attenuated surface water runoff from the proposed development site at a maximum discharge rate of 0.106m^3/s to an existing drainage channel downstream of the site and to discharge attenuated surface water runoff from the proposed access road at a maximum discharge rate of 0.0021m^3/s to the wetland area located adjacent to and on the western side of the Blackrock Road. Outflow from this wetland area is conveyed through existing open drainage channels and a secondary wetland area adjacent to the Blackrock Road in a south to north direction after which the channel is culverted under Blackrock Road where discharge is then to Dundalk Bay estuary.

The purpose of this hydraulic assessment and analysis is to assess the hydraulic capacity or not of the existing conveyance channel watercourses and existing culvert crossing of the Blackrock Road and other culverts to convey the additional volume of attenuated surface waters and to determine if this additional conveyance volume may or may not result in an adverse impact to the existing hydrological regime of the area or to increase flood risk elsewhere.

In accordance with *'The Planning System and Flood Risk Management – Guidelines for Planning Authorities' DOEHLG 2009'* the hydraulic assessment and analysis has been undertaken on a joint probability scenario of attenuated discharge at the rate of 0.106m^3/s to the existing drainage channel downstream and north of the proposed development site and at a rate of 0.00021m^3/s to the existing wetland area during the occurrence of a 1% AEP (1 in 100 year) and a 0.1% AEP (1 in 1000 year) fluvial flood event in the conveyance channel watercourses. In addition, the occurrence of a mean annual fluvial flood event in the conveyance channel watercourses has been assessed.

An assessment is also undertaken in relation to the proposed new access roadway to serve the proposed development site, including an analysis of the impact that this roadway may or may not have on the existing hydrological regime of the area. Quoted ground levels or estimated flood levels relate to ordnance datum (Malin) unless stated otherwise.

3 Proposed Site Description

3.1 General

The proposed development site is located on lands between Blackrock Road and Birches Lane at Haggardstown, Blackrock, Co. Louth. The site is bounded to the north and east by existing residential properties, to the west by a golf course, and to the south by agricultural lands. The total area of the proposed development site is approximately 17.5 hectares.

The regional location of the proposed development site is illustrated on *Figure 1* below and shown on *Drawing Number IE1723-001-A in Appendix A*.

Figure 1 - Site Location

3.2 Existing Topography Levels at Site

The proposed development site slopes moderately in a south-west to north-east direction at an approximate slope of 3.18% (1 in 31).

Ground elevations at the proposed development site range from 23.78mOD (Malin) at the south-west corner of the site to 2.71mOD (Malin) at the north-east boundary of the site.

3.3 Local Hydrology, Landuse & Existing Drainage

The most immediate hydrological features in the vicinity of the proposed development are two drainage conveyance channels located beyond the eastern boundary of the site and adjacent to the Blackrock road (eastern drainage channels), the northern drainage channel located adjacent to and north of Blackrock road (northern drainage channel), the Upper Marshes Stream located approximately 225m beyond the north site boundary and the Irish Sea located approximately 220m beyond the eastern site boundary.

The scope of this particular hydraulic assessment and analysis is specific to the existing eastern and northern drainage conveyence channels listed above and as illustrated in *Figure 1*.

3.4 Conveyance Channel Catchment Areas

The catchment areas of the conveyance channels were delineated utilising 1:50,000 Discovery Series Mapping and a Light Detection and Ranging (LiDAR) derived Digital Terrain Model (DTM) acquired from Ordnance Survey Ireland, and have been estimated to be 0.092km^2 and 0.373km^2 to points downstream of the proposed development site as illustrated in *Figure 2* below.

An assessment of the upstream catchment area of the northern conveyance channel indicates a mainly rural catchment area, with an urban fraction accounting for approximately 10.14% of the total catchment area. The upstream catchment area of the eastern conveyance channels indicates a mainly rural catchment area, with an urban fraction accounting for approximately 13.31% of the total catchment area.

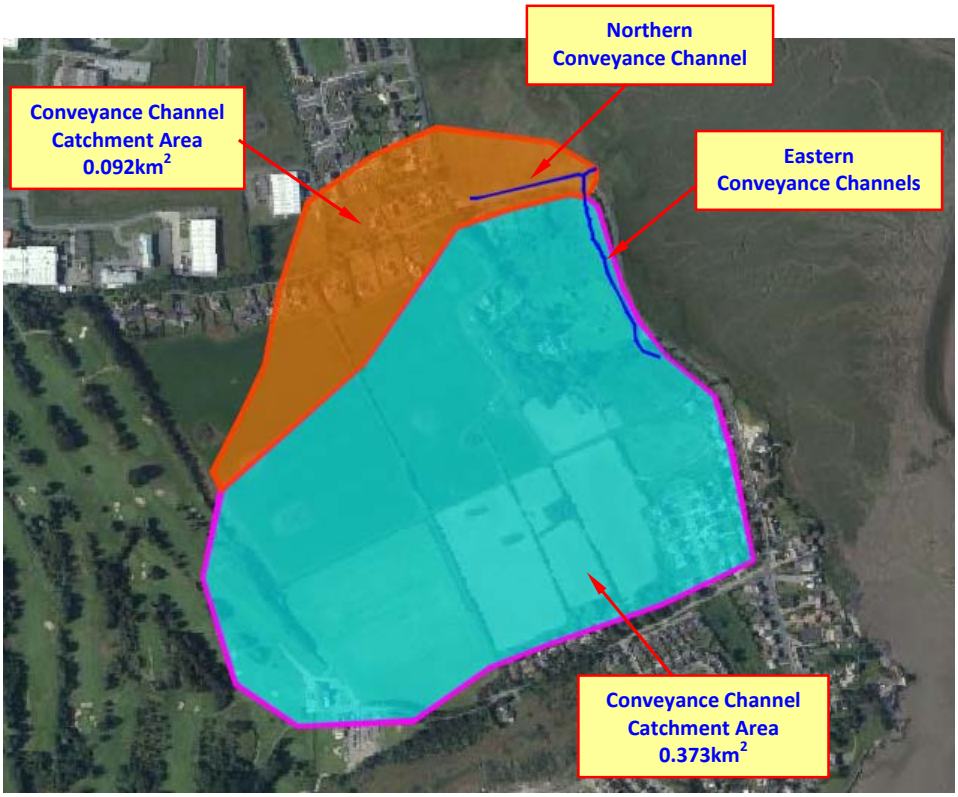


Figure 2 – Conveyance Channel Catchment Areas

3.5 Peak Flow Estimation –Mean Annual Flood Method for Small Catchments

Given the small size of the catchment area of the conveyance channels, the FSU portal software is not considered appropriate to estimate the median or mean flood volume. The mean annual flood , Q_{BAR} (m^3/s), is therefore estimated by utilising any of the three multiple parameter regression equations detailed in the Flood Studies Report (FSR) and Flood Studies Supplementary Reports (FSSR) or the Institute of Hydrology Report (IH) No. 124 'Flood Estimation for Small Catchments' regression equation.

These equations are listed below:-

$$Qbar\ Rural = 0.00066 \times Area^{0.92} \times SAAR^{1.22} \times SOIL^{2.0} \qquad EQN\ 1.5\ (FSSR)$$

$$Qbar\ Rural = 0.0288 \times Area^{0.90} \times RSMD^{1.23} \times SOIL^{1.77} \times STMFRQ^{0.23} \qquad EQN\ 1.6\ (FSR)$$

$$Qbar\ Rural = 0.00108 \times Area^{0.89} \times SAAR^{1.17} \times SOIL^{2.17} \qquad EQN\ 7.1\ (IH124)$$

where,

AREA = the topographic catchment area

Area $_{eastern\ channel}$ ***= 0.373 Km***^{2}

Area $_{northern\ channel}$ ***= 0.092 Km***^{2}

SAAR = Standard Annual Average Rainfall

SAAR = 843 mm (*from Met Éireann data)*

STMFRQ = the stream frequency of the catchment, which is equal to the number of channel junctions within the catchment divided by the catchment area. STMFRQ = (J/ A) = 1/0.373 (eastern channels) & = 1/0.092 (northern channel)

STMFRQ $_{eastern\ channels}$ ***= 2.691***

STMFRQ $_{northern\ channel}$ ***= 10.869***

RSMD = the 5 year, 1 day rainfall excess (mm) for the catchment and is estimated using the following equation or can be directly derived from Figure 3 below:

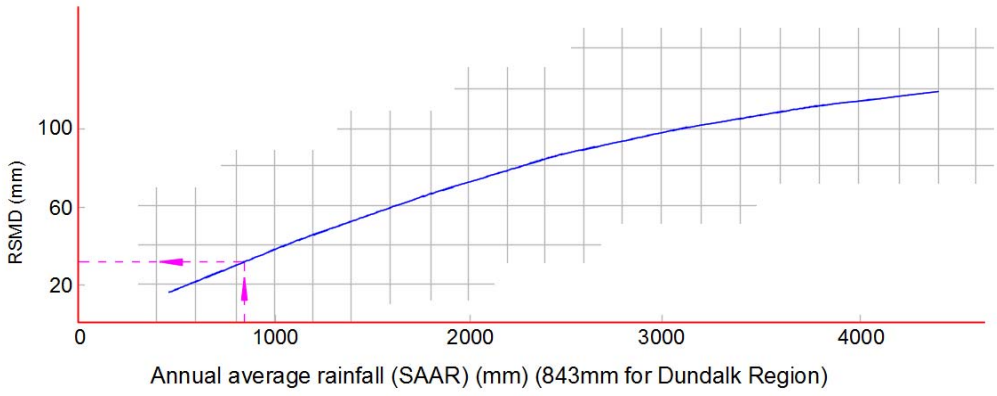


Figure 3 – Plot of 5 year, 1 day rainfall excess, RSMD, against mean annual rainfall, SAAR

RSMD = 32mm, *for SAAR value of 843mm taken from Met Éireann data*

SOIL = A number depending on the soil type and relating to the winter rain acceptance potential of the soils in the catchment. Values for SOIL are obtained from *Figure 4* and *Figure 5* below, which are replicated from map I. 4.18 (I) in the FSR.

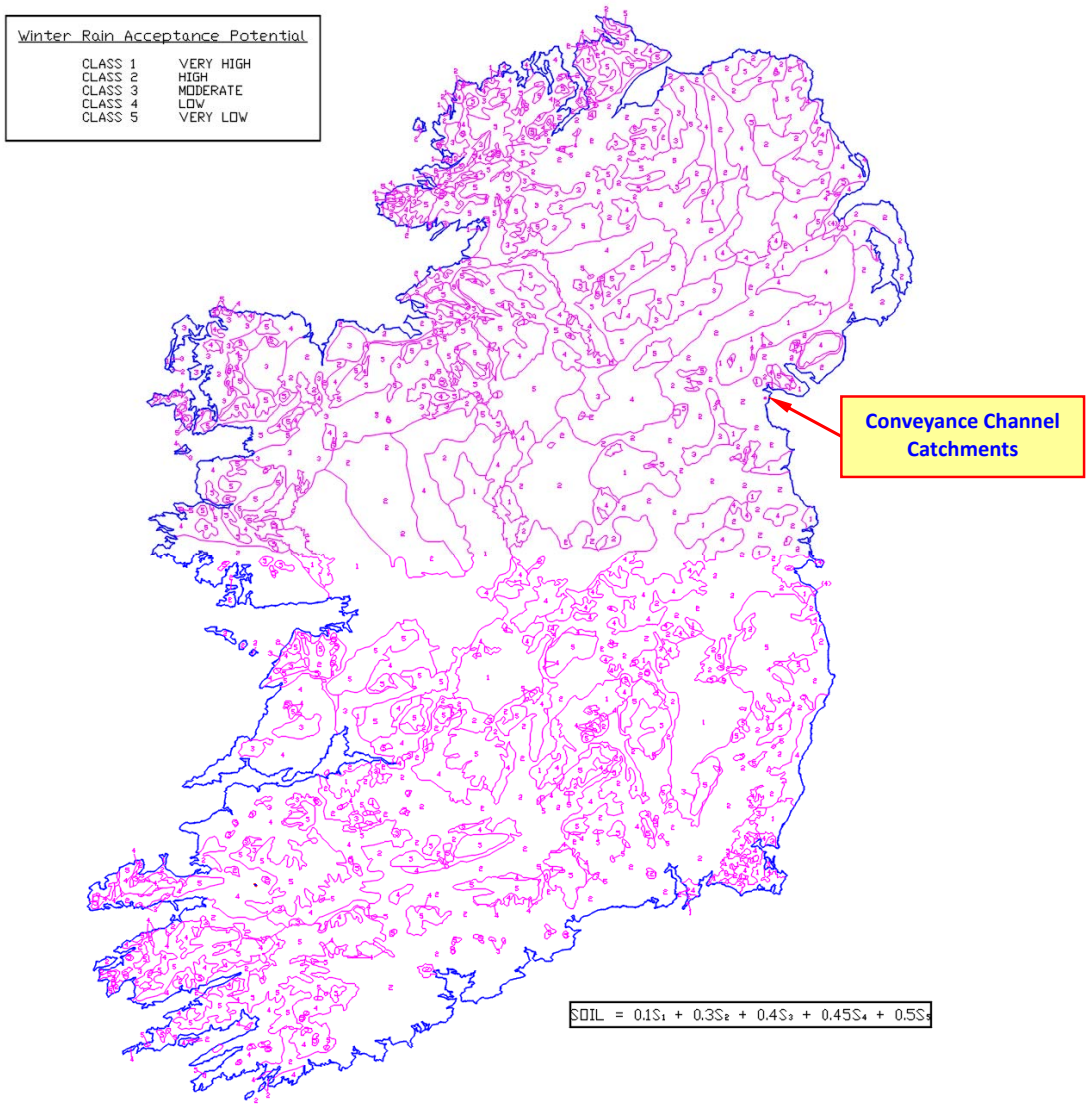


Figure 4 - Winter Rainfall Acceptance Potential

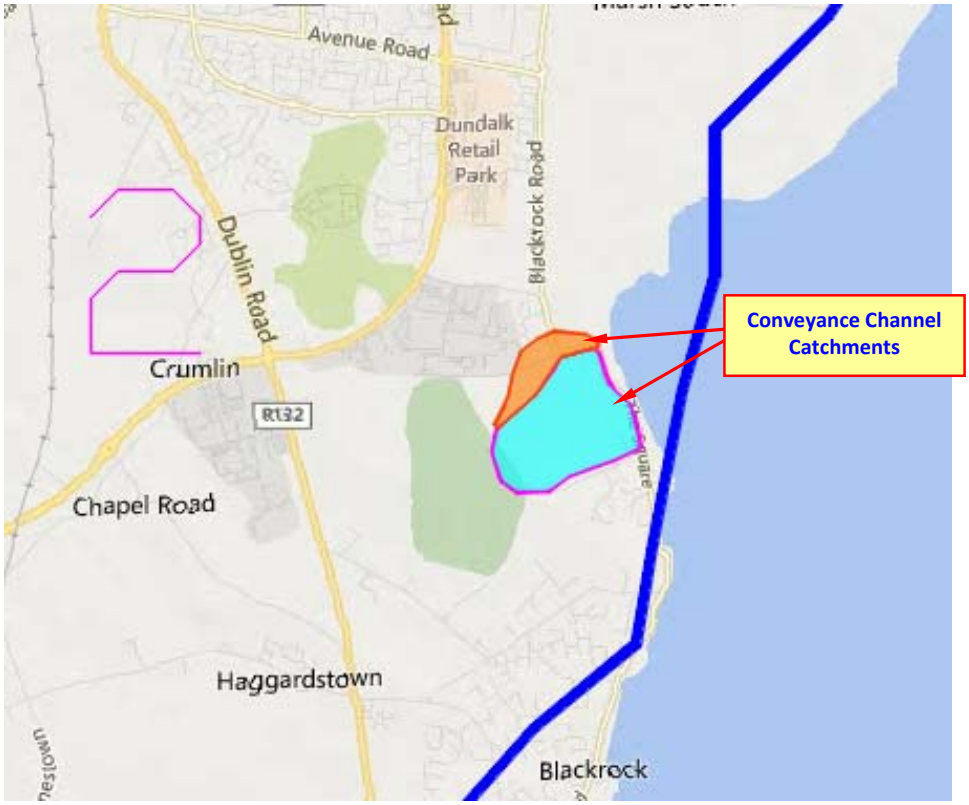


Figure 5 - Winter Rainfall Acceptance Potential

From *Figure 4* and *Figure 5* above (not to scale) the conveyance channel catchment areas comprise 100% SOIL Type 2.

Therefore:

SOIL = 0.15(S1) + 0.3(S2) + 0.40(S3) + 0.45(S4) + 0.5(S5)

SOIL = 0.15(0) + 0.3(1) + 0.40(0) + 0.45(0) + 0.5(0)

SOIL = 0.3

For catchment areas less than 50 hectares (0.5 km^2) in area it is recommended that the mean annual runoff rate be calculated for a 50 hectare catchment and the runoff for the actual catchment is then determined through linear interpolation.

Therefore:

Qbar Rural = 0.00066 x Area$^{0.92}$ x SAAR$^{1.22}$ x SOIL$^{2.0}$ ***EQN 1.5(FSSR)***

$\Rightarrow Q_{BAR} = 0.00066 \times 0.5^{0.92} \times 843^{1.22} \times 0.3^{2.0}$

$\Rightarrow$ ***Q_{BAR} = 0.1165 m^3/s*** *(for 50 hectare catchment area)*

Qbar Rural = 0.0288 x Area$^{0.90}$ x RSMD$^{1.23}$ x SOIL$^{1.77}$ x STMFRQ$^{0.23}$ ***EQN 1.6 (FSR)***

$\Rightarrow Q_{BAR\ eastern\ channel} = 0.0288 \times 0.5^{0.90} \times 35.41^{1.23} \times 0.3^{1.77} \times 2.691^{0.23}$

$\Rightarrow$ ***$Q_{BAR\ eastern\ channels}$ = 0.185 m^3/s*** *(for 50 hectare catchment area)*

$\Rightarrow Q_{BAR\ northern\ channel} = 0.0288 \times 0.5^{0.90} \times 35.41^{1.23} \times 0.3^{1.77} \times 10.869^{0.23}$

$\Rightarrow$ ***$Q_{BAR\ northern\ channel}$ = 0.2551 m^3/s*** *(for 50 hectare catchment area)*

Qbar Rural = 0.00108 x Area$^{0.89}$ x SAAR$^{1.17}$ x SOIL$^{2.17}$ ***EQN 7.1 (IH124)***

$\Rightarrow 0.00108 \times 0.5^{0.89} \times 843^{1.17} \times 0.3^{2.17}$

$\Rightarrow$ ***Q_{BAR} = 0.1133 m^3/s*** *(for 50 hectare catchment area)*

For the purposes of this Site Specific Flood Risk Assessment, the more conservative Q_{BAR} estimates of ***0.185 m^3/s*** and ***0.2551 m^3/s*** are utilised for the eastern and northern drainage channels respectively. The FSR equation has a standard factorial error of 1.58, therefore the design ***Q_{BAR} Rural*** estimates are:

$\Rightarrow Q_{BAR\ eastern\ channels} = 0.185\ m^3/s \times 1.58 =$ ***0.2923 m^3/s.***

$\Rightarrow Q_{BAR\ northern\ channel} = 0.2551\ m^3/s \times 1.58 =$ ***0.4031 m^3/s.***

The flow for the catchment areas under consideration is then estimated via linear interpolation as listed below:-

Catchment Qbar Rural = Qbar Design x Catchment Area
0.5

Therefore:-

Site Qbar Rural$_{eastern\ channels}$ = 0.2923. x 0.373
0.5

$\Rightarrow$ ***$Q_{BAREast\ channel}$ = 0.2181 m^3/s***

Site Qbar Rural$_{northern\ channel}$ = 0.4031. x 0.092
0.5

$\Rightarrow$ ***$Q_{BARnorthern\ channel}$ = 0.0742 m^3/s***

The urban fraction for the eastern conveyance channels catchment is 13.31%. The urban fraction for the northern conveyance channel catchment is 10.14%. The ratio of stormwater runoff generated by urban areas to those generated by rural areas can be estimated by utilising the multiple parameter equation, *EQN 7.4*, detailed in the Institute of Hydrology Report No. 124 'Flood Estimation for Small Catchments'. This equation is as listed below:-

$\Rightarrow Qbar_{Urban}/Qbar_{Rural} = (1+Urban\%)^{2NC} \times (1+Urban\%((21/CIND)-0.3)$

where,

Urban% = the overall decimal percentage of the catchment area that is considered to be urbanised

Urban% $_{eastern\ channels}$ = 0.1331

Urban% $_{northern\ channel}$ = 0.1014

NC = 0.92 – 0.00024 SAAR (for 500 $\leq$ SAAR $\leq$ 1100mm)

NC = 0.92 – 0.00024(843) = 0.718

CIND = Catchment Index ***CIND = 102.4 SOIL +0.28 (CWI – 125)***

CWI = Catchment Wetness Index which is a function of SAAR and can be estimated from Figure 6 below:

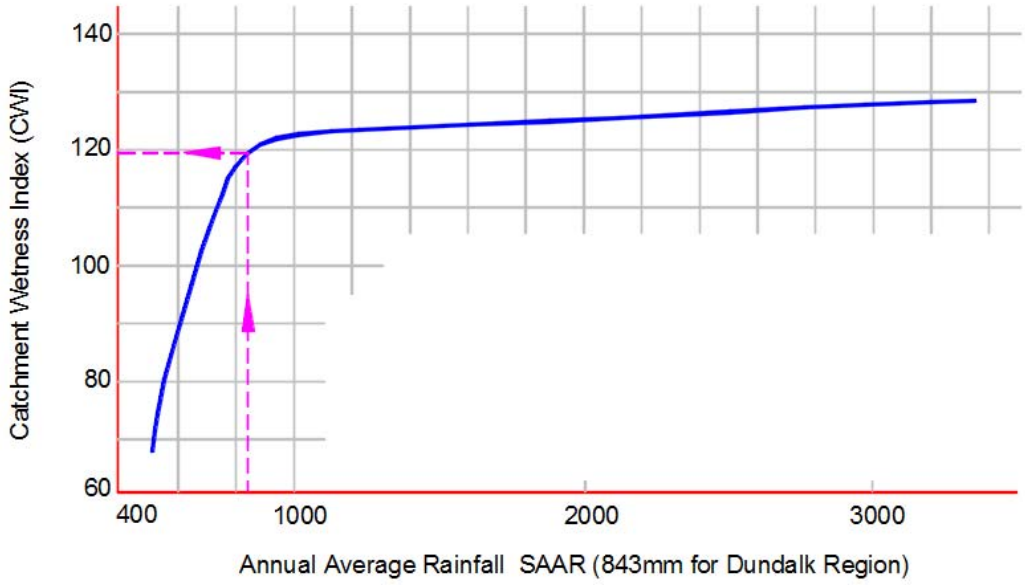


Figure 6 – Plot of Catchment Wetness Index, CWI against mean annual rainfall, SAAR

CWI = 122.23, *for SAAR of 843*

Therefore:

CIND = 102.4(SOIL) +0.28(CWI – 125) *EQN 1.5*

CIND = 29.94

$Qbar_{Urban}/Qbar_{Rural\ Eastern\ Channels} = (1+Urban\%)^{2NC} \times (1+Urban\%((21/CIND)-0.3))$

$Qbar_{Urban}/Qbar_{Rural\ Eastern\ Channels} = (1+0.1331)^{(2 \times 0.718)} \times (1+0.1331((21/29.94)-0.3))$

$\boldsymbol{Qbar_{Urban}/Qbar_{Rural\ Eastern\ Channels} = 1.26}$

$Qbar_{Urban}/Qbar_{Rural\ Northern\ Channel} = (1+0.1014)^{(2 \times 0.718)} \times (1+0.1014((21/29.94)-0.3))$

$\mathbf{Qbar_{Urban}/Qbar_{Rural\ Northern\ Channel} = 1.196}$

Therefore:

$Qbar_{Urban\ Eastern\ Channels} = Qbar_{Rural} \times Qbar_{Urban}/Qbar_{Rural}$

$\mathbf{Qbar_{Urban\ Eastern\ Channels} = 0.2181 \times 1.26 = 0.2748\ m^3/s}$

$\mathbf{Qbar_{Urban\ Northern\ Channel} = 0.0742 \times 1.196 = 0.0885\ m^3/s}$

3.6 Estimated Flows for Different Return Periods

The return period flows 'Q_T' are estimated using the index flood method and multiplying the annual maximum flow by the appropriate growth factor 'X_T' using the FSR (1975) national growth curve for Ireland, as shown in *Figure 7* below: -

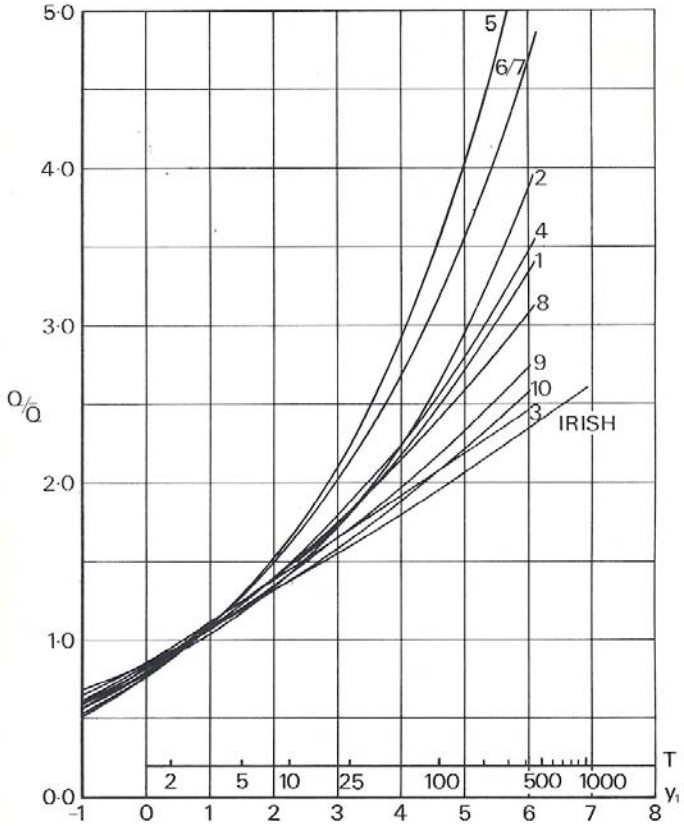


Figure 7 – Regional Growth Factors

For flood return periods 2, 5, 10, 20, 50, 100 and 1000 years the growth factors determined from *Figure 5* are listed in *Table 1* below: -

Flood Return Period (Yrs)	*2*	*5*	*10*	*20*	*50*	*100*	*1000**
Growth Curve Factor (Q_T/Q_{BAR})	*0.95*	*1.20*	*1.37*	*1.54*	*1.77*	*1.96*	*2.59*

Table 1 - Growth Factors Applied to Irish Catchments for Q_{BAR} Discharge Prediction

Table 2 below lists the estimated peak flood flow in the watercourse at the point of interest for different return periods: -

Flood Return Period (Yrs)	2	5	10	20	50	100	1000*
Eastern Channels Estimated Peak Flow (m^3/s)	0.2611	0.3298	0.3765	0.4232	0.4864	0.5386	0.7117
Northern Channel Estimated Peak Flow (m^3/s)	0.0840	0.1062	0.1212	0.1362	0.1566	0.1734	0.2292

Table 2 – Estimated Peak Flows in the Drainage channel for Different Return Periods

The estimated 1% AEP (1 in 100 year) and 0.1% AEP (1 in 1000 year) flood flows for the conveyance channel watercourses is therefore:-

$$Q_{100\ Eastern\ Channels} = 0.5386\ m^3/s$$

$$Q_{1000\ Eastern\ Channesl} = 0.7117\ m^3/s$$

$$Q_{100\ Northern\ Channel} = 0.1734\ m^3/s$$

$$Q_{1000\ Northern\ Channel} = 0.2292\ m^3/s$$

*(*Note – The Q_{100} value is a design flow. The Q_{1000} value is estimated and is presented only to assess the 1000 year Average Recurrence Interval (ARI) in the context of the 'Planning System and Flood Risk Management Guidelines')*

3.7 Hydraulic Analysis of Drainage Channels

A hydraulic model was developed for the eastern and northern conveyance channels along a reach length of approximately 273.19m and 124.02m respectively, including existing hydraulic structures (culverts).

The hydraulic model developed is usually based on an appropriate computer software package that utilises topographical information from the watercourse channel and flood plain geometry, the hydraulic resistance characteristics *(Manning's 'n')* of the watercourse and flood plain and appropriate boundary conditions at the upstream and downstream extent of the study area. The extent of modelled reach length is illustrated in *Figure 8* below:-

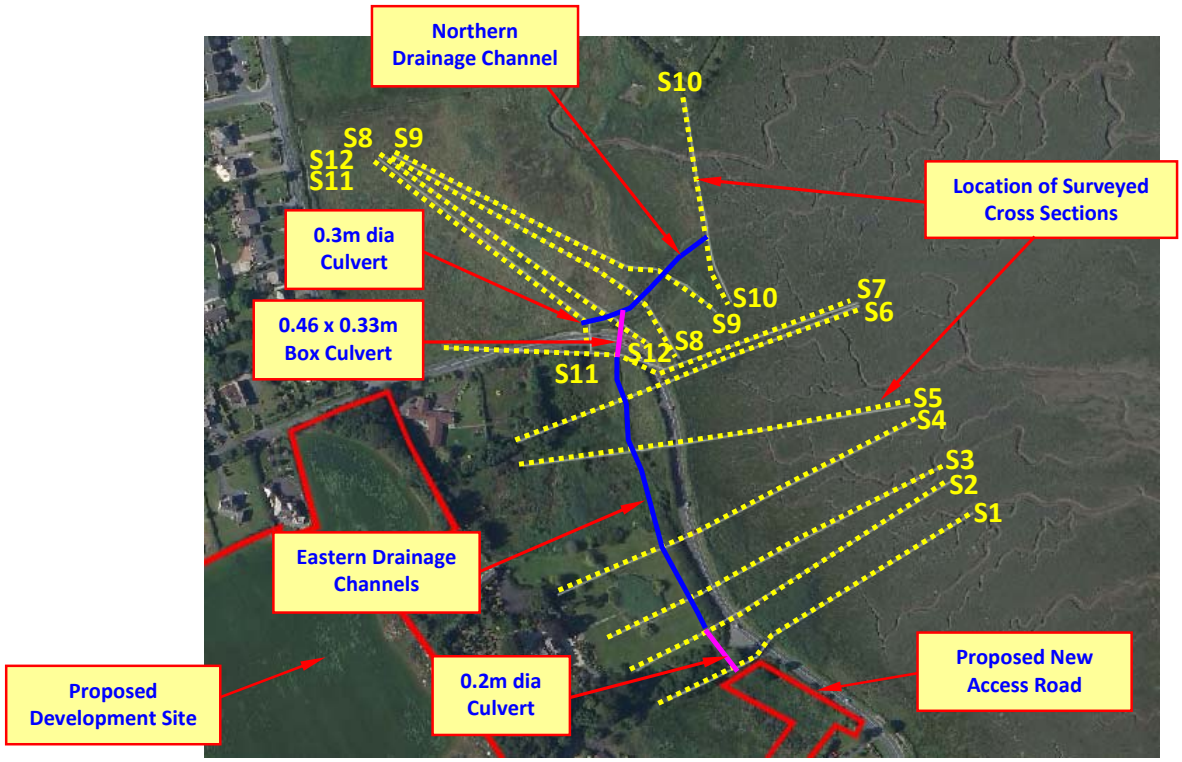


Figure 8 - Hydraulic Model Extents

Detailed topographical cross-sectional survey data at each of the cross-sectional locations illustrated above was acquired from a topographical survey undertaken by Land Survey Services Ltd. In addition the hydraulic structures (culverts) along the modelled conveyance channels were surveyed.

A copy of the full cross-sectional survey is contained in *Appendix B*.

3.7.1 Hydraulic Model Selection and Assumptions

A number of computer based hydraulic models are available which will predict flood levels for a given design flow. For this particular assessment the HEC-RAS V4.1 computer model was employed. HEC-RAS was developed by the Hydrologic Engineering Centre of the US Army Corps of Engineers and is a one-dimensional hydraulic model that computes both steady and unsteady flow profiles for specified upstream and downstream flow conditions. HEC-RAS is a robust and well-regarded application and is in wide spread use by engineering consultants, hydrologists and relevant authorities throughout the world. The program also supports hydraulic structures such as bridges, culverts, and weirs and can also analyse floodplain storage. It is well regarded for use in the application of watercourses and flood plain modelling.

The following are the main assumptions used in the development of the HEC-RAS hydraulic model:

- Cross-section information between successive surveyed cross-sections was obtained by interpolation, where required.
- The openings of the culverts and the reach modelled were assumed to be free from blockages or debris in all events.
- The hydraulic model assumes that flood volume input to the existing wetland areas equals flood volume output and does not account for any possible attenuating effect offered by the wetland areas.

3.7.2 Initial Boundary Conditions

In consideration the eastern and northern conveyance channel ultimately discharge to Dundalk Bay, the hydraulic model was developed utilising a known downstream tidal water level.

The Register of Hydrometric Stations Ireland indicates that station 06061 is an active recorder station located within Dundalk Harbour. Tidal water level data from this hydrometric station is applicable for use in the developed hydraulic model. Annual maxima tidal Water level data for this gauging station was therefore acquired from the OPW and the mean tidal level data was incorporated as a downstream boundary condition in the hydraulic model.

3.7.3 *Watercourse Channel Roughness Coefficients*

The Manning's 'n' coefficient represents the hydraulic resistance to flow of the stream channel or flood plain. The Manning's 'n' coefficients chosen are estimated from a visual inspection of the conveyance channels and associated flood plain lands.

Guidance is available on selecting appropriate Manning's 'n' values *(from Chow 1959, French 1986),* however the Manning's 'n' coefficients are usually subsequently refined upon the development of the model by calibrating with any historical flooding data in the area, but only if available.

Table 3 below lists recommended watercourse channel overbank land roughness co-efficient for various vegetation types.

Type of Channel and Description	Minimum	Normal	Maximum
A. *Natural Streams*			
1. **Main Channels**			
a. Clean, straight, full, no rifts or deep pools	0.025	0.030	0.033
b. Same as above, but more stones and weeds	0.030	0.035	0.040
c. Clean, winding, some pools and shoals	0.033	0.040	0.045
d. Same as above, but some weeds and stones	0.035	0.045	0.050
e. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
f. Same as "d" but more stones	0.045	0.050	0.060
g. Sluggish reaches, weedy. deep pools	0.050	0.070	0.080
h. Very weedy reaches, deep pools, or floodways with heavy stands of timber and brush	0.070	0.100	0.150
2. **Flood Plains**			
a. Pasture no brush			
1. Short grass	0.025	0.030	0.035
2. High grass	0.030	0.035	0.050
b. Cultivated areas			
1. No crop	0.020	0.030	0.040
2. Mature row crops	0.025	0.035	0.045
3. Mature field crops	0.030	0.040	0.050
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.050	0.070
2. Light brush and trees, in winter	0.035	0.050	0.060
3. Light brush and trees, in summer	0.040	0.060	0.080
4. Medium to dense brush, in winter	0.045	0.070	0.110
5. Medium to dense brush, in summer	0.070	0.100	0.160
d. Trees			
1. Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
2. Same as above, but heavy sprouts	0.050	0.060	0.080
3. Heavy stand of timber, few down trees, little undergrowth, flow below branches	0.080	0.100	0.120
4. Same as above, but with flow into branches	0.100	0.120	0.160
5. Dense willows, summer, straight	0.110	0.150	0.200

Table 3 – Manning's 'n' Values for Channels and Flood Plains

With reference to *Table 3* above, varying roughness co-efficients were applied to the hydraulic model to reflect the type and form of vegetation observed during the survey of the watercourse undertaken by a hydrological engineer from IE Consulting. In respect of the main channel of the eastern and northern conveyance channels, an applied roughness co-efficent of 0.050 was chosen, reflecting the relatively sluggish and somewhat densely vegetated nature of the channels. An applied flood plain roughness co-efficent of 0.040 was utilised reflecting the relatively dense vegetative nature of these lands.

3.7.4 Initial Hydraulic Model Development

A total channel length of approximately 273.19m and 124.02m along the eastern and northern conveyance channels was modelled as illustrated in *Figure 7* above. The cross-sections surveyed were incorporated into the model together with various culverts as shown in *Figures 7* above.

3.8 Digital Terrain Model Construction

In order to assist in the hydraulic assessment and analysis and to enable an accurate representation of flood zone delineation mapping to be developed, a detailed Digital Terrain Model (DTM) was developed for the modelled area of the eastern and northern conveyance channels. The DTM was developed utilising the LiDAR height data for the area acquired from Ordnance Survey Ireland and topographical survey data for the area provided to IE Consulting. Development of a DTM allows the flood level predictions from the modelling software to be analysed in more detail at the specific location of the modelled conveyance channels. The contour mapping and DTM developed for the area is illustrated in *Figure 9*, *Figure 10* and *Figure 11* below.

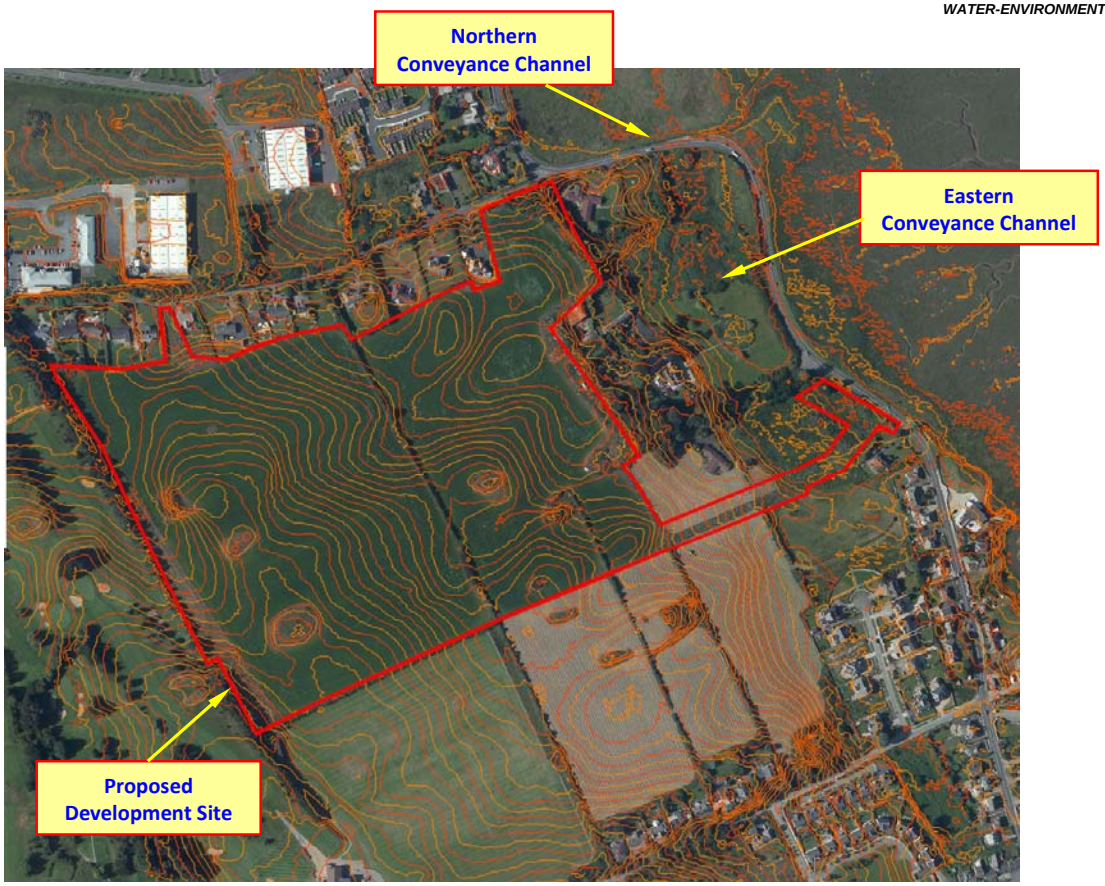
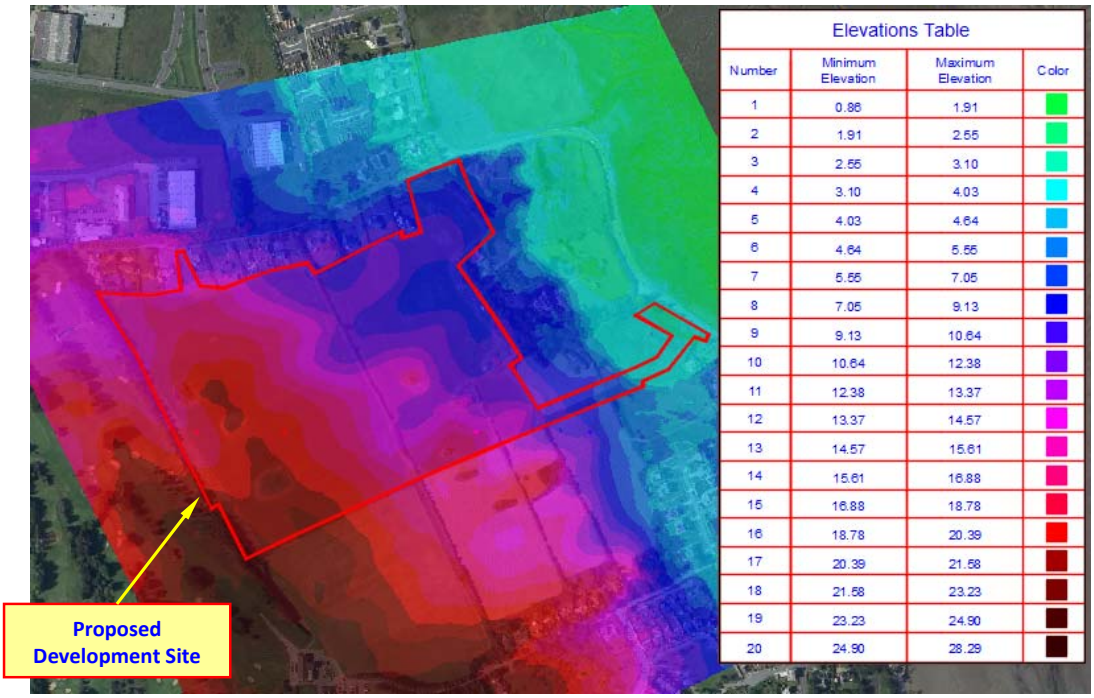


Figure 9 –LiDAR Derived Contour Mapping



Elevations Table

Number	Minimum Elevation	Maximum Elevation	Color
1	0.86	1.91	
2	1.91	2.55	
3	2.55	3.10	
4	3.10	4.03	
5	4.03	4.64	
6	4.64	5.55	
7	5.55	7.05	
8	7.05	9.13	
9	9.13	10.64	
10	10.64	12.38	
11	12.38	13.37	
12	13.37	14.57	
13	14.57	15.61	
14	15.61	16.88	
15	16.88	18.78	
16	18.78	20.39	
17	20.39	21.58	
18	21.58	23.23	
19	23.23	24.90	
20	24.90	28.29	

Figure 10 – LiDAR Derived DTM

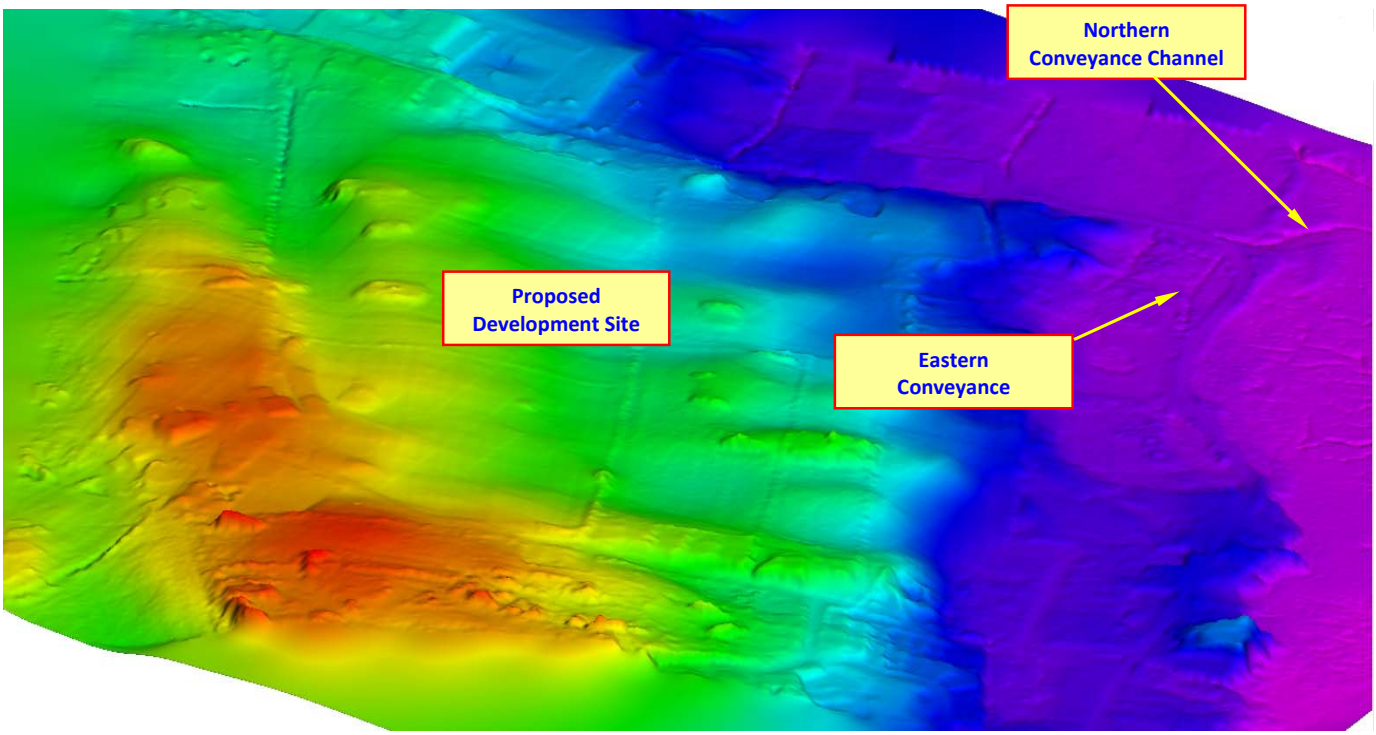


Figure 11 – LiDAR Derived DTM (Exaggerated Vertical Scale)

3.9 Hydraulic Model Simulation Results

The predicted 1% AEP (1 in 100 year) return period volumes of 0.539m³/s and 0.1734m³/s were utilised as the critical flow parameter in the HEC-RAS hydraulic model for the eastern and northern conveyance channels respectively. For the purposes of flood zone delineation peak flows of 0.712m³/s and 0.230m³/s were utilised for the 0.1% AEP (1 in 1000 year) return period volumes for the eastern and northern conveyance channels respectively.

The model simulation is represented by a longitudinal profile through the modeled reach. *Figure 12* below illustrates the longitudinal profiles of the predicted 1% AEP and 0.1% AEP flood levels along the modeled reach of the eastern and northern conveyance channels.

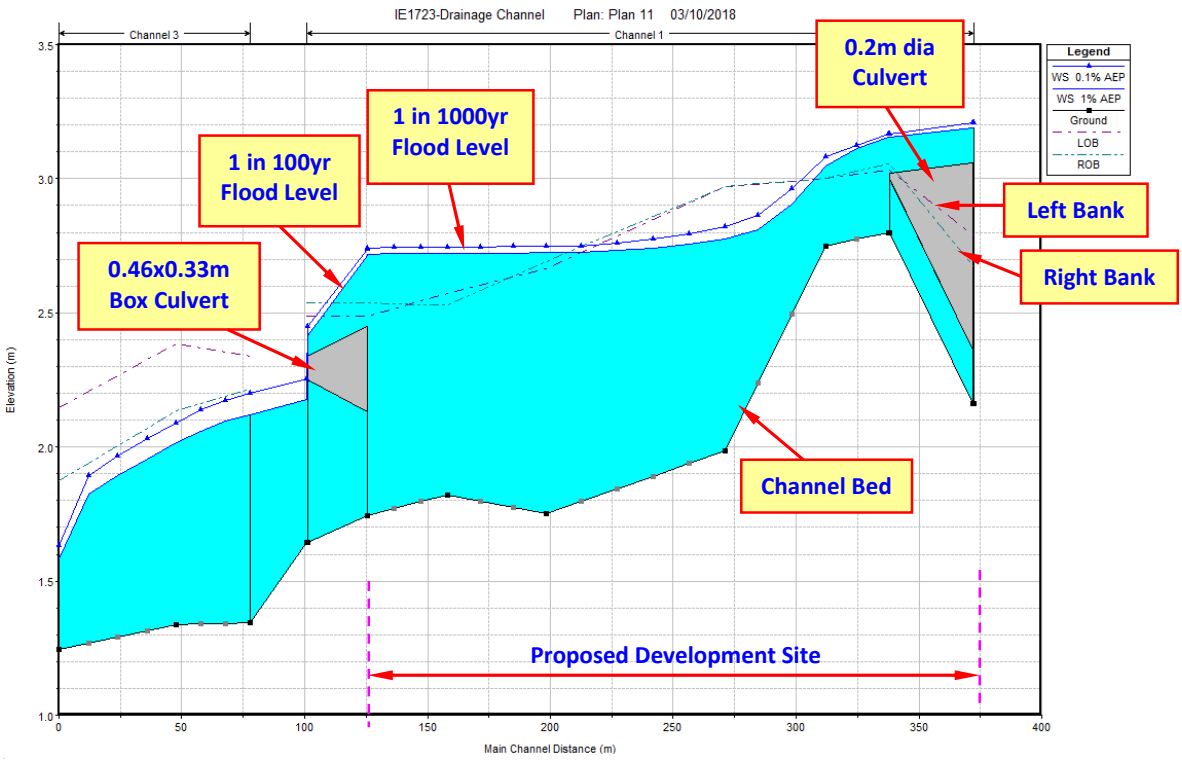


Figure 12 – Modelled Conveyance Channel Profile

Table 4 below summarises the predicted 1% AEP (1 in 100 year) and 0.1% AEP (1 in 1000 year) flood levels at cross-sectional locations along the modelled reach of the conveyance channels.

Cross Section Location (Upstream to Downstream)	Predicted Flood Levels (m Malin)	
	1 in 100 Year (1% AEP)	1 in 1000 Year (0.1% AEP)
1	3.19	3.21
2	3.15	3.17
3	3.05	3.08
4	2.78	2.82
5	2.72	2.75
9	2.72	2.75
7	2.72	2.74
8	2.12	2.2
9	2.01	2.09
10	1.58	1.63
11	2.26	2.31
12	2.15	2.18

Table 4 –Predicted Current Scenario 1% AEP & 0.1% AEP Flood Levels

The hydraulic model indicates that some out of bank flooding may occur at certain locations along the channel length during the 1 in 100 year (1% AEP) and 1 in 1000 year (0.1% AEP) flood events in consideration of the current scenario.

Drawing Number IE1723-002-A, Appendix A, illustrates the delineated flood zones along the modeled reach of the conveyance channels in consideration of the current scenario.

3.10 Proposed Scenario Hydraulic Model Simulation Results

It is proposed to discharge attenuated surface water runoff from the proposed development site at a maximum discharge rate of 0.106m^3/s to the northern drainage conveyance channel and discharge attenuated surface water runoff from the proposed access road at a maximum discharge rate of 0.0021m^3/s to existing wetland area located adjacent to and on the western side of the Blackrock Road. Outflow from this wetland area is conveyed through the existing eastern conveyance channel and a secondary wetland area adjacent to the Blackrock Road in a south to north direction after which the channel is culverted under Blackrock Road where discharge is then to Dundalk Bay estuary via the northern conveyance channel.

The hydraulic simulation model was therefore re-run in consideration of the 0.106m^3/s and 0.0021m^3/s attenuated surface water runoff from the proposed development site and access road as an additional maximum input to the 1% AEP and 0.1% AEP flow volumes in the northern and eastern conveyance channels – i.e. the Proposed Scenario.

Table 5 below summarises the predicted 1% AEP and 0.1% AEP flood levels at cross-sectional locations along the modelled reach of the drainage channels for the existing and proposed scenarios.

Cross Section Location (Upstream to Downstream)	Predicted Water Levels (m Malin)				Change in Level (m)	Change in Level (m)
	Existing Scenario		Proposed Scenario			
	1 in 100 Year (1% AEP)	1 in 1000 Year (0.1% AEP)	1 in 100 Year (1% AEP)	1 in 1000 Year (0.1% AEP)	1 in 100 Year (1% AEP)	1 in 1000 Year (0.1% AEP)
1 (Eastern Channels)	3.19	3.21	3.19	3.21	0.00	0.00
2 (Eastern Channels)	3.15	3.17	3.15	3.17	0.00	0.00
3 (Eastern Channels)	3.05	3.08	3.05	3.08	0.00	0.00
4 (Eastern Channels)	2.78	2.82	2.78	2.82	0.00	0.00
5 (Eastern Channels)	2.72	2.75	2.72	2.75	0.00	0.00
6 (Eastern Channels)	2.72	2.75	2.72	2.75	0.00	0.00
7 (Eastern Channels)	2.72	2.74	2.72	2.74	0.00	0.00
8 (Northern Channel)	2.12	2.2	2.16	2.23	0.04	0.03
9 (Northern Channel)	2.01	2.09	2.05	2.12	0.04	0.03
10 (Northern Channel)	1.58	1.63	1.61	1.66	0.03	0.03
11 (Eastern Channel)	2.26	2.31	2.26	2.31	0.00	0.00
12 (Northern Channel)	2.15	2.18	2.15	2.20	0.00	0.02

Table 5 –Predicted Existing & Proposed Scenario 1% AEP & 0.1% AEP Flood Levels

As listed in *Table 5* above, the hydraulic simulation model in consideration of the proposed scenario indicates that the input of attenuated surface water discharges from the proposed development site to the northern drainage channel at a maximum discharge rate of 0.106m^3/s has the potential to increase 1% AEP and 0.1% AEP flood levels to between 0.03m (30mm) and 0.04m (40mm) between cross-sectional locations 8-8 to 10-10 and 0.02m (20mm) at cross-sectional locations 12-12.

The input of attenuated surface water discharge from the proposed new access road to the eastern drainage channels at a maximum discharge rate of 0.0021m^3/s is not predicted to result in any measurable increase in current scenario fluvial flood levels within these drainage channel or the existing wetland areas.

In the context of the occurrence of a 1% AEP (1 in 100 year) or a 0.1% AEP (1 in 1000 year) fluvial flood event these small predictive increases in flood levels in the northern drainage conveyance channel are imperceptible and immeasurable and would not result in an adverse impact to the existing hydrological regime or result in an increased flood risk to adjacent lands or properties or result in an adverse impact to the existing hydrological regime of the area.

It is also noted that this analysis assumes an absolute worst-case scenario where the maximum discharge rate (0.106m^3/s) of attenuated stormwater from the proposed development site would discharge to the northern conveyance channel in conjunction with the occurrence of a 1% AEP or a 0.1% AEP fluvial flood event. The probability of both of these events occurring in conjunction with each other is extremely low.

It is also noted that the maximum discharge rate of 0.106m^3/s of attenuated stormwaters from the proposed development site includes a climate change factor allowance, and therefore in reality the actual maximum discharge rate will be less than 0.106m^3/s.

Drawing Number IE1723-003-B, Appendix A, illustrates the delineated flood zones along the modeled reach of the conveyance channels in consideration of the proposed scenario.

Drawing Number IE1723-004-B, Appendix A, illustrates a comparison of the existing scenario and proposed scenario 1% AEP (1 in 100 year) flood extents along the modeled reach of the conveyance channels.

Drawing Number IE1723-005-B, Appendix A, illustrates a comparison of the existing scenario and proposed scenario 0.1% AEP (1 in 1000 year) flood extents along the modeled reach of the conveyance channels.

As illustrated on *Drawings Number IE1723-004-B and IE1723-005-B*, in the context of the occurrence of a 1% AEP (1 in 100 year) or a 0.1% AEP (1 in 1000 year) the proposal to discharge attenuated surface water discharge from the proposed development site at a maximum discharge rate of 0.106m^3/s and from the proposed access road at a maximum discharge rate of 0.0021m^3/s is not predicted to result in an adverse impact to the existing hydrological regime of the area or result in an increased flood risk to adjacent properties.

4 Hydrological Impact of Proposed Access Road

As illustrated on the drawings and details produced by Finn Design Partnership the proposed development site shall be served by a new 6m wide access road, incorporating a 1.5m wide grass verge, 2m wide cycle track and a 2m wide footpath. The access road shall tie into the existing R172 Public Road at the location illustrated on Finn Design Partnership Drawing Number 100.

An assessment and analysis has therefore been undertake in order determine the impact that the proposed access road may or may not have on the existing hydrological and flooding regime of the area.

4.1 Initial Screening Assessment

The purpose of the screening assessment is to establish the level of flooding risk that may or may not exist for a particular site and to collate and assess existing current or historical information and data which may indicate the level or extent of any flood risk. An initial screening assessment has therefore been undertaken in order to determine the potential fluvial, pluvial, tidal /coastal and groundwater flooding mechanism pertaining to the location of the proposed access road.

The following information and data was collated as part of the flood risk screening assessment for the site of the proposed access road:-

OPW PFRA Flood Mapping

Preliminary Flood Risk Assessment (PFRA) Mapping for Ireland was produced by the OPW in 2011. OPW PFRA flood map number 2019/MAP/134/A illustrates indicative flood zones within this area of Co. Louth.

Figure 13 below illustrates an extract from the above indicative flood map in the vicinity of the proposed development site.

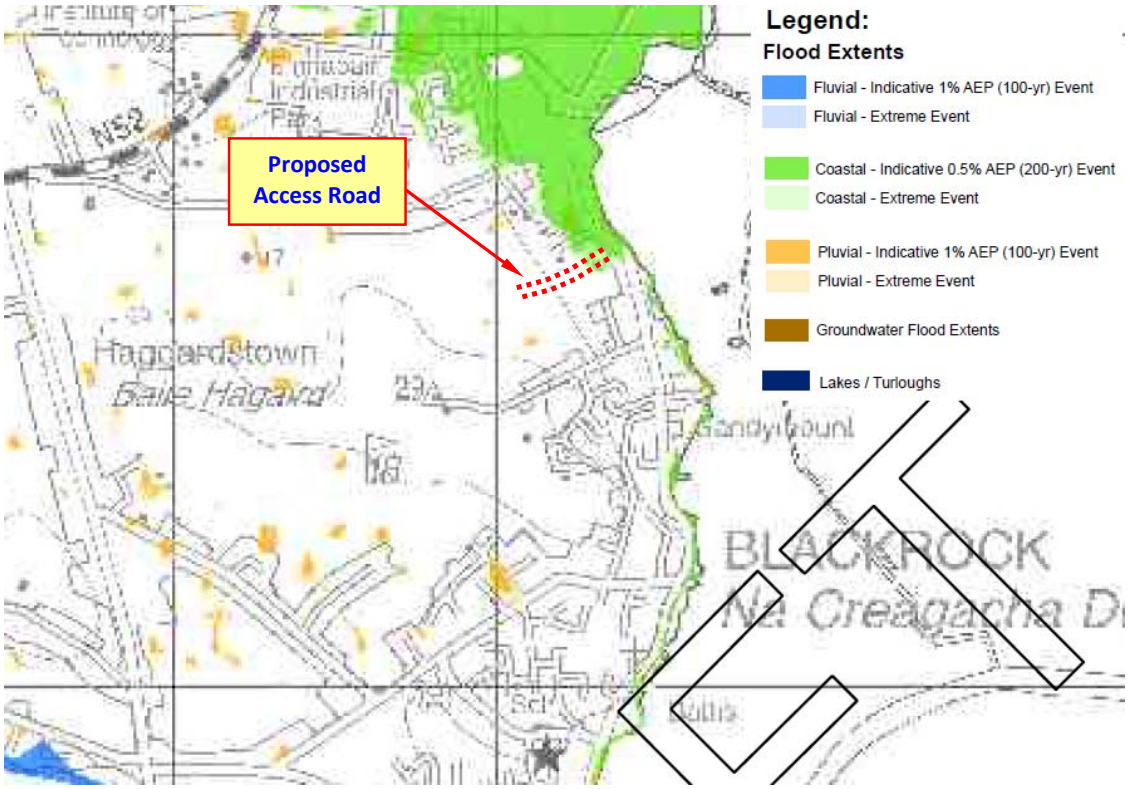


Figure 13 – OPW PFRA Indicative Flood Mapping

Figure 13 above indicates that part of the proposed access road falls within an indicative coastal flood zone. No fluvial, pluvial or groundwater flood zones are mapped within or immediately adjacent to the boundary of the proposed access road.

Figure 14 below illustrates the PFRA indicative flood zones from *Figure 13* overlaid onto higher resolution background mapping.

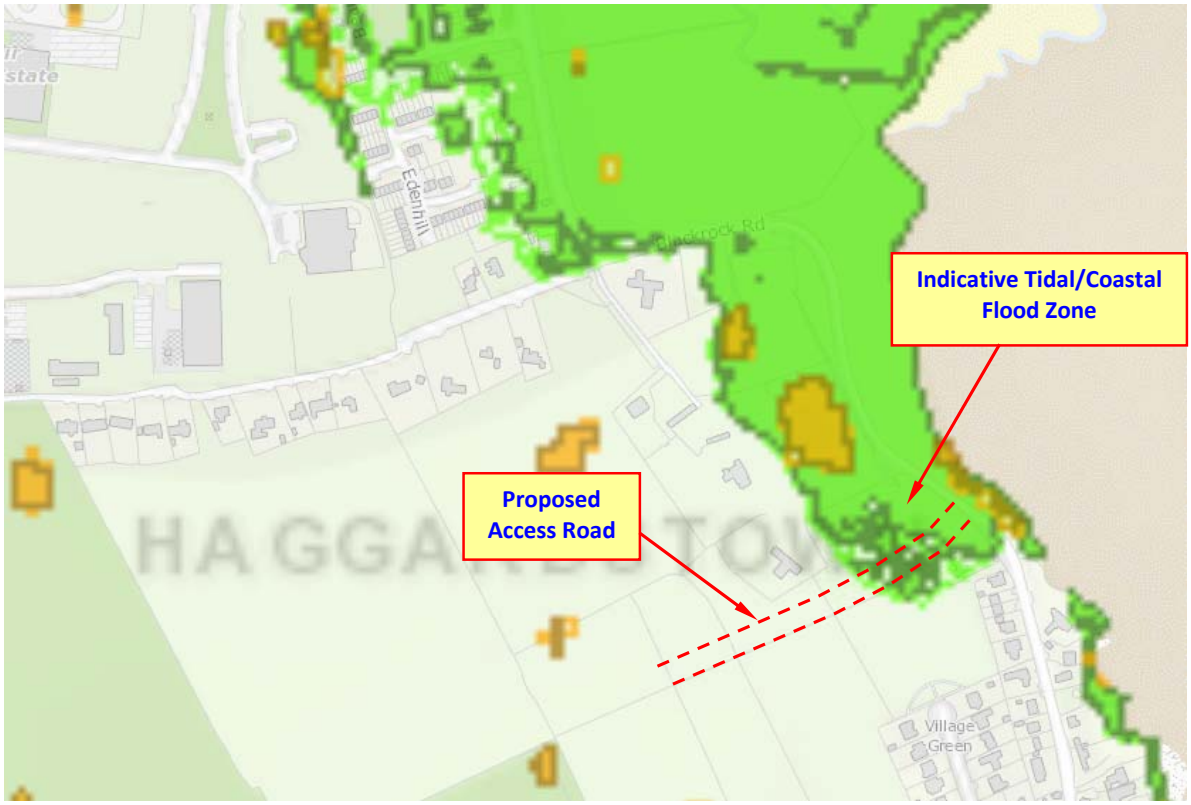


Figure 14 – OPW PFRA Indicative Flood Mapping

It should be noted that the indicated extent of flooding illustrated on these maps was developed using a low resolution digital terrain model (DTM) and illustrated flood extents are intended to be indicative only. The flood extents mapped on the PFRA maps are not intended to be used on a site specific basis.

OPW Flood Maps Website

The OPW Flood Maps Website (www.floodmaps.ie) was consulted in relation to available historical or anecdotal information on any flooding incidences or occurrences in the vicinity of the proposed access road. *Figure 15* below illustrates mapping from the Flood Maps website in the vicinity of the access road site.

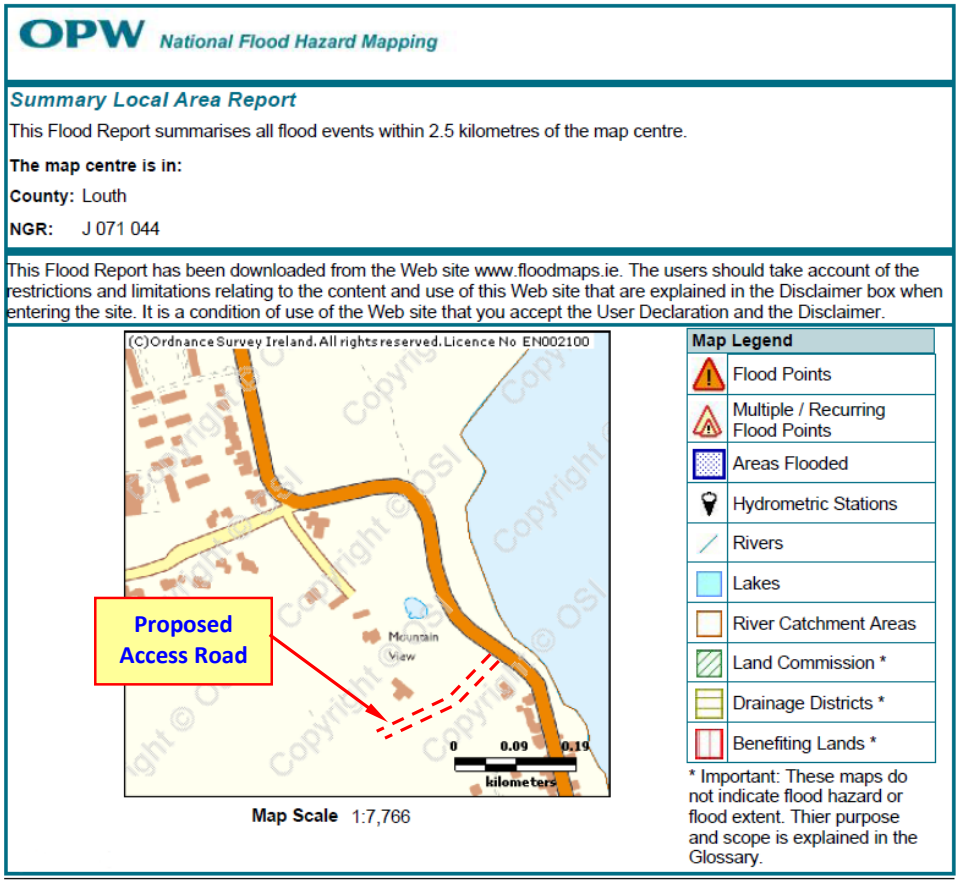


Figure 15 – OPW Flood Maps

Figure 15 above does not indicate and historical or anecdotal instances of flooding at the location of the proposed access road.

North-Western Neagh Bann CFRAM Study

The North-Western Neagh Bann Catchment Flood Risk & Management Study (CFRAMS) has been undertaken by the OPW and the Final version of the flood maps were issued in August 2016. Fluvial and tidal/coastal flood risk extent and depth maps for further assessment areas within the general Blackrock have also been produced. OPW CFRAMS predictive flood map numbers *N06BRK_EXFCD_F0_02* and *N06BRK_EXCCD_F0_02* illustrate predictive extreme fluvial and tidal/coastal flood extent zones in the general vicinity of the proposed access road site.

Figure 16 below (extracted from CFRAMS flood map *N06BRK_EXFCD_F0_02*), illustrates the predicted extreme 10% AEP (1 in 10 year), 1% AEP (1 in 100 year) or 0.1% AEP (1 in 1000 year) fluvial flood extents in the vicinity of the proposed access road site

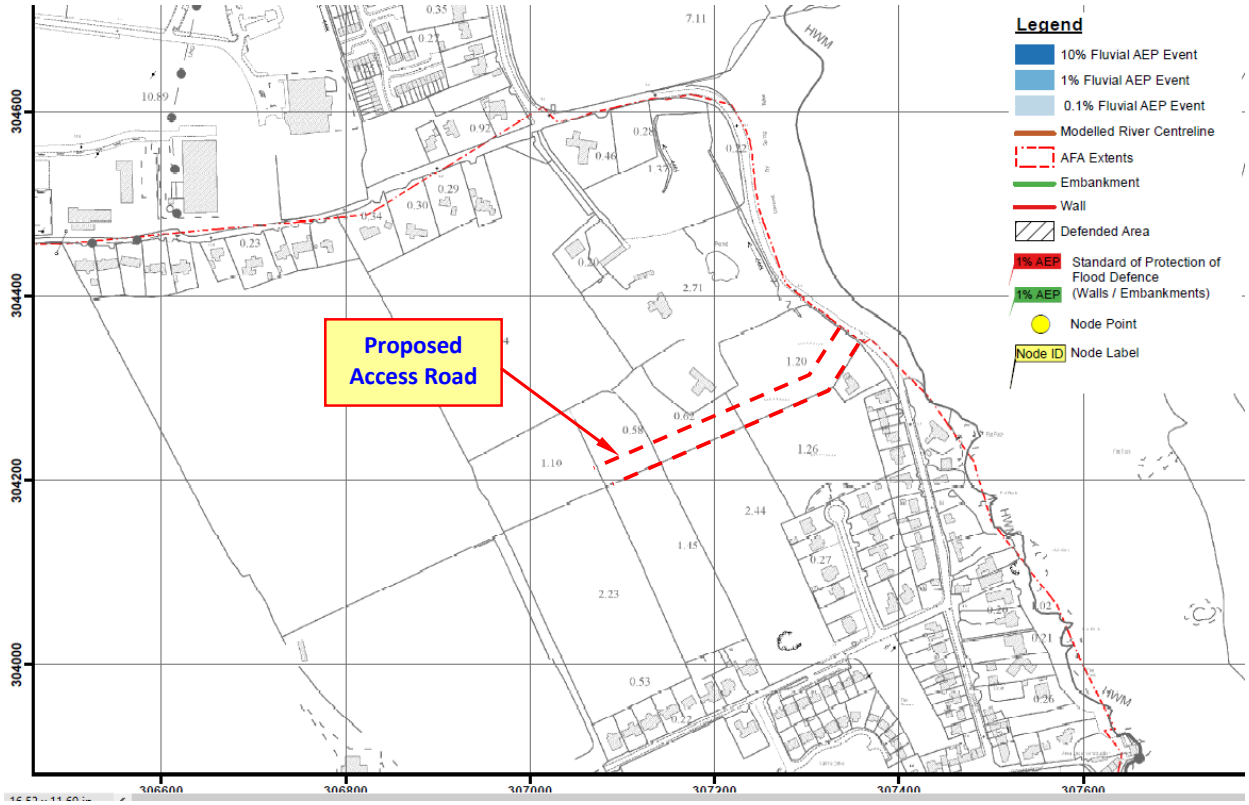


Figure 16 – OPW CFRAMS Fluvial Flood Extent Maps

Figure 16 above indicates that the proposed access road does not fall with any 10% AEP (1 in 10 year), 1% AEP (1 in 100 year) or 0.1% AEP (1 in 1000 year) predictive fluvial flood zone.

A full copy of the above OPW predictive CFRAMS flood map is contained in *Appendix C.*

Figure 17 below (extracted from CFRAMS flood map *N06BRK_EXCCD_F0_02*), illustrates the predicted extreme 10% AEP (1 in 10 year), 0.5% AEP (1 in 200 year) and 0.1% AEP (1 in 1000 year) tidal/coastal flood extents in the vicinity of the proposed access road.

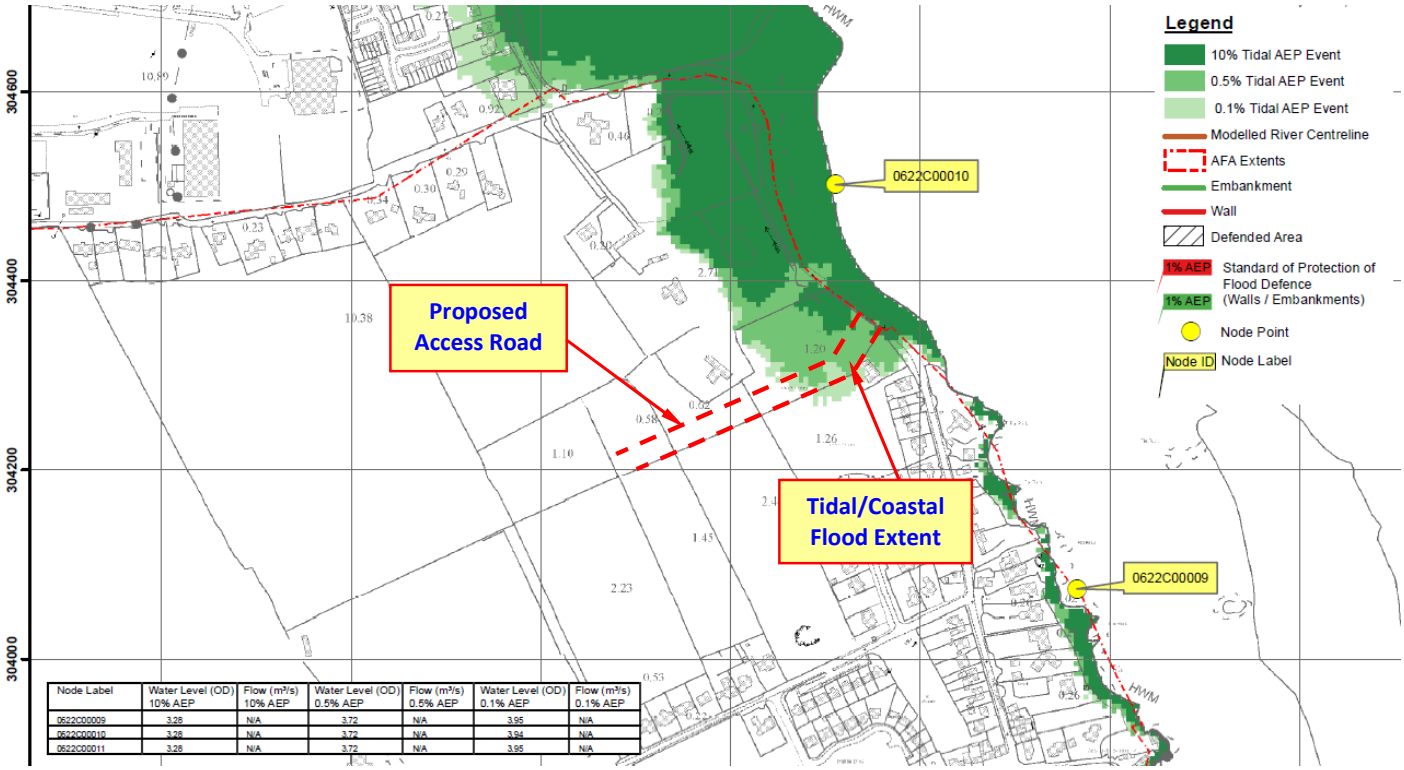


Figure 17 – OPW CFRAMS Fluvial Flood Extent Maps

Figure 17 above indicates that the part of the proposed access road falls with a 0.5% AEP (1 in 200 year) and 0.1% AEP (1 in 1000 year) or 0.1% AEP (1 in 1000 year) predictive tidal/coastal flood zone.

A full copy of the above OPW predictive CFRAMS flood map is contained in *Appendix C.*

The OPW CFRAMS tidal/coastal flood map also provides information and data in relation to predicted flood water levels for 10% AEP, 0.5% AEP and 0.1% AEP tidal/coastal flood events at node points with Dundalk Bay estuary. As illustrated in *Figure 17* above, the node point closest to the site of the proposed access road is referenced as node point *0622C0010*, which is located approximately 165m north of the access road site. Details of the predicted current scenario tidal/coastal flood levels for this node point are illustrated in *Table 6* below, which has been extracted from OPW CFRAMS flood map reference *N06BRK_EXCCD_F0_02*.

Node Label	Flood Level (m OD) 10% AEP	Flood Level (m OD) 0.5% AEP	Flood Level (m OD) 0.1% AEP
N06BRK_EXCCD_F0_02	3.28	3.72	3.94

Table 6 – CFRAMS Predicted Tidal/Coastal Flood Levels

4.2 Site Specific Current & Mid-Range Future Scenario Flood Zone Delineation

Utilising a LiDAR derived digital terrain model, the flood level information listed in *Table 6* above, and a specialist software package employed by IE Consulting, a site specific delineation of the 0.5% AEP (1 in 200 year) and 0.1% AEP (1 in 1000 year) current and mid-range future scenario flood zones were delineated. The software enables a user defined flood level to the thematically mapped and delineated over a generated digital terrain model.

In addition to the current scenario tidal/coastal flood levels listed in *Table 6* above, the 'Planning system & Risk Management Guidelines' recommends that potential flood impact be assessed in consideration of a mid-range future climate change scenario. The OPW Irish Coastal Protection Strategy Study (ICPSS) recommends that an allowance of 0.5m be added to predictive current scenario tidal/coastal flood levels in order to account for a mid-range future climate change scenario. Therefore the mid-range future climate change scenario 0.5% AEP and 0.1% AEP tidal/coastal flood levels applicable to the location of the proposed access road site are 3.72m+0.5m = **4.22m OD** and 3.94m+0.5m = **4.44m OD** respectively.

Drawing Number IE1723-006-A, Appendix A, illustrates the site specific delineation of the current scenario 0.5% AEP (1 in 200 year) and 0.1% AEP (1 in 1000 year) tidal/coastal flood extents at the location of the proposed access road.

Drawing Number IE1723-007-A, Appendix A, illustrates the site specific delineation of the mid-range future climate change scenario 0.5% AEP (1 in 200 year) and 0.1% AEP (1 in 1000 year) tidal/coastal flood extents at the location of the proposed access road.

As illustrated on the above drawings a small area of the proposed access road may be impacted due to a current scenario and mid-range future climate change scenario 0.5% AEP and 0.1% AEP tidal/coastal flood event.

4.3 Flood Depth & Volume Analysis

An analysis was undertaken to assess the depths and volumes of tidal/coastal flood waters that may potentially inundate the small area of the proposed access road during the occurrence of a 0.1% AEP (1 in 1000 year) mid-range future climate change scenario tidal/coastal flood event.

Using the hydrology module of an appropriate software package further analysis was therefore undertaken to determine the range of 0.1% AEP flood water depths and volumes that may possibility inundate this small area of the proposed access road and to determine the potential volume of tidal/coastal flood water that may be offset due to construction of the road.

Drawing Number IE1723-008-A, Appendix A, illustrates the calculated depth of mid-range future climate change scenario0.1% AEP flood waters that may occur within the boundary of the proposed access road site in consideration of the existing undeveloped scenario and in consideration of the proposed developed and constructed scenario.

The possible depth of tidal/coastal flood waters is illustrated on the drawing via a graphical representation of flood depths within the boundary of the proposed access road site and via a table of predicted flood water depths. The tidal/coastal flood water depth table presents flood water depths over 20 separate elevation ranges within the boundary of the proposed access road site for the existing undeveloped scenario and the proposed developed scenario.

The potential maximum and mean 0.1% AEP flood depths and flood volumes predicted to occur with the boundary of the proposed access road site are summarised in *Table 9* below.

	Existing Undeveloped Scenario 0.1% AEP + CC Flood	Proposed Developed Scenario 0.1% AEP + CC Flood
Maximum Flood Depth (m)	**2.03**	**1.56**
Mean Flood Depth (m)	**1.04**	**0.65**
Total Flood Water Volume (m^3)	**3785**	**1967**

Table 9 – Pre and Post Development Site Flood Depth and Inundation Volumes

As listed in *Table 9* above, in consideration of the occurrence of a mid-range future climate change scenario 0.1% AEP (1 in 1000 year) tidal/coastal flood event, development of the proposed access road has the potential to result in the displacement of approximately 1818m^3 (3785-1967) of tidal/coastal flood waters.

4.4 Impact of the Proposed Access Road

As presented above, the site of the proposed access road does not fall within an indicative or predictive fluvial, pluvial or groundwater flood zone, therefore development of the road as proposed will not result in any adverse impact to the existing fluvial, pluvial or groundwater flooding regime of the area.

A small area of the proposed access road falls with a delineated current scenario and mid-range future climate change scenario 0.5% AEP (1 in 200 year) and 0.1% AEP (1 in 1000 year) tidal/coastal flood zone. The assessment and analysis presented above indicates that the proposed access road has the potential to displace approximately 1818m^3 of 0.1% AEP mid-range future climate change scenario tidal / coastal flood waters.

This volume of potentially displaced tidal / coastal food waters is imperceptible in consideration of the occurrence of a 0.1% AEP mid-range future climate change scenario tidal / coastal flood event in Dundalk Bay estuary and the wholly massive volume of flood waters associated with this tidal/coastal flood event.

It is generally acknowledged by the OPW that infilling and other development works within any coastal flood plain area shall have a negligible effect on the extent of the coastal flood plain now, or in the future, taking account of anticipated climate change. Accordingly, such development within any coastal flood plain will not result in additional flood risk elsewhere within the coastal flood plain.

In summary, development of the access road as proposed is not predicted to result in any adverse impact to the existing hydrological regime of the area or to result in an increased flood risk elsewhere and is considered to be appropriate from a hydrological and flood risk perspective.

5 Summary Conclusions

In consideration of the findings of this hydraulic assessment and analysis the following conclusions are made:-

- *A hydrological analysis has been undertaken in order to predict estimated 1 in 100 year (1% AEP) and 1 in 1000 year (0.1% AEP) flood volumes in the eastern and northern conveyance channels.*
- *A detailed hydraulic model has been developed for the eastern and northern drainage channels over reach lengths of approximately 273.19m and 124.02m respectively.*
- *In consideration of the proposed developed scenario, the hydraulic simulation model indicates that the input of attenuated surface water discharges from the proposed development site to the northern drainage channel at a maximum discharge rate of 0.106m^3/s has the potential to increase 1% AEP and 0.1% AEP flood levels to between 0.03m (30mm) and 0.04m (40mm) between cross-sectional locations 8-8 to 10-10 and 0.02m (20mm) at cross-sectional locations 12-12.*
- *In the context of the occurrence of a 1% AEP (1 in 100 year) or a 0.1% AEP (1 in 1000 year) fluvial flood event these small predictive increases in flood levels in the northern drainage conveyance channel are imperceptible and immeasurable and would not result in an adverse impact to the existing hydrological regime or result in an increased flood risk to adjacent lands or properties or result in an adverse impact to the existing hydrological regime of the area.*
- *The hydraulic simulation model indicates that the input of attenuated surface water discharge from the proposed new access road to the eastern drainage channels and at a maximum discharge rate of 0.0021m^3/s is not predicted to result in any measurable increase in current scenario fluvial flood levels within these drainage channel or the existing wetland areas.*
- *Development of the access road as proposed is not predicted to result in any adverse impact to the existing hydrological regime of the area or to result in an increased flood risk elsewhere and is considered to be appropriate from a hydrological and flood risk perspective.*

APPENDIX A

Drawing Number IE1723-001-A

Drawing Number IE1723-002-B

Drawing Number IE1723-003-B

Drawing Number IE1723-004-B

Drawing Number IE1723-005-B

Drawing Number IE1723-006-A

Drawing Number IE1723-007-A

Drawing Number IE1723-008-A

IE Consulting
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IE CONSULTING
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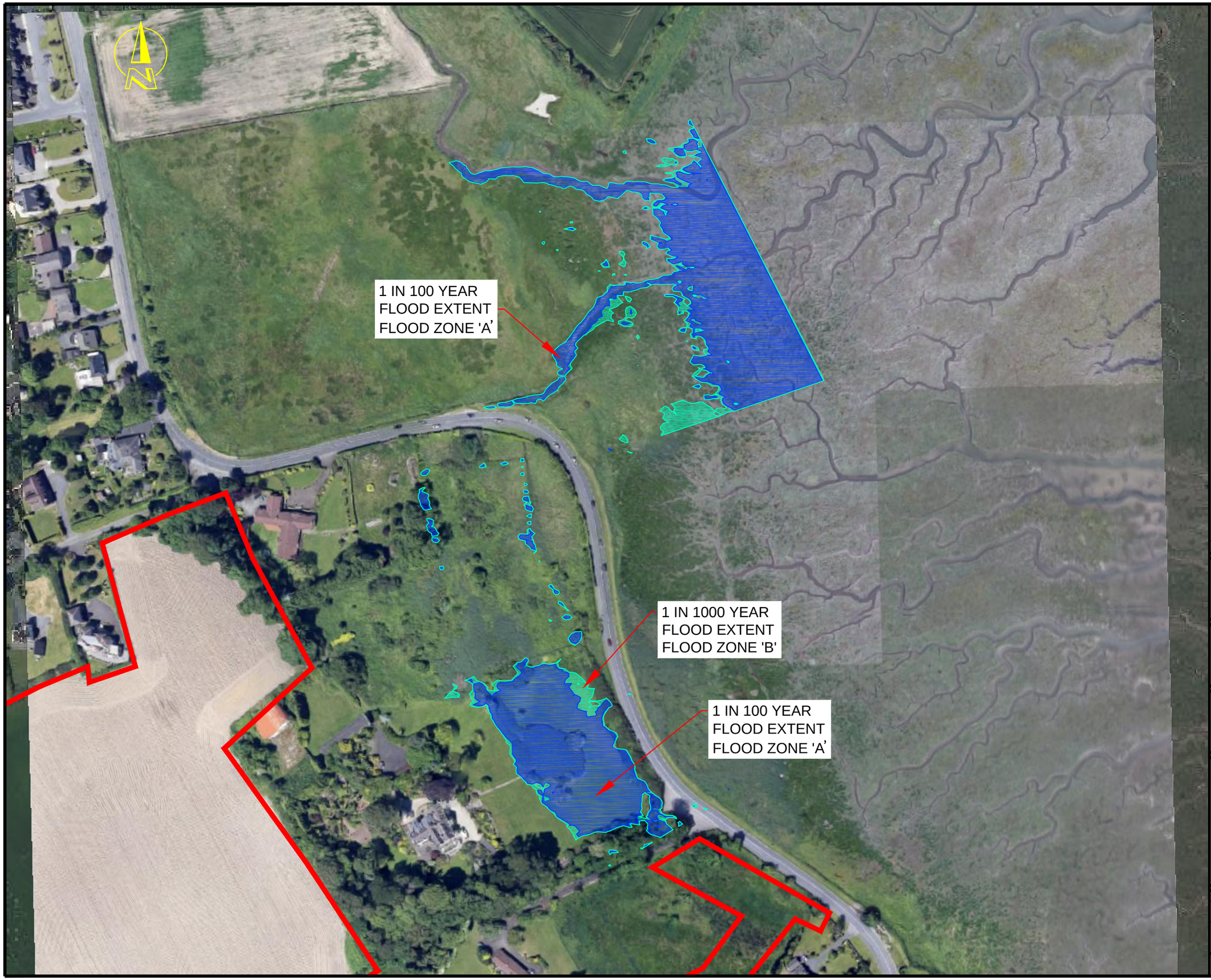
Project Title:	Proposed Development Hydraulic Assessment
Project Address:	Haggardstown, Blackrock, Co. Louth
Client:	Kingsbridge Consultancy Ltd
Drg. Title:	Site Location Map

Dwg.Scale:	Date:	Dwg.No:	Job No:	Revision:	Dwg.By:
1:50,000	03/10/18	IE1723-001	IE1723	A	LM



LEGEND

- SITE BOUNDARY
- 100 YEAR FLOOD EXTENT (1% AEP) FLOOD ZONE 'A'
- 1000 YEAR FLOOD EXTENT (0.1% AEP) FLOOD ZONE 'B'
- FLOOD ZONE 'C'

rev.	date	amendment	drn	ckd
A	03.10.18	PLANNING	LMc	PMS

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PROPOSED DEVELOPMENT AT
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HYDRAULIC MODELING
ASSESSMENT & ANALYSIS

EXISTING SCENARIO 1 IN 100 YEAR (1% AEP)
& 1 IN 1000 YEAR (0.1% AEP)
FLUVIAL FLOOD EXTENTS

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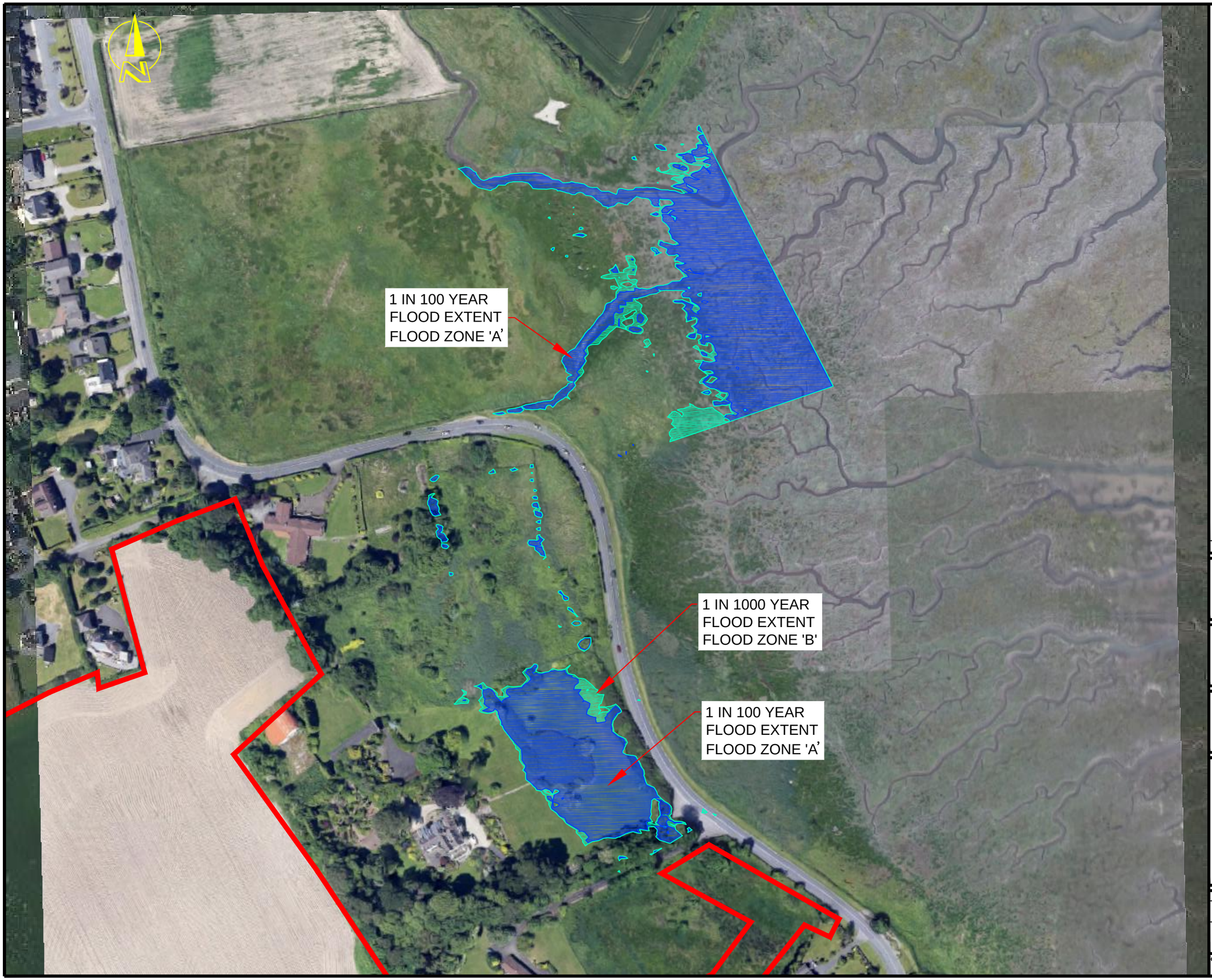
		date: 02.10.2018	



LEGEND

- SITE BOUNDARY
- 100 YEAR FLOOD EXTENT (1% AEP) FLOOD ZONE 'A'
- 1000 YEAR FLOOD EXTENT (0.1% AEP) FLOOD ZONE 'B'
- FLOOD ZONE 'C'

rev.	date	amendment	drn	ckd
B	09.08.19	PLANNING	LMc	PMS
A	03.10.18	PLANNING	LMc	PMS

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ASSESSMENT & ANALYSIS

PROPOSED SCENARIO 1 IN 100 YEAR (1% AEP) & 1 IN 1000 YEAR (0.1% AEP) FLUVIAL FLOOD EXTENTS

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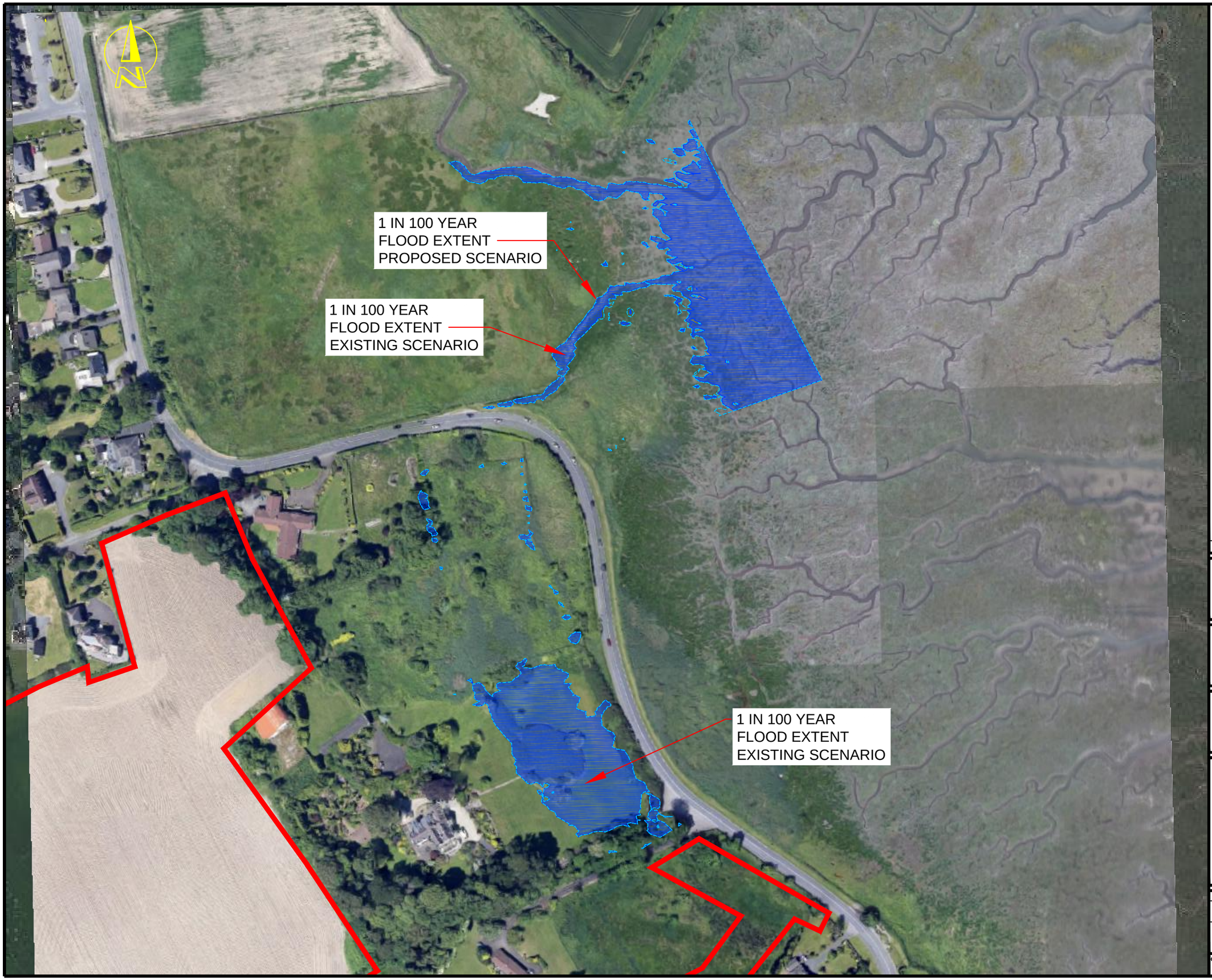

LEGEND

- SITE BOUNDARY
- 100 YEAR FLOOD EXTENT (1% AEP) EXISTING SCENARIO
- 100 YEAR FLOOD EXTENT (1% AEP) PROPOSED SCENARIO

rev.	date	amendment	drn	ckd
B	09.05.19	PLANNING	LMc	PMS
A	03.10.18	PLANNING	LMc	PMS

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HYDRAULIC MODELING
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EXISTING & PROPOSED SCENARIO
1 IN 100 YEAR (1% AEP)
FLUVIAL FLOOD EXTENT COMPARISON

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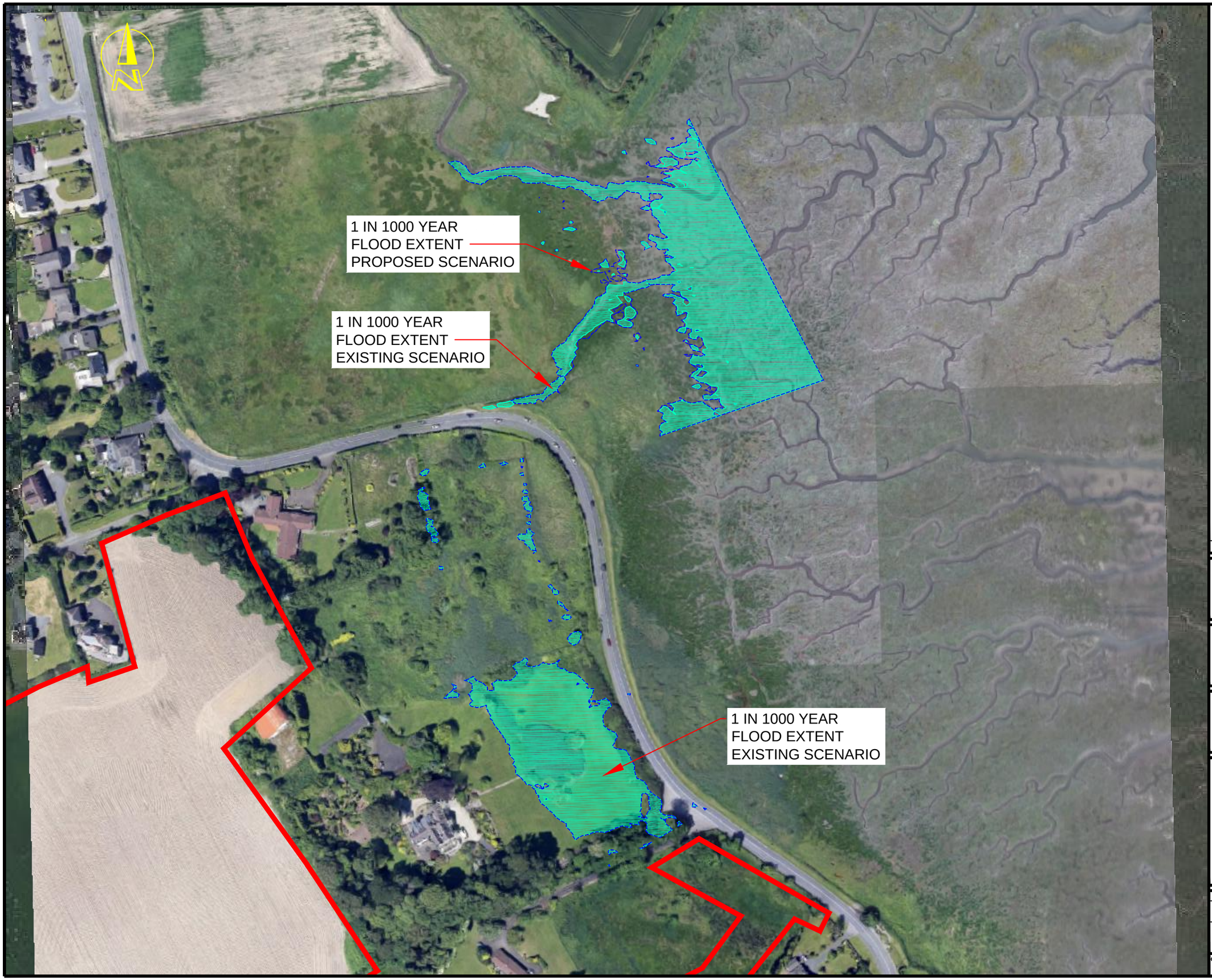

LEGEND

- SITE BOUNDARY
- 1000 YEAR FLOOD EXTENT (0.1% AEP) EXISTING SCENARIO
- 1000 YEAR FLOOD EXTENT (0.1% AEP) PROPOSED SCENARIO

rev.	date	amendment	drn	ckd
B	09.05.19	PLANNING	LMc	PMS
A	03.10.18	PLANNING	LMc	PMS

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ASSESSMENT & ANALYSIS

EXISTING & PROPOSED SCENARIO
1 IN 1000 YEAR (0.1% AEP)
FLUVIAL FLOOD EXTENTS

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		approved: PMS	
		date: 02.10.2018	

LEGEND

- SITE BOUNDARY
- CURRENT SCENARIO 200 YEAR COASTAL FLOOD EXTENT (0.5% AEP)
- CURRENT SCENARIO 1000 YEAR COASTAL FLOOD EXTENT (0.1% AEP)

rev.	date	amendment	drn	ckd
A	30.04.19	PLANNING	LMc	PMS

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HYDROLOGICAL IMPACT ASSESSMENT OF PROPOSED ACCESS ROAD

CURRENT SCENARIO

1 IN 200 YEAR (0.5% AEP) & 1 IN 1000 YEAR (0.1% AEP) COASTAL FLOOD EXTENTS

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		approved: PMS	
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LEGEND

- SITE BOUNDARY
- MID RANGE SCENARIO 200 YEAR COASTAL FLOOD EXTENT (0.5% AEP)
- MID RANGE SCENARIO 1000 YEAR COASTAL FLOOD EXTENT (0.1% AEP)

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A	30.04.19	PLANNING	LMc	PMS

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HYDROLOGICAL IMPACT ASSESSMENT

OF PROPOSED ACCESS ROAD

MID RANGE FUTURE SCENARIO

1 IN 200 YEAR (0.5% AEP) & 1 IN 1000 YEAR

(0.1% AEP) COASTAL FLOOD EXTENTS

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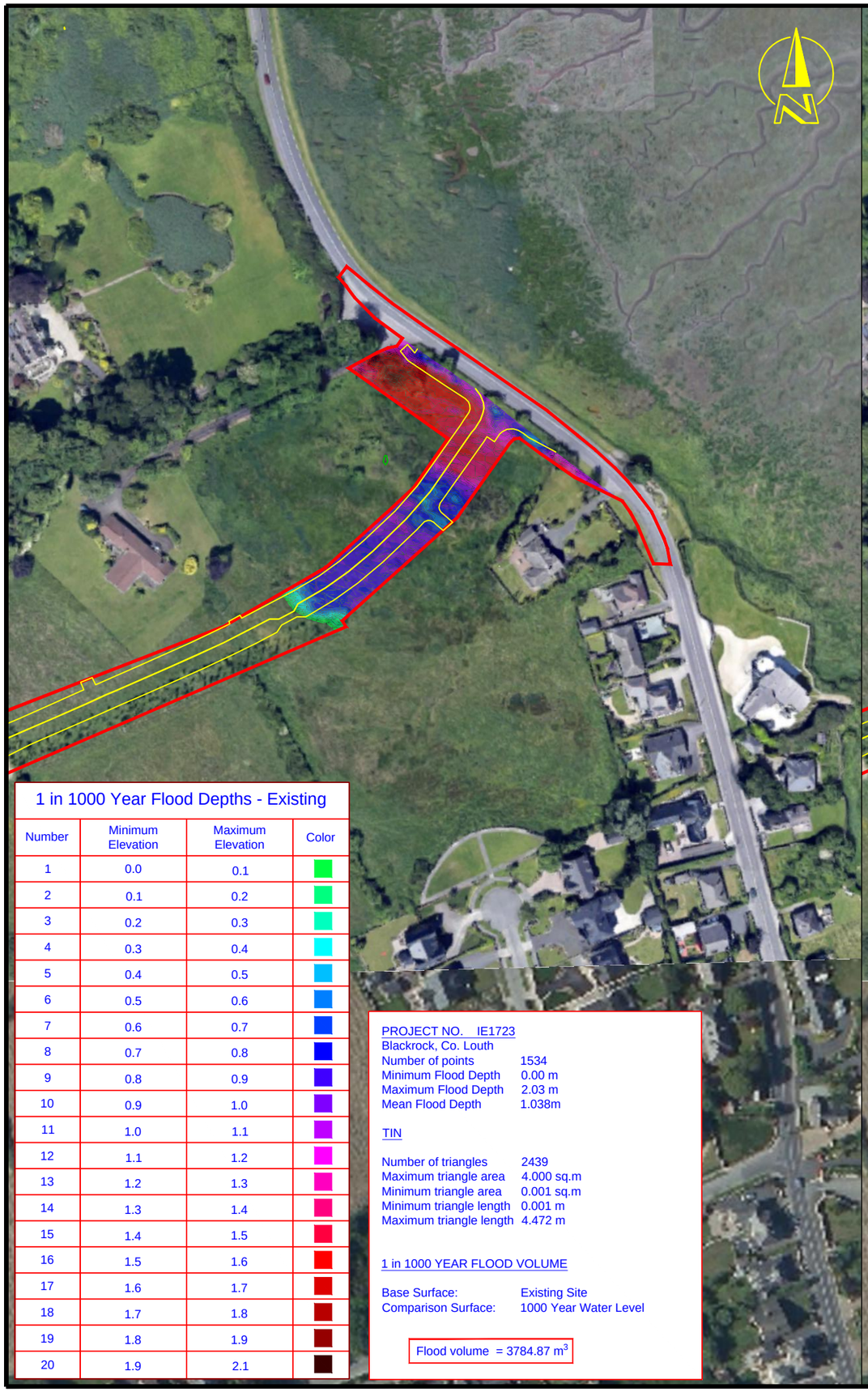


1 in 1000 Year Flood Depths - Existing

Number	Minimum Elevation	Maximum Elevation	Color
1	0.0	0.1	
2	0.1	0.2	
3	0.2	0.3	
4	0.3	0.4	
5	0.4	0.5	
6	0.5	0.6	
7	0.6	0.7	
8	0.7	0.8	
9	0.8	0.9	
10	0.9	1.0	
11	1.0	1.1	
12	1.1	1.2	
13	1.2	1.3	
14	1.3	1.4	
15	1.4	1.5	
16	1.5	1.6	
17	1.6	1.7	
18	1.7	1.8	
19	1.8	1.9	
20	1.9	2.1	

PROJECT NO. IE1723
Blackrock, Co. Louth

Number of points	1534
Minimum Flood Depth	0.00 m
Maximum Flood Depth	2.03 m
Mean Flood Depth	1.038m

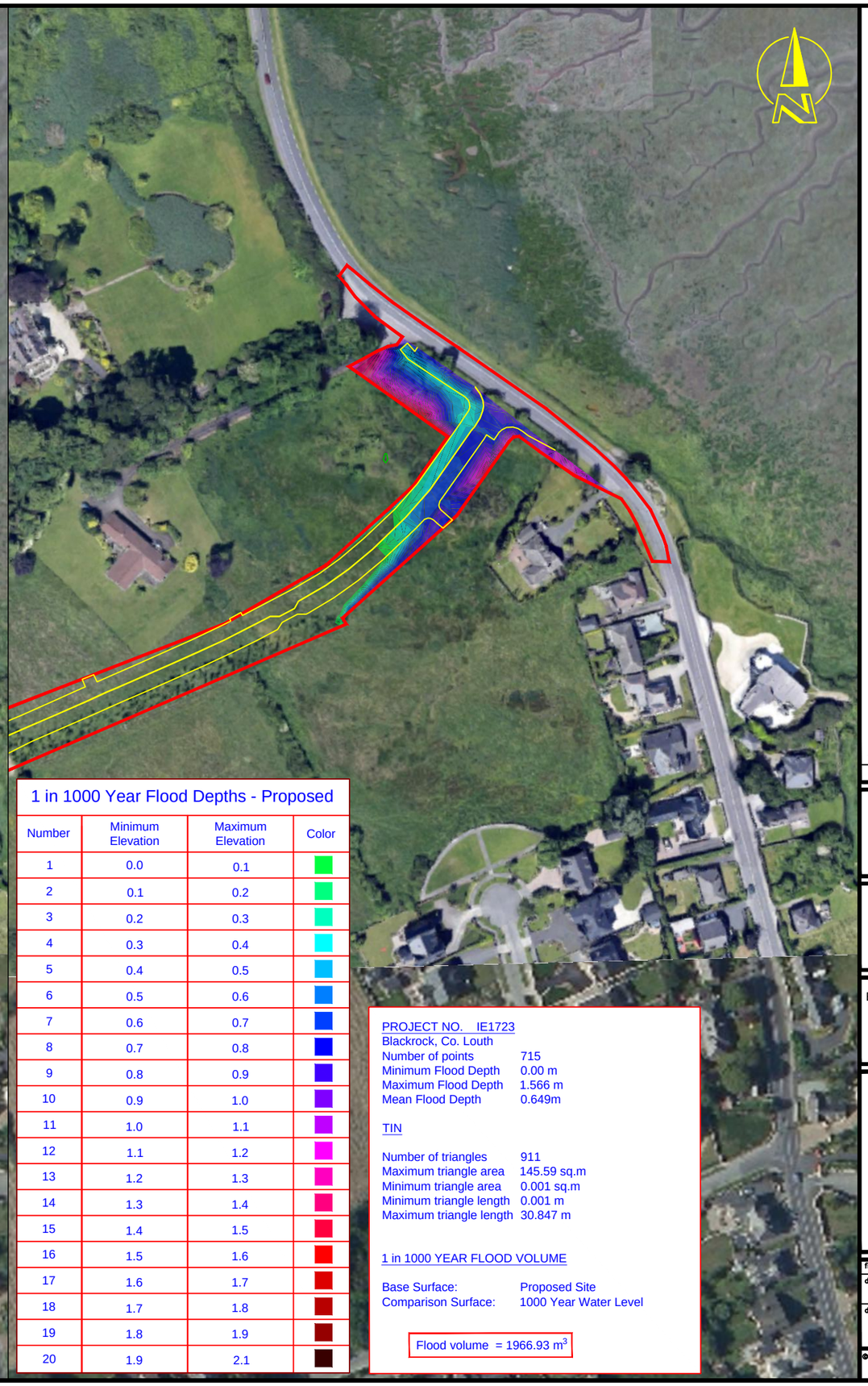
TIN

Number of triangles	2439
Maximum triangle area	4.000 sq.m
Minimum triangle area	0.001 sq.m
Minimum triangle length	0.001 m
Maximum triangle length	4.472 m

1 in 1000 YEAR FLOOD VOLUME

Base Surface:	Existing Site
Comparison Surface:	1000 Year Water Level

Flood volume = 3784.87 m^3



1 in 1000 Year Flood Depths - Proposed

Number	Minimum Elevation	Maximum Elevation	Color
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2	0.1	0.2	
3	0.2	0.3	
4	0.3	0.4	
5	0.4	0.5	
6	0.5	0.6	
7	0.6	0.7	
8	0.7	0.8	
9	0.8	0.9	
10	0.9	1.0	
11	1.0	1.1	
12	1.1	1.2	
13	1.2	1.3	
14	1.3	1.4	
15	1.4	1.5	
16	1.5	1.6	
17	1.6	1.7	
18	1.7	1.8	
19	1.8	1.9	
20	1.9	2.1	

PROJECT NO. IE1723
Blackrock, Co. Louth

Number of points	715
Minimum Flood Depth	0.00 m
Maximum Flood Depth	1.566 m
Mean Flood Depth	0.649m

TIN

Number of triangles	911
Maximum triangle area	145.59 sq.m
Minimum triangle area	0.001 sq.m
Minimum triangle length	0.001 m
Maximum triangle length	30.847 m

1 in 1000 YEAR FLOOD VOLUME

Base Surface:	Proposed Site
Comparison Surface:	1000 Year Water Level

Flood volume = 1966.93 m^3

LEGEND

SITE BOUNDARY

rev.	date	amendment	drn	ckd
A	30.04.19	PLANNING	LMc	PMS

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PROPOSED DEVELOPMENT AT
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HYDROLOGICAL IMPACT ASSESSMENT
OF PROPOSED ACCESS ROAD

EXISTING & PROPOSED SCENARIO COMPARISON
OF 1 IN 1000 YEAR (0.1% AEP +CC) COASTAL
FLOOD VOLUME & DEPTH ANALYSIS

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INNOVATION CENTRE
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drawing no.	rev	checked: NOM	
IE1723-008	A	approved: PMS	
		date: 30.04.2019	

APPENDIX B

Topographical Cross-Sectional Survey

- Notes
-Section levels surveyed 06-09-2018.
-Original survey shown grey (CSS survey).
-LSS survey shown pink.
-Section lines shown magenta.
-Sections drawn from left to right looking downstream.

Land Survey Services

Riverview House, 76 Hill Street, Milford, Co. Armagh, BT60 3PB
Tel ● 028 37 525045 Fax ● 028 37 524346 Mobile ● 07860429910
email:info@landsurveyservicesni.com ● web:www.landsurveyservicesni.com

- Location:
Blackrock, Dundalk.

- Client:
Finn Design.

- Levels Related To:
Original survey.

- Grid:
Ordnance Survey ITM.

- Checked by:
Kenny Moorcroft.

- Plot scale:
1:500 @ A0

- Cad scale:
1:1

- Date:
13/09/2018

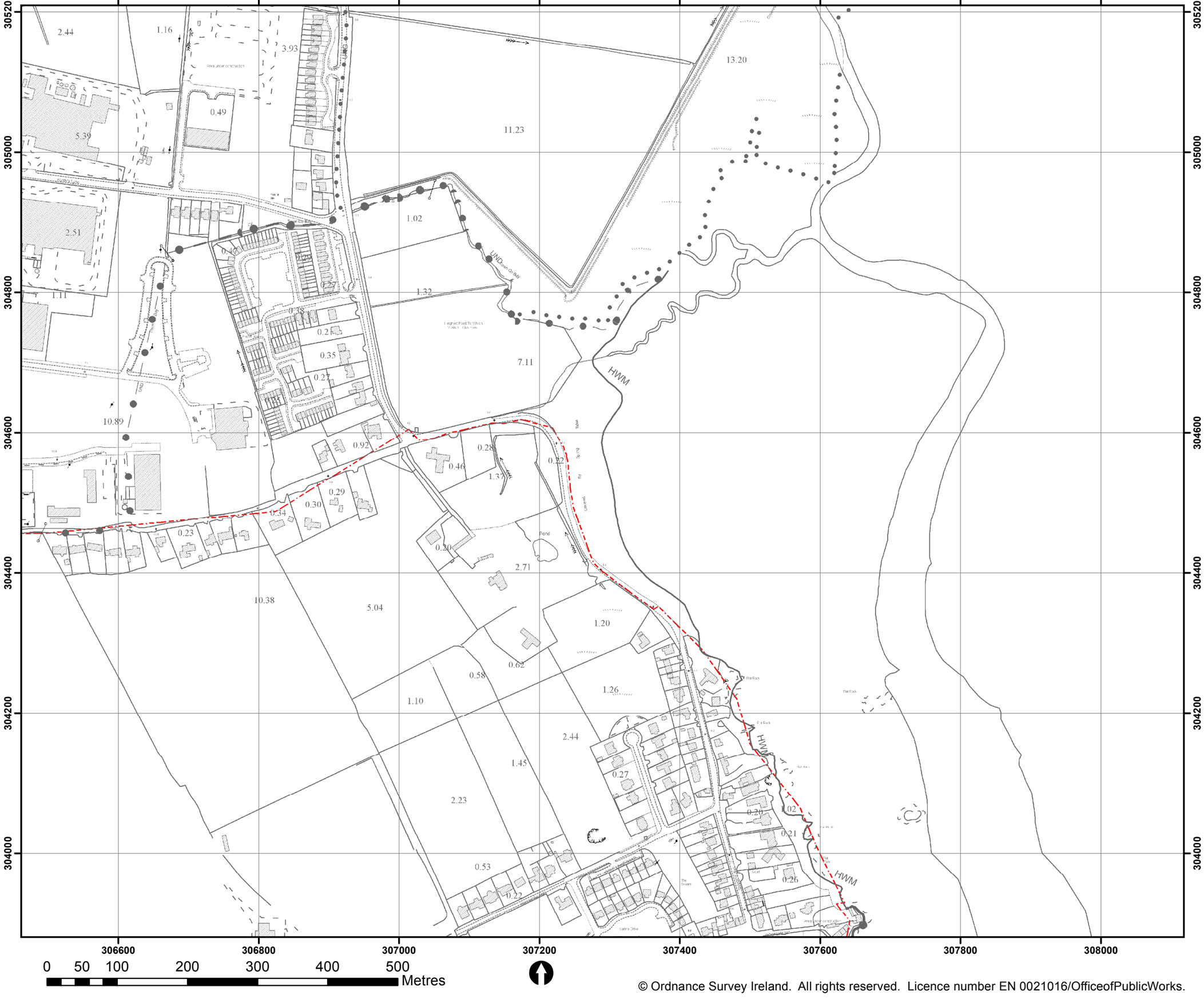
- Job No:
28957

- Drawing No:
02

- Project:
Section Levels.

APPENDIX C

OPW CFRAMS Fluvial & Tidal/Coastal Flood Extent Maps



IMPORTANT USER NOTE:
THE VIEWER OF THIS MAP SHOULD REFER TO THE DISCLAIMER, GUIDANCE NOTES AND CONDITIONS OF USE THAT ACCOMPANY THIS MAP.

Legend

- 🟦 10% Fluvial AEP Event
- 🟦 1% Fluvial AEP Event
- 🟦 0.1% Fluvial AEP Event
- — Modelled River Centreline
- ☐ AFA Extents
- — Embankment
- — Wall
- ▨ Defended Area
- 1% AEP / 1% AEP Standard of Protection of Flood Defence (Walls / Embankments)
- ● Node Point
- Node ID Node Label

FINAL

REV:	NOTE:	DATE:

NORTH WESTERN
NEAGH BANN
CFRAM
STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

OPW
Oifig na nOibreacha Poiblí
The Office of Public Works

RPS

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Jonathan Swift Street
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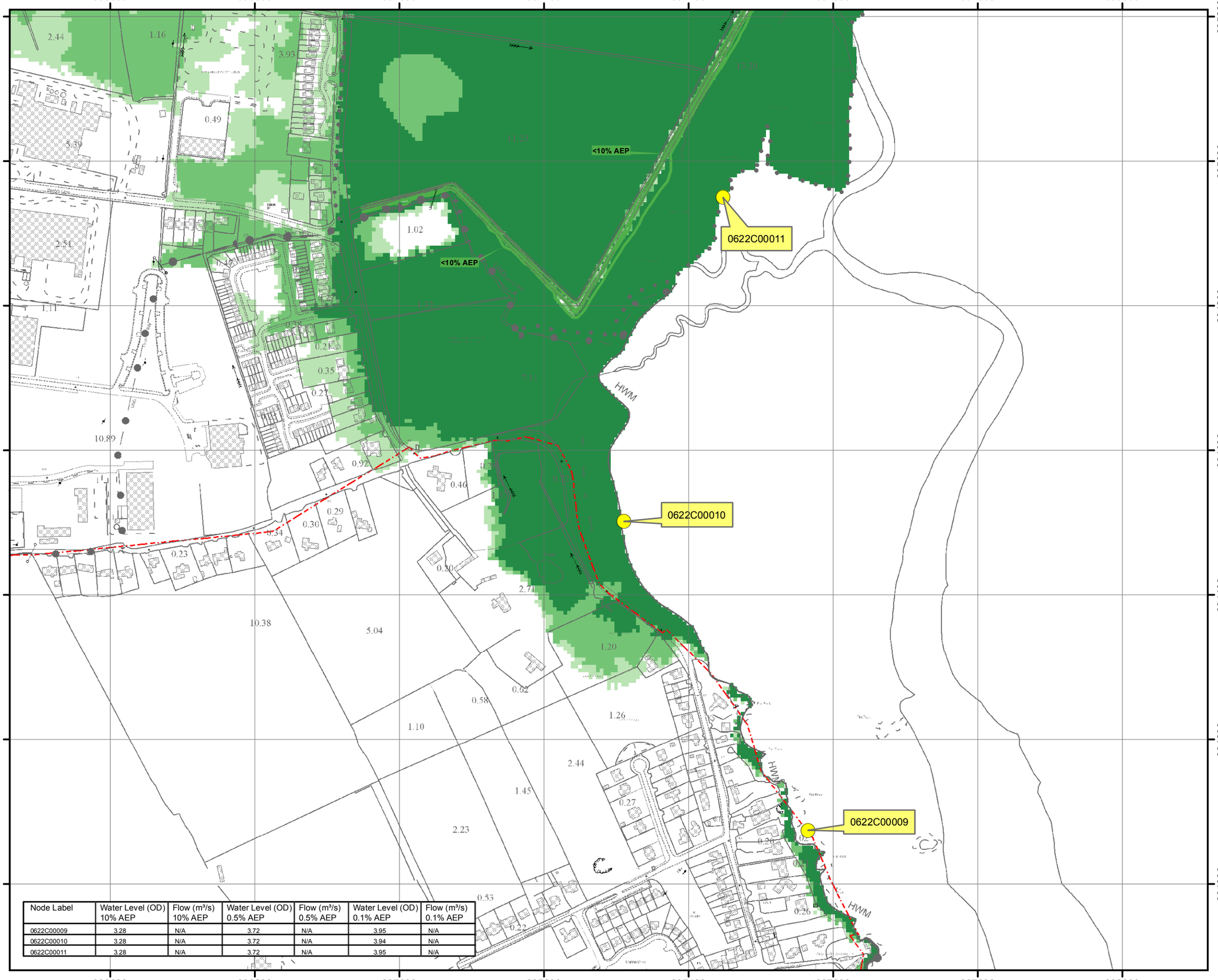
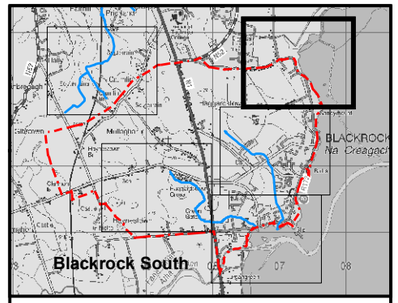
W www.rpsgroup.com
E ireland@rpsgroup.com

Map:
Blackrock South Fluvial Flood Extents

Map Type: EXTENT
Source: Fluvial
Map Area: HPW
Scenario: CURRENT
Drawn By : C.C. **Date :** 9 August 2016
Checked By : E.H. **Date :** 9 August 2016
Approved By : S.P. **Date :** 9 August 2016
Drawing No. :
N06BRK_EXFCD_F0_02
Map Series : Page 2 of 5
Drawing Scale : 1:5,000 @A3



Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 0.5% AEP	Flow (m³/s) 0.5% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
0622C00009	3.28	N/A	3.72	N/A	3.95	N/A
0622C00010	3.28	N/A	3.72	N/A	3.94	N/A
0622C00011	3.28	N/A	3.72	N/A	3.95	N/A



IMPORTANT USER NOTE:
THE VIEWER OF THIS MAP SHOULD REFER TO THE DISCLAIMER, GUIDANCE NOTES AND CONDITIONS OF USE THAT ACCOMPANY THIS MAP.

Legend

- 10% Tidal AEP Event
- 0.5% Tidal AEP Event
- 0.1% Tidal AEP Event
- Modelled River Centreline
- AFA Extents
- Embankment
- Wall
- Defended Area
- 1% AEP — Standard of Protection of Flood Defence
- 1% AEP — (Walls / Embankments)
- Node Point
- Node ID — Node Label

FINAL

REV:	NOTE:	DATE:

NORTH WESTERN NEAGH BANN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

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Map:
Blackrock South Tidal Flood Extents

Map Type:	**EXTENT**
Source:	**TIDAL**
Map Area:	**COASTAL**
Scenario:	**CURRENT**
Drawn By :	**C.C.** **Date : 4 August 2016**
Checked By :	**E.H.** **Date : 4 August 2016**
Approved By :	**S.P.** **Date : 4 August 2016**
Drawing No. :	**N06BRK_EXCCD_F0_02**
Map Series :	**Page 2 of 5**
Drawing Scale :	**1:5,000 @A3**