Environmental Impact Assessment Report

Application to An Bord Pleanála for permission for a strategic housing development at Growth Area 2, located in the townland of Stapolin, Baldoyle, Dublin 13

Volume 3 – EIA Appendix

Prepared by: AWN Consulting, March 2022

Prepared for: Lismore Homes Limited

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Appendix 6.1

Criteria for rating site importance of Geological Features (NRA)

Table 9.1 Criteria for rating site importance of Geological Features (NRA)

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale Degree or extent of soil contamination is significant on a national or regional scale Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale.	Geological feature rare on a regional or national scale (NHA) Large existing quarry or pit Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and/or soft organic soil underlying route is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site) Well drained and/or high fertility soils Moderately sized existing quarry or pit Marginally economic extractable mineral resource
Medium	Attribute has a medium quality, significance or value on a local scale Degree or extent of soil contamination is moderate on a local scale Volume of peat and/or soft organic soil underlying route is moderate on a local scale	Contaminated soil on site with previous light industrial usage Small recent landfill site for mixed wastes Moderately drained and/or moderate fertility soils Small existing quarry or pit Sub-economic extractable mineral resource
Low	Attribute has a low quality, significance or value on a local scale Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying route is small on a local scale	Large historical and/or recent site for construction and demolition wastes. Small historical and/or recent landfill site for construction and demolition wastes. Poorly drained and/or low fertility soils. Uneconomically extractable mineral resource.

Table 9.2 Criteria for rating impact magnitude at EIS stage – Estimation of magnitude of impact on soil / geology attribute (NRA)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute	Loss of high proportion of future quarry or pit reserves
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Loss of moderate proportion of future quarry or pit reserves
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of	Loss of small proportion of future quarry or pit reserves
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	No measurable changes in attributes
Minor Beneficial	Results in minor improvement of attribute quality	Minor enhancement of geological heritage feature
Moderate Beneficial	Results in moderate improvement of attribute quality	Moderate enhancement of geological heritage feature
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature

The NRA criteria for estimation of the importance of hydrogeological attributes at the site during the EIA stage are summarised in Table 4 below.

Table 9.3 Criteria for rating Site Attributes - Estimation of Importance of Hydrogeology Attributes (NRA)

Magnitude of Impact	Criteria	Typical Examples
Extremely High	Attribute has a high quality or value on an international	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. SAC or SPA status
Very High	Attribute has a high quality or value on a regional or national scale	Regionally Important Aquifer with multiple well fields Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes
High	Attribute has a high quality or value on a local scale	Regionally Important Aquifer Groundwater provides large proportion of baseflow to local rivers Locally important potable water source supplying >1000 homes Outer source protection area for regionally important water source
Medium	Attribute has a medium quality or value on a local scale	Locally Important Aquifer Potable water source supplying >50 homes Outer source protection area for locally important water source
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer Potable water source supplying <50 homes

Table 9.4 Criteria for Rating Impact Significance at EIS Stage – Estimation of Magnitude of Impact on Hydrogeology Attribute (NRA)

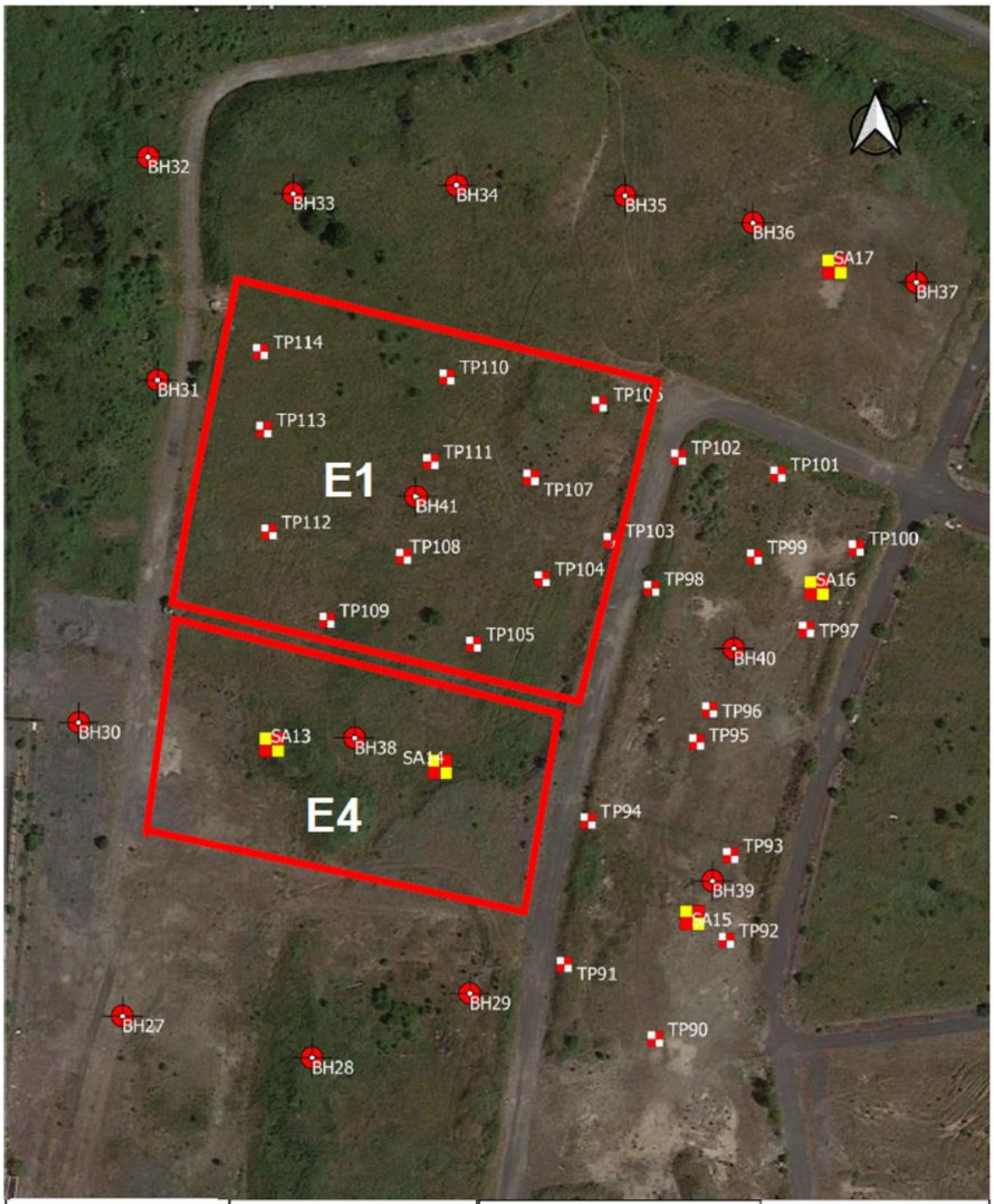
Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and /or quality and integrity of attribute	Removal of large proportion of aquifer. Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. Potential high risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >2% annually.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Removal of moderate proportion of aquifer. Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. Potential medium risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >1% annually.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Removal of small proportion of aquifer. Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >0.5% annually.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Calculated risk of serious pollution incident <0.5% annually.

Table 9.5: Rating of Significant Environmental Impacts at EIS Stage (NRA)

Importance of Attribute	Magnitude of Importance			
	Neglible	**Small Adverse**	**Moderate Adverse**	**Large Adverse**
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant/moderate	Profound/Significant	Profound
High	Imperceptible	Moderate/Slight	Significant/moderate	Profound/Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/Moderate

Appendix 6.2

Site Investigation Locations



GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

Ground Investigations Ireland Ltd.
Catherinstown House,
Hazelhatch Road,
Newcastle, Co. Dublin
www.gii.ie 01-6015175/5176

Client:
CS CONSULTING GROUP

0 28 56 84 112 m

Project Title:
Baldoyle

Drawing Title:
Baldoyle GA3

GII Project Reference:
9161-10-19

Drawn By: AB

Date: 13/03/2020

Cable Percussion

Soakaway

Trial Pit

Appendix 6.3

Lab Reports and WAC Comparison

Element

Element Materials Technology
Unit 3 Deeside Point
Zone 3
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Deeside
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Ireland

Attention :	Diarmaid MagLochlainn
Date :	18th February, 2020
Your reference :	9161-10-19
Our reference :	Test Report 20/1987 Batch 1
Location :	Baldoyle
Date samples received :	10th February, 2020
Status :	Final report
Issue :	1

Eighteen samples were received for analysis on 10th February, 2020 of which eighteen 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.

Authorised By:

Bruce Leslie
Project Manager

Client Name: Ground Investigations Ireland
Reference: 9161-10-19
Location: Baldoyle
Contact: Diarmaid MagLochlainn
EMT Job No: 20/1987

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-3	4	5-7	8	9-11	12-14	15	16-18	19	20-22	LOD/LOR	Units	Method No.
Sample ID	TP02	TP06	TP09	TP85	TP86	TP90	TP93	TP94	TP96	TP99			
Depth	0.50	0.50	1.50	0.50	0.50	0.50	1.50	0.50	0.50	0.50			
COC No / misc													
Containers	V J T	T	V J T	T	V J T	V J T	T	V J T	T	V J T			
Sample Date	21/01/2020	21/01/2020	21/01/2020	21/01/2020	21/01/2020	22/01/2020	22/01/2020	22/01/2020	22/01/2020	23/01/2020			
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	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020			
Antimony	2	-	2	-	2	2	-	2	-	2	<1	mg/kg	TM30/PM15
Arsenic #	14.8	-	11.1	-	8.5	12.0	-	12.1	-	11.7	<0.5	mg/kg	TM30/PM15
Barium #	81	-	96	-	60	79	-	136	-	59	<1	mg/kg	TM30/PM15
Cadmium #	2.6	-	1.5	-	2.1	2.0	-	1.9	-	1.9	<0.1	mg/kg	TM30/PM15
Chromium #	40.8	-	20.3	-	22.5	18.8	-	22.0	-	22.0	<0.5	mg/kg	TM30/PM15
Copper #	28	-	24	-	18	26	-	26	-	27	<1	mg/kg	TM30/PM15
Lead #	30	-	17	-	12	18	-	21	-	22	<5	mg/kg	TM30/PM15
Mercury #	<0.1	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	<0.1	mg/kg	TM30/PM15
Molybdenum #	3.9	-	3.1	-	3.0	3.3	-	3.4	-	3.0	<0.1	mg/kg	TM30/PM15
Nickel #	60.0	-	35.2	-	24.9	36.4	-	40.3	-	45.4	<0.7	mg/kg	TM30/PM15
Selenium #	2	-	1	-	1	<1	-	<1	-	<1	<1	mg/kg	TM30/PM15
Zinc #	107	-	79	-	61	72	-	89	-	100	<5	mg/kg	TM30/PM15
PAH MS													
Naphthalene #	<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	mg/kg	TM4/PM8
Acenaphthene #	<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	mg/kg	TM4/PM8
Phenanthrene #	<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	mg/kg	TM4/PM8
Fluoranthene #	<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	mg/kg	TM4/PM8
Benzo(a)anthracene #	<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	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	<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	mg/kg	TM4/PM8
Indeno(123cd)pyrene	<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	mg/kg	TM4/PM8
Benzo(ghi)perylene #	<0.04	-	<0.04	-	<0.04	<0.04	-	<0.04	-	<0.04	<0.04	mg/kg	TM4/PM8
Coronene	<0.04	-	<0.04	-	<0.04	<0.04	-	<0.04	-	<0.04	<0.04	mg/kg	TM4/PM8
PAH 6 Total #	<0.22	-	<0.22	-	<0.22	<0.22	-	<0.22	-	<0.22	<0.22	mg/kg	TM4/PM8
PAH 17 Total	<0.64	-	<0.64	-	<0.64	<0.64	-	<0.64	-	<0.64	<0.64	mg/kg	TM4/PM8
Benzo(b)fluoranthene	<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	mg/kg	TM4/PM8
Benzo(j)fluoranthene	<1	-	<1	-	<1	<1	-	<1	-	<1	<1	mg/kg	TM4/PM8
PAH Surrogate % Recovery	95	-	103	-	100	96	-	93	-	86	<0	%	TM4/PM8
Mineral Oil (C10-C40)	<30	-	<30	-	<30	<30	-	<30	-	<30	<30	mg/kg	TM5/PM8/PM16

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Ground Investigations Ireland
Reference: 9161-10-19
Location: Baldoyle
Contact: Diarmaid MagLochlainn
EMT Job No: 20/1987

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	1-3	4	5-7	8	9-11	12-14	15	16-18	19	20-22	LOD/LOR	Units	Method No.
Sample ID	TP02	TP06	TP09	TP85	TP86	TP90	TP93	TP94	TP96	TP99			
Depth	0.50	0.50	1.50	0.50	0.50	0.50	1.50	0.50	0.50	0.50			
COC No / misc													
Containers	V J T	T	V J T	T	V J T	V J T	T	V J T	T	V J T			
Sample Date	21/01/2020	21/01/2020	21/01/2020	21/01/2020	21/01/2020	22/01/2020	22/01/2020	22/01/2020	22/01/2020	23/01/2020			
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	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020			
TPH CWG													
Aliphatics													
>C5-C6 #	<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	mg/kg	TM36/PM12
>C8-C10	<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	mg/kg	TM5/PM8/PM16
>C12-C16 #	<4	-	<4	-	<4	<4	-	<4	-	<4	<4	mg/kg	TM5/PM8/PM16
>C16-C21 #	<7	-	<7	-	<7	<7	-	<7	-	<7	<7	mg/kg	TM5/PM8/PM16
>C21-C35 #	<7	-	<7	-	<7	<7	-	<7	-	<7	<7	mg/kg	TM5/PM8/PM16
>C35-C40	<7	-	<7	-	<7	<7	-	<7	-	<7	<7	mg/kg	TM5/PM8/PM16
Total aliphatics C5-40	<26	-	<26	-	<26	<26	-	<26	-	<26	<26	mg/kg	TM5/TM36/PM8/PM12/PM16
>C6-C10	<0.1	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	<0.1	mg/kg	TM36/PM12
>C10-C25	<10	-	<10	-	<10	<10	-	<10	-	<10	<10	mg/kg	TM5/PM8/PM16
>C25-C35	<10	-	<10	-	<10	<10	-	<10	-	<10	<10	mg/kg	TM5/PM8/PM16
Aromatics													
>C5-EC7 #	<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	mg/kg	TM36/PM12
>EC8-EC10 #	<0.1	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	<0.1	mg/kg	TM36/PM12
>EC10-EC12 #	<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	mg/kg	TM5/PM8/PM16
>EC16-EC21 #	<7	-	<7	-	<7	<7	-	<7	-	<7	<7	mg/kg	TM5/PM8/PM16
>EC21-EC35 #	<7	-	<7	-	<7	<7	-	<7	-	<7	<7	mg/kg	TM5/PM8/PM16
>EC35-EC40	<7	-	<7	-	<7	<7	-	<7	-	<7	<7	mg/kg	TM5/PM8/PM16
Total aromatics C5-40	<26	-	<26	-	<26	<26	-	<26	-	<26	<26	mg/kg	TM5/TM36/PM8/PM12/PM16
Total aliphatics and aromatics(C5-40)	<52	-	<52	-	<52	<52	-	<52	-	<52	<52	mg/kg	TM5/TM36/PM8/PM12/PM16
>EC6-EC10 #	<0.1	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	<0.1	mg/kg	TM36/PM12
>EC10-EC25	<10	-	<10	-	<10	<10	-	<10	-	<10	<10	mg/kg	TM5/PM8/PM16
>EC25-EC35	<10	-	<10	-	<10	<10	-	<10	-	<10	<10	mg/kg	TM5/PM8/PM16
MTBE #	<5	-	<5	-	<5	<5	-	<5	-	<5	<5	ug/kg	TM31/PM12
Benzene #	<5	-	<5	-	<5	<5	-	<5	-	<5	<5	ug/kg	TM31/PM12
Toluene #	<5	-	<5	-	<5	<5	-	<5	-	<5	<5	ug/kg	TM31/PM12
Ethylbenzene #	<5	-	<5	-	<5	<5	-	<5	-	<5	<5	ug/kg	TM31/PM12
m/p-Xylene #	<5	-	<5	-	<5	<5	-	<5	-	<5	<5	ug/kg	TM31/PM12
o-Xylene #	<5	-	<5	-	<5	<5	-	<5	-	<5	<5	ug/kg	TM31/PM12
PCB 28 #	<5	-	<5	-	<5	<5	-	<5	-	<5	<5	ug/kg	TM17/PM8
PCB 52 #	<5	-	<5	-	<5	<5	-	<5	-	<5	<5	ug/kg	TM17/PM8
PCB 101 #	<5	-	<5	-	<5	<5	-	<5	-	<5	<5	ug/kg	TM17/PM8
PCB 118 #	<5	-	<5	-	<5	<5	-	<5	-	<5	<5	ug/kg	TM17/PM8
PCB 138 #	<5	-	<5	-	<5	<5	-	<5	-	<5	<5	ug/kg	TM17/PM8
PCB 153 #	<5	-	<5	-	<5	<5	-	<5	-	<5	<5	ug/kg	TM17/PM8
PCB 180 #	<5	-	<5	-	<5	<5	-	<5	-	<5	<5	ug/kg	TM17/PM8
Total 7 PCBs #	<35	-	<35	-	<35	<35	-	<35	-	<35	<35	ug/kg	TM17/PM8

Please see attached notes for all abbreviations and acronyms

Element Materials Technology

Client Name: Ground Investigations Ireland
Reference: 9161-10-19
Location: Baldoyle
Contact: Diarmaid MagLochlainn
EMT Job No: 20/1987

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	1-3	4	5-7	8	9-11	12-14	15	16-18	19	20-22	LOD/LOR	Units	Method No.
Sample ID	TP02	TP06	TP09	TP85	TP86	TP90	TP93	TP94	TP96	TP99			
Depth	0.50	0.50	1.50	0.50	0.50	0.50	1.50	0.50	0.50	0.50			
COC No / misc													
Containers	V J T	T	V J T	T	V J T	V J T	T	V J T	T	V J T			
Sample Date	21/01/2020	21/01/2020	21/01/2020	21/01/2020	21/01/2020	22/01/2020	22/01/2020	22/01/2020	22/01/2020	23/01/2020			
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	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020			
Natural Moisture Content	20.7	-	11.9	-	10.1	10.4	-	17.6	-	15.4	<0.1	%	PM4/PM0
Moisture Content (% Wet Weight)	17.2	-	10.6	-	9.2	9.4	-	14.9	-	13.3	<0.1	%	PM4/PM0
Hexavalent Chromium #	<0.3	-	<0.3	-	<0.3	<0.3	-	<0.3	-	<0.3	<0.3	mg/kg	TM38/PM20
Sulphate as SO4 (2:1 Ext) #	-	0.0126	-	0.0024	-	-	0.0346	-	0.0084	-	<0.0015	g/l	TM38/PM20
Chromium III	40.8	-	20.3	-	22.5	18.8	-	22.0	-	22.0	<0.5	mg/kg	NONE/NONE
Total Organic Carbon #	0.82	-	0.35	-	0.40	0.38	-	0.68	-	0.37	<0.02	%	TM21/PM24
pH #	8.51	8.41	8.72	8.56	8.70	8.80	8.75	8.47	8.87	8.52	<0.01	pH units	TM73/PM11
Mass of raw test portion	0.1126	-	0.1011	-	0.0983	0.0962	-	0.1056	-	0.1082		kg	NONE/PM17
Mass of dried test portion	0.09	-	0.09	-	0.09	0.09	-	0.09	-	0.09		kg	NONE/PM17

Please see attached notes for all abbreviations and acronyms

Element Materials Technology

Client Name: Ground Investigations Ireland
Reference: 9161-10-19
Location: Baldoyle
Contact: Diarmaid MagLochlainn
EMT Job No: 20/1987

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	23-25	26-28	29-31	32-34	35	36-38	39	40			LOD/LOR	Units	Method No.
Sample ID	TP102	TP103	TP109	TP111	TP111	TP113	TP113	TP103					
Depth	0.50	0.50	0.50	0.50	1.50	0.50	1.50	1.50					
COC No / misc													
Containers	V J T	V J T	V J T	V J T	T	V J T	T	T					
Sample Date	25/01/2020	23/01/2020	24/01/2020	24/01/2020	24/01/2020	24/01/2020	24/01/2020	23/01/2020					
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020					
Antimony	4	2	2	2	-	2	-	-			<1	mg/kg	TM30/PM15
Arsenic #	22.7	9.5	17.8	14.0	-	13.6	-	-			<0.5	mg/kg	TM30/PM15
Barium #	118	49	138	127	-	56	-	-			<1	mg/kg	TM30/PM15
Cadmium #	1.9	1.5	3.4	2.2	-	2.1	-	-			<0.1	mg/kg	TM30/PM15
Chromium #	39.3	17.8	35.3	26.8	-	23.4	-	-			<0.5	mg/kg	TM30/PM15
Copper #	50	20	38	34	-	29	-	-			<1	mg/kg	TM30/PM15
Lead #	38	13	52	35	-	21	-	-			<5	mg/kg	TM30/PM15
Mercury #	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	-			<0.1	mg/kg	TM30/PM15
Molybdenum #	7.0	2.6	3.1	3.9	-	3.0	-	-			<0.1	mg/kg	TM30/PM15
Nickel #	77.8	32.6	50.0	47.3	-	40.5	-	-			<0.7	mg/kg	TM30/PM15
Selenium #	3	<1	2	2	-	<1	-	-			<1	mg/kg	TM30/PM15
Zinc #	156	60	133	108	-	80	-	-			<5	mg/kg	TM30/PM15
PAH MS													
Naphthalene #	<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	mg/kg	TM4/PM8
Acenaphthene #	<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	mg/kg	TM4/PM8
Phenanthrene #	<0.03	<0.03	0.34	0.17	-	<0.03	-	-			<0.03	mg/kg	TM4/PM8
Anthracene #	<0.04	<0.04	0.06	0.05	-	<0.04	-	-			<0.04	mg/kg	TM4/PM8
Fluoranthene #	<0.03	<0.03	0.37	0.32	-	<0.03	-	-			<0.03	mg/kg	TM4/PM8
Pyrene #	<0.03	<0.03	0.34	0.30	-	<0.03	-	-			<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	<0.06	<0.06	0.20	0.24	-	<0.06	-	-			<0.06	mg/kg	TM4/PM8
Chrysene #	<0.02	<0.02	0.21	0.22	-	<0.02	-	-			<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	<0.07	<0.07	0.32	0.32	-	<0.07	-	-			<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	<0.04	<0.04	0.19	0.20	-	<0.04	-	-			<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene	<0.04	<0.04	0.09	0.09	-	<0.04	-	-			<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04	<0.04	<0.04	<0.04	-	<0.04	-	-			<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	<0.04	<0.04	0.11	0.11	-	<0.04	-	-			<0.04	mg/kg	TM4/PM8
Coronene	<0.04	<0.04	<0.04	<0.04	-	<0.04	-	-			<0.04	mg/kg	TM4/PM8
PAH 6 Total #	<0.22	<0.22	1.08	1.04	-	<0.22	-	-			<0.22	mg/kg	TM4/PM8
PAH 17 Total	<0.64	<0.64	2.23	2.02	-	<0.64	-	-			<0.64	mg/kg	TM4/PM8
Benzo(b)fluoranthene	<0.05	<0.05	0.23	0.23	-	<0.05	-	-			<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	<0.02	<0.02	0.09	0.09	-	<0.02	-	-			<0.02	mg/kg	TM4/PM8
Benzo(j)fluoranthene	<1	<1	<1	<1	-	<1	-	-			<1	mg/kg	TM4/PM8
PAH Surrogate % Recovery	99	100	90	92	-	106	-	-			<0	%	TM4/PM8
Mineral Oil (C10-C40)	<30	<30	<30	<30	-	<30	-	-			<30	mg/kg	TM5/PM8/PM16

Please see attached notes for all abbreviations and acronyms

Client Name: Ground Investigations Ireland
Reference: 9161-10-19
Location: Baldoyle
Contact: Diarmaid MagLochlainn
EMT Job No: 20/1987

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	23-25	26-28	29-31	32-34	35	36-38	39	40			LOD/LOR	Units	Method No.
Sample ID	TP102	TP103	TP109	TP111	TP111	TP113	TP113	TP103					
Depth	0.50	0.50	0.50	0.50	1.50	0.50	1.50	1.50					
COC No / misc													
Containers	V J T	V J T	V J T	V J T	T	V J T	T	T					
Sample Date	25/01/2020	23/01/2020	24/01/2020	24/01/2020	24/01/2020	24/01/2020	24/01/2020	23/01/2020					
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020					
TPH CWG													
Aliphatics													
>C5-C6 #	<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	mg/kg	TM36/PM12
>C8-C10	<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	mg/kg	TM5/PM8/PM16
>C12-C16 #	<4	<4	<4	<4	-	<4	-	-			<4	mg/kg	TM5/PM8/PM16
>C16-C21 #	<7	<7	<7	<7	-	<7	-	-			<7	mg/kg	TM5/PM8/PM16
>C21-C35 #	<7	<7	<7	<7	-	<7	-	-			<7	mg/kg	TM5/PM8/PM16
>C35-C40	<7	<7	<7	<7	-	<7	-	-			<7	mg/kg	TM5/PM8/PM16
Total aliphatics C5-40	<26	<26	<26	<26	-	<26	-	-			<26	mg/kg	TM5/TM36/PM8/PM12/PM16
>C6-C10	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	-			<0.1	mg/kg	TM36/PM12
>C10-C25	<10	<10	<10	<10	-	<10	-	-			<10	mg/kg	TM5/PM8/PM16
>C25-C35	<10	<10	<10	<10	-	<10	-	-			<10	mg/kg	TM5/PM8/PM16
Aromatics													
>C5-EC7 #	<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	mg/kg	TM36/PM12
>EC8-EC10 #	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	-			<0.1	mg/kg	TM36/PM12
>EC10-EC12 #	<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	mg/kg	TM5/PM8/PM16
>EC16-EC21 #	<7	<7	<7	<7	-	<7	-	-			<7	mg/kg	TM5/PM8/PM16
>EC21-EC35 #	<7	<7	<7	<7	-	<7	-	-			<7	mg/kg	TM5/PM8/PM16
>EC35-EC40	<7	<7	<7	<7	-	<7	-	-			<7	mg/kg	TM5/PM8/PM16
Total aromatics C5-40	<26	<26	<26	<26	-	<26	-	-			<26	mg/kg	TM5/TM36/PM8/PM12/PM16
Total aliphatics and aromatics(C5-40)	<52	<52	<52	<52	-	<52	-	-			<52	mg/kg	TM5/TM36/PM8/PM12/PM16
>EC6-EC10 #	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	-			<0.1	mg/kg	TM36/PM12
>EC10-EC25	<10	<10	<10	<10	-	<10	-	-			<10	mg/kg	TM5/PM8/PM16
>EC25-EC35	<10	<10	<10	<10	-	<10	-	-			<10	mg/kg	TM5/PM8/PM16
MTBE #	<5	<5	<5	<5	-	<5	-	-			<5	ug/kg	TM31/PM12
Benzene #	<5	<5	<5	<5	-	<5	-	-			<5	ug/kg	TM31/PM12
Toluene #	<5	<5	<5	<5	-	<5	-	-			<5	ug/kg	TM31/PM12
Ethylbenzene #	<5	<5	<5	<5	-	<5	-	-			<5	ug/kg	TM31/PM12
m/p-Xylene #	<5	<5	<5	<5	-	<5	-	-			<5	ug/kg	TM31/PM12
o-Xylene #	<5	<5	<5	<5	-	<5	-	-			<5	ug/kg	TM31/PM12
PCB 28 #	<5	<5	<5	<5	-	<5	-	-			<5	ug/kg	TM17/PM8
PCB 52 #	<5	<5	<5	<5	-	<5	-	-			<5	ug/kg	TM17/PM8
PCB 101 #	<5	<5	<5	<5	-	<5	-	-			<5	ug/kg	TM17/PM8
PCB 118 #	<5	<5	<5	<5	-	<5	-	-			<5	ug/kg	TM17/PM8
PCB 138 #	<5	<5	<5	<5	-	<5	-	-			<5	ug/kg	TM17/PM8
PCB 153 #	<5	<5	<5	<5	-	<5	-	-			<5	ug/kg	TM17/PM8
PCB 180 #	<5	<5	<5	<5	-	<5	-	-			<5	ug/kg	TM17/PM8
Total 7 PCBs #	<35	<35	<35	<35	-	<35	-	-			<35	ug/kg	TM17/PM8

Please see attached notes for all abbreviations and acronyms

Element Materials Technology

Client Name: Ground Investigations Ireland
Reference: 9161-10-19
Location: Baldoyle
Contact: Diarmaid MagLochlainn
EMT Job No: 20/1987

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	23-25	26-28	29-31	32-34	35	36-38	39	40			LOD/LOR	Units	Method No.
Sample ID	TP102	TP103	TP109	TP111	TP111	TP113	TP113	TP103					
Depth	0.50	0.50	0.50	0.50	1.50	0.50	1.50	1.50					
COC No / misc													
Containers	V J T	V J T	V J T	V J T	T	V J T	T	T					
Sample Date	25/01/2020	23/01/2020	24/01/2020	24/01/2020	24/01/2020	24/01/2020	24/01/2020	23/01/2020					
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020					
Natural Moisture Content	21.7	11.4	16.7	18.1	-	12.3	-	-			<0.1	%	PM4/PM0
Moisture Content (% Wet Weight)	17.8	10.3	14.3	15.3	-	11.0	-	-			<0.1	%	PM4/PM0
Hexavalent Chromium #	<0.3	<0.3	<0.3	<0.3	-	<0.3	-	-			<0.3	mg/kg	TM38/PM20
Sulphate as SO4 (2:1 Ext) #	-	-	-	-	0.0743	-	0.0039	0.0090			<0.0015	g/l	TM38/PM20
Chromium III	39.3	17.8	35.3	26.8	-	23.4	-	-			<0.5	mg/kg	NONE/NONE
Total Organic Carbon #	0.58	0.28	1.92	1.19	-	0.56	-	-			<0.02	%	TM21/PM24
pH #	8.46	8.68	8.27	8.24	8.42	8.78	8.79	8.72			<0.01	pH units	TM73/PM11
Mass of raw test portion	0.1053	0.1018	0.1097	0.1079	-	0.1039	-	-				kg	NONE/PM17
Mass of dried test portion	0.09	0.09	0.09	0.09	-	0.09	-	-				kg	NONE/PM17

Please see attached notes for all abbreviations and acronyms

Client Name: Ground Investigations Ireland
Reference: 9161-10-19
Location: Baldoyle
Contact: Diarmaid MagLochlainn
EMT Job No: 20/1987

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	1-3	5-7	9-11	12-14	16-18	20-22	23-25	26-28	29-31	32-34	LOD/LOR	Units	Method No.
Sample ID	TP02	TP09	TP86	TP90	TP94	TP99	TP102	TP103	TP109	TP111			
Depth	0.50	1.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50			
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	21/01/2020	21/01/2020	21/01/2020	22/01/2020	22/01/2020	23/01/2020	25/01/2020	23/01/2020	24/01/2020	24/01/2020			
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	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020			
Dissolved Antimony #	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.004	<0.002	<0.002	<0.002	mg/l	TM30/PM17
Dissolved Antimony (A10) #	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.04	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Arsenic #	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	mg/l	TM30/PM17
Dissolved Arsenic (A10) #	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	mg/kg	TM30/PM17
Dissolved Barium #	<0.003	<0.003	0.007	0.004	0.003	0.007	<0.003	0.003	0.006	0.007	<0.003	mg/l	TM30/PM17
Dissolved Barium (A10) #	<0.03	<0.03	0.07	0.04	<0.03	0.07	<0.03	0.03	0.06	0.07	<0.03	mg/kg	TM30/PM17
Dissolved Cadmium #	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	mg/l	TM30/PM17
Dissolved Cadmium (A10) #	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM30/PM17
Dissolved Chromium #	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	mg/l	TM30/PM17
Dissolved Chromium (A10) #	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	mg/kg	TM30/PM17
Dissolved Copper #	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	mg/l	TM30/PM17
Dissolved Copper (A10) #	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	TM30/PM17
Dissolved Lead #	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/l	TM30/PM17
Dissolved Lead (A10) #	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM30/PM17
Dissolved Molybdenum #	<0.002	0.015	0.004	0.007	0.011	0.011	<0.002	0.004	0.002	0.006	<0.002	mg/l	TM30/PM17
Dissolved Molybdenum (A10) #	<0.02	0.15	0.04	0.07	0.11	0.11	<0.02	0.04	<0.02	0.06	<0.02	mg/kg	TM30/PM17
Dissolved Nickel #	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	mg/l	TM30/PM17
Dissolved Nickel (A10) #	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Selenium #	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	mg/l	TM30/PM17
Dissolved Selenium (A10) #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
Dissolved Zinc #	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.003	0.004	<0.003	<0.003	mg/l	TM30/PM17
Dissolved Zinc (A10) #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.03	0.04	<0.03	<0.03	mg/kg	TM30/PM17
Mercury Dissolved by CVAF #	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	mg/l	TM61/PM0
Mercury Dissolved by CVAF #	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	mg/kg	TM61/PM0
Phenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l	TM26/PM0
Phenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM26/PM0
Fluoride	0.4	<0.6 $_{AA}$	0.5	0.4	0.4	0.3	<0.3	0.5	0.6	0.6	<0.3	mg/l	TM173/PM0
Fluoride	4	<6 $_{AA}$	5	4	4	3	<3	5	6	6	<3	mg/kg	TM173/PM0
Sulphate as SO4 #	5.8	0.9	19.9	11.3	21.3	5.2	4.8	<0.5	8.7	42.0	<0.5	mg/l	TM38/PM0
Sulphate as SO4 #	58	9	199	113	213	52	48	<5	87	420	<5	mg/kg	TM38/PM0
Chloride #	0.5	<0.3	<0.3	0.4	0.3	0.7	<0.3	<0.3	<0.3	<0.3	<0.3	mg/l	TM38/PM0
Chloride #	5	<3	<3	4	<3	7	<3	<3	<3	<3	<3	mg/kg	TM38/PM0
Dissolved Organic Carbon	3	3	<2	3	3	3	6	3	4	4	<2	mg/l	TM60/PM0
Dissolved Organic Carbon	30	30	<20	30	30	30	60	30	40	40	<20	mg/kg	TM60/PM0
pH	7.49	7.90	8.22	7.91	8.18	8.03	7.98	7.98	8.13	8.07	<0.01	pH units	TM73/PM0
Total Dissolved Solids #	123	103	73	190	218	89	156	47	70	123	<35	mg/l	TM20/PM0
Total Dissolved Solids #	1230	1030	730	1900	2179	890	1559	470	700	1231	<350	mg/kg	TM20/PM0

Please see attached notes for all abbreviations and acronyms

Client Name: Ground Investigations Ireland
Reference: 9161-10-19
Location: Baldoyle
Contact: Diarmaid MagLochlainn
EMT Job No: 20/1987

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	36-38												
Sample ID	TP113												
Depth	0.50												
COC No / misc													
Containers	V J T												
Sample Date	24/01/2020												
Sample Type	Soil												
Batch Number	1												
Date of Receipt	10/02/2020												
											LOD/LOR	Units	Method No.
Dissolved Antimony #	<0.002										<0.002	mg/l	TM30/PM17
Dissolved Antimony (A10) #	<0.02										<0.02	mg/kg	TM30/PM17
Dissolved Arsenic #	<0.0025										<0.0025	mg/l	TM30/PM17
Dissolved Arsenic (A10) #	<0.025										<0.025	mg/kg	TM30/PM17
Dissolved Barium #	<0.003										<0.003	mg/l	TM30/PM17
Dissolved Barium (A10) #	<0.03										<0.03	mg/kg	TM30/PM17
Dissolved Cadmium #	<0.0005										<0.0005	mg/l	TM30/PM17
Dissolved Cadmium (A10) #	<0.005										<0.005	mg/kg	TM30/PM17
Dissolved Chromium #	<0.0015										<0.0015	mg/l	TM30/PM17
Dissolved Chromium (A10) #	<0.015										<0.015	mg/kg	TM30/PM17
Dissolved Copper #	<0.007										<0.007	mg/l	TM30/PM17
Dissolved Copper (A10) #	<0.07										<0.07	mg/kg	TM30/PM17
Dissolved Lead #	<0.005										<0.005	mg/l	TM30/PM17
Dissolved Lead (A10) #	<0.05										<0.05	mg/kg	TM30/PM17
Dissolved Molybdenum #	0.003										<0.002	mg/l	TM30/PM17
Dissolved Molybdenum (A10) #	0.03										<0.02	mg/kg	TM30/PM17
Dissolved Nickel #	<0.002										<0.002	mg/l	TM30/PM17
Dissolved Nickel (A10) #	<0.02										<0.02	mg/kg	TM30/PM17
Dissolved Selenium #	<0.003										<0.003	mg/l	TM30/PM17
Dissolved Selenium (A10) #	<0.03										<0.03	mg/kg	TM30/PM17
Dissolved Zinc #	<0.003										<0.003	mg/l	TM30/PM17
Dissolved Zinc (A10) #	<0.03										<0.03	mg/kg	TM30/PM17
Mercury Dissolved by CVAF #	<0.00001										<0.00001	mg/l	TM61/PM0
Mercury Dissolved by CVAF #	<0.0001										<0.0001	mg/kg	TM61/PM0
Phenol	<0.01										<0.01	mg/l	TM26/PM0
Phenol	<0.1										<0.1	mg/kg	TM26/PM0
Fluoride	0.6										<0.3	mg/l	TM173/PM0
Fluoride	6										<3	mg/kg	TM173/PM0
Sulphate as SO4 #	<0.5										<0.5	mg/l	TM38/PM0
Sulphate as SO4 #	<5										<5	mg/kg	TM38/PM0
Chloride #	<0.3										<0.3	mg/l	TM38/PM0
Chloride #	<3										<3	mg/kg	TM38/PM0
Dissolved Organic Carbon	3										<2	mg/l	TM60/PM0
Dissolved Organic Carbon	30										<20	mg/kg	TM60/PM0
pH	8.07										<0.01	pH units	TM73/PM0
Total Dissolved Solids #	36										<35	mg/l	TM20/PM0
Total Dissolved Solids #	360										<350	mg/kg	TM20/PM0

Client Name: Ground Investigations Ireland
Reference: 9161-10-19
Location: Baldoyle
Contact: Diarmaid MagLochlainn
EMT Job No: 20/1987

Report : EN12457_2

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-3	5-7	9-11	12-14	16-18	20-22	23-25	26-28	29-31	32-34						
Sample ID	TP02	TP09	TP86	TP90	TP94	TP99	TP102	TP103	TP109	TP111						
Depth	0.50	1.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50						
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	21/01/2020	21/01/2020	21/01/2020	22/01/2020	22/01/2020	23/01/2020	25/01/2020	23/01/2020	24/01/2020	24/01/2020						
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	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	10/02/2020	Inert	Stable Non-reactive	Hazardous	LOD LOR	Units	Method No.
Solid Waste Analysis																
Total Organic Carbon #	0.82	0.35	0.40	0.38	0.68	0.37	0.58	0.28	1.92	1.19	3	5	6	<0.02	%	TM21/PM24
Sum of BTEX	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	6	-	-	<0.025	mg/kg	TM31/PM12
Sum of 7 PCBs #	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	1	-	-	<0.035	mg/kg	TM17/PM8
Mineral Oil	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	500	-	-	<30	mg/kg	TM5/PM8/PM16
PAH Sum of 6 #	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	1.08	1.04	-	-	-	<0.22	mg/kg	TM4/PM8
PAH Sum of 17	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	2.23	2.02	100	-	-	<0.64	mg/kg	TM4/PM8
CEN 10:1 Leachate																
Arsenic #	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.5	2	25	<0.025	mg/kg	TM30/PM17
Barium #	<0.03	<0.03	0.07	0.04	<0.03	0.07	<0.03	0.03	0.06	0.07	20	100	300	<0.03	mg/kg	TM30/PM17
Cadmium #	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.04	1	5	<0.005	mg/kg	TM30/PM17
Chromium #	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	0.5	10	70	<0.015	mg/kg	TM30/PM17
Copper #	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	2	50	100	<0.07	mg/kg	TM30/PM17
Mercury #	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.01	0.2	2	<0.0001	mg/kg	TM61/PM0
Molybdenum #	<0.02	0.15	0.04	0.07	0.11	0.11	<0.02	0.04	<0.02	0.06	0.5	10	30	<0.02	mg/kg	TM30/PM17
Nickel #	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.4	10	40	<0.02	mg/kg	TM30/PM17
Lead #	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.5	10	50	<0.05	mg/kg	TM30/PM17
Antimony #	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.04	<0.02	<0.02	0.06	0.7	5	<0.02	mg/kg	TM30/PM17
Selenium #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.1	0.5	7	<0.03	mg/kg	TM30/PM17
Zinc #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.03	0.04	<0.03	4	50	200	<0.03	mg/kg	TM30/PM17
Total Dissolved Solids #	1230	1030	730	1900	2179	890	1559	470	700	1231	4000	60000	100000	<350	mg/kg	TM20/PM0
Dissolved Organic Carbon	30	30	<20	30	30	30	60	30	40	40	500	800	1000	<20	mg/kg	TM60/PM0
Mass of raw test portion	0.1126	0.1011	0.0983	0.0962	0.1056	0.1082	0.1053	0.1018	0.1097	0.1079	-	-	-		kg	NONE/PM17
Dry Matter Content Ratio	80.2	88.8	91.7	93.9	85.1	83.2	85.2	88.7	81.9	83.7	-	-	-	<0.1	%	NONE/PM4
Leachant Volume	0.878	0.889	0.892	0.894	0.884	0.882	0.884	0.889	0.88	0.883	-	-	-		l	NONE/PM17
Eluate Volume	0.8	0.85	0.8	0.85	0.875	0.775	0.7	0.8	0.8	0.8	-	-	-		l	NONE/PM17
pH #	8.51	8.72	8.70	8.80	8.47	8.52	8.46	8.68	8.27	8.24	-	-	-	<0.01	pH units	TM73/PM11
Phenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1	-	-	<0.1	mg/kg	TM26/PM0
Fluoride	4	<6 BA	5	4	4	3	<3	5	6	6	-	-	-	<3	mg/kg	TM173/PM0
Sulphate as SO4 #	58	9	199	113	213	52	48	<5	87	420	1000	20000	50000	<5	mg/kg	TM38/PM0
Chloride #	5	<3	<3	4	<3	7	<3	<3	<3	<3	800	15000	25000	<3	mg/kg	TM38/PM0

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

Client Name: Ground Investigations Ireland
Reference: 9161-10-19
Location: Baldoyle
Contact: Diarmaid MagLochlainn
EMT Job No: 20/1987

Report : **EN12457_2**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	36-38															
Sample ID	TP113															
Depth	0.50															
COC No / misc																
Containers	V J T															
Sample Date	24/01/2020															
Sample Type	Soil															
Batch Number	1															
Date of Receipt	10/02/2020											Inert	Stable Non-reactive	Hazardous	LOD LOR	Units	Method No.
Solid Waste Analysis																	
Total Organic Carbon #	0.56											3	5	6	<0.02	%	TM21/PM24
Sum of BTEX	<0.025											6	-	-	<0.025	mg/kg	TM31/PM12
Sum of 7 PCBs #	<0.035											1	-	-	<0.035	mg/kg	TM17/PM8
Mineral Oil	<30											500	-	-	<30	mg/kg	TM5/PM8/PM16
PAH Sum of 6 #	<0.22											-	-	-	<0.22	mg/kg	TM4/PM8
PAH Sum of 17	<0.64											100	-	-	<0.64	mg/kg	TM4/PM8
CEN 10:1 Leachate																	
Arsenic #	<0.025											0.5	2	25	<0.025	mg/kg	TM30/PM17
Barium #	<0.03											20	100	300	<0.03	mg/kg	TM30/PM17
Cadmium #	<0.005											0.04	1	5	<0.005	mg/kg	TM30/PM17
Chromium #	<0.015											0.5	10	70	<0.015	mg/kg	TM30/PM17
Copper #	<0.07											2	50	100	<0.07	mg/kg	TM30/PM17
Mercury #	<0.0001											0.01	0.2	2	<0.0001	mg/kg	TM61/PM0
Molybdenum #	0.03											0.5	10	30	<0.02	mg/kg	TM30/PM17
Nickel #	<0.02											0.4	10	40	<0.02	mg/kg	TM30/PM17
Lead #	<0.05											0.5	10	50	<0.05	mg/kg	TM30/PM17
Antimony #	<0.02											0.06	0.7	5	<0.02	mg/kg	TM30/PM17
Selenium #	<0.03											0.1	0.5	7	<0.03	mg/kg	TM30/PM17
Zinc #	<0.03											4	50	200	<0.03	mg/kg	TM30/PM17
Total Dissolved Solids #	360											4000	60000	100000	<350	mg/kg	TM20/PM0
Dissolved Organic Carbon	30											500	800	1000	<20	mg/kg	TM60/PM0
Mass of raw test portion	0.1039											-	-	-		kg	NONE/PM17
Dry Matter Content Ratio	86.9											-	-	-	<0.1	%	NONE/PM4
Leachant Volume	0.886											-	-	-		l	NONE/PM17
Eluate Volume	0.6											-	-	-		l	NONE/PM17
pH #	8.78											-	-	-	<0.01	pH units	TM73/PM11
Phenol	<0.1											1	-	-	<0.1	mg/kg	TM26/PM0
Fluoride	6											-	-	-	<3	mg/kg	TM173/PM0
Sulphate as SO4 #	<5											1000	20000	50000	<5	mg/kg	TM38/PM0
Chloride #	<3											800	15000	25000	<3	mg/kg	TM38/PM0

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

Client Name: Ground Investigations Ireland

Reference: 9161-10-19

Location: Baldoyle

Contact: Diarmaid MagLochlainn

Matrix : Solid

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	EPH Interpretation
20/1987	1	TP02	0.50	1-3	No interpretation possible
20/1987	1	TP09	1.50	5-7	No interpretation possible
20/1987	1	TP86	0.50	9-11	No interpretation possible
20/1987	1	TP90	0.50	12-14	No interpretation possible
20/1987	1	TP94	0.50	16-18	No interpretation possible
20/1987	1	TP99	0.50	20-22	No interpretation possible
20/1987	1	TP102	0.50	23-25	No interpretation possible
20/1987	1	TP103	0.50	26-28	No interpretation possible
20/1987	1	TP109	0.50	29-31	No interpretation possible
20/1987	1	TP111	0.50	32-34	No interpretation possible
20/1987	1	TP113	0.50	36-38	No interpretation possible

Client Name: Ground Investigations Ireland
Reference: 19/10/9161
Location: Baldoyle
Contact: Diarmaid MagLochlainn

Note:

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level less than 0.1%, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Date Of Analysis	Analysis	Result
20/1987	1	TP02	0.50	2	12/02/2020	**General Description (Bulk Analysis)**	soil.stones
					12/02/2020	**Asbestos Fibres**	NAD
					12/02/2020	**Asbestos ACM**	NAD
					12/02/2020	**Asbestos Type**	NAD
					12/02/2020	**Asbestos Level Screen**	NAD
20/1987	1	TP09	1.50	6	12/02/2020	**General Description (Bulk Analysis)**	soil/stones
					12/02/2020	**Asbestos Fibres**	NAD
					12/02/2020	**Asbestos ACM**	NAD
					12/02/2020	**Asbestos Type**	NAD
					12/02/2020	**Asbestos Level Screen**	NAD
20/1987	1	TP86	0.50	10	12/02/2020	**General Description (Bulk Analysis)**	soil-stones
					12/02/2020	**Asbestos Fibres**	NAD
					12/02/2020	**Asbestos ACM**	NAD
					12/02/2020	**Asbestos Type**	NAD
					12/02/2020	**Asbestos Level Screen**	NAD
20/1987	1	TP90	0.50	13	12/02/2020	**General Description (Bulk Analysis)**	soil-stones
					12/02/2020	**Asbestos Fibres**	NAD
					12/02/2020	**Asbestos ACM**	NAD
					12/02/2020	**Asbestos Type**	NAD
					12/02/2020	**Asbestos Level Screen**	NAD
20/1987	1	TP94	0.50	17	12/02/2020	**General Description (Bulk Analysis)**	Soil/Stones
					12/02/2020	**Asbestos Fibres**	NAD
					12/02/2020	**Asbestos ACM**	NAD
					12/02/2020	**Asbestos Type**	NAD
					12/02/2020	**Asbestos Level Screen**	NAD
20/1987	1	TP99	0.50	21	12/02/2020	**General Description (Bulk Analysis)**	Soil/Stones
					12/02/2020	**Asbestos Fibres**	NAD
					12/02/2020	**Asbestos ACM**	NAD
					12/02/2020	**Asbestos Type**	NAD
					12/02/2020	**Asbestos Level Screen**	NAD
20/1987	1	TP102	0.50	24	12/02/2020	**General Description (Bulk Analysis)**	soil.stones
					12/02/2020	**Asbestos Fibres**	NAD
					12/02/2020	**Asbestos ACM**	NAD

Client Name: Ground Investigations Ireland
Reference: 19/10/9161
Location: Baldoyle
Contact: Diarmaid MagLochlainn

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Date Of Analysis	Analysis	Result
20/1987	1	TP102	0.50	24	12/02/2020	**Asbestos Type**	NAD
					12/02/2020	**Asbestos Level Screen**	NAD
20/1987	1	TP103	0.50	27	12/02/2020	**General Description (Bulk Analysis)**	soil/stones
					12/02/2020	**Asbestos Fibres**	NAD
					12/02/2020	**Asbestos ACM**	NAD
					12/02/2020	**Asbestos Type**	NAD
					12/02/2020	**Asbestos Level Screen**	NAD
20/1987	1	TP109	0.50	30	12/02/2020	**General Description (Bulk Analysis)**	soil-stones
					12/02/2020	**Asbestos Fibres**	NAD
					12/02/2020	**Asbestos ACM**	NAD
					12/02/2020	**Asbestos Type**	NAD
					12/02/2020	**Asbestos Level Screen**	NAD
20/1987	1	TP111	0.50	33	12/02/2020	**General Description (Bulk Analysis)**	soil-stones
					12/02/2020	**Asbestos Fibres**	NAD
					12/02/2020	**Asbestos ACM**	NAD
					12/02/2020	**Asbestos Type**	NAD
					12/02/2020	**Asbestos Level Screen**	NAD
20/1987	1	TP113	0.50	37	12/02/2020	**General Description (Bulk Analysis)**	soil/stones
					12/02/2020	**Asbestos Fibres**	NAD
					12/02/2020	**Asbestos Fibres (2)**	NAD
					12/02/2020	**Asbestos ACM**	NAD
					12/02/2020	**Asbestos ACM (2)**	NAD
					12/02/2020	**Asbestos Type**	NAD
					12/02/2020	**Asbestos Type (2)**	NAD
					12/02/2020	**Asbestos Level Screen**	NAD

Client Name: Ground Investigations Ireland

Reference: 9161-10-19

Location: Baldoyle

Contact: Diarmaid MagLochlainn

Matrix : Solid

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
20/1987	1	TP02	0.50	1-3	EPH, GRO, PAH, PCB	Sample holding time exceeded prior to receipt
20/1987	1	TP09	1.50	5-7	EPH, GRO, PAH, PCB	Sample holding time exceeded prior to receipt
20/1987	1	TP86	0.50	9-11	EPH, GRO, PAH, PCB	Sample holding time exceeded prior to receipt
20/1987	1	TP90	0.50	12-14	EPH, GRO, PAH, PCB	Sample holding time exceeded prior to receipt
20/1987	1	TP94	0.50	16-18	EPH, GRO, PAH, PCB	Sample holding time exceeded prior to receipt
20/1987	1	TP99	0.50	20-22	EPH, GRO, PAH, PCB	Sample holding time exceeded prior to receipt
20/1987	1	TP102	0.50	23-25	EPH, GRO, PAH, PCB	Sample holding time exceeded prior to receipt
20/1987	1	TP103	0.50	26-28	EPH, GRO, PAH, PCB	Sample holding time exceeded prior to receipt
20/1987	1	TP109	0.50	29-31	EPH, GRO, PAH, PCB	Sample holding time exceeded prior to receipt
20/1987	1	TP111	0.50	32-34	EPH, GRO, PAH, PCB	Sample holding time exceeded prior to receipt
20/1987	1	TP113	0.50	36-38	EPH, GRO, PAH, PCB	Sample holding time exceeded prior to receipt

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

EMT Job No.: 20/1987

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. Limits of detection for analyses carried out on as received samples are not moisture content corrected. 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.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

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

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

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.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

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.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited.
*	Analysis subcontracted to an Element Materials Technology 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
AA	x2 Dilution

BA	x2 Dilution

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

EMT Job No: 20/1987

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 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 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 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM16	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.			AR	
TM5	Modified 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	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.			AR	Yes
TM5	Modified 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	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
TM17	Modified US EPA method 8270. Determination of specific Polychlorinated Biphenyl congeners 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
TM20	Modified BS 1377-3: 1990/USEPA 160.3 Gravimetric determination of Total Dissolved Solids/Total Solids	PM0	No preparation is required.	Yes		AR	Yes
TM21	Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4.	PM24	Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis.	Yes		AD	Yes

EMT Job No: 20/1987

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
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.			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.			AD	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
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	PM17	Modified method BS EN12457-2 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.	Yes		AR	Yes
TM31	Modified USEPA 8015B. Determination of Methyltertbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM31	Modified USEPA 8015B. Determination of Methyltertbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	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. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results can be confirmed using GCMS.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	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. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results can be confirmed using GCMS.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM0	No preparation is required.	Yes		AR	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AD	Yes

EMT Job No: 20/1987

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
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AR	Yes
TM60	TC/TOC analysis of Waters by High Temperature Combustion followed by NDIR detection. Based on the following modified standard methods: USEPA 9060, APHA Standard Methods for Examination of Water and Wastewater 5310B, ASTM D 7573, and USEPA 415.1.	PM0	No preparation is required.			AR	Yes
TM61	Modified US EPA methods 245.7 and 200.7. Determination of Mercury by Cold Vapour Atomic Fluorescence.	PM0	No preparation is required.	Yes		AR	Yes
TM65	Asbestos Bulk Identification method based on HSG 248.	PM42	Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.	Yes		AR	
TM73	Modified US EPA methods 150.1 and 9045D and BS1377:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.			AR	Yes
TM73	Modified US EPA methods 150.1 and 9045D and BS1377:1990. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes		AR	No
TM173	Analysis of fluoride by ISE (Ion Selective Electrode) using modified ISE method 340.2	PM0	No preparation is required.			AR	Yes
NONE	No Method Code	NONE	No Method Code			AD	Yes
NONE	No Method Code	PM17	Modified method BS EN12457-2 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.				
NONE	No Method Code	PM17	Modified method BS EN12457-2 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.			AR	

EMT Job No: 20/1987

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
NONE	No Method Code	PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.			AR	

Appendix 7.1

TII criteria for rating the magnitude and significance of impacts

Table 10.1: Criteria for rating impact magnitude at EIS stage – Estimation of magnitude of impact on hydrology attributes (NRA, 2009)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and/ or quality and integrity of attribute	Loss or extensive change to a water body or water dependent habitat
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Calculated risk of serious pollution incident >1% annually2
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Increase in predicted peak flood level >10mm1
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Negligible change in predicted peak flood level1
Minor Beneficial	Results in minor improvement of attribute quality	Calculated reduction in pollution risk of 50% or more where existing risk is <1% annually2
Moderate Beneficial	Results in moderate improvement of attribute quality	Calculated reduction in pollution risk of 50% or more where existing risk is >1% annually2
Major Beneficial	Results in major improvement of attribute quality	Reduction in predicted peak flood level >100mm1

Additional examples are provided in the NRA Guidance Document

1 Refer to Annex 1, Methods E and F, Annex 1 of HA216/06

1 Refer to Appendix B3 / Annex 1, Method D, Annex 1 of HA216/06

Source: 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' by the National Roads Authority (NRA, 2009)

Table 10.2 Criteria for Rating Impact Significance of Hydrological Attributes (NRA, 2009)

Importance	Criteria	Typical Examples
Extremely High	Attribute has a high quality or value on an international scale	River, wetland or surface water body ecosystem protected by EU legislation e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.
Very High	Attribute has a high quality or value on a regional or national scale	River, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Quality Class A (Biotic Index Q4, Q5) Flood plain protecting more than 50 residential or commercial properties from flooding Nationally important amenity site for wide range of leisure activities
High	Attribute has a high quality or value on a local scale	Salmon fishery Locally important potable water source supplying >1000 homes Quality Class B (Biotic Index Q3-4) Flood plain protecting between 5 and 50 residential or commercial properties from flooding Locally important amenity site for wide range of leisure activities
Medium	Attribute has a medium quality or value on a local scale	Coarse fishery Local potable water source supplying >50 homes Quality Class C (Biotic Index Q3, Q2- 3) Flood plain protecting between 1 and 5 residential or commercial properties from flooding
Low	Attribute has a low quality or value on a local scale	Locally important amenity site for small range of leisure activities Local potable water source supplying <50 homes Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding Amenity site used by small numbers of local people

Source: 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' by the National Roads Authority (NRA, 2009)

Appendix 7.2

Residential Development Baldoyle GA2, Flood Risk Assessment

JBA Consulting Engineers

Residential Development Baldoyle GA2, Flood Risk Assessment

Final Report

January 22

2021s1085

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Revision History

Revision Ref / Date Issued	Amendments	Issued to
S3-P01 - 05/10/2021	Draft Report	Lismore Homes
A3-C01 - 12/11/2021	Final Report	Lismore Homes
A3-C02 - 18/01/2022	Minor Updates	Lismore Homes

Contract

This report describes work commissioned by Jerome O'Brien of JB Barry, on behalf of Lismore Homes Ltd. Lismore Homes Ltd's representative for the contract was Antoinette Kennedy. David Casey and Anastasiya Ilyasova of JBA Consulting carried out this work.

Prepared by ..... David Casey BSc MSc PGCert MCIWEM
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Principal Analyst

Purpose

This document has been prepared as a Flood Risk Assessment report on behalf of Lismore Homes. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

JBA Consulting has no liability regarding the use of this report except to Lismore Homes.

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JBA is aiming to reduce its per capita carbon emissions.

Contents

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Abbreviations

1D ..... One Dimensional (modelling)
2D ..... Two Dimensional (modelling)
AEP ..... Annual Exceedance Probability
CFRAM ..... Catchment Flood Risk Assessment and Management
DoEHLG ..... Department of the Environment, Heritage and Local Government
FARL ..... FEH index of flood attenuation due to reservoirs and lakes
FB ..... Freeboard
FFL ..... Finish Floor Levels
FRA ..... Flood Risk Assessment
FSR ..... Flood Studies Report
FSU ..... Flood Studies Update
GSI ..... Geological Survey of Ireland
LHB ..... Left Hand Bank
OPW ..... Office of Public Works
PFRA ..... Preliminary Flood Risk Assessment
RFI ..... Request for Further Information
RHB ..... Right Hand Bank
RR ..... Rainfall-Runoff
SAAR ..... Standard Average Annual Rainfall (mm)
SFRA ..... Strategic Flood Risk Assessment
URBEXT ..... FEH index of fractional urban extent
WL ..... Water Level

1 Introduction

Under the Planning System and Flood Risk Management Guidelines for Planning Authorities (DoEHLG & OPW, 2009) proposed development must undergo a Flood Risk Assessment prior to planning to ensure sustainability and effective management of flood risk.

1.1 Terms of Reference and Scope

JBA Consulting have been commissioned by Lismore Homes to prepare a Flood Risk Assessment (FRA) to accompany a planning application for a proposed residential development identified as Baldoyle GA2 in Baldoyle, Dublin 13.

1.2 Flood Risk Assessment; Aims and Objectives

This study is being completed to inform the future development of the site as it relates to flood risk. It aims to identify, quantify and communicate to the client the risk of flooding to land, property and people and the measures that would be recommended to manage the risk in order to facilitate the development of the site.

The objectives of the FRA are to:

- Identify potential sources of flood risk;
- Confirm the level of flood risk and identify key hydraulic features;
- Assess the impact that the proposed development has on flood risk;
- Develop appropriate flood risk mitigation and management measures which will allow for the long-term development of the site.

Recommendations for development have been provided in the context of the OPW/DECLG planning guidance, "The Planning System and Flood Risk Management". A review of the likely effects of climate change, and the long-term impacts this may have on development has also been undertaken.

For general information on flooding, the definition of flood risk, flood zones and other terms see 'Understanding Flood Risk' in Appendix A.

1.3 Development Proposal

A Strategic Housing Development for the construction of 1,007 residential apartments (consisting of 58 no. studio units, 247 no. 1 bedroom units, 94 no. 2 bedroom 3 person units, 563 no. 2 bedroom 4 person units, and 45 no. 3 bedroom units), communal residential community rooms, and a ground floor creche in 16 no. buildings with heights varying from 4 to 12 storeys, basement and surface level car parking, secure bicycle parking, landscaping, water supply connection at Red Arches Road, and all ancillary site development works on a site located in the townland of Stapolin, Coast Road, Baldoyle, Dublin 13.

The minimum FFL provided on site is 6.2mOD.

Refer to Figure 1-1 for the proposed site layout.

Figure 1-1: Site Layout

1.4 Report Structure

Section 2 of this report gives an overview of the study location and associated watercourses. Section 3 contains background information and initial assessment of flood risk. The hydrology and hydraulic model/results are provided in Section 4. Site specific mitigation measures are outlined in Section 5. Conclusions are provided in Section 6.

2 Site Background

This section describes the proposed development site at Baldoyle, Co. Dublin, including watercourses, geology and the wider geographical area.

2.1 Location

The proposed development is located in Baldoyle, Co. Dublin, approximatively 500m west of the Baldoyle Estuary.

The site is a greenfield with two small roads crossing it. It is bordered by local roads from south and west and The Dublin - Malahide railway line runs in close proximity to the western boundary. Residential developments are located to the south, while to the north and east lies agricultural lands and grasslands.

The site location and watercourses are shown in Figure 2-1 below.

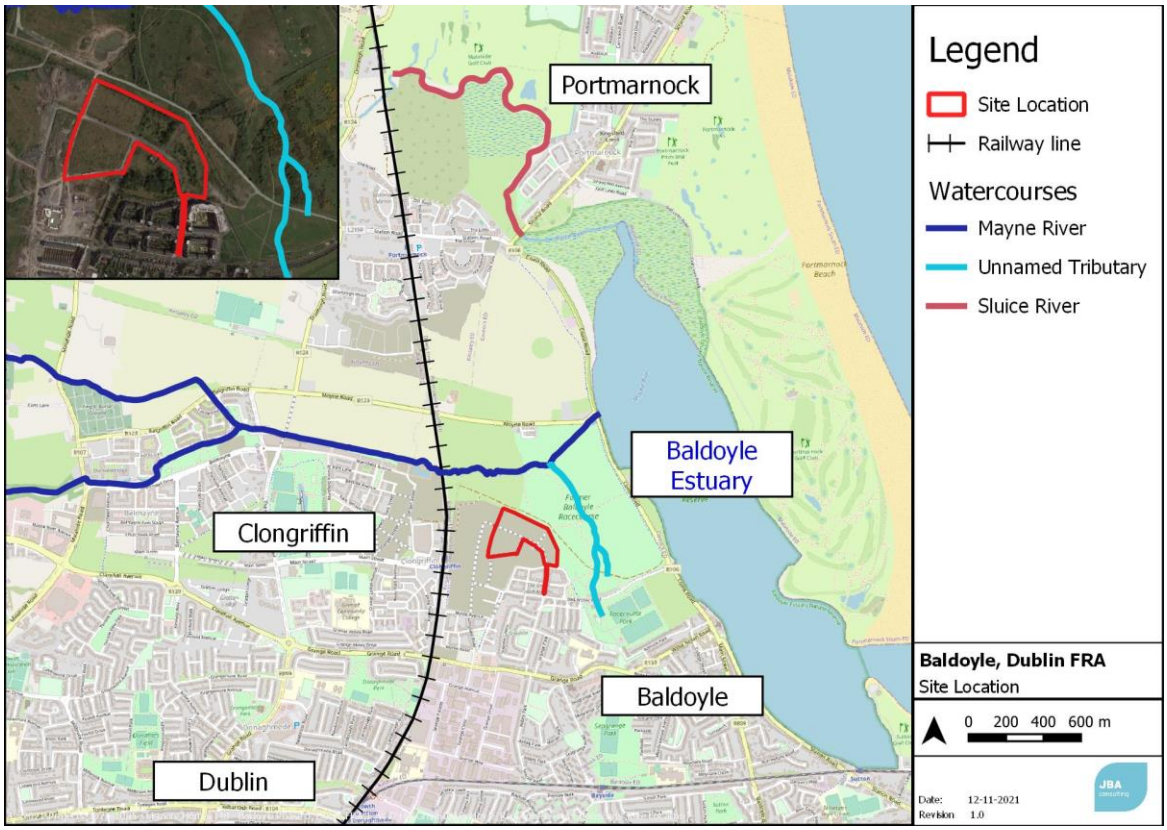


Figure 2-1: Site Location and Watercourses

2.2 Watercourses

The closest watercourse to the site is the River Mayne, which flows in an eastern direction north of the site (see Figure 2-1). The River Mayne discharges into the Baldoyle Estuary Nature Reserve c. 1km to the north-east of the site. The Baldoyle Estuary Nature Reserve opens to the Irish Sea c. 2.0km to the south-east.

The Racecourse Stream, a tributary of the River Mayne flows in a northern direction c. 200 m to the east of the site. The Sluice River discharges to the Baldoyle Estuary Nature Reserve c. 1.4km to the north of the site.

2.3 Site Topography

The general topography of the area is shown in Figure 2-2 below. There is a slight fall from the south-west to the north-east of the site from approximatively 7.58mOD to 3.09mOD.

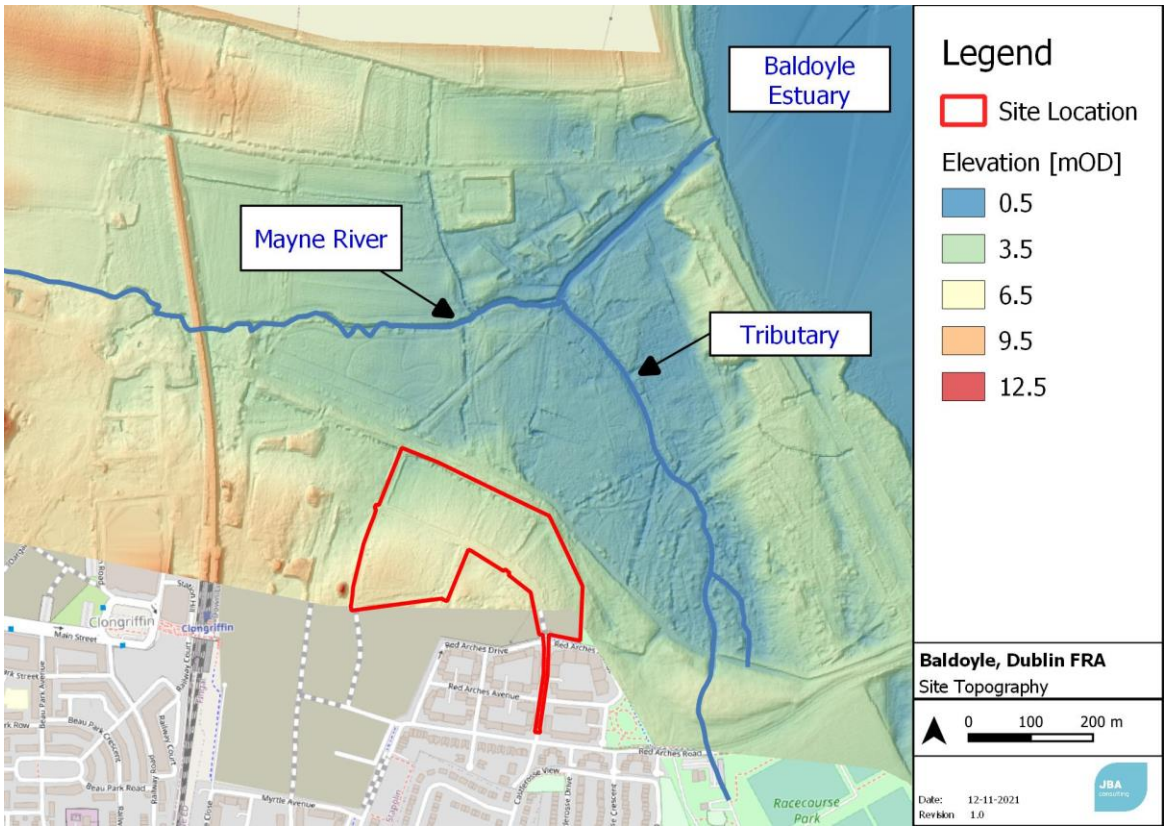


Figure 2-2: Site Topography (source: https://en-ie.topographic-map.com)

2.4 Site Geology

The Geological Survey of Ireland (GSI) groundwater and geological data viewer of the site and local area were reviewed. The underlying bedrock at the site is the Malahide Formation, which is described as Argillaceous bioclastic limestone and shale, as shown in Figure 2-3. The Quaternary Sediments at the site location are Alluvium and Till derived from limestones. It is noted that the presence of alluvium type soils indicated the occurrence of historical flooding, in the absence of other records.

The associated groundwater vulnerability, which is the risk of groundwater infiltrations through the bedrock and risk of groundwater contamination from the site, is classified as 'Low'. The subsoil permeability is deemed 'Low'.

There are no karst features located near the site.

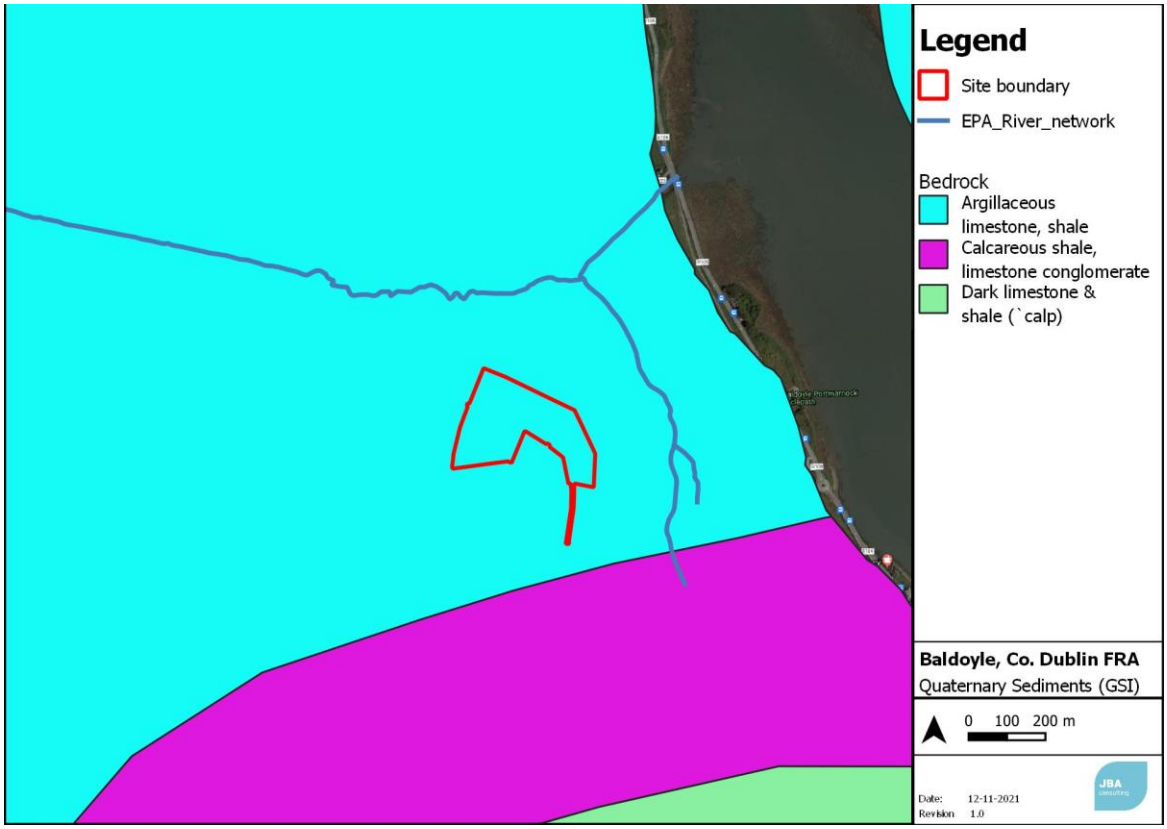


Figure 2-3: Quaternary Sediments (source: GSI)

3 Flood Risk Identification

An assessment of the potential and scale of flood risk at the site was conducted using historical and predictive information. This identifies any sources of potential flood risk to the site and reviews historic flooding information. The findings from the flood risk identification stage of the assessment are provided in the following sections. Further detail on the Planning Guidelines and technical concepts are provided in Appendix A.

3.1 Flood History

A number of sources of flood information were reviewed to establish whether there was any recorded flood history at or near the site location. This includes the OPW's website, www.floodinfo.ie and general internet searches.

3.1.1 Floodmaps.ie

The OPW host a national flood hazard mapping database that is now incorporated into www.floodinfo.ie, which highlights areas at risk of flooding through the collection of recorded data and observed flood events. Review of the flood events in the area confirm that there has been no identified historic flood event recorded within the site. The following past flood events in the surrounding area are shown in

Figure 3-1:

- 1 - Recurring: Flooding at Mayne River Bridge, Baldoyle. Approximately 500m to the north-east of the site. Flooding due to incapacity of Mayne River Bridge during high tides. Flood Relief Scheme completed in 2001.
- 2 - October 2011: Flooding at Coast Road, Baldoyle. Approximately 500m to the east of the site. Flood source: runoff from surface water drainage. Two residential properties were affected. No apparent flooding from River Mayne.
- 3 - Recurring: Baldoyle coastal flooding. Approximately 500m to the east of the site. Flood source: Coastal/Estuarine Waters.
- 4 - October 2011: Flooding at Brookstone Road, Baldoyle. Approximately 900m to the south-east of the site. Flood source: surface water. The drainage system was inundated

due to heavy prolonged rainfall. There was no evidence of direct flooding from the watercourse.

- 5 - December 1954: Flooding at Grange Stream Baldoyle. Approximately 1.1km south-east of the site. Flood source: Fluvial. A number of defence assets were put in place since the flood event.
- 6 - October 2002: Flooding at Grange Road, Baldoyle. Approximately 950m south-east of the site. Flood source: surface water. Surface water screens were obstructed with material, which contributed to the flooding of Grange Road. The main cause of the flooding was blocked gullies.
- 7 - November 1982: Flooding at Grange Road, Donaghmede. Approximately 800m south of the site. Flood source: blocked culvert on the Little Dargle stream.
- 8 - June 1993: Balgriffin Park, Raheeny, Dublin 5. Approximately 1.5km west of the site. Flood source: Mayne River. A residential dwelling was damaged.
- 10 - Recurring: Strand Road, Portmarnock. Approximately 1.3km north of the site. Flood source: Sluice River.

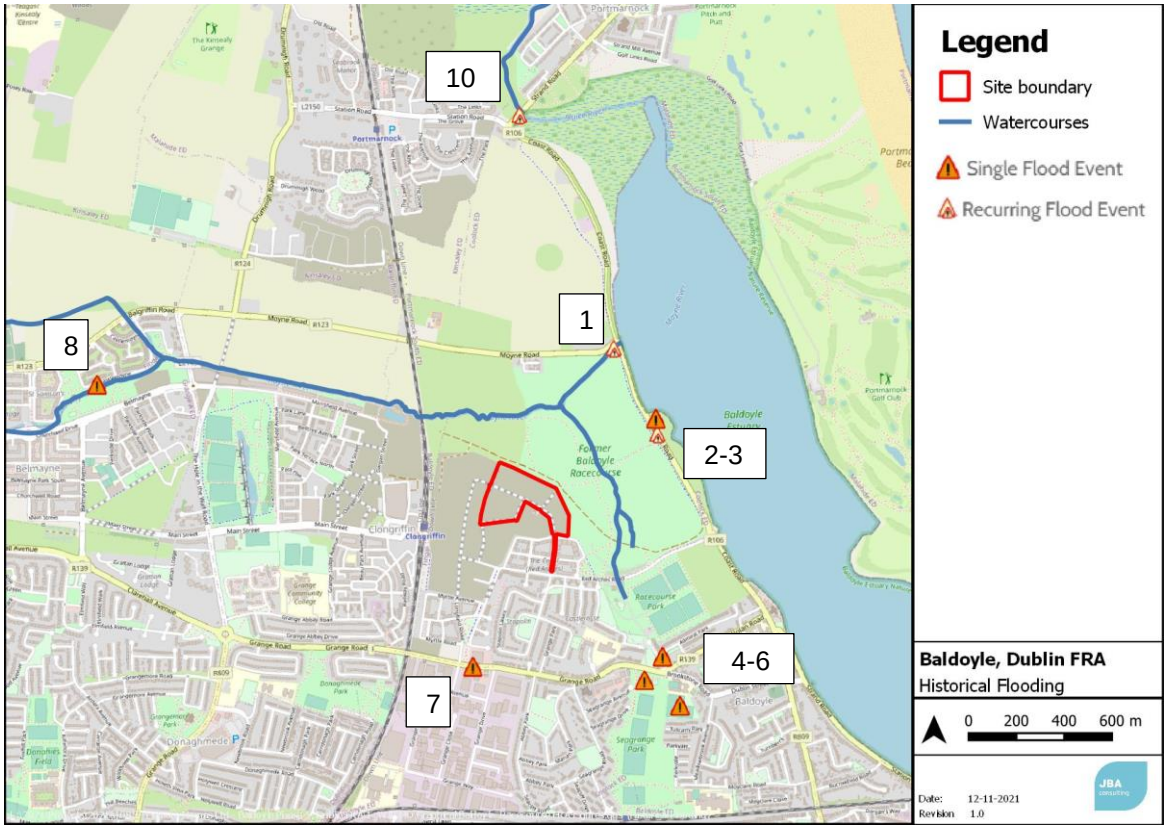


Figure 3-1: Historical Flooding (source: floodinfo.ie)

3.1.2 Internet Searches

An internet search was performed to gather information about whether the site was previously affected by flooding. Reports of repeated tidal flooding along the Baldoyle to Portmarnock walking and cycling greenway were found; the greenway runs alongside the Coast Road, approximately 400m to the east of the site.

No reports indicating flooding at the site were found.

3.2 Predictive Flooding

The area has been subject to a number of predictive flood mapping or modelling studies:

- OPW Preliminary Flood Risk Analysis (PFRA);

- FEM-FRAMS Fingal East Meath Flood Risk Assessment and Management Study;
- Fingal Development Plan 2017-2023 Strategic Flood Risk Assessment (SFRA);
- FloodResilienCity Project.

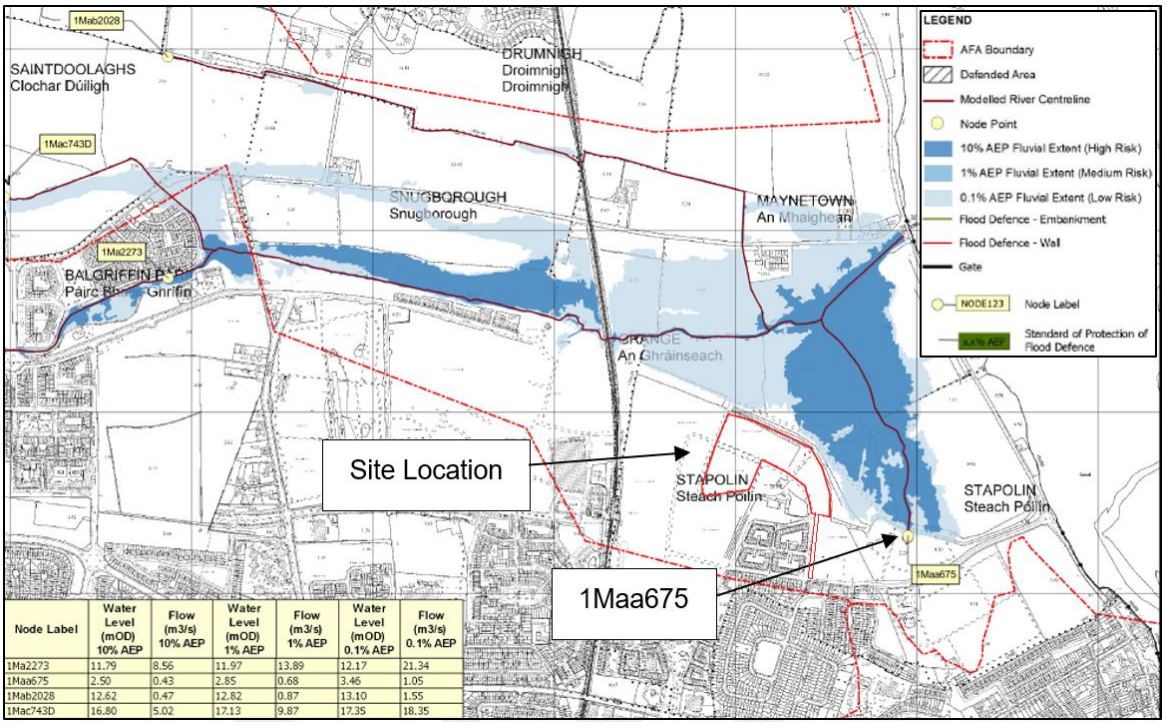
The level of detail presented by each method varies according to the quality of the information used and the approaches involved. The CFRAM is the most detailed assessment of flood extent and supersedes the fluvial flood outlines presented by the OPW PRFA study.

3.2.1 OPW Preliminary Flood Risk Analysis (PFRA)

The Preliminary Flood Risk Assessment (PFRA) is a requirement of the EU Flood Directive (2007/60/EC). One of the PFRA deliverables is flood probability mapping for various sources: pluvial (surface water), groundwater, fluvial and tidal. The PFRA is a preliminary or 'indicative' assessment and analysis has been undertaken to identify areas potentially prone to flooding. The fluvial and coastal data has largely been superseded by the CFRAMS flood mapping however the PFRA mapping still provides valuable information regarding pluvial and groundwater flooding. At the time of writing, the updated PFRA mapping has not been made public.

3.2.2 FEM-FRAMS Fingal East Meath Flood Risk Assessment and Management study

The FEMFRAM study was a detailed flood mapping study undertaken in the north Dublin region as a pilot study area for the CFRAM programme. Following the detailed hydraulic modelling, flood maps were produced for the 10%, 1%, and 0.1% AEP fluvial flood events. As shown in Figure 3-2, the FEMFRAM mapping confirms that the site is located in Flood Zone C. The peak flood levels and flows for the 1% and 0.1% AEP events for the closest node (1Maa675) are provided in Table 3-1.



Node Label	Water Level (mOD) 10% AEP	Flow (m3/s) 10% AEP	Water Level (mOD) 1% AEP	Flow (m3/s) 1% AEP	Water Level (mOD) 0.1% AEP	Flow (m3/s) 0.1% AEP
1Ma2273	11.79	8.56	11.97	13.89	12.17	21.34
1Maa675	2.50	0.43	2.85	0.68	3.46	1.05
1Mab2028	12.62	0.47	12.82	0.87	13.10	1.55
1Mac743D	16.80	5.02	17.13	9.87	17.35	18.35

Figure 3-2 FEMFRAM Fluvial Flood Extents (Source: floodinfo.ie)

Table 3-1: FEM FRAM Peak Flow/Levels (Fluvial)

Node	1% AEP		0.1% AEP	
1Maa675	0.68 (m3/s)	2.85mOD	1.05(m3/s)	3.46mOD

Flood maps were also produced for the 10%, 0.5%, and 0.1% AEP tidal flood events. As shown in Figure 3-3, the FEMFRAM mapping places the site outside the 0.1% flood extents. The peak flood levels and flows for the 0.5% and 0.1% AEP events for the closest node are provided in Table 3-2.

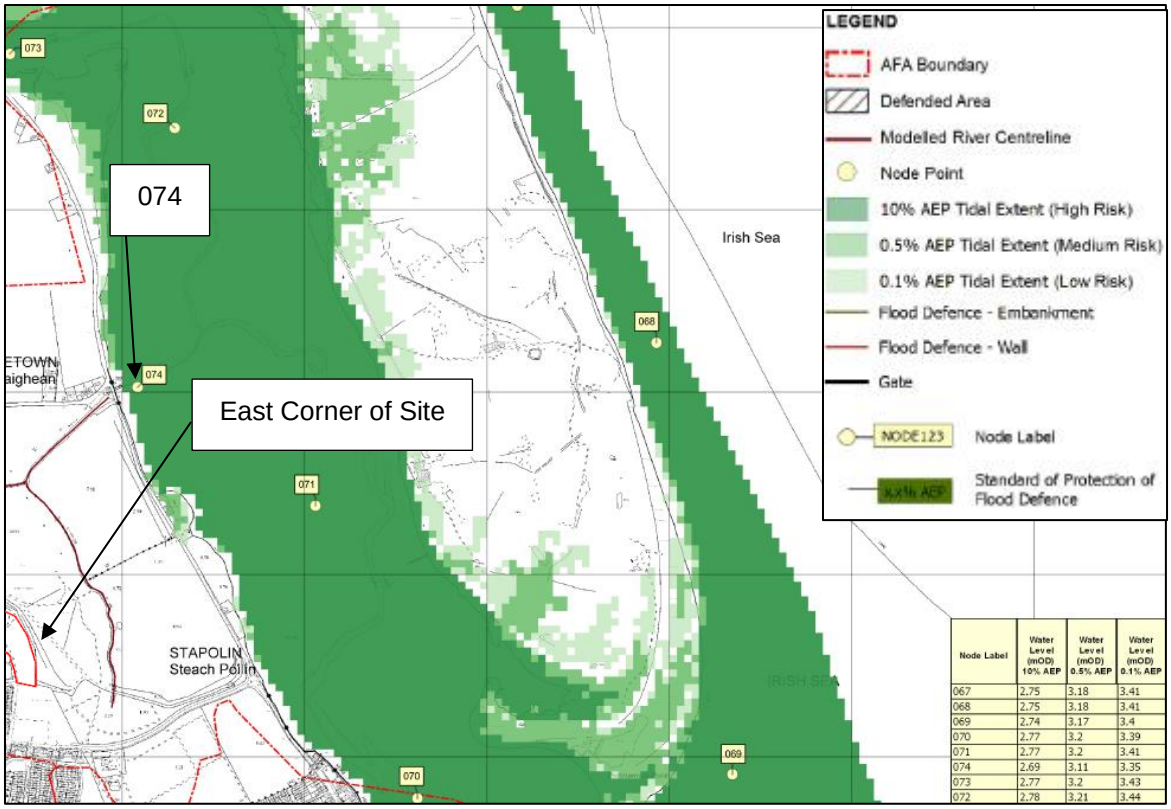


Figure 3-3 FEMFRAM Tidal Flood Extents (Source: floodinfo.ie)

Table 3-2: FEM FRAM Peak Levels (Tidal)

Node	10% AEP	0.5% AEP	0.1% AEP
074	2.69mOD	3.11mOD	3.35mOD

3.2.3 Fingal Development Plan 2017-2023 Strategic Flood Risk Assessment (SFRA)

The Fingal County Council Development Plan (CDP) 2017-2023 is the governing document for development in the area. It aims to set out the priorities and goals of the council over the lifetime of the plan for spatial and sectoral development. Under the Fingal CoCo CDP 2017-2023 the site is zoned as Residential).

As part of the Development Plan, a Strategic Flood Risk Assessment (SFRA) was commissioned to inform development based on flood risk. The SFRA informs the strategic land use planning decisions by providing an assessment of flood risk within the region and enables the application of the sequential approach, including Justification Test. A range of flood sources have been investigated as part of the SFRA (PFRA, FEMFRAM, Eastern CFRAM etc.), however the final flood maps are based on FEMFRAM mapping for the site area. The SFRA is based on the Planning System and Flood Risk Management Guidelines and uses the same sequential approach and Justification Test.

With specific reference to Section 5.9.14 of the SFRA, an FRA is required to be undertaken to demonstrate that developments would not have adverse flood risk impacts.

The baseline mapping is the FEM FRAM flood maps, as presented in Section 3.2.2.

3.2.4 FloodResilienCity Project

A report was undertaken as part of the EU Interreg IVB Flood ResilienCity Project to identify pluvial flooding hazards across Dublin City. The EU Interreg programme is a collaboration between EU partner authorities and organisations of which Dublin City is a member. The aim of the programme is to share knowledge and experience at a European Level. As part of the project, a city-wide pluvial model was developed to provide hazard mapping for Dublin City.

The results are presented in Figure 3-4 below and indicate that pluvial flooding occurs within the site during the 10% AEP pluvial event.

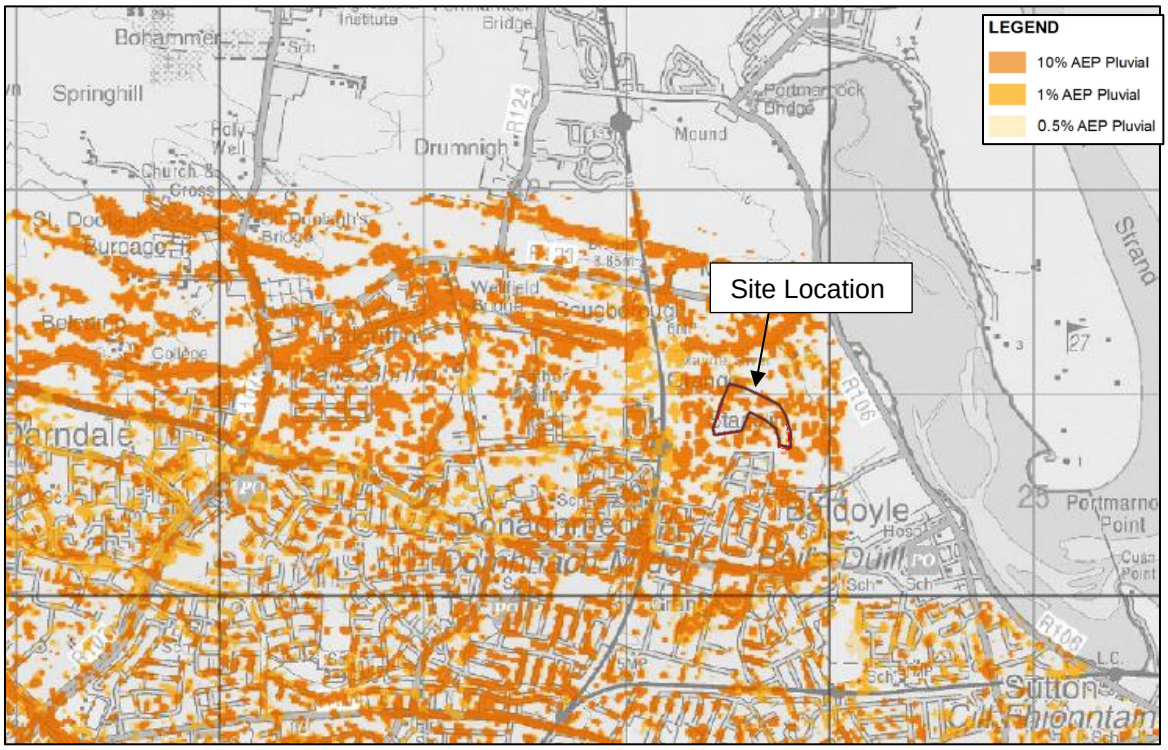


Figure 3-4: FloodResiliencity Pluvial Flood Mapping (source: http://www.floodinfo.ie/)

3.3 Flood Sources

The initial stage of a Flood Risk Assessment requires the identification and consideration of probable sources of flooding. Following the initial phase of this Flood Risk Assessment, it is possible to summarise the level of potential risk posed by each source of flooding. The flood sources are described below.

3.3.1 Fluvial

Following review of the available information, the River Mayne and the Racecourse Stream from the south have been identified as the main source of fluvial flood risk to the site. Review of the FEMFRAM fluvial flood extents confirms that the site is within Flood Zone C.

To confirm the flood risk to the development from climate change and residual risks, it was necessary to undertake hydraulic modelling to appraise the potential impacts. Further discussion on the hydraulic model is undertaken in Section 4.

3.3.2 Tidal

Review of the FEM FRAM tidal flood extents shows the site is not at flood risk from the tidal events. However, a more detailed analysis of the tidal flood risk to the site is presented in Section 4.

3.3.3 Pluvial/ Surface Water

Following review of the available information, the site is at risk of pluvial flooding during the 10% AEP event. Localised pluvial impacts at the site corresponds with localised depressions. The pluvial flood risk will be managed by the proposed stormwater system which is detailed further in Section 4.3.1.1.

3.3.4 Groundwater

Review of the site geology shows that the Quaternary Sediments at the site location include Alluvium, indicating historical flooding. Groundwater vulnerability and subsoil permeability are both ‘low’. There is no recorded risk of groundwater flooding onsite and a lack of karst features at the site indicate an overall low risk from groundwater flooding to the site. Therefore, groundwater flooding to the site has been screened out at this stage.

4 Hydraulic Model

4.1 Hydrology Assessment

To assist in the estimation of potential flood risk to the proposed development from the Mayne River, this section provides flow estimates for the 1% and 0.1% AEP flood event flows expected along the watercourse that flows through the northern section of the site. The unnamed tributary has also been included in the assessment. An overview of the hydrology is provided in the following section.

4.1.1 Catchment Characteristics

The physical characteristics of the catchment influence the hydrology, this includes catchment size, soil type, steepness and the average annual rainfall. Table 4-1 outlines the parameters calculated for the site catchment. Figure 4-2 overpage details the catchment area.

Table 4-1: Catchment Characteristics (source: OPW FSU)

Descriptor	09_1505_1	09_1428_02	Mayne Tributary
Centroid X	242090	241940	-
Centroid Y	317780	318770	-
Area	14.90	19.76	1.29
SAAR	714.24	709.38	711.63
FARL	1.00	1.00	1.00
BFI Soil	0.56	0.57	0.56
URBEXT	0.39	0.35	0.01
MSL	6.34	8.52	2.13
S1085	7.89	7.17	4.69
Stream Frequency	7.00	11.00	1.85
DrainD	0.89	0.85	1.00
ArtDrain2	0.00	0.00	0.00
Soil (number)	2.00	2.00	2.00
SMDBAR	7.00	7.00	7.00
M5-2day	56.96	57.02	56.20
M5-1day	44.23	48.32	47.60

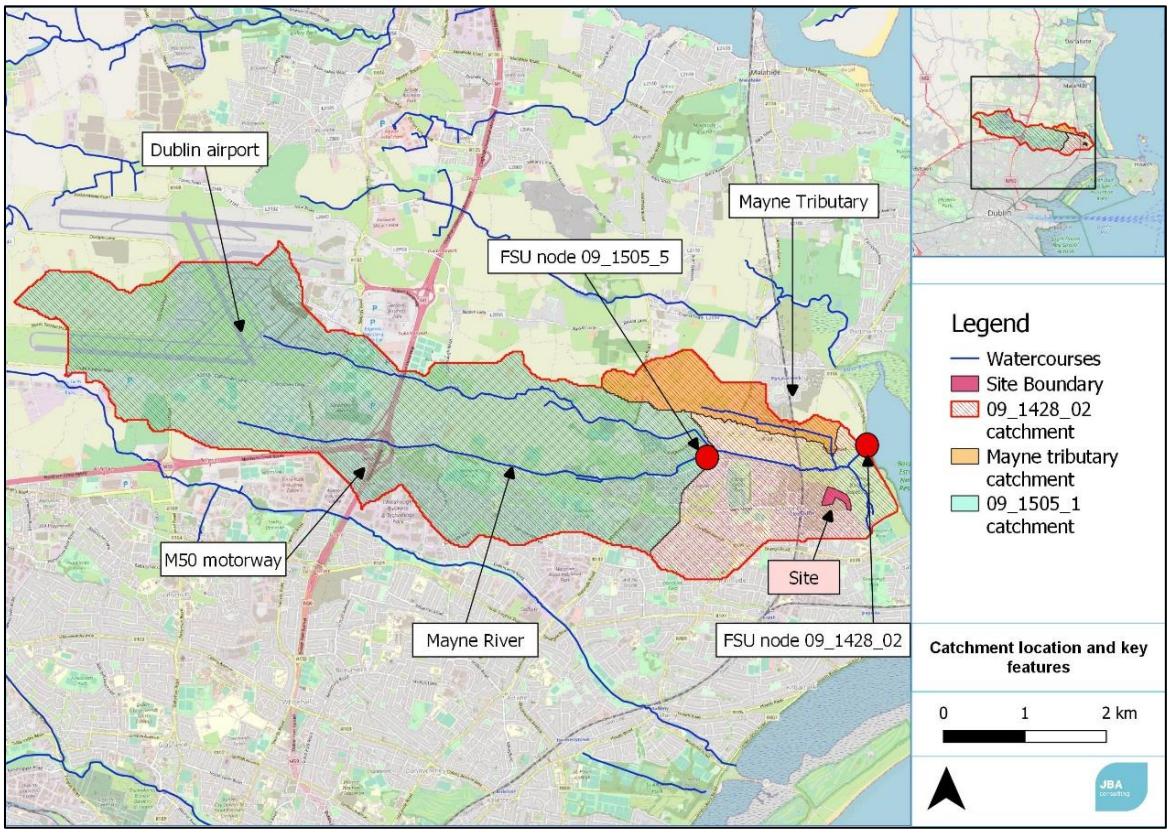


Figure 4-1: Catchment Area

4.1.2 Flow estimation

The flow estimations for the Mayne River and its tributary have been based on a single site analysis based on a 24-year hydrometric data and a weighted average growth curve (refer to Appendix B for more detail). The analysis provides both the Qmed and appropriate growth curves for the determination of the peak flows for the 1%, 0.1% AEP etc. The FSU Small Catchment method has been used to estimate the flows for the Racecourse Stream, due to the size of the catchment. Refer to the attached Hydrology Check file located in Appendix B for a comprehensive overview of the hydrology estimation process.

The final design flows for the Mayne River and its tributary are provided in Table 4-2.

Table 4-2: Design Flows

AEP (%)	09_1505_1 (Point inflow)	Mayne Tributary (Point inflow)	09_1428_02 (Lateral inflow)
50%	5.55	0.13	0.74
20%	8.04	0.19	1.07
10%	9.66	0.22	1.28
4%	11.43	0.27	1.53
2%	13.04	0.30	1.75
1%	14.49	0.34	1.91
0.1%	19.04	0.44	2.54

4.1.3 Tidal levels

The downstream tidal levels have been sourced from the FEM FRAM hydrological report for the 10yr, 50yr, 200yr and 1000yr tidal flood events. The tidal hydrography was sourced from Dublin port, which was provided by the Marine Institute (marine.ie.)

The final tidal peak flood levels used in the hydraulic model are presented in Table 4-3 below.

Table 4-3: Peak Tidal Flood Levels

AEP event (%)	Tidal Levels (mOD)
20% (5yr)	2.46
10% (10yr)	2.55
5% (20yr)	2.64
2% (50yr)	2.76
1% (100yr)	2.86
0.5% (200yr)	3.20
0.1% (1000yr)	3.41

4.1.4 Climate Change

Current OPW guidance requires that the effects of climate change be considered when assessing flood risk. The expected increase in peak flows, rainfall and tidal level is provided in the draft OPW guidance which provides allowances for two different climate change scenarios. These are the Mid-Range Future Scenario (MRFS) and the High-End Forecast Scenario (HEFS). The recommended allowances for climate change are given in Table 4-4 below. The potential implications for the development from climate change are discussed further in Section 4.1.4.

Table 4-4 OPW Climate Change Guidance

	MRFS	HEFS
Extreme Rainfall Depths	+20%	+30%
Flood Flows	+20%	+30%
Mean Sea Level Rise	+500mm	+1000m

4.1.5 Design Flood Events

The main design flood events on which the proposed development will be assessed are the 1% AEP fluvial/ 0.5% AEP tidal and the 0.1% AEP fluvial/tidal scenarios. These provide the Flood Zone A and B extents, and all finish level (Building FFLs) will be reference to these levels. Outside of the baseline events above the design will also be appraised against the potential impact of climate change and residual risks.

To ensure that the necessary fluvial and tidal boundaries have been applied a realistic combination of the upstream fluvial and downstream tidal models need to be determined. A joint probability analysis was undertaken as part of the FEM FRAM study which was based on the Defra/EA Joint Probability – Dependence Mapping and Best Practice (2006). To ensure consistency between the FEM FRAM study and the JBA modelling, the combined events have been sourced from the FEM FRAM hydrological report for the Mayne River system. See Table 4-5 for the combination of events which has been extracted FEM FRAM hydrological report (Table 8 pg57).

Table 4-5: Applied Combination Flood Event (AEP)

Design event (AEP)	Boundary Return Period (AEP)	
	Fluvial Boundary	Sea Level Boundary
50%	50%	50%
50%	50%	50%
20%	20%	50%
20%	50%	20%
10%	10%	50%
10%	50%	10%
4%	4%	50%
4%	50%	4%
2%	2%	50%
2%	50%	2%
1%	1%	20%
1%	20%	1%
0.50%	0.50%	10%
0.50%	10%	0.50%
0.10%	0.10%	2%
0.10%	2%	0.10%

Note: the table was converted from yearly return periods to AEP (%)

The following scenarios have been selected as the design events in the hydraulic model as part of the FRA to test both the fluvial and tidally dominated events.

1. Fluvial
    a. 1% AEP Fluvial + 5% AEP Tidal (Flood Zone A)
    b. 0.1% AEP Fluvial + 2% AEP Tidal (Flood Zone B)
2. Tidal
    a. 0.5% AEP Tidal + 10% AEP Fluvial (Flood Zone A)
    b. 0.1% AEP Tidal + 2% AEP Fluvial (Flood Zone B)

To assess the worst-case scenario, the peak of the fluvial event was set to match the peak tidal level, with two tidal cycles prior to the peak of the fluvial/tidal events. This ensures natural tidal storage is represented in the model prior to flood peak.

As previously stated, in addition to the above main design flood events, sensitivity scenarios will be undertaken to appraise the proposed design against the potential impact of climate change and the residual risk of sluice gate blockage.

4.2 Hydraulic Model

To provide a detailed assessment of flood risk at the site, a 1D-2D ESTRY-TUFLOW hydraulic model was constructed. It allows for the modelling of river channels, streams, floodplains and hydraulic structures to predict water levels for a range of scenarios (see Figure 4-2 for the hydraulic model structure). The hydraulic model was developed in the following stages:

- A 1D-2D ESTRY-TUFLOW model of the Mayne River created using a DTM and available surveyed data;
- The existing structures were inserted into the model based on survey and a baseline condition was established;
- Hydraulic simulations were run to derive the existing flood extents for the 1% and 0.1% AEP flood events;
- The post-development design has been assessed against a range of climate change scenarios (MRFS & HEFS);
- The blockage of the sluice gate downstream was tested to assess the residual risk for the site.

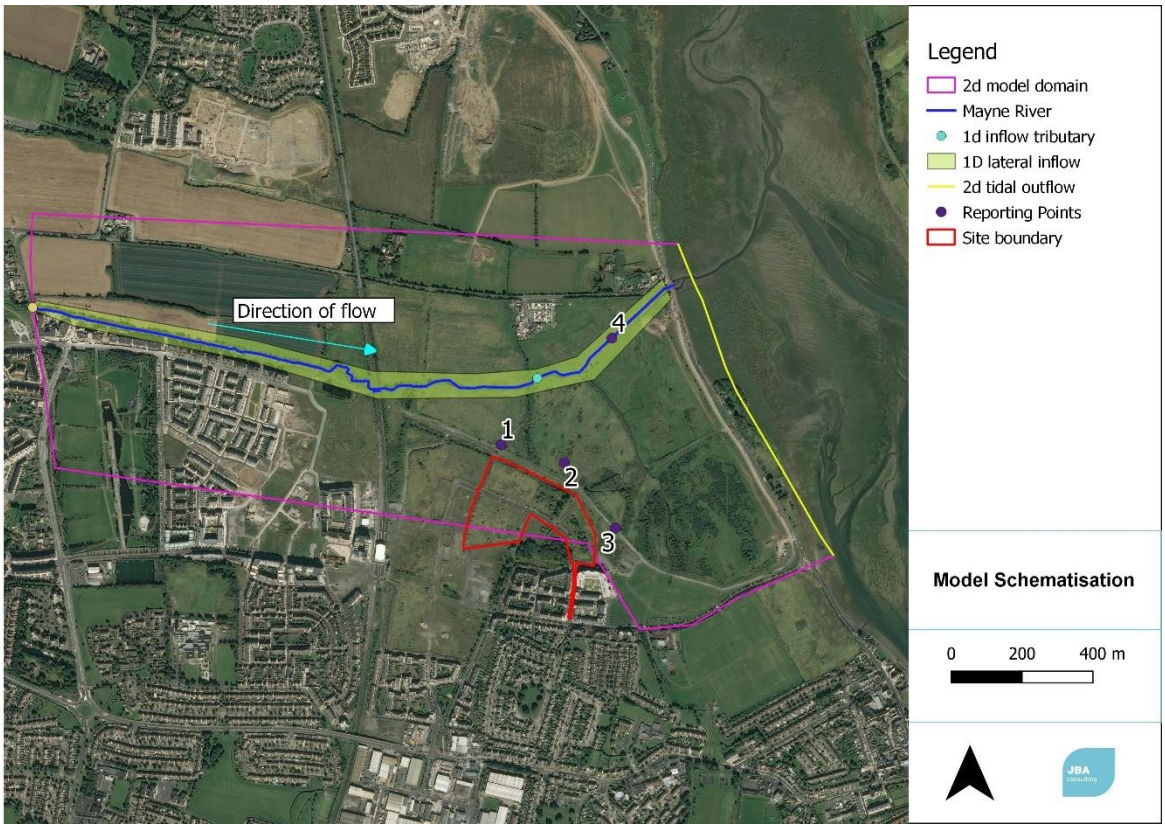


Figure 4-2: Model Schematisation

4.3 Model Results

4.3.1 Pre-Development Scenario

4.3.1.1 Fluvial events

The model results show the site is not impacted by fluvial inundation during both the 1% and 0.1% AEP fluvial flood events. The flood extents are presented in Figure 4-3 and flood levels in Table 4-6.

The main flood mechanism north of the site is flow conveyance rather than flood storage. Floodwaters overtop the riverbank downstream of the railway line and flow past the northern boundary of the site.

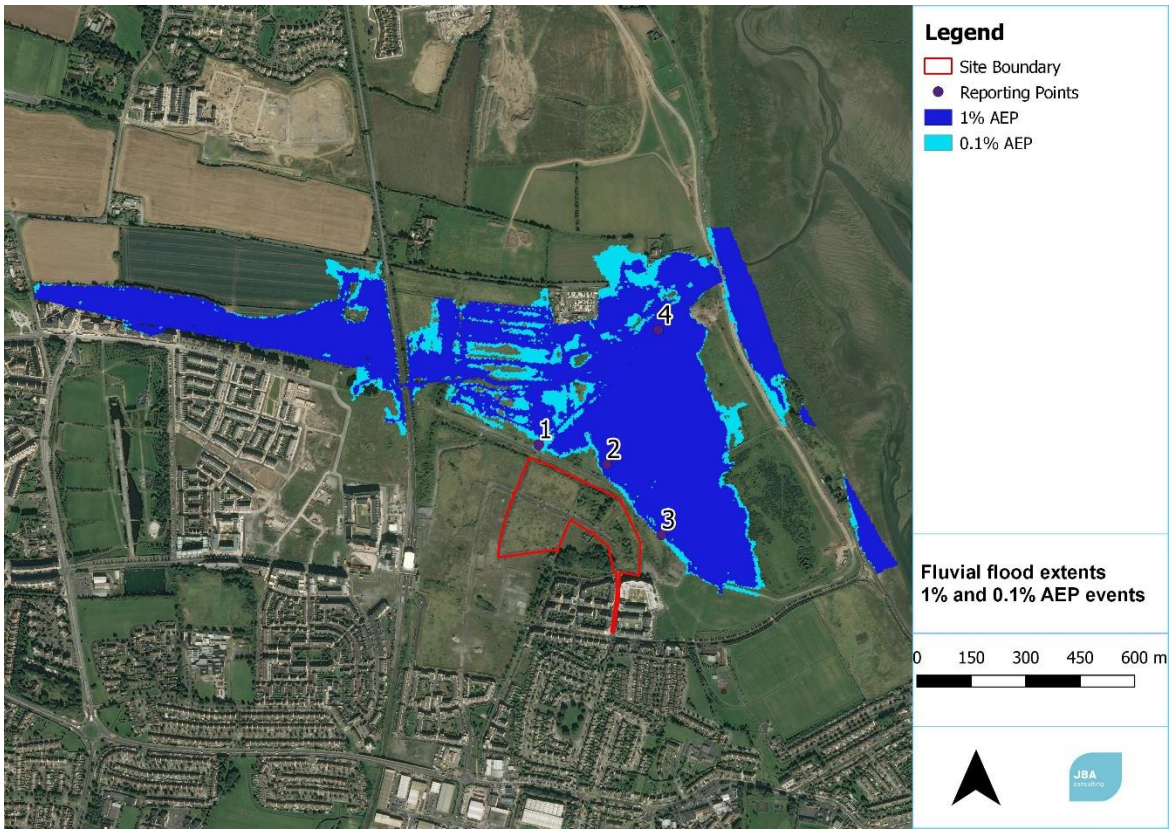


Figure 4-3: 1% and 0.1% AEP fluvial flood extents - pre-development scenario

Table 4-6: 1% and 0.1% AEP fluvial levels- pre-development scenario [mOD]

Reporting Point	Fluvial 1% AEP	Fluvial 0.1% AEP
1	2.63	2.93
2	2.57	2.93
3	2.57	2.93
4	2.57	2.93

4.3.1.2 Tidal events

The modelling results confirm that the site is not at flood risk during the 0.5% AEP and the 0.1% AEP tidal flood events. The flood extents are presented in Figure 4-4 and flood levels in Table 4-7.

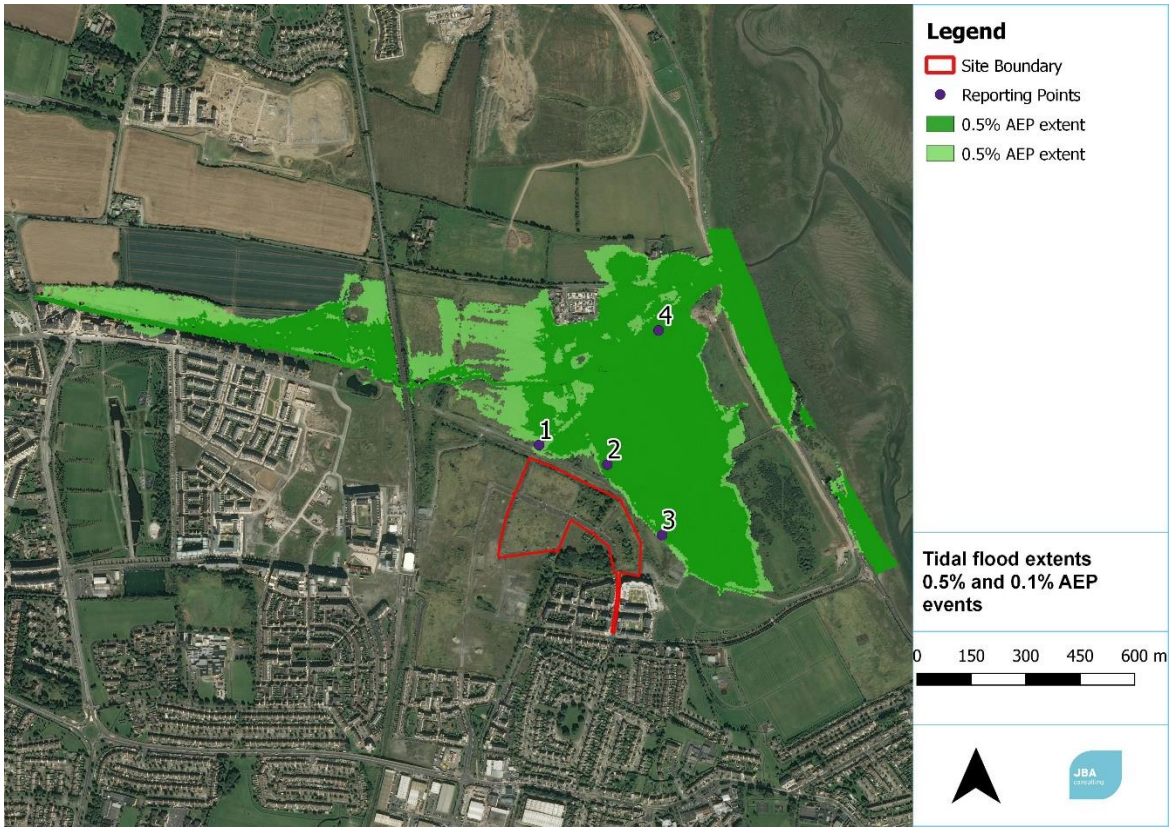


Figure 4-4: 0.5% and 0.1% AEP tidal flood extents - pre-development scenario

Table 4-7: 0.5% and 0.1% AEP tidal levels - pre-development scenario [mOD]

Reporting Point	Tidal 0.5% AEP	Tidal 0.1% AEP
1	2.66	3.15
2	2.66	3.15
3	2.66	3.16
4	2.66	3.13

4.3.2 Post-Development Scenario

A number of flood events have been developed and analysed at the site including a range of pluvial and tidal events. It is important to identify the dominant flood event at the site to guide the development of mitigation measures. For the identification of the Flood Zone A & B onsite, the fluvial 1% AEP and 0.1% AEP events produce the wider flood extents adjacent at the site, when compared to the tidal events. Therefore, Flood Zone A & B delineation is solely based on the fluvial events.

All the relevant flood maps are presented in Appendix C.2. The site is located in Flood Zone C and is appropriate for residential development.

The peak flood levels bordering the site are produced by the climate change (HEFS) scenarios and specifically by the tidal HEFS events. As can be seen in Figure 4-5 below, during the baseline tidal event tidal waters are retained within the estuary by the Coast Road. The volume of floodwaters entering the parklands area is controlled by the elevation along Coast Road. The flood levels are presented in Table 4-8 with the corresponding reporting point 4.

The HEFS event (climate change analysis) requires the addition of 1m above the baseline levels, which also has the effect of lengthening the duration when flood levels are above the Coast Road. This results in a considerably larger volume of tidal waters entering the park land area up the site.

A range of flood levels and profiles for various events are provided in Figure 4-5 and Table 4-8 . As shown in Figure 4-5, the 0.1% AEP HEFS flood event produced the highest flood levels adjacent to the site. The flood level is also consistent across the entire parkland which confirms that the Coast Road has no impact on flood levels during this event. The same can be stated for the duration of the flood event and operation of the sluice gate as the peak flood level recorded adjacent to the site equals the tidal level within the Baldoyle Estuary.

Table 4-8: Water levels [mOD]

Reporting Point	Fluvial 1% AEP	Fluvial 0.1% AEP	Fluvial 1% AEP HEFS	Fluvial 0.1% AEP HEFS	Tidal 0.5% AEP HEFS	Tidal 0.1% AEP HEFS
4	2.57	2.93	2.92	3.11	4.20	**4.42**

Note: Figure 4-5 is intended to highlight the impact of the Coast Road on flood extents through the site. The lowest FFL of the residential buildings is 6.20mOD, which provides a freeboard of 1.78m above the tidal 0.1% HEFS flood event. This event produces the highest flood level in the vicinity of the site.

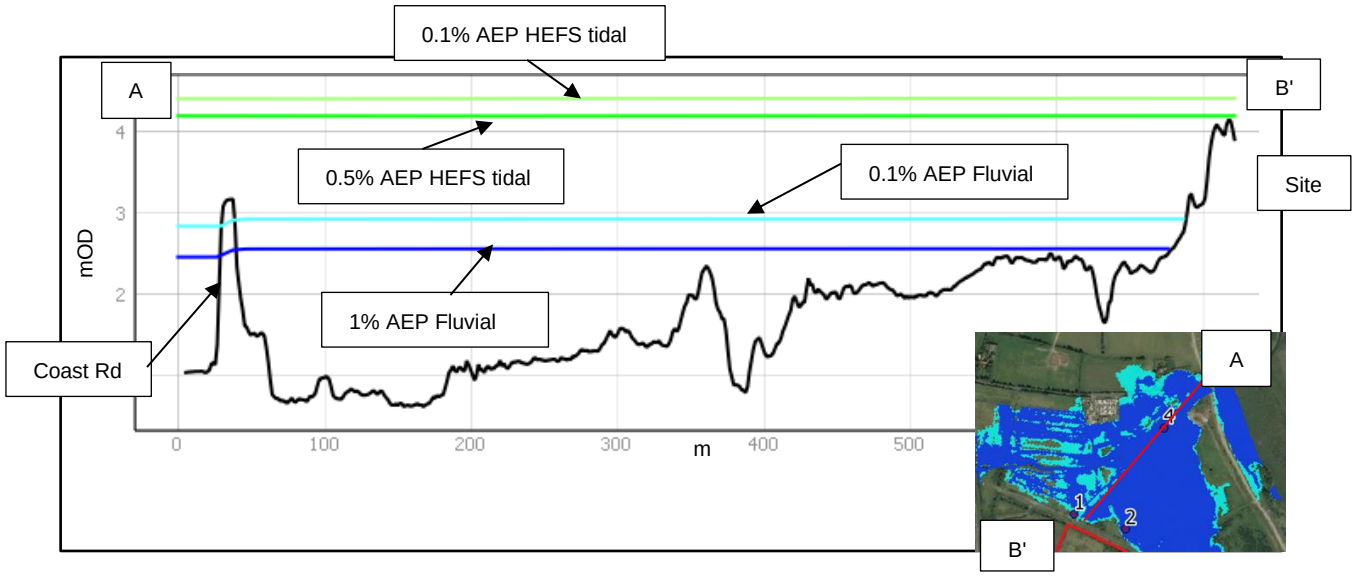


Figure 4-5: Comparison of Flood Levels

5 Flood Risk Assessment

5.1 Flood Risk

From reviewing the available sources of flooding outlined in Section 3, all of the site is located in Flood Zone C. Refer to Appendix C.1 for the flood map.

The aim of the FRA is to ensure that all residential properties are located in Flood Zone C and protected from inundation with an appropriate freeboard, and to ensure no impact from climate change or residual risks.

As outlined in Section 4.3.2, the design event selected to guide the mitigation measures is the 0.1% AEP HEFS tidal event. As noted, during the maximum flood extent, it is not impacted by the elevations along the Coast Road (sluice gate/tidal lock/ event duration etc).

5.2 Mitigation

5.2.1 Finished Floor Levels

As per the Fingal SFRA requirements it is necessary to place residential areas 0.5m above the 0.1% AEP flood event, which equates to 3.66mOD in accordance with the FRA guidelines. The provided minimum residential FFL for the site is 6.2mOD which provides a freeboard of 3.16m above the 0.1% AEP tidal event (3.04mOD).

5.2.2 Access

The primary access route onto the development is from the southern boundary of the site which is connected to the existing road network. The site access is situated within Flood Zone C and therefore access to the site can be maintained during a flood event.

5.3 Climate Change

In accordance with the OPW guidelines, it is necessary to assess the risk associated with climate change. The site has been assessed in accordance to the High End Future Scenario (HEFS) for both fluvial and tidal events, as presented in Table 4-4.

The flood extents for the tidal and fluvial (HEFS) are presented in Appendix C.2. Review of the flood maps confirm that the residential properties are not at risk of inundation from any event including the tidal 0.1% AEP HEFS flood event. Based on the provided FFL of 6.2mOD, a freeboard of 1.79m has been provided above the tidal 0.1% AEP HEFS tidal event (4.41mOD).

Table 5-1: Water levels [mOD] - Climate Change (HEFS) Scenario

Reporting Point	Tidal 0.5% AEP HEFS	Tidal 0.1% AEP HEFS	Fluvial 1% AEP HEFS	Fluvial 0.1% AEP HEFS
+1	4.20	4.42	2.93	3.11
2	4.20	4.41	2.92	3.11
3	4.20	4.41	2.92	3.11
4	4.20	4.41	2.92	3.11

5.3.1 Stormwater design/Fluvial Flooding

A stormwater system is provided onsite to manage fluvial/surface water flows onsite. Refer to the Civil Engineer drawings provided in the application for the detailed design layout.

In accordance with the LAP, no stormwater attenuation has been provided due to the close proximity to the Baldoyle Estuary. The surface water will discharge to the regional wetland north of the site. The volume of the stormwater discharge is minimal in comparsion to the predicred floodwaters during a fluvial/tidal flood events, and furthermore there are no sensitive receptors within the wetland that would be impacted by any minimal increase in stormwater flows. SUDS measures have been incorporated into the proposed design.

Localised pluvial flooding has been identified onsite that corresponds with localised depressions and does not present a flood risk to the development. The proposed stormwater system will manage

surface water within the site boundary post development. To further protect against fluvial flooding, a threshold of 150mm is recommended between the FFL and surrounding hardstanding areas.

5.4 Basement

The lowest basement entrance level has been set at 4.65mOD and there is no unsealed openings below this level. The lowest basement FFL has been set at 2.9mOD. With reference to the LAP, the basement entrance level needs to be places at least 0.5m above the 0.5% AEP tidal event (2.66mOD) which has been provided. The access level for the basement (4.65mOD) provides a freeboard of 0.23m above the tidal 0.1% AEP HEFS flood level (4.42mOD), which is the highest predicted flood level. Therefore the flood risk has been minimuise to the basement level.

To avoid potential flooding, basements should be sealed below this level (4.65mO) to comply with Objective FRM4 of the Baldoyle-Stapolin LAP.

5.5 Residual Risk

Residual risks are defined as risks that remain after all risk avoidance, substitution and mitigation measures have been taken. The flood risk assessment identifies the following as the main sources of residual risk to the proposed development as the blockage of the sluice gate.

A scenario has been developed to appraise the potential impact on the development following a blockage of the sluice gate during the 0.1% AEP fluvial flood event. The resulting 0.1% AEP flood level under the blockage scenario is 3.10mOD. This is below the provided FFL of 6.2mOD, therfore the development will not be impacted during the identifed residual risk scenario. Refer to Appendix D for the resulting flood map.

6 Conclusion

It is proposed to develop a residential development identified as Phase 5 in Baldoyle GA2, Co. Dublin. The scheme forms a continuation of existing residential development to the south. The site is currently classified as greenfield.

The River Mayne is the main river waterbody in the study area and is tidally influenced. The Baldoyle Estuary is located to the east of the site.

Review of the historic flood information does not provide any evidence of flooding at the site. The nearest flood event is situated along Coast Road, 600m east of the site.

Review of the FEM FRAM predictive flood maps confirms that site is not at risk of flooding and is fully located in Flood Zone C.

A site specific flood model has been developed that modelled a range of fluvial and tidal events, including residual risks. The results confirm that the proposed development is not at risk of inundation from the modelled flood events and further confirms that the site is in Flood Zone C.

The main design event selected is the 0.1% AEP HEFS tidal event as the HEFS tidal events provide the maximum flood levels onsite and significantly higher than the fluvial equivalent. The tidal HEFS levels are not impacted by the River Mayne sluice gates, Coast Road elevation or flood duration.

Outside of the main flood events, the site has also been assessed for the potential impacts of climate change and residual risks. As part of the climate change assessment, a 30% increase in fluvial flows and 1m in tidal levels have been incorporated into the 1%/0.5% and 0.1% AEP events respectively. The results confirm that the proposed residential development will not be impacted from any of the modelled flood events up to the 0.1% AEP HEFS tidal scenario.

The provided minimum FFL onsite is 6.2mOD which proivdes a freeboard of 1.79m over the 0.1% AEP HEFS tidal flood event, which produces the highet flood level adjacent to the site. This FFL also protects the development from all modelled flood events, including climate change and residual risks.

Considering the above, the Flood Risk Assessment was undertaken in accordance with 'The Planning System and Flood Risk Management' guidelines. The FRA is in agreement with the core principles contained within the Planning Guidelines.

Appendices

A Appendix - Understanding Flood Risk

Flood Risk is generally accepted to be a combination of the likelihood (or probability) of flooding and the potential consequences arising. Flood Risk can be expressed in terms of the following relationship:

Flood Risk = Probability of Flooding x Consequences of Flooding

A.1 Probability of Flooding

The likelihood or probability of a flood event (whether tidal or fluvial) is classified by its Annual Exceedance Probability (AEP) or return period years, a 1% AEP flood 1 in 100 chance of occurring in any given year. In this report, flood frequency will primarily be expressed in terms of AEP, which is the inverse of the return period, as shown in the table below and explained above. This can helpful when presenting results to members of the public who may associate the concept of return period with a regular occurrence rather than an average recurrence interval and is the terminology which will be used throughout this report.

Table: Conversion between return periods and annual exceedance probabilities

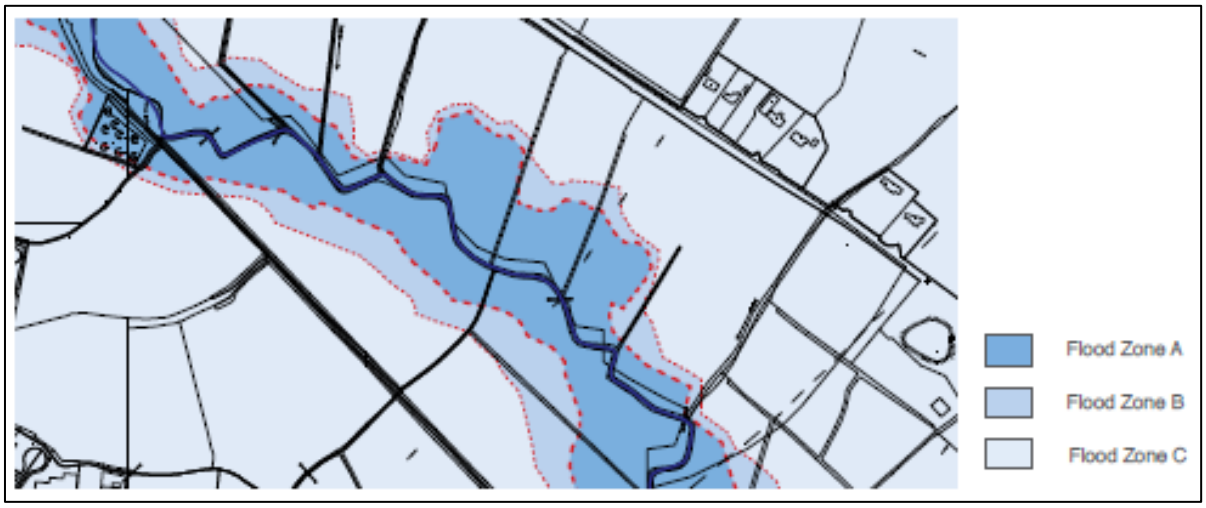
Return period (years)	Annual exceedance probability (%)
2	50
10	10
50	2
100	1
200	0.5
1000	0.1

A.2 Flood Zones

Flood Zones are geographical areas illustrating the probability of flooding. For the purpose of the Planning Guidelines, there are 3 types of levels of flood zones, A, B and C.

Zone	Description
Flood Zone A	Where the probability of flooding is highest, greater than 1% (1 in 100) from river flooding or 0.5% (1 in 200) for coastal/ tidal Flooding
Flood Zone B	Moderate probability of flooding, between 1% and 0.1% from rivers and between 0.5% and 0.1% from coastal/ tidal.
Flood Zone C	Lowest probability of flooding, less than 0.1% from both rivers and coastal/ tidal.

It is important to note that the definition of the flood zones is based on an undefended scenario and does not take into account the presence of flood protection structures such as flood walls or embankments. This is to allow for the fact that there is a residual risk of flooding behind the defences will be maintained in perpetuity.



A.3 Consequences of Flooding

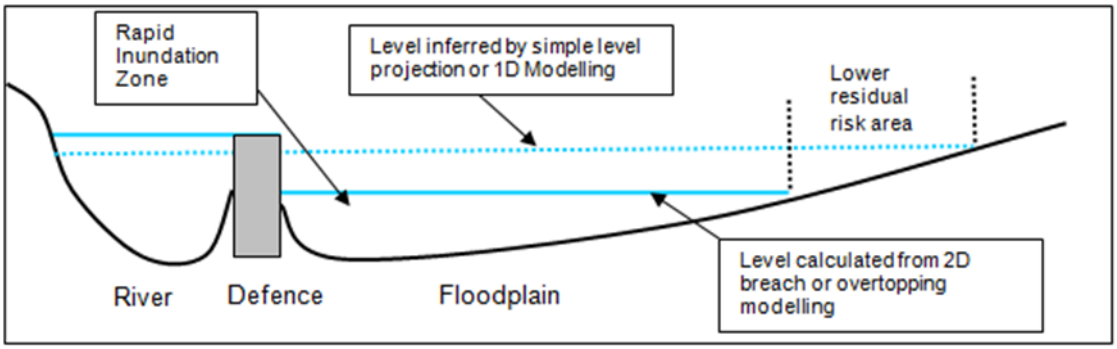
Consequences of flooding depend on the Hazards caused by flooding (depth of water, speed of flow. Rate of onset, duration, wave-action effects, water quality) and the vulnerability of receptors (type of development, nature, e.g., age-structure of the population, presence and reliability of mitigation measures etc.)

The 'Planning System and Flood Risk Management' provides three vulnerability categories, based on type of development, nature, which are detailed in the FRA Guidelines, and are summarised as:

- **Highly vulnerable**, including residential properties, essential infrastructure and emergency service facilities.
- **Less vulnerable**, such as retail and commercial and local transport infrastructure, such as changing rooms.
- **Water compatible**, including open space, outdoor recreation and associated essential infrastructure, such as changing rooms.

A.4 Residual Risk

The presence of flood defences, by their very nature, hinder the movement of flood water across the floodplain and prevent flooding unless river levels rise above the defence crest level or a breach occurs. This known as residual risk:



B Appendix - Hydrology Check File

Flood estimation report: 2021s1085 Baldoyle Phase 5 FRA

Approval

	Name and qualifications	Date
Method statement prepared by:	Hannah Moore B.A. mod MSc	22/09/2020
Method statement reviewed by:	Tom Sampson BSc MSc FRGS C.WEM MCIWEM	
Calculations prepared by:	Hannah Moore B.A. mod MSc	22/09/2020
Calculations reviewed by:	Tom Sampson BSc MSc FRGS C.WEM MCIWEM	

Revision History

Revision Ref/Date	Amendments	Issued to
P01.01/ 01/09/2020	First issue for review	Tom Sampson
P01.02/ 22/09/2020	Updates following review and feedback from hydraulic modelling team	Tom Sampson

Contents

Abbreviations

AMAX .....Annual Maximum
AREA .....Catchment area (km^2)
BFI .....Base Flow Index
BFIsoil.....Base Flow Index based on soil type
CFMP .....Catchment Flood Management Plan
CFRAM .....Catchment Flood Risk Assessment and Management
FARL.....FEH index of flood attenuation due to reservoirs and lakes
FEH .....Flood Estimation Handbook
FSR .....Flood Studies Report
QMED .....Median Annual Flood (with return period 2 years)
SAAR .....Standard Average Annual Rainfall (mm)
SPR .....Standard percentage runoff
Tp(0) .....Time to peak of the instantaneous unit hydrograph
URBEXT.....FEH index of fractional urban extent

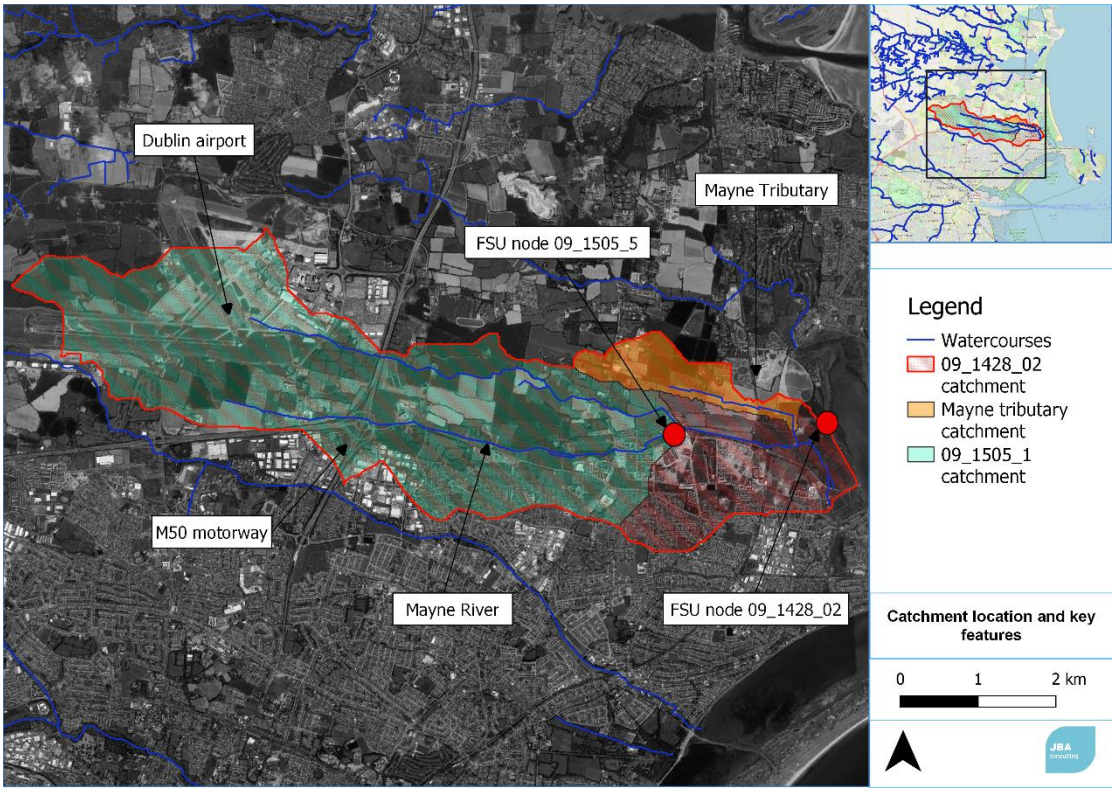
1 Method statement

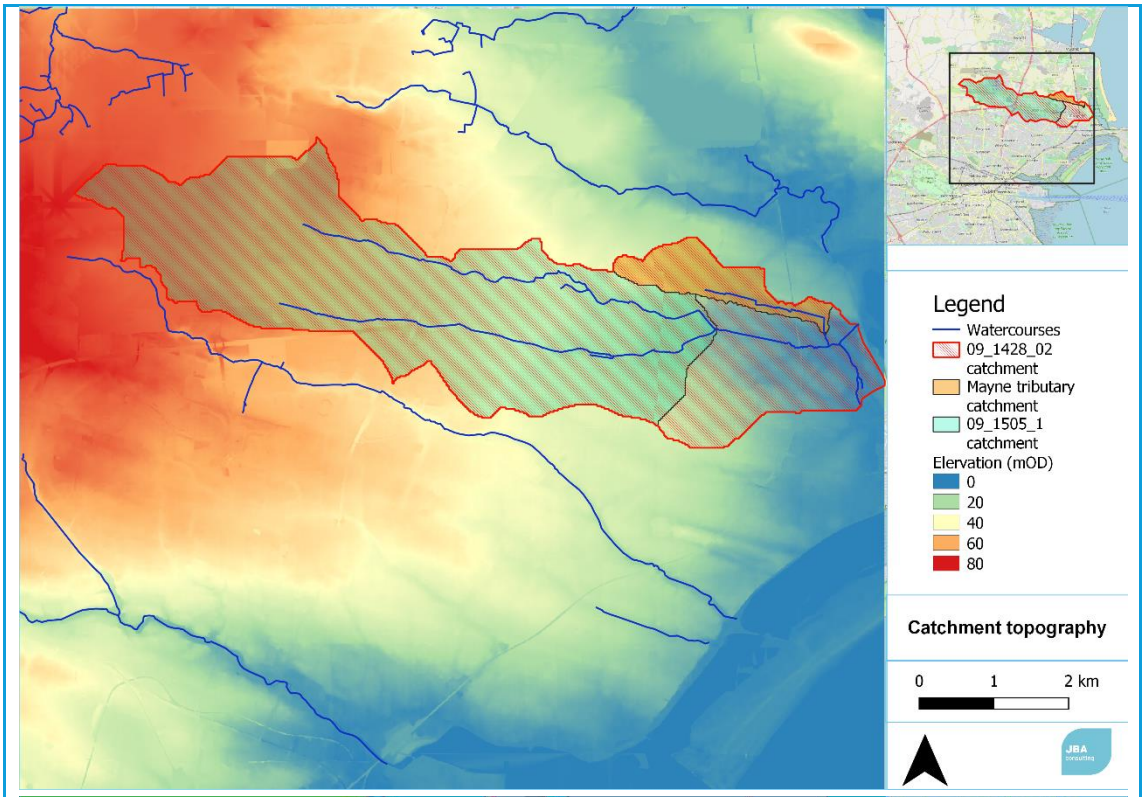
1.1 Requirements for flood estimates

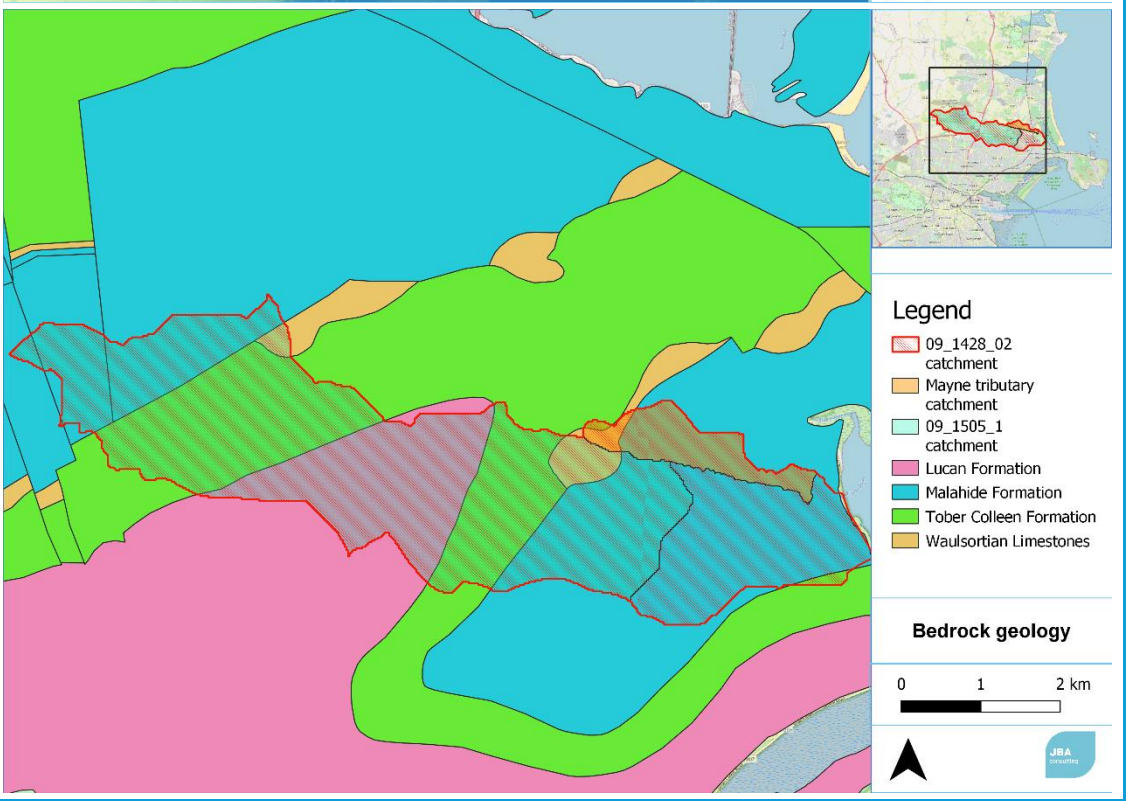
Overview • Purpose of study • Point or catchment flood estimates? • Peak flows or hydrographs ? • Range of return periods	Aim of project – flood risk assessment for cut and infill of land within FZ B/C to ensure no adverse impacts. Peak flows required for the 1% and 0.1% AEP events.

1.2 The catchment

Map (Include river network, catchment boundary and gauging stations)







Description Include topography, climate, geology, soils, land use and any unusual features that may affect the flood hydrology.	Topography: Catchments slope from west to east at a reasonable gradient with the lowest point near where the river flows into the Baldoyle estuary. Geology and soils: The catchments are situated on a number of geological formations. The formations largely consist of various types of limestone with minor conglomerates and shales. The soil is classified as low indicating that the catchments is poorly draining. Features: The M50 motorway and a railway line cut through

	the 09_1428_02 and 09_1505_1 catchments creating manmade hydrological boundaries. These will impact the movement of flow and will not be taken into consideration in the natural catchment flow estimation methods but may be critical in understanding the storage and response of the catchment. It is also noted a large part of the catchment is urbanised.

1.3 Gauging stations (flow or level)

Water-course	Station name	Gauging authority number	Gauging Authority	Catchment area (km²)	Type (rated / ultrasonic / level…)	Record length
Mayne	Hole in the wall	08006	EPA		Staff gauge	1977 - 1987

1.4 Data available at each flow gauging station

Station name	Start and end of FSU portal flood peak record	Update for this study? (CFRAM or latest data)	OK for QMED?	OK for pooling?	Data quality check needed?	Other comments on station and flow data quality
Hole in the wall	Not included	NA	NA	NA	Yes	See extract from FEM FRAMS hydrology report detailing the gauge. Large amount of uncertainty for a limited record length. Also noted that the area has gone through a considerable amount of urbanisation since gauge record finished so flows unlikely to be representative of current catchment.

Station 08006 Hole in the Wall on the Mayne River consists of approximately 10 years of hydrometric data, i.e., from 09/03/1977 to 01/03/1987. The data consists of several gaps in the years 1977, 1985, 1986 and 1987. The zero datum at the gauge changed four times in 1977, three times in 1978 and one time in 1981 whereas the rating equation changed seven times in the ten years. The station was also not included in the OPW review of gauging stations (Hydro-Logic, 2006) and hence the high flow rating quality of this station was unknown. Therefore the data was not further analysed and not included in the hydrological analysis. However, this station is considered to provide valuable information for the calibration of the hydraulic model of the Mayne River in the future. According to the 'FCC Report on Fingal Hydrometric Stations', the old station at the Hole in the Wall Road is to be renewed subject to funding being made available. It is therefore recommended the reinstallation of the Station 08006 Hole in the Wall Road on a priority basis so that the existing (with rating review) and future hydrometric data at this station could provide useful information for the forecasting of flood flows in the Mayne River.

Extract taken from the FEM FRAMS hydrology report (pg. 9)

1.5 Other data available and how it has been obtained

Type of data	Data relevant to this study?	Data available?	Source of data	Details
Historic flood data Include chronology and interpretation of flood history in Annex or separate report.	Yes	Yes	Floodinfo.ie	Records of flooding occurring within area surrounding the site from multiple sources (pluvial and fluvial)
CFRAM study method & outputs	Yes	Yes	Floodinfo.ie and FEM FRAMS documents	Hydrology and hydraulics information available for the area as modelled under FEM FRAMS (pilot CFRAM study)
Results from other previous studies	Yes	Yes	Floodinfo.ie and FEM FRAMS documents	Hydrology and hydraulics information available for the area as modelled under FEM FRAMS (pilot CFRAM study)

1.6 Hydrological understanding of catchment

Hydrological interpretation Catchment processes, response time, propagation of flood, contributions from tributaries	From an initial examination of the catchment features the response of the watercourses is expected to be flashy. Runoff entering the watercourses in the upper reaches moves quickly through the system due to the slope. The low soil permeability also potentially increases the amount of runoff within the catchment particularly in prolonged wet periods. The influence of the manmade hydrological barriers is not fully known however they will impact how, when, and where the flow is stored and discharged into the system. The downstream boundary of the system is tidal however the impact of this on flows is regulated and controlled by an existing sluice gate structure.

Outline the conceptual model, addressing questions such as: • Where are the main sites of interest? • What is likely to cause flooding at those locations? (peak flows, flood volumes, combinations of peaks, groundwater, snowmelt, tides…) • Might those locations flood from runoff generated on part of the catchment only, e.g. downstream of a reservoir? • Is there a need to consider temporary debris dams that could collapse?	Site is located along the Mayne River within the wider flood plain area close to where the river flows into the Irish sea. There is a sluice gate at the outflow of the river into the Baldoyle estuary which controls the tidal influence in the channel.
Any unusual catchment features to take into account? e.g. • highly permeable – avoid ReFH if BFIHOST>0.65, consider permeable catchment adjustment for statistical method if SPRHOST<20%	Railway and M50 motorway cut across catchments creating hydrological barriers potentially altering where flow enters the system.

• highly urbanised – seek local flow data; consider method that can account for differing sewer and topographic catchments • pumped watercourse – consider lowland catchment version of rainfall-runoff method • major reservoir influence (FARL<0.90) – consider flood routing, extensive floodplain storage – consider choice of method carefully • Karst groundwater • Catchment change • Arterial Drainage / Drainage District	

1.7 Initial choice of approach

Is FSU appropriate? (it may not be for extremely heavily urbanised or complex catchments) If not, describe other methods to be used.	Area of the Mayne river catchments is such that it is worth considering FSU (19km2, 14.9km2) as well as FSU small catchments. Only FSU small catchments considered for Mayne tributary due to its size.
Initial choice of method(s) and reasons How will hydrograph shapes be derived if needed? Will the catchment be split into sub-catchments? If so, how?	FSU, FSU small catchments, initial approach is to estimate single point inflow, may consider point and lateral flow after examination with hydraulic model
Software to be used (with version numbers)	FSU Portal / JSpeed / JBA's Flood Estimation Software (JFes) v.8

2 Locations where flood estimates required

The table below lists the locations of subject sites. The site codes listed below are used in all subsequent tables to save space.

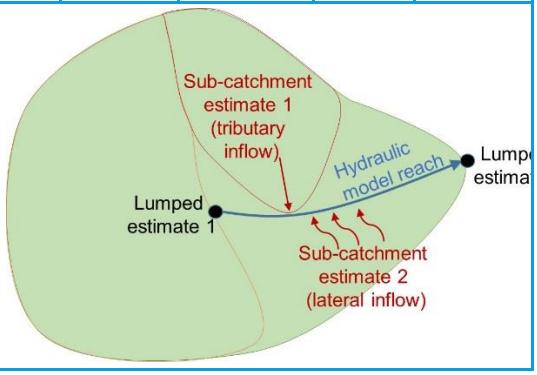
2.1 Summary of subject sites

Site code	Type of estimate L: lumped catchment S: Sub-catchment	Watercourse	Name or description of site	Easting	Northing	AREA (km^2)	Revised AREA if altered
09_1428_02	L	Mayne					
09_1505_1	L	Mayne					
Mayne trib	S	Mayne Tributary					

Note: Lumped catchments (L) are complete catchments draining to points at which design flows are required.

Sub-catchments (S) are catchments or intervening areas that are being used as inputs to a semi-distributed model of the river system. There is no need to report any design flows for sub-catchments, as they are not relevant: the relevant result is the hydrograph that the sub-catchment is expected to contribute to a design flood event at a point further downstream in the river system. This will be recorded within the hydraulic model output files. However, catchment descriptors and ReFH model parameters should be recorded for sub-catchments so that the results can be reproduced.

The schematic diagram illustrates the distinction between lumped and sub-catchment estimates.



2.2 Important catchment descriptors at each subject site (incorporating any changes made)

Descriptor	09_1505_1	09_1428_02	Mayne Tributary
Centroid X	242090	241940	-
Centroid Y	317780	318770	-
Area	14.90	19.76	1.29
SAAR	714.24	709.38	711.63
FARL	1.00	1.00	1.00
BFI Soil	0.56	0.57	0.56
URBEXT	0.39	0.35	0.01
MSL	6.34	8.52	2.13
S1085	7.89	7.17	4.69
Stream Frequency	7.00	11.00	1.85
DrainD	0.89	0.85	1.00
ArtDrain2	0.00	0.00	0.00
Soil (number)	2.00	2.00	2.00
SMDBAR	7.00	7.00	7.00
M5-2day	56.96	57.02	56.20
M5-1day	44.23	48.32	47.60

2.3 Checking catchment descriptors

Record how catchment boundary was checked and describe any changes (add maps if needed)	A visual check of the catchment boundaries using the Ireland aligned DTM data was also done. An additional 0.2km2 was added to the catchment area from the original FSU catchment of node 09_1428_02 to account for the fact that an area at the downstream boundary of the watercourse likely drains into the catchment and not the estuary. The Mayne tributary is not included in the FSU database so a catchment was derived using GIS tools.
Record how other catchment descriptors were checked and describe any changes. Include before/after table if necessary.	Catchment descriptors were sourced from FSU database for ungauged node 09_1428_02 and 09_1505_1. A visual inspection of the descriptors was carried out to ensure no odd or unrealistic values were being used to describe the catchment. The descriptors for the Mayne Tributary were derived from first principles and referring to the values from near by FSU nodes
Source of URBEXT	FSU database

3 FSU Statistical method

3.1 Overview of estimation of QMED at subject site

3.1.1 Ungauged QMED estimation

Number	09_1428_02	09_1505_1
Catchment area (km2)	19.57	14.90
Qmed (rural) m^3/s	2.42	1.98
Urban Adjustment Factor	1.55	1.64
Qmed (urban) m^3/s	3.78	3.25
Qmed (small catchments) m^3/s	2.15	1.75

3.2 Data transfer for QMED estimation

Table 3-1. Pivotal gauge options

	Pivotal option A	Pivotal option B	Pivotal option C
Name	Kinsaley Hall	Ballyboghill	Naul
Number	08005	08012	08002
FSU gauge quality ranking	A2	B	A1
Catchment area (km2)	9.17	25.95	33.43
Qmed gauged m3/s	2.49	4.35	5.41
Qmed(rural) m3/s	1.31	4.17	3.78
On same watercourse as subject site (Y/N)	N	N	N
In same catchment as subject site (Y/N)	N	N	N
Hydrological similarity to ungauged location	0.70	0.81	0.80
URBEXT	0.25	0.01	0.01
Any other catchment features (e.g. Arterial Drainage)	Weir removed in 1983	-	-
Gauge type	Weir	Weir	Weir
Operator	EPA	EPA	EPA
Status	Active	Inactive	Active
Reasons for choosing or dismissing	Closest gauge to watercourse, hydrologically similar	B ranked gauge indicating data not highest quality	Gauge at a distance from subject site and has significantly lower URBEXT value which is critical for this catchment

3.2.1 Discussion on gauge data, data transfer and pivotal sites

An investigation of the potential use of a pivotal gauge to further refine the Qmed values estimated using real gauge data was carried out. As the two watercourses are so close to each other a single pivotal gauge will be used for the two watercourses. A list of potential pivotal gauges for the ungauged sites was sourced from the OPW FSU database which includes all reviewed gauges Ireland. Table 3-1 summarises the pivotal site short list.

Of the shortlisted gauges one is a B ranked gauge indicating the data provided is of lesser quality - the Ballyboghill gauge. This gauge is discounted from consideration due to its data quality.

From the remaining gauges the Naul gauge has an A1 data ranking. Comparing the Naul and Kinsaley Hall gauges the Naul gauge has higher quality data but is located at a larger distance from the watercourses considered and has different catchment characteristics such as area and URBEXT. The Kinsaley Hall gauged catchment is close to the watercourses considered and has more similar catchment characteristics and is recommended for use as the pivotal gauge.

Refer to Figure 3-1 for the location of the Kinsaley Hall gauge. Figure 3-2 shows the AMAX series for the gauge. The Kinsaley Hall was an active gauge between 1977 and 2001, two AMAX records for the gauge are available - one from the OPW FSU site (1983-2000) and the second from the EPA hydronet website (1977-2001). With regards to the EPA data although the record is longer there were several changes to the gauge (e.g. weir removal) that occurred prior to 1983. To ensure consistency within the gauge records and rating curve applied it is recommended that the data prior to 1983 not be used in analysis.

Figure 3-1 compares the two AMAX records available. There are notable differences in the peak flows recorded from both data sets. Review of the data sets revealed that different rating curves must have been applied to the recorded water levels. There are no records of any rating review or the actual rating curve used in the OPW FSU data. It was also noted that the AMAX recorded of water levels recorded differed for each data set, there is no information as to why the water levels recorded differ.

It was decided that the EPA AMAX from 1983-2001 be used for analysis because:

- The EPA oversaw the gauge when it was operational;
- There is no information as to how the OPW data was sourced or the rating curve applied to the data;
- The rating curve and full data record is available from the EPA and a clear trail of data collection and application can be seen through the AMAX series and is therefore considered a more reliable data source;
- The EPA data was used in the FEM FRAM study which is the most up to date assessment of the watercourse and flood risk for the area.

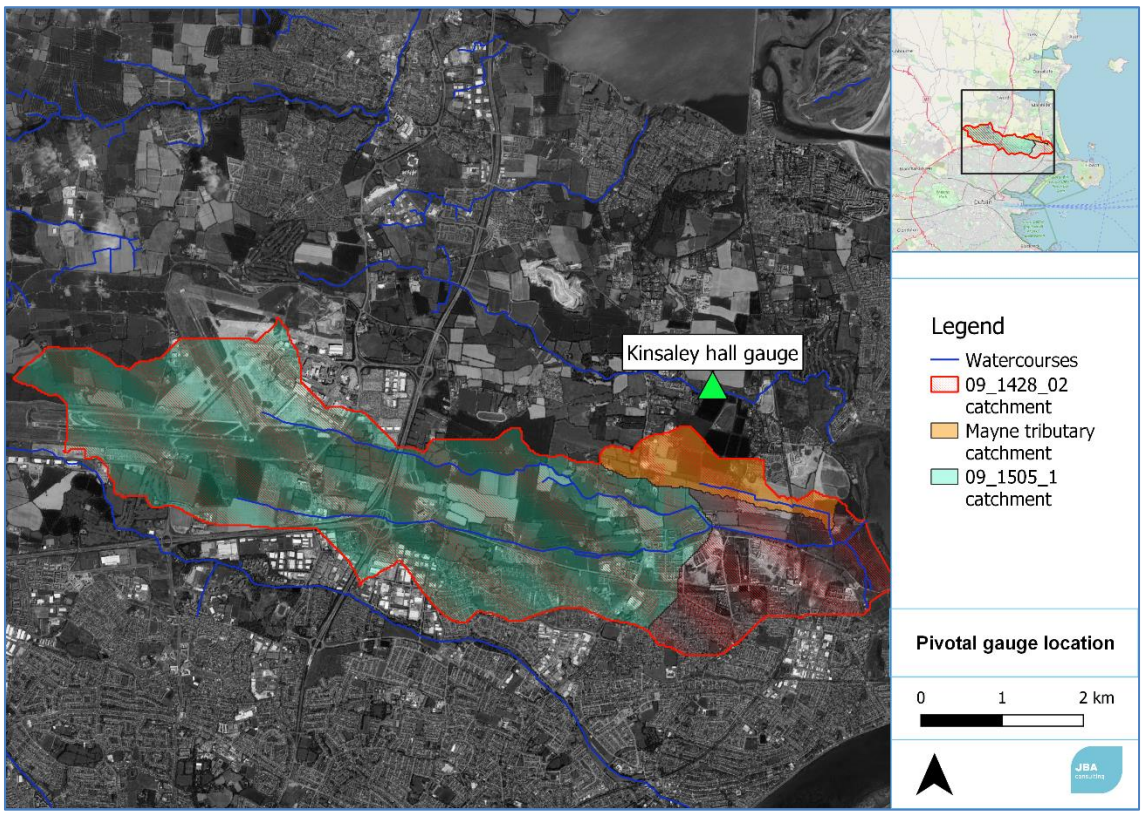


Figure 3-1: Pivotal gauge location

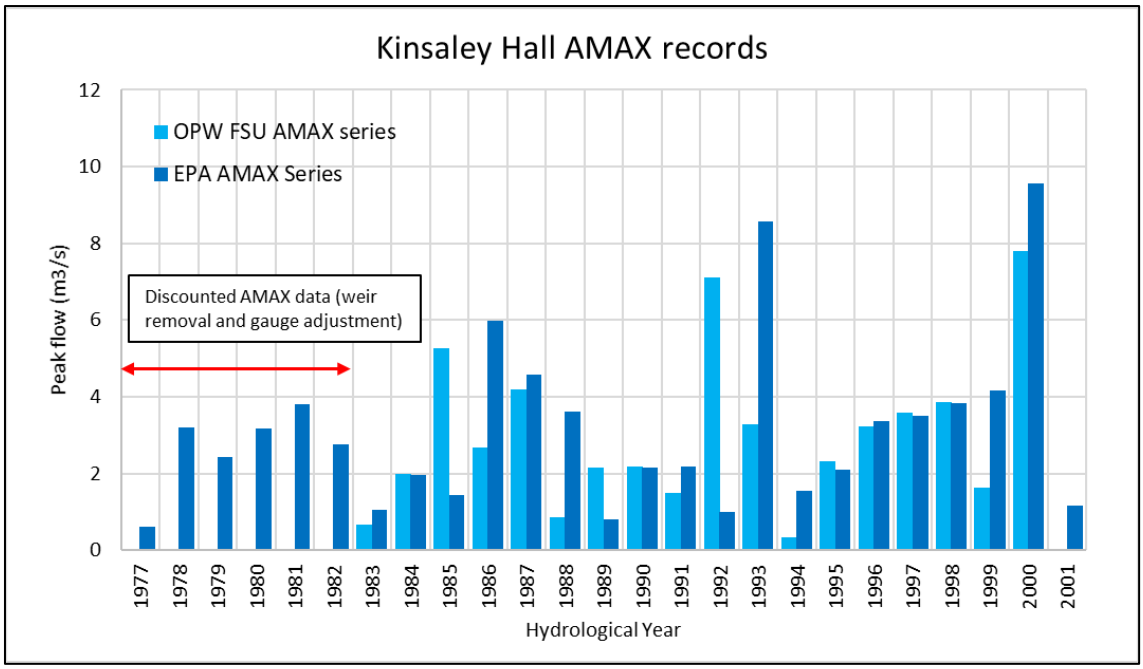


Figure 3-2: Kinsaley Hall AMAX records

The gauged Qmed value from the Kinsaley Hall EPA AMAX series is recorded as 2.76m3/s while the AMAX Qmed (Qmed Stat) for the data set is 1.62m3/s. The gauged Qmed value from the OPW AMAX data was 2.50m3/s.

As part of ECFRAM study the Kinsaley Hall gauge on the Sluice River (08005) was assessed and underwent a rating review. The FEM FRAMs have calculated a Qmed of 3.17m^3/s for the gauge. This was increased from the EPA rating of 2.76m^3/s. The rating review was undertaken by building an ISIS model of the Sluice River and calibrated with the historic flow data. The ISIS model provided a rating curve at the cross-section. The review found that below 2.60m3/s the ISIS curve

underestimated flows therefore, the EPA curve was used for flows <2.60m3/s while the ISIS rating curve used on the higher flows (refer to Figure 3-2).

The adjusted rating curve has been based on the ISIS model developed for the Sluice River, with the aim of replicating the recorded water levels and associated flows. The gauge is located downstream of a culvert system. The details of the rating review have not been provided but based on the approach undertaken. Accepting that this rating review was undertaken by competent personnel, who would be tasked with undertaking an exercise of this type, it was decided to incorporate the Qmed value of 3.17m3/s into the final design flows.

Table 3-2: Rating equations for the Kinsaley Hall gauge

Rating Equation in the form: Q(h) = C*(h+a) [b]						
Section	Min stage (m)	Max stage(m)	C	a	b	Rating curve
1	0.161	0.190	65689900	0	12.95	EPA
2	0.190	0.287	72.42	0	4.68	EPA
3	0.287	0.550	4.04	0	2.37	EPA
4	0.550	0.770	3.50	0	2.0	HB
5	0.770	0.950	5.25	0	3.70	HB
6	0.950	1.200	4.75	0	1.95	HB
7	1.200	1.500	3.70	0	3.10	HB

Therefore, the pivotal gauge with updated FEM FRAMS Qmed and rating curve will be used to calculated adjusted Qmed for the statistical methods used. Table 3-3 compares the gauged and ungauged catchments.

Table 3-3. Pivotal sites chosen and QMED adjustment factors

Descriptor	09_1428_02	09_1505_1	Pivotal site
Area	19.52	14.90	9.17
SAAR	709.38	714.24	710.76
FARL	1.00	1.00	1.00
BFI Soil	0.57	0.56	0.52
URBEXT	0.35	0.39	0.25
S1085	7.17	7.89	6.89
DrainD	0.85	0.89	0.91
ArtDrain2	0.00	0.00	0.00
FSU Gauge ranking	-	-	A2
Hydrological similarity	-	-	0.70
FSU record	-	-	1983 – 2019
Qmed(rural) m3/s	2.42	1.98	1.31
Qmed (URBEXT) m3/s	3.76	3.25	1.83
Qmed(gauged) m3/s	-	-	3.17
Qmed stat	-	-	1.62
Adjustment factor	-	-	1.71
Adjusted Qmed m3/s	6.42	5.55	-
FINAL SELECTED QMED m3/s	6.42	5.55	-

3.3 Growth Curves

3.3.1 Single site analysis

A single site analysis can be carried out on the Kinsaley Hall gauges to estimate the peak flows for the site. The EPA AMAX series data with the updated FEM FRAMS rating curve from 1983-2001 was used for the analysis. The inhouse AMAX analysis software package JSpeed was used to carry out the analysis. Refer to Table 3-4 for peak flow estimates and Figure 3-3 for the AMAX plot. An Extreme Value type 1 (EV1) distribution was used for analysis as it best fit the AMAX data.

Table 3-4: Single site peak flow estimates - Sluice River

AEP event (%)	Growth curve
50%	1.00
20%	1.84
10%	2.41
5%	2.94
2%	3.63
1%	4.16
0.1%	5.87

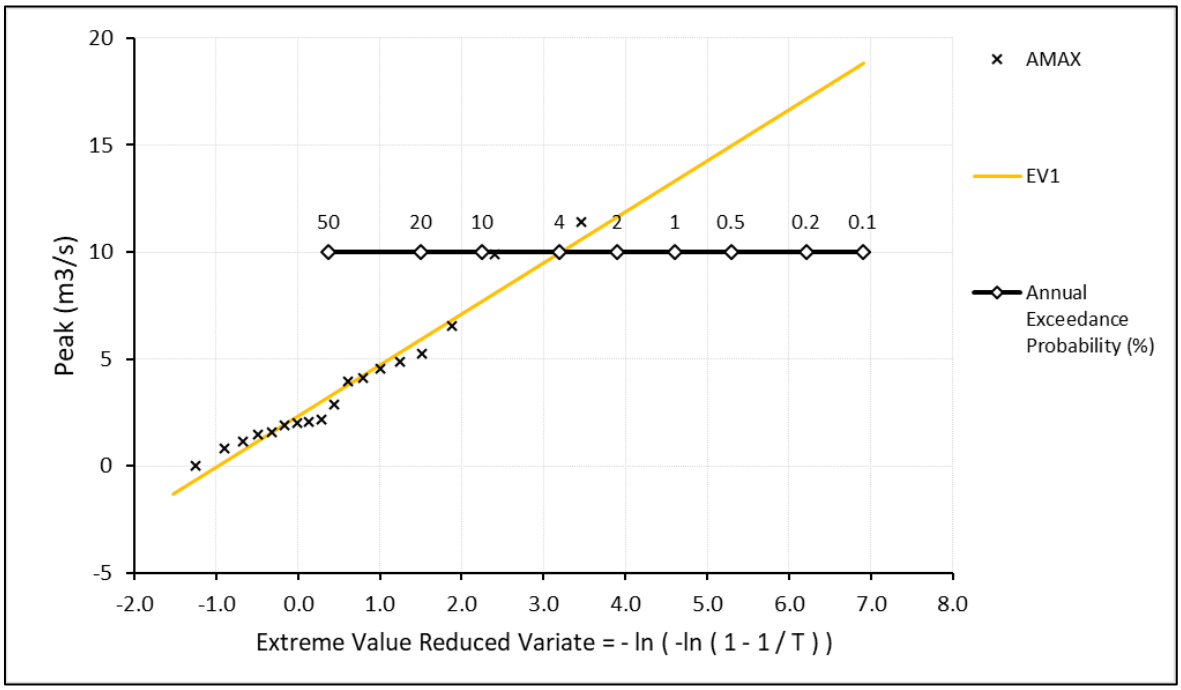


Figure 3-3: JSpeed single site analysis growth curve - Sluice River

3.3.2 Derivation of pooling groups

Refer to Appendix A.1 for more detail of the site specific pooling group derived.

Table 3-5. Pooling group details

Name of group	No. of pooled years	No. of stations	Changes made to default pooling group, with reasons	Distribution	Shape	Scale
Mayne River	539	16	Review of pooling group found no changes necessary	GEV	0.035	0.31

3.3.3 Discussion on growth curves

Table 3-6 compares the growth curves derived with the FEM FRAMS hydrology report growth curve. What is apparent from the table is that the single site and FEM FRAMS curves are extremely steep which is generally associated with steep sloped catchments. While the catchment has a slope, it is not overly steep, and a large proportion of the catchment is located within a flat low-lying area particularly at the lower end of the catchment. Based on this the upper portions of the single site and FEM FRAMS growth curves are not considered representative or appropriate to use for higher flow estimation however given that the single site analysis growth curve is based on real data and has a data quality ranking that gives confidence in lower return period estimations it is proposed that this data also be incorporated into the growth curve selected. To ensure that a comprehensive approach is undertaken in the estimation of the growth curves, it has been decided to combine the single site analysis and FSU pooled growth curve values to be weighed 20% to the single site analysis and 80% to the FSU growth curve.

Table 3-6: Growth curve comparison

AEP (%)	Single site – Kinsaley Hall	FSU growth curve	FEM FRAMS growth curve (pg. 30 of FEM FRAMS hydrology report)	Weighted growth curve
50%	1.00	1.00	1.00	1.00
20%	1.84	1.35	1.52	1.45
10%	2.41	1.57	1.89	1.74
4%	2.94	1.84	2.38	2.06
2%	3.63	2.03	2.76	2.35
1%	4.16	2.22	3.16	2.61
0.1%	5.87	2.82	4.60	3.43

3.4 Final flow estimates – FSU method

Table 3-7: Peak flow estimates – FSU method

AEP (%)	Peak flow (m3/s)	
	09_1428_2	09_1505_1
50%	6.42	5.55
20%	9.30	8.04
10%	11.16	9.66
4%	13.23	11.43
2%	15.09	13.04
1%	16.74	14.49
0.1%	22.02	19.04

4 FSU small catchments method

Refer to Appendix A for a summary of the FSU small catchments method. The weighted growth curve derived for the full FSU statistical method has been applied to generate flows for higher return periods.

Table 4-1: Peak flow estimates – FSU SC method

AEP (%)	Peak flow (m3/s)		
	09_1428_2	09_1505_1	Mayne tributary
50%	2.15	1.75	0.13
20%	3.11	2.54	0.19
10%	3.74	3.04	0.22
4%	4.43	3.60	0.27
2%	5.05	4.11	0.30
1%	5.61	4.56	0.34
0.1%	7.37	6.00	0.44

5 Comparison of flow estimates

Table 5-1 compares the peak flow estimates from the FSU and FSU SC methods. From the table the FSU method generates the highest flows for the watercourse. This is due to the higher Qmed value in the FSU method. As the catchment is less than 25km2 it is generally recommended that the FSU SC method be used as the FSU statistical method was developed for catchments greater than 25km2. However, review of the data and expected catchment response suggests that the FSU SC method underestimates flows. Although the catchment is outside the recommended range for the FSU method the flows estimated using it are preferred as they are considered more representative of the catchment response.

Table 5-1: Comparison of peak flow estimates 09_1428_2

AEP (%)	FSU (m3/s)	FSU SC (m3/s)	Growth curve
50%	6.42	2.15	1.00
20%	9.30	3.11	1.45
10%	11.16	3.74	1.74
4%	13.23	4.43	2.06
2%	15.09	5.05	2.35
1%	16.74	5.61	2.61
0.1%	22.02	7.37	3.43

Table 5-2: Comparison of peak flow estimates 09_1505_1

AEP (%)	FSU (m3/s)	FSU SC (m3/s)	Growth curve
50%	5.55	1.75	1.00
20%	8.04	2.54	1.45
10%	9.66	3.04	1.74
4%	11.43	3.60	2.06
2%	13.04	4.11	2.35
1%	14.49	4.56	2.61
0.1%	19.04	6.00	3.43

Table 5-3: Peak flow estimates – Mayne tributary

AEP (%)	FSU SC (m3/s)	Growth curve
50%	0.13	1.00
20%	0.19	1.45
10%	0.22	1.74
4%	0.27	2.06
2%	0.30	2.35
1%	0.34	2.61
0.1%	0.44	3.43

To ensure that flows are applied appropriately a single point inflow at the top of the model will be used and then laterals applied. The peak flows estimated at 09_1505_1 will be used as the point source inflows for the Mayne river and the lateral flow will be the difference in flows between the 09_1505_1 and 09_1428_02 estimates. Further to this the Mayne tributary will be applied as a point inflow to the model however this catchment is included in the 09_1428_02 catchment. To ensure no double counting occurs the peak flow value for the Mayne tributary will be subtracted from the lateral flow applied. Table 5-4 shows the final flows applied to the model.

Table 5-4: Final peak flow estimates to be applied to the model

AEP (%)	09_1505_1 (point)	Mayne tributary (point)	09_1428_02 (lateral)
50%	5.55	0.13	0.74
20%	8.04	0.19	1.07
10%	9.66	0.22	1.28
4%	11.43	0.27	1.53
2%	13.04	0.30	1.75
1%	14.49	0.34	1.91
0.1%	19.04	0.44	2.54

6 Hydrograph shape and storm duration

Two methods are considered for the generation of hydrograph shape: FSU and FSR RR. Figure 6-2 and Figure 6-2 shows the hydrographs generated for the catchment considered. The FSU method hydrographs are approximately long with a steep rising limb and an elongated falling limb. In contrast the FSR RR hydrographs are much shorter (8-12 hours) and the limbs are the same shape. Although the FSU method has been used to estimate the peak flows it is thought that the hydrograph duration estimated is not appropriate for the catchment. It is therefore recommended that the FSU hydrograph shape be used but the storm duration and hydrograph length be reduced to approximately 12 hours (FSR RR length). This ensures that the correct shape is being used and that the length is appropriate for the catchment and not overestimated. To further check the appropriateness of the storm duration it is recommended that sensitivity tests be carried out using the hydraulic model where the hydrograph length is increased and decreased by 20%.

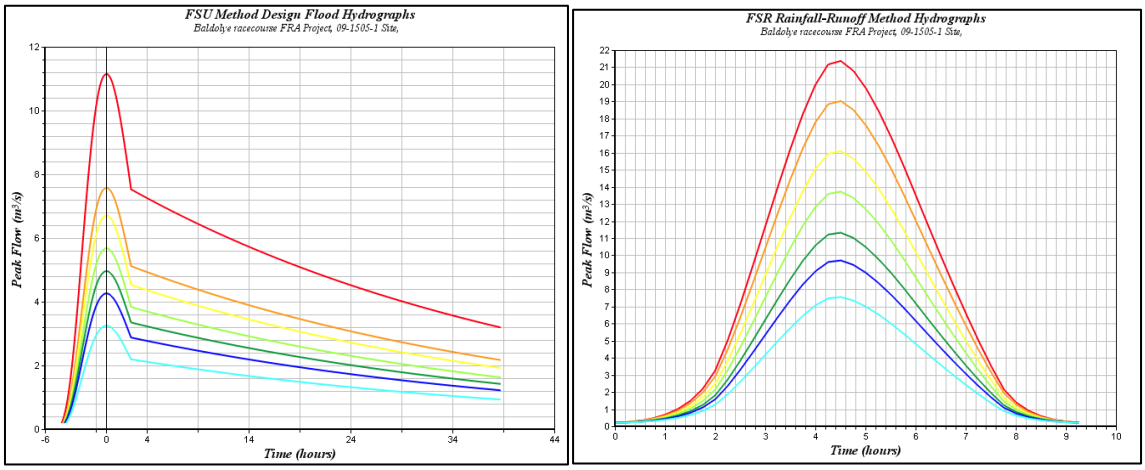


Figure 6-1: 09_1505_1 flow hydrographs – FSU (left) and FSR RR (right)

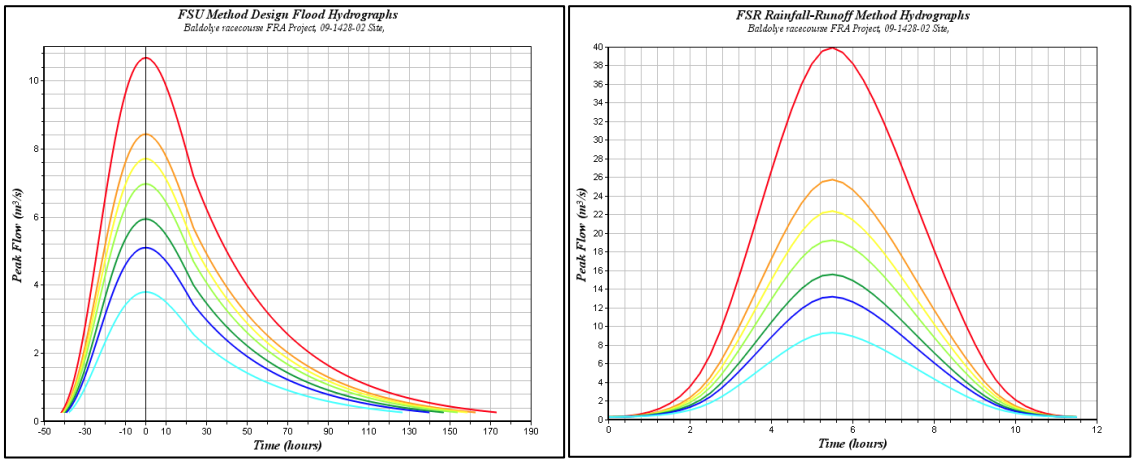


Figure 6-2: 09_1428_02 flow hydrographs – FSU (left) and FSR RR (right)

7 Downstream Boundary

The downstream boundary of the Mayne River is the Baldoyle Estuary. The watercourse considered is therefore subject to tidal influences at the downstream boundary which needs to be accounted for. It is recommended that the downstream of the Mayne River model have a HT downstream boundary to simulate the tidal influence present.

Figure 7-1 shows the FEM FRAMS tidal flood extent map for the Baldoyle estuary. The map show that downstream of section of the Mayne River is not at risk from tidal flooding for any of the return periods considered. This is due to a sluice gate present at the outflow point of the river. There is also a node label with reported levels at the mouth of the Mayne River (node 074). To simulate the potential tidal influence on the watercourse it is suggested to set a constant HT downstream boundary to the 10% AEP tidal level reported. This allows a conservative approach to be taken during the assessment.

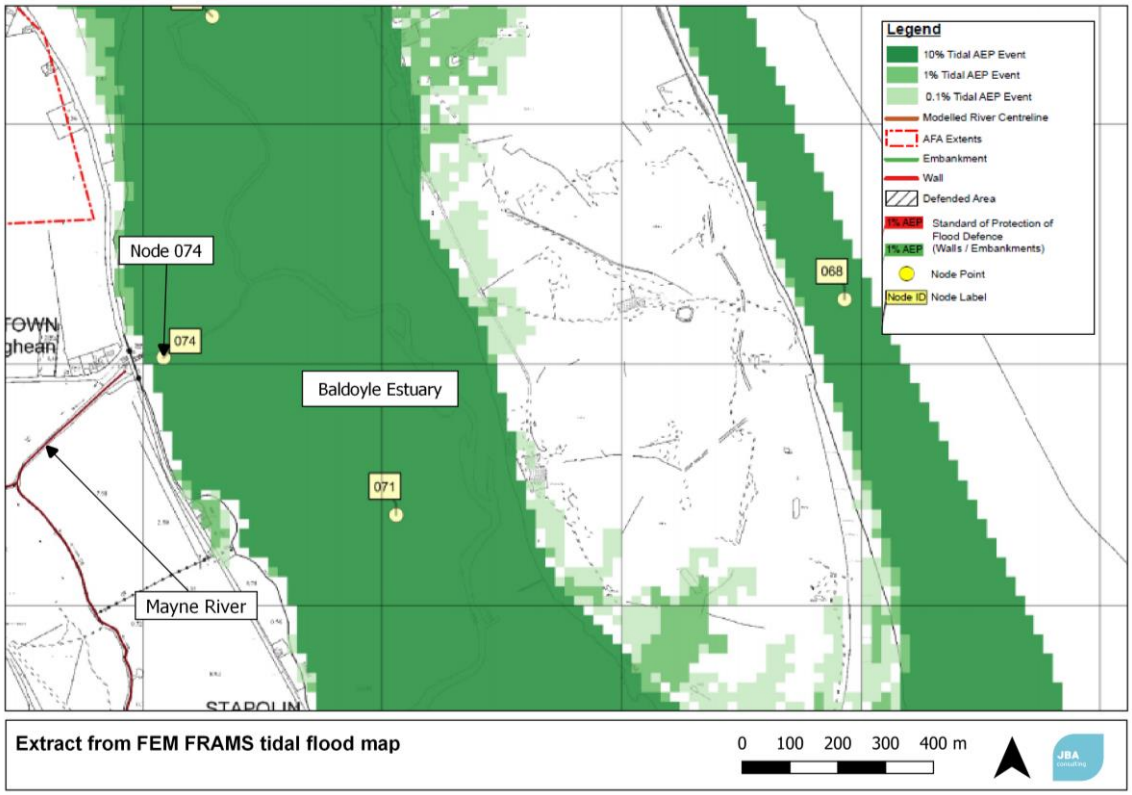


Figure 7-1: Extract from FEM FRAMS tidal flood map

Table 7-1: Water levels reported at node 074

% AEP event	Water level (mOD)
10%	2.69
1%	3.11
0.1%	3.35

8 CFRAM & other study Comparison

The Mayne River and surrounding area were modelled as part of the Fingal East Meath Flood Risk Assessment and Management Study (FEM FRAMS) which was a pilot study for the CFRAM mapping project. Table 8-1 compares the modelled FEM FRAM reported flows for the nearest node with those estimated for this check file.

From the table it is noted that the flows reported in FEM FRAMS differ to those estimated in this report. The flows estimated in this check file are higher than those estimated in FEM FRAMS apart for the 0.1% AEP event due to the difference in the growth curves applied (FEMS FRAMS has steeper curve, refer to Section 3.3.3).

Investigation into the methods used to calculate the flows applied in the FEM FRAMS model was carried out. Both the hydrology and hydraulics reports for the study were examined however there was little information provided. Only peak flows estimated at gauged locations were presented and no other record of inflows to any of the hydraulic models provided. From the documents the inflow values for the FEM FRAMS study were generated using either FSSR16 method or using the Institute of Hydrology Unit Hydrograph (UH) method. The UH method was used to generate inflows for catchments and sub catchments less than 25km2 and so was applied along the Mayne River which has a total catchment area of approximately 19km2 and has no gauge along the watercourse. It is mentioned in the text that the UH method used did not take in to account any catchment characteristics (Qbar was not calculated and applied) for the study. This method is very simplistic and does not allow any consideration of catchment variability. In light of this it is noted that the flow estimations from this check file take catchment characteristics into consideration and are therefore more representative of the catchment in question.

Given the approach taken in the FEM FRAM study and the lack of detail as to how and where the flows are applied and the inappropriate growth curve applied it is recommended that the FEM FRAMS estimated peak flows be ignored and the flows estimated for this check file be used in analysis instead. This also ensures that the most conservative flow values are used in the assessment of the flood risk to the site.

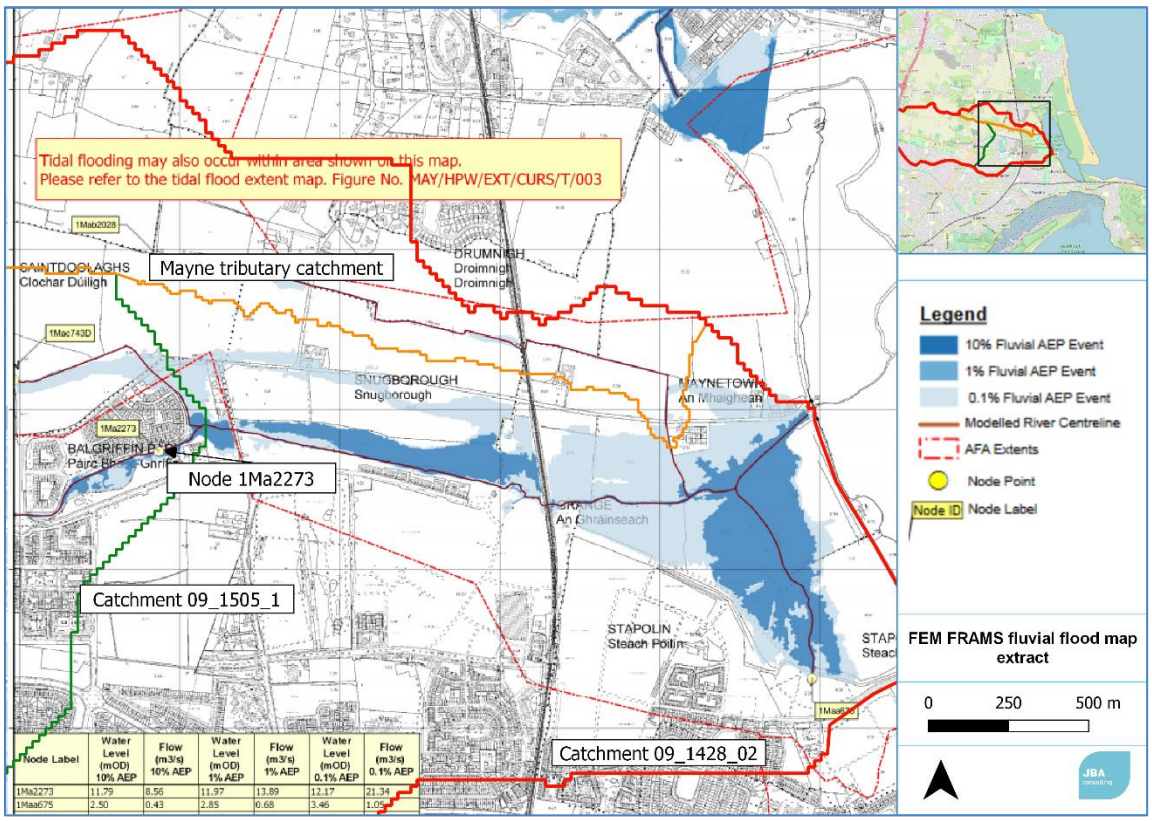


Figure 8-1: FEM FRAMS fluvial flood map extract

Table 8-1: Comparison of peak flows (m3/s)

AEP	09_1505_1	FEM FRAM 1Ma2273
10%	9.66	8.56
1%	14.46	13.89
0.1%	19.04	21.34

9 Discussion and summary of results

9.1 Final choice of method

Choice of method and reasons Include reference to type of study, nature of catchment and type of data available.	FSU method chosen as it is considered most representative and ensures a conservative approach is taken when assessing flood risk to the site
Climate change allowance	+20% flow as per OPW MRFS
How will the flows be applied to a hydraulic model? If relevant. Will model inflows be adjusted to achieve a match with lumped flow estimates, or will the model be allowed to route inflows?	Single inflow point at upstream extent of model
Recommended sensitivity tests for hydraulic model e.g. peak flow, volume, hydrograph shape, downstream boundary, bankfull	Flow routing test recommended (no structures model run) to ensure that it is appropriate to apply hydrology estimated at a downstream point upstream and examine the impact of storage and other hydrological barriers within the system.

9.2 Assumptions, limitations and uncertainty

List the main assumptions made (specific to this study)	Watercourse is ungauged therefore no flow checking, or validation can be carried out.
Discuss any particular limitations, e.g. applying methods outside the range of catchment types or return periods for which they were developed.	FSU method applied outside of normal recommended range but considered more appropriate than the FSU SC method give expected catchment response.
Comment on the suitability of the results for future studies, e.g. at nearby locations or for different purposes.	Appropriate for further FRA work along the watercourse but should be reviewed prior to use to see if there have been any further studies or gauges installed since the completion of this check file. Not suitable for low flow analysis.
Give any other comments on the study, e.g. suggestions for additional work.	FEM FRAMS hydrology is very uncertain due to lack of clarity and explanation within the documentation.

9.3 Checks

Are the results consistent, for example at confluences?	No confluences explicitly modelled
Has joint probability been considered?	Yes fluvial-tidal considered. Fluvial confluences downstream of site.
Have adjustments to catchment descriptor methods or gauge data been applied?	Yes pivotal gauge = Kinsaley Hall used – weighted growth curve used.
Is storm duration important?	Potentially, sensitivity tests recommended on hydrograph length.
How do the results compare with those of other studies? Explain any differences and conclude which results should be preferred.	Results reasonably similar to FEM FRAMS reported nodes but reporting higher flow values.
Describe any other checks on the results	Hydraulic routing test recommended and sensitivity test on hydrograph length and volume
Location of calculation sheets, data and records.	Jfes (Search for quotation number Q20-1580), project folder.
Unscaled hydrographs	L:\2020\Projects\2020s1166 - Richmond Homes - Baldoyle Racecourse Dublin FRA\1_WIP\HO\Non_Graphical_Review

9.4 Final results

AEP (%)	09_1505_1 (P)	Mayne Tributary (P)	09_1428_02 (L)
50%	5.55	0.13	0.74
20%	8.04	0.19	1.07
10%	9.66	0.22	1.28
4%	11.43	0.27	1.53
2%	13.04	0.30	1.75
1%	14.49	0.34	1.91
0.1%	19.04	0.44	2.54

Appendices

A Methods

A.1 The FSU method

The Flood Studies Update (FSU) method to estimate Qmed as described in research reports produced from FSU work packages 2.2 and 2.3, has been used. Qmed can be estimated using a regression equation based on seven different physical catchment descriptors, in conjunction with an urban adjustment, developed in FSU work package 2.3.

The multivariate regression equation was developed on the basis of data from 199 gauged catchments, linking Qmed to a set of catchment descriptors.

$$QMED = 1.237 \times 10^{-5} AREA^{0.937} BFI_{soil}^{-0.922} SAAR^{1.306} FARL^{2.217} DRAIND^{0.341} S1085^{0.185} (1 + ARTDRAIN2)^{0.408}$$

Where:

- AREA is the catchment area (km2).
- BFIsoils is the base flow index derived from soils data
- SAAR is long-term mean annual rainfall amount in mm
- FARL is the flood attenuation by reservoir and lake
- DRAIND is the drainage density
- S1085 is the slope of the main channel between 10% and 85% of its length measured from the catchment outlet (m/km).
- ARTDRAIN2 is the percentage of the catchment river network included in the Drainage

The urban extent can be taken into account using the following equation:

$$Q_{MEDfinal} = Qmed\,(1 + URBEXT)^{1.482}$$

Where URBEXT is the percentage of the catchment covered by urban land use.

Following the calculation of QMED the calculated adjustment factor and a growth curve are applied to generate the peak flows for AEP events. In this case the growth curve produced by the FSU pooling group for the ungauged catchment has been applied.

The catchment descriptors can be used to determine Qmed. In order to improve on this initial estimate of QMED, the data transfer process can be used. In the terminology of the FSU research reports, the gauging station where the adjustment factor is calculated is referred to as a donor site. An adjustment factor for QMED is calculated as the ratio of the gauged to the ungauged estimate of QMED at the gauging station. This factor is then used to adjust the initial estimate of QMED at the hydrological estimation point.

The growth factors for this site are also calculated from the FSU using pooling groups.

For pooled analysis within the FSU, gauges are chosen on the basis of their similarity with the subject catchment according to three catchment descriptors, i.e. AREA, SAAR and BFIsoil. The report on FSU WP 2.2 presents two alternative equations for calculating the similarity of catchments according to these three descriptors. For this study, equal weight was given to each of these variables, applying the similarity distance formula given as Equation 10.2 in the report on FSU WP 2.2.

Not all gauges in Ireland were considered for use in pooling, because the analysis required to fit a flood growth curve makes use of the magnitude of each annual maximum flow, and thus it is necessary that even the highest flows are reliably measured. This excludes gauges where there is significant uncertainty in the high flow rating.

Although there is some evidence from research on UK data that flood growth curves are affected by additional catchment descriptors such as FARL, the FSU research found that FARL was not a useful variable for selection of pooling groups (uncertainty was greater when FARL was included than when it was excluded) and therefore no attempt was made to allow for the presence of lakes in the composition of pooling groups. Similarly, no allowance was made for arterial drainage in selecting pooling groups.

For pooled growth curves, WP 2.2 recommends considering 3-parameter distributions, because the extra data provided by the pooling group ensures that the standard error is lower than it would be for single-site analysis. The report states that either the generalised extreme value (GEV) or generalised logistic (GL) distributions are worth considering. For this study, GEV has been fitted for the pooled analysis.

A.1.1 Pooling group details.

Station No.	Name	Watercourse	Years	Cumulative years
08002	Naul	Delvin	35	35
09002	Lucan	Griffeen	21	56
10021	Common's Road	Shanganagh	9	65
08009	Balheary	Ward	16	81
14009	Cushina	Cushina	38	119
08008	Broadmeadow	Broadmeadow	36	155
14007	Derrybrook	Stradbally	38	193
24022	Hospital	Mahore	35	228
14011	Rathangan	Slate	39	267
36031	Lisdarn	Cavan	45	312
25040	Roscrea	Bunow	35	347
09001	Leixlip	Ryewater	9	356
25023	Milltown	Little Brosna	63	419
205020	Comber	Enier	35	454
206001	Mountmill bridge	Clanrye	43	497
07001	Tremblestown	Tremblestown	42	539

Statistic	Value
Number of station-years pooled	539
Number of stations	16
Mean length of AMAX records pooled	34
Shape	0.315
Scale	0.035
Distribution	GEV

A.2 The SC Small Catchments Method

The FSU small catchments method was created as part of FSU working package 4 and is discussed in 'Work Package 4.2 - Flood Estimation in Small and Urbanised Catchments'.

The FSU small catchment equation is a 5 variable regression equation that was developed after the examination of multiple small catchments equations and regression analysis of multiple catchment descriptors. The FSU small catchment equation for QMED is:

$$Qmed = (2.0951*10^{-5})*(AREA^{0.9245})*(SAAR^{1.2695})*(BFI^{0.9030})*(FARL^{2.3163})*(S1085^{0.2513})$$

Where:

- AREA is the catchment area (km2)
- SAAR is long-term mean annual rainfall amount in mm
- BFISoil is the base flow within the catchment soil
- FARL is the percentage of the catchment covered by lakes or reservoirs
- S1085 is the slope of the main channel between 10% and 85% of its length measured from the catchment outlet (m/km)

The urban extent can be taken into account using the same method as above for the FSU standard method.

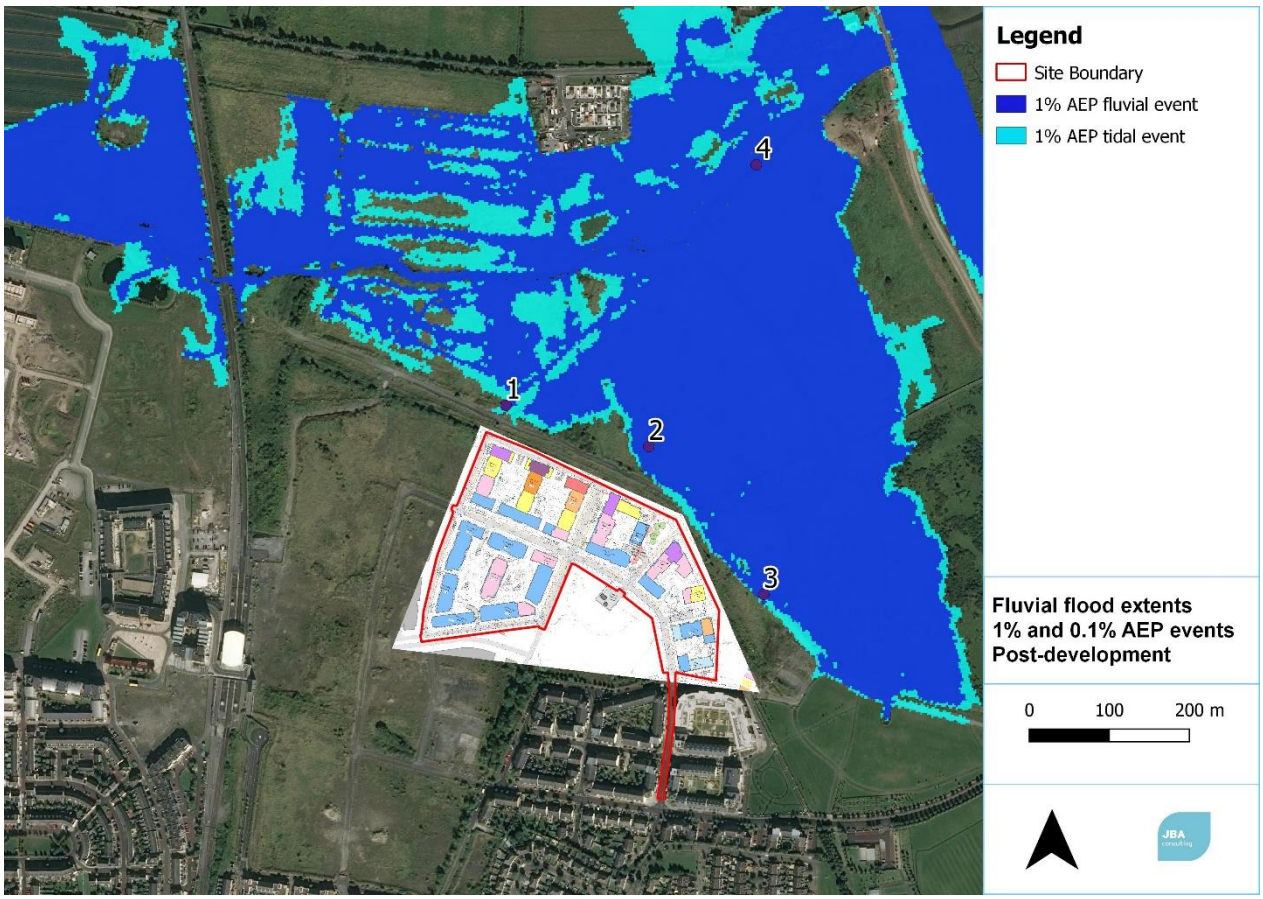
B CFRAM report extracts

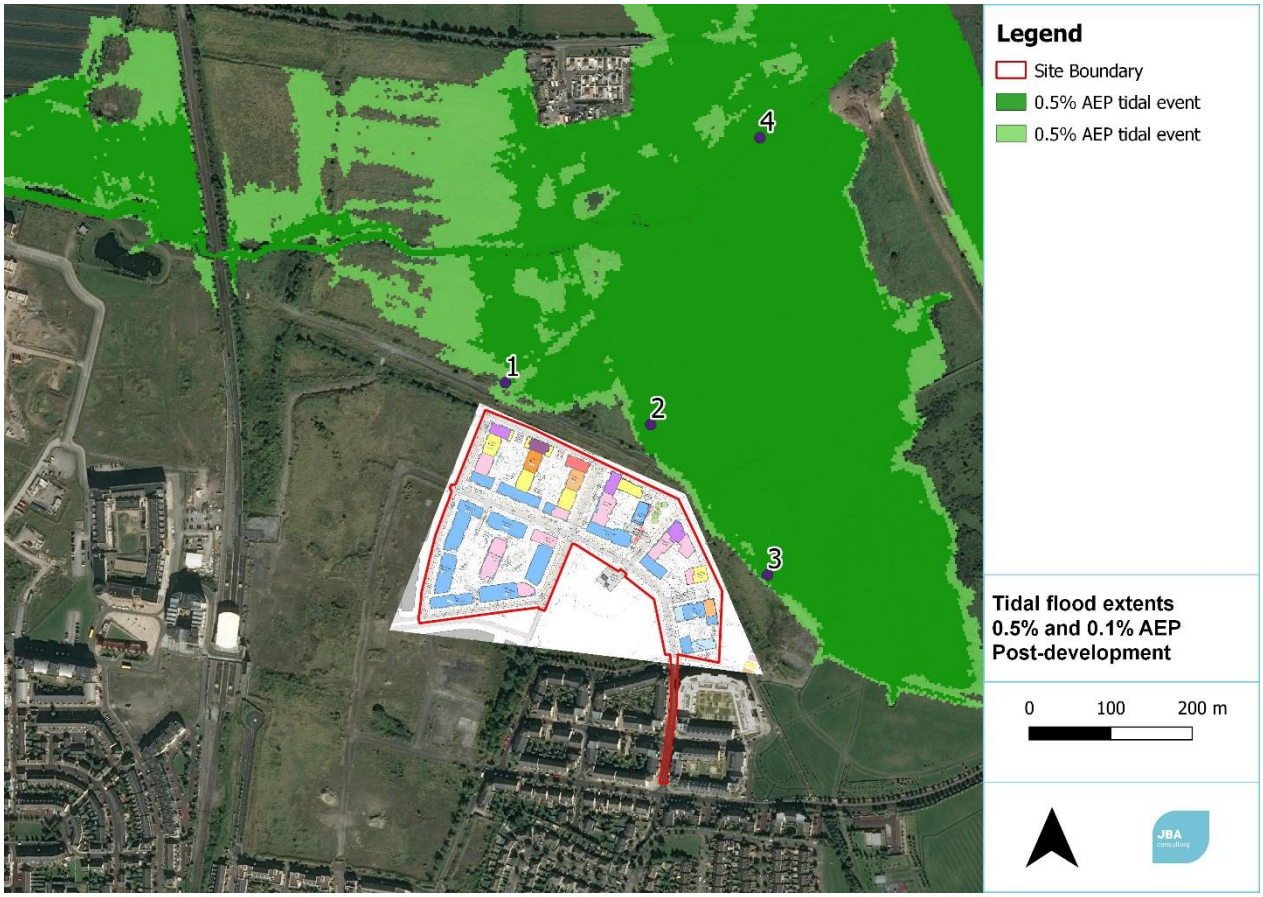
For FEM FRAMS documents see link below:

"\\IRE-RDC03\General\Reference\CFRAM\FEMFRAMS"

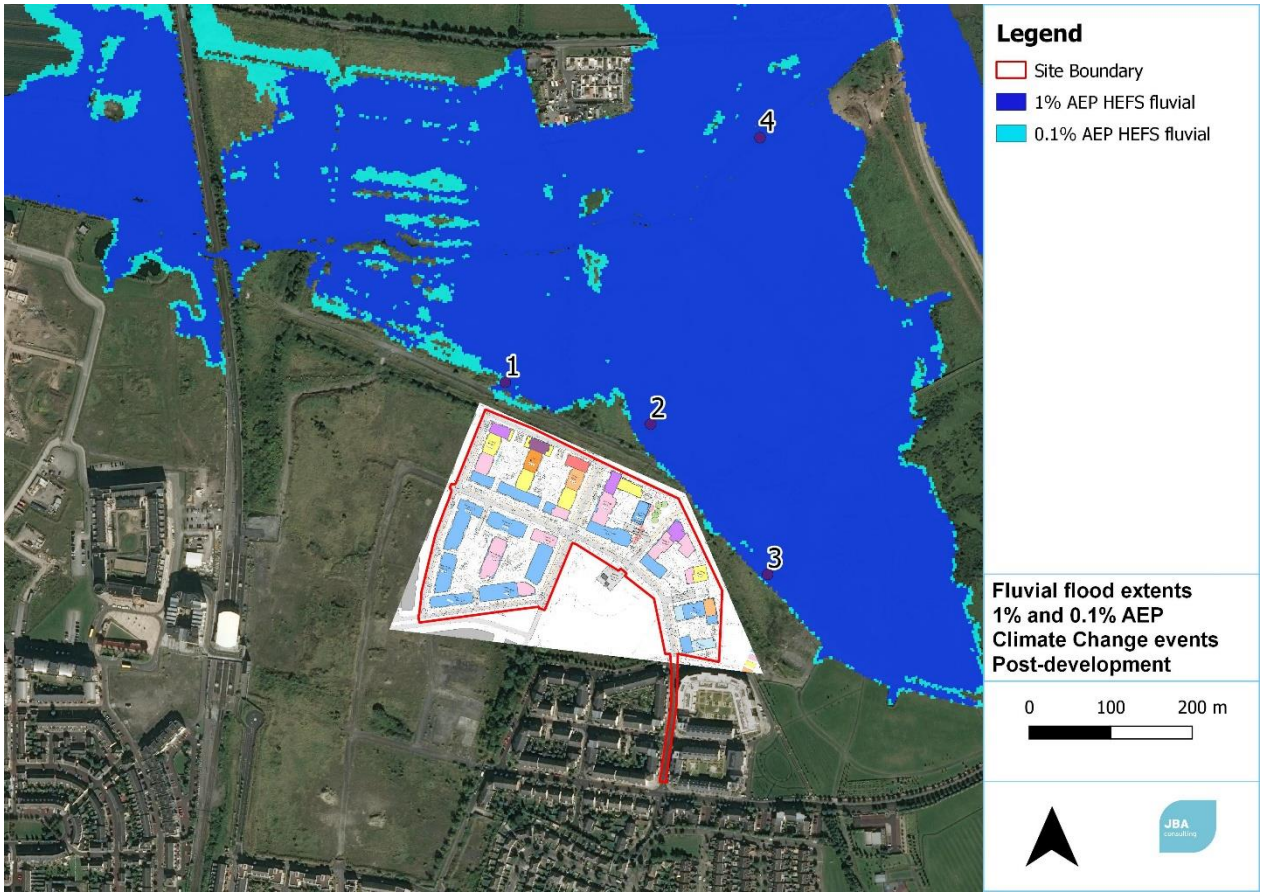
C Appendix - Flood Maps

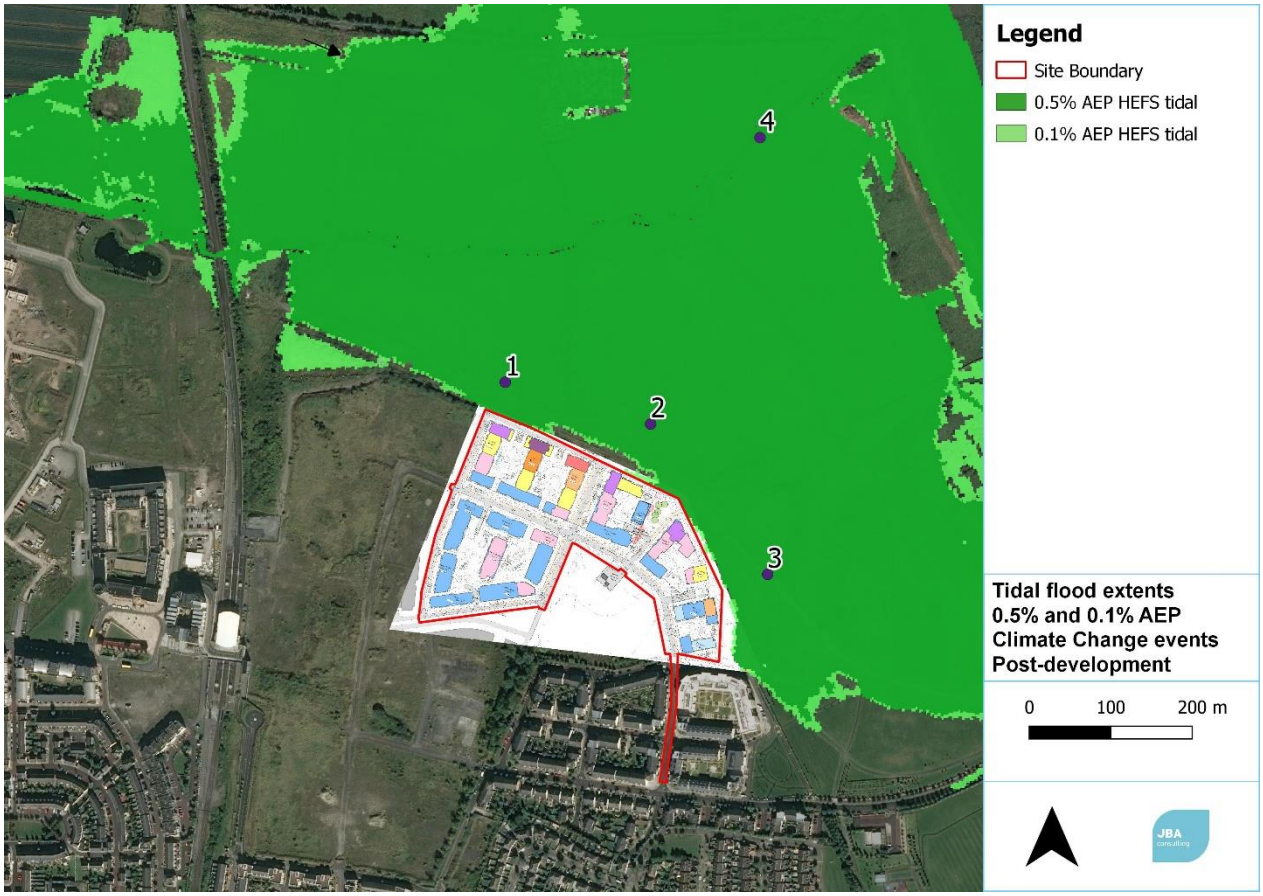
C.1 Flood Map



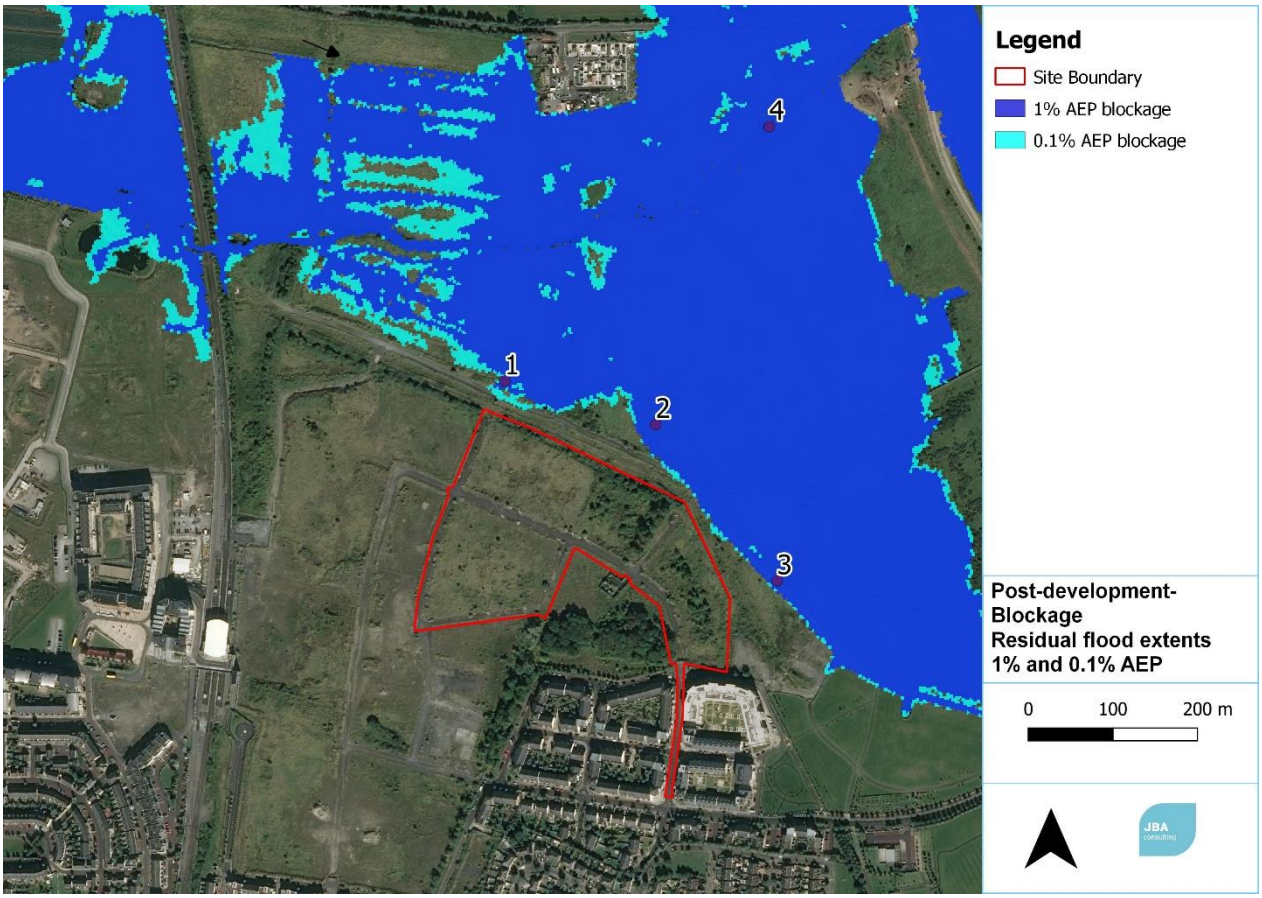


C.2 Climate Change Flood Map




Legend
Site Boundary
0.5% AEP HEFS tidal
0.1% AEP HEFS tidal
1
2
3
4
Tidal flood extents
0.5% and 0.1% AEP
Climate Change events
Post-development
0
100
200 m

D Appendix -Residual Risk



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Appendix 7.3

Hydrological & Hydrogeological Qualitative Risk Assessment

AWN Consulting

HYDROLOGICAL & HYDROGEOLOGICAL QUALITATIVE RISK ASSESSMENT

for

A PROPOSED STRATEGIC HOUSING DEVELOPMENT AT BALDOYLE-STAPOLIN, DUBLIN 13."GROWTH AREA 2"

Technical Report Prepared For

Lismore Homes Ltd.

Technical Report Prepared By

Marcelo Allende
BSC, BEng, Environmental Consultant

Teri Hayes Director
BSc MSc PGeo, Director

Our Reference

MA/21/12473SR03

Date of Issue

23 March 2022

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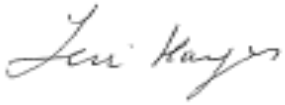
Signature		
Name	Marcelo Allende	Teri Hayes
Title	Environmental Consultant	Director
Date	23 March 2022	23 March 2022

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Tables

Figures

1.0 INTRODUCTION

1.1 Background

AWN have been requested by Lismore Homes Ltd. to carry out a Hydrological and Hydrogeological Qualitative Risk Assessment for a Strategic Housing Development at a site located at Baldoyle-Stapolin Growth Area 2 (GA02), Baldoyle, Dublin 13.

The development will consist of the construction of 1,007 apartments (consisting of 58 no. studio units (38.1 – 52.3 sq.m.), 247 no. 1 bedroom units (48.9 – 79.7 sq.m.), 94 no. 2 bedroom 3 person units (67.3 – 80.42 sq.m.), 563 no. 2 bedroom 4 person units (77.7 – 106.1 sq.m.), and 45 no. 3 bedroom units (93.5 – 130.66 sq.m.), 6 no. communal residential community rooms, and a ground floor creche in 16 no. buildings with heights varying from 4 to 12 storeys, basement and surface level car parking, secure bicycle parking, landscaping, water supply connection at Red Arches Road, and all ancillary site development works on a c. 6.1 hectare site.

A full description of the proposed development can be found in the EIAR, Chapter 2 - Description of the Proposed Development.

1.2 Hydrological Setting

The proposed development is located on a originally agricultural greenfield; however, site clearance commenced after 2005 and by 2009, the vast majority of the site of the proposed project and the surrounding had been cleared with areas of construction activity, roads and bare ground. The surrounding environment can be described as a mix of remnant agricultural, parkland to the north and residential to the south. The proposed Racecourse Regional Park is located directly to the north). A greenfield area known as the “Haggard” lies to the south with residential apartments at Red Arches Drive located south of this.

According to the EPA river network (EPA maps, https://gis.epa.ie/EPAMaps/ accessed on 10-03-2022), the nearest surface water receptors are the Snugborough Stream (that lies 650 m to the east) and the Mayne River (550 m to the north of the proposed development site). The Snugborough rises to the south and is culverted between Seagrange Park and the Red Arches Road before joining the Mayne River. Refer to site location and local drainage in Figure 1.1 below.

The Mayne outfalls into the Mayne or Baldoyle Estuary which hosts the Baldoyle Bay South Special Area of Conservation (SAC)/ Special Protection Area (SPA)/ proposed Natural Heritage Area (pNHA). These Natura 2000 Sites are located c. 350m to the northeast of the subject site (refer to Figure 1.2 below).

There would be an indirect discharge to Baldoyle Bay waterbody from the Proposed Development site through the stormwater site drainage which in turn discharges to the Mayne River as described in Section 1.3 below.

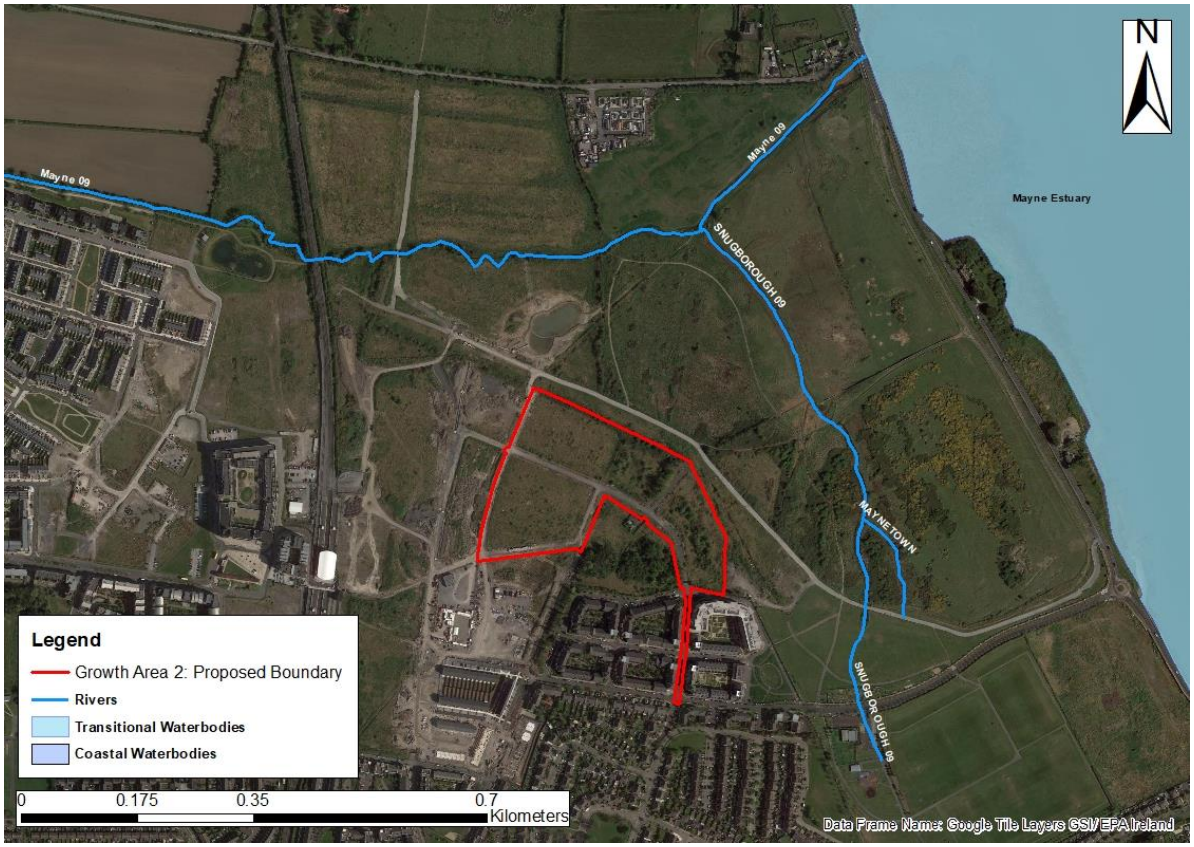

Figure 1.1 *Site Location in relation to local drainage*

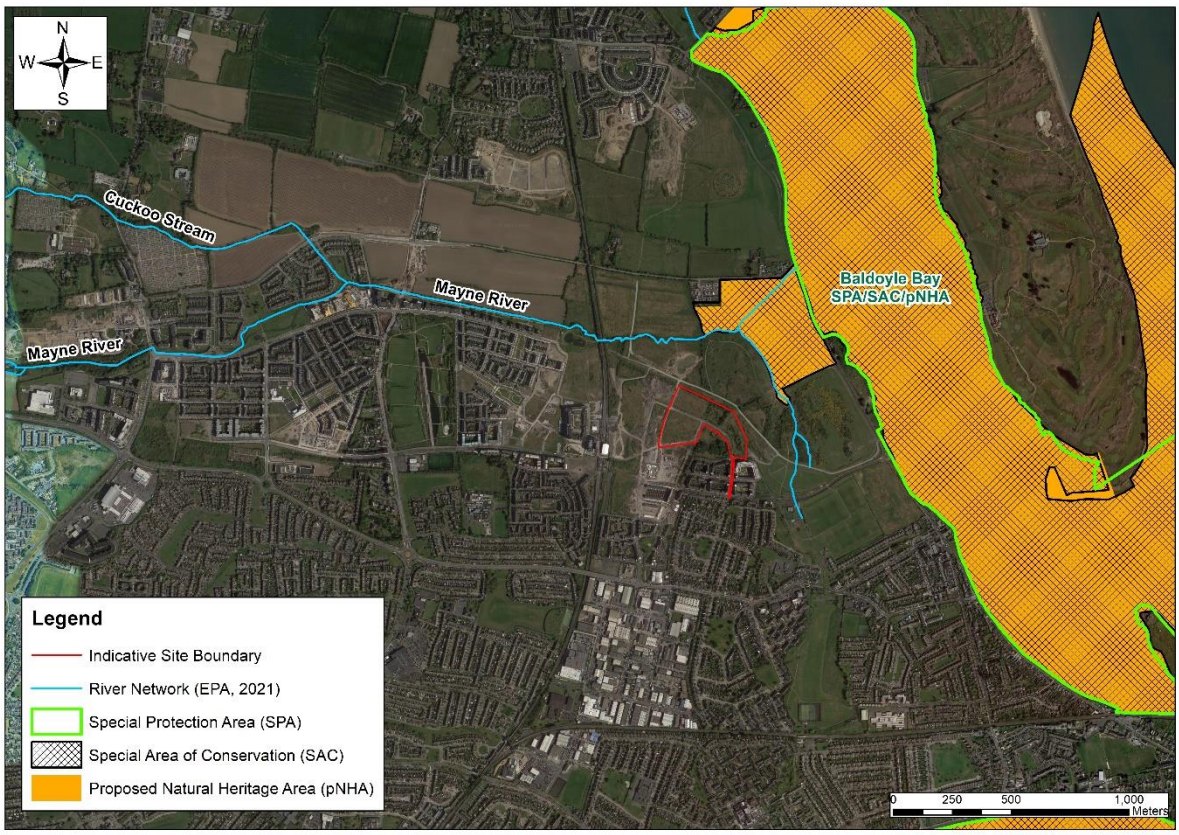

Figure 1.2 *Site Location in relation to Natura 2000 Sites*

A review of the EPA (2021) on-line database indicates there are no other NPWS protected areas within a radius of 1 kilometre from of the Proposed Development site.

In addition, the South Dublin Bay is located c. 10 Km to the south of the site and also hosts Natura 2000 sites (South Dublin Bay SAC/pNHA and South Dublin Bay and River Tolka Estuary SPA). There would be an indirect discharge to Dublin Bay water body from the Proposed Development site through the foulwater site drainage as described in Section 1.3 below.

1.3 Objective of Report

The scope of this desktop review is to assess the potential for any likely significant impacts on receiving waters and protected areas during construction or post-development.

In particular, this review considers the likely impact of construction and operation impacts (construction run-off, and domestic sewage) from the proposed development on water quality and overall water body status within the Baldoyle Bay and Dublin Bay, including bathing water locations, whose EU sites are more distant from the site. The assessment relies on information regarding construction and design provided by Lismore Homes as follows:

- Construction Environmental Management Plan For Proposed Development At Baldoyle-Stapolin, Dublin 13 AWN Consulting. March 2022.

- Construction Surface Water Management Plan For Proposed Development At Baldoyle-Stapolin, Dublin 13. AWN Consulting. March 2022.

- Water Services Report. Residential Development Baldoyle GA2. Barry & Partners. February 2022.

Flood Risk Assessment. Residential Development Baldoyle GA2. Barry & Partners. February 2022.This report was prepared by Marcelo Allende (BSc BEng), and Teri Hayes (BSc MSc PGeol EurGeol). Marcelo is a Water Resources Engineer with over 15 years of experience in environmental consultancy and water resources studies. Marcelo is an Environmental Consultant with AWN Consulting, a member of the International Association of Hydrogeologists (Irish Group) and a member of Engineers Ireland (MIEI). Teri is a hydrogeologist with over 25 years of experience in water resource management and impact assessment. She has a Masters in Hydrogeology and is a former President of the Irish Group of the Association of Hydrogeologists (IAH) and has provided advisory services on water related environmental and planning issues to both public and private sector bodies. She is qualified as a competent person as recognised by the EPA in relation to contaminated land assessment (IGI Register of competent persons www.igi.ie). Her specialist area of expertise is water resource management eco-hydrogeology, hydrological assessment and environmental impact assessment.

1.4 Description of Drainage

Existing Baseline Environment

The nearest surface water receptor are the are the Snugborough Stream (WFD Code: IE_EA_09M030500; EPA code: 09S29) and the Mayne River (same WFD code, EPA code 09M03); WFD refers to the Water Framework Directive [Directive 2000/60/EC]). The Snugborough rises to the south and is culverted between Seagrange Park and the Red Arches Road before joining the Mayne River. The Mayne outfalls into the

Mayne or Baldoyle Estuary which hosts the Natura 2000 Sites which are located c. 350m to the northeast of the subject site.

Currently, storm water run-off discharges through an existing 1500 mm stormwater culvert passing underneath the north Fringe Sewer, flowing south to north, which discharges into the Mayne River. There is no direct hydraulic connection to the Mayne River or Snugbourough Stream, however, there is an indirect hydraulic connection via the stormwater system which is discharged to the Mayne River. The Mayne River ultimately discharges to the Baldoyle Estuary. Refer to the Water Services Report (Barry & Partners, 2021) for further details.

Construction Phase

There is no significant dewatering required during the construction phase which would result in the localised lowering of the water table. There may be localised pumping of surface run-off from the excavations during and after heavy rainfall events to ensure that the excavation is kept relatively dry.

The discharge of treated construction water from rainfall into excavated areas, or from any localised dewatering may be required during construction. This treated construction water will be discharged to the existing 1500 mm diameter concrete stormwater main, that traverses underneath the north fringe sewer and discharges to the Mayne River.

Operational Phase

It is noted that there is an existing stormwater drainage network located within the site; however, due to its poor condition it is not intended to make use of the existing network and therefore it will be removed and a new network constructed in its place.

It is the requirement of the Baldoyle-Stapolin Local Area Plan (LAP) that a constructed wetland be installed within the flood plain, just beyond the line of the existing North Fringe foul sewer to provide the required water quality treatment for this proposed development and other developments on the LAP lands. This wetland has been consented (Reg.: F16A/0412), designed and constructed to provide water quality treatment for this proposed development. Therefore, it is proposed to connect surface water runoff from the proposed development to a new surface water sewer network within the Baldoyle Stapolin LAP lands to the west to allow connection into this wetland.

This new network will discharge to a new permitted network to be installed by The Shoreline Partnership for Growth Area 3 (ABP ref. 311016-21). This discharges to a new outfall pipe which traverses over the North Fringe Sewer and discharges into a new permitted wetland in the open space area. The wetland discharges to the Mayne River and ultimately to Baldoyle Estuary through a series of flap valves.

In accordance with Section 4.3 of Appendix 1 of the Baldoyle-Stapolin Local Area Plan (LAP), since the site is located adjacent to the tidal estuary at Baldoyle and as there is no downstream development before outfalling to the Irish Sea, the proposed development is not required to provide full attenuation for the 100-year return storm as per the requirements in Section 6.6, Volume 2 of the Greater Dublin Strategic Drainage Study (GDSDS). In addition, the lands discharge into salt wetlands which are the flood estuary of the Mayne River and extend over c. 40 ha (100-year flood plain). Therefore, the principal issue is the quality of water discharging from the LAP lands and not the quantity of water being discharged to the estuary.

Full Interception storage will be provided in the development area which means that both treatment storage and long-term storage (neither of which would be practical in this development) are not required. Interception storage will be provided within SuDS devices composed of:

- Green roofs and green roofs podium;
- Permeable paving and bio-retention Bio-retention areas within public open spaces.
- Swales running parallel to road carriageways/footpaths.
- Filtration trenches running parallel to road carriageways/footpaths.
- Silt and Hydrocarbon interceptors for road carriageways/carpark areas.

With regard to the foul water, It is proposed to connect the foul sewerage from the development to the existing foul sewer network in the Baldoyle Stapolin LAP lands. The network discharges to an existing pumping station in Stapolin Haggard from where it is pumped to the North Fringe Sewer. The North Fringe interceptor ultimately outfalls to Ringsend WWTP, where it is treated and ultimately discharges into South Dublin Bay. The WWTP and pumping station operate under an EPA licence D0034-01.

According to the Flood Risk Assessment carried out by Barry & Partners (2021) and a detailed site-specific flood model, all proposed residential development is located in Flood Zone C (i.e., where the probability of flooding from rivers is less than 0.1% or 1 in 1000 years – probability of fluvial flooding is low risk), therefore the proposed dwellings are not at risk of inundation from any of the modelled flood events, including the climate change and residual risk scenarios.

2.0 ASSESSMENT OF BASELINE WATER QUALITY, RIVER FLOW AND WATER BODY STATUS

A reliable Conceptual Site Model (CSM) requires an understanding of the existing hydrological and hydrogeological setting. This is described below for the proposed development site and surrounding hydrological and hydrogeological environs.

2.1 Hydrological Catchment Description

The proposed development site lies within the Liffey and Dublin Bay Catchment (Hydrometric Area 09) and River Mayne sub-catchment (WFD name: Liffey_SC_090, Id 09_17) (EPA, 2021). WFD refers to the Water Framework Directive (Directive 2000/60/EC). The Snugborough Stream rises to the south and is culverted between Seagrange Park and the Red Arches Road before joining the Mayne River. The Mayne outfalls into the Mayne/ Baldoyle Estuary. As mentioned above, this waterbody hosts Natura 2000 Sites (Baldoyle Bay SAC/SPA/pNHA).

Baldoyle Bay has been designated as an SPA (Special Protection Area) by the NPWS (National Park and Wildlife Service) and Local Authority, under the RAMSAR Convention. It was declared a Statutory Nature Reserve in 1988 and supports several habitats as listed in the EU Habitats Directive.

The Environmental Protection Agency (EPA, 2021) on-line mapping presents the available water quality status information for water bodies in Ireland. The Snugborough Stream and the Mayne River belong to the same WFD surface waterbody (Mayne_010). This waterbody has been assigned with a Water Framework Directive (WFD) Directive 2000/60/EC status (2013 – 2018) of '*Poor*'. The WFD risk score for this waterbody is considered '*At Risk*' of not achieving Good status.

The Mayne Estuary (Baldoyle Bay) is considered a transitional water feature. The waterbody has '*Moderate*' status. The WFD risk score for this waterbody is considered '*Under Review*'.

With regard to local bathing areas, Dublin Bay and Irish Sea hosts a number of swimming locations protected by the bathing water directive 2006/7. Water quality data is collected from bathing areas and is reported by the EPA on www.beaches.ie. The EPA bathing status is not based on single events, rather it is based on a review of data over 4 years (based on data collected during the bathing season June 1st and September 15th as outlined in the EPA (2021) Bathing Water Quality Report only). Bathing classes are determined as Excellent (highest cleanest class), Good (Generally good water quality), Sufficient (The water quality meets the minimum standard) and Poor (The water quality has not met the minimum standard). However, there are no identified bathing areas in the vicinity of the subject site, the nearest bathing area is the Sutton, Burrow Beach which is located c. 2.8 Km to the southeast of the site which has been qualified as having '*Excellent*' status for the four consecutive years 2018 to 2020 and '*Good*' status in 2021. In addition, it should be noted that the bathing status has no direct relevance to the water quality status of the Natura sites due to rapid mixing and dilution resulting in no measurable change in water quality within the overall water body.

As the Proposed Development will have no additional stormwater run-off from current during stormwater event, the development will, therefore, have no measurable impact on the water quality in any overflow situation at Ringsend WWTP apart from a minor contribution from foul sewage. As explained in Section 3.4 below, the maximum contribution of foul sewage (peak flow of 32.7 l/s) from the Proposed Development is 0.29% of the peak hydraulic capacity at Ringsend WWTP. The proposed stormwater and foul water networks are entirely independent systems and rainfall will have no impact on foul flows to the Ringsend WWTP.

It should be noted that the bathing status has no direct relevance to the water quality status of the Natura 2000 sites due to rapid mixing and dilution resulting in no measurable change in water quality within the overall water body.

2.2 Aquifer Description and Superficial Deposits

Mapping from the Geological Society of Ireland (GSI, 2022 http://www.gsi.ie, accessed on 14-03-2022) indicates the bedrock underlying the site is part of the Malahide Formation (code CDMALH) which comprises argillaceous bioclastic limestone and shale. The lithological description comprises calcareous shales, siltstones and sandstones, and occasional thin limestones at its base.

The GSI also classifies the principal aquifer types in Ireland as:

- Lk - Locally Important Aquifer - Karstified
- Ll - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive
- Pl - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
- Pu - Poor Aquifer - Bedrock which is Generally Unproductive
- Rkd - Regionally Important Aquifer (karstified diffuse)

Presently, from the GSI (2022) National Bedrock Aquifer Map, the GSI classifies the bedrock aquifer within the Malahide Formation beneath the subject site as a *'Locally Important Aquifer – Bedrock which is Moderately Productive only in Local Zones.*

The proposed development is within the '*Dublin*' groundwater body (Ground Waterbody Code: IE_EA_G_008) and is classified under the WFD Status 2013-2018 (EPA, 2021) as having '*Good status'*. The WFD Risk Score system for this GWB is under review.

Aquifer vulnerability is a term used to represent the intrinsic geological and hydrological characteristics that determine the ease with which groundwater may be contaminated generally by human activities. The GSI (2022) guidance presently classifies the bedrock aquifer vulnerability in the region of the subject site as '*Low*' which indicates a general overburden depth potential of >10m. This shows that the aquifer is moderately protected by low permeability glacial clays. This was confirmed in 2019 and 2020 investigations undertaken by GII (refer to Chapter 6 of the EIAR for further details). The aquifer vulnerability class in the region of the site is presented as Figure 2.1 below.

Figure 2.1 *Aquifer Vulnerability (Source: GSI, 2022)*

The GSI/ Teagasc (2022) mapping database of the quaternary sediments in the area of the subject site indicates the principal subsoil type in the residential area comprises Limestone till Carboniferous (TLs, i.e. Till derived from limestones).

3.0 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) is developed based on a good understanding of the hydrological and hydrogeological environment, plausible sources of impact and knowledge of receptor requirements. This in turn allows possible Source Pathway

Receptor (S-P-R) linkages to be identified. If no S-P-R linkages are identified, then there is no risk to identified receptors.

3.1 Assessment of Plausible Sources

Potential sources during both the construction and operational phases are considered. For the purposes of undertaking the potential of any hydrological/ hydrogeological S-P-R linkages, all potential sources of contamination are considered *without taking account of* any measures intended to avoid or reduce harmful effects of the proposed project (mitigation measures) i.e. a worst-case scenario. Construction sources (short-term) and operational sources (long-term) are considered below.

Construction Phase

The following potential sources are considered plausible risk scenarios for the proposed construction site:

(i) Hydrocarbons or any hazardous chemicals will be stored in specific bunded areas. Refuelling of plant and machinery will also be carried out in bunded areas to minimise risk of any potential being discharged from the site. As a worst-case scenario, a rupture of a 1,000 litre tank to ground is considered in this analysis which disregards the effect of bunding. This would be a single short-term event.

(ii) Leakage may occur from construction site equipment. As a worst-case scenario an unmitigated leak of 300 litres is considered. This would be a single short-term event.

(iii) Use of wet cement is a requirement during construction. Run-off water from recent cemented areas will result in highly alkaline water with high pH. As this would only occur during particular phases of work this is again considered as a single short-term event rather than an ongoing event.

(iv) Construction requires soil excavation and removal. Unmitigated run-off could contain a high concentration of suspended solids during earthworks. These could be considered intermittent short-term events, i.e. on the basis that adequate mitigation measures which are already incorporated in the Construction Environmental Management Plan (CEMP) and Surface Water Management Plan (SWMP) fail.

(v) During the excavations for foundations, no significant dewatering is expected given the low permeability overburden underlying the site.

Operational Phase

The following sources (or risk scenarios) are considered plausible post construction:

(i) The development site includes car parking areas at the ground level. Leakage of petrol/ diesel fuel may occur from these areas, run-off may contain a worst-case scenario of 70 litres for example. Any corresponding risk here would be mitigated by the interception storage system which comprises permeable paving and filter drains.

(ii) The stormwater drainage system follows SuDS measures, which are composed of permeable paving, filter drains, green roofs, tree pits, bio-retention area, attenuation systems, vortex flow restricting devices (Hydrobrake or similar) and petrol interceptors before discharging into the projected network and the

wetland area following the characteristics of a greenfield run-off. It should be noted that the worst-case scenario (70 litres) under consideration here disregards the effect of SuDS and petrol interceptors.

(iii) The development will be fully serviced with separate foul and stormwater sewers which will have adequate capacity for the facility as it was confirmed by Irish Water (refer to Water Services Report, Appendix 1) and it is required by its licensing requirements. Discharge from the site to the public foul sewer will be sewage and grey water only due to the residential nature of the proposed development. The foul discharge from the site will join the public sewer and will be treated at the Irish Water Ringsend Wastewater Treatment Plant (WWTP) prior to subsequent discharge to Dublin Bay. This WWTP is required to operate under an EPA licence (D0034-01) and meet environmental legislative requirements as set out in such licence. It is noted that a planning permission for a new upgrade to this facility is currently in the process of construction/ implementation.

This plant operates under an EPA licence (D0034-01) and is currently in the process of being upgraded to a PE of 2.4million to meet the increased demand of the Dublin area. The most recent Annual Environmental Report (AER 2020) shows it is currently operating for a PE peak loading of 2.27million while originally designed for 1.64million. However, the current maximum hydraulic load (832,269 m^3/day) is less than the Peak hydraulic capacity as constructed (959,040 m^3/day) i.e. prior to any upgrade works.

Irish Water is working to provide infrastructure to achieve compliance with the Urban Wastewater Treatment Directive for a population equivalent of 2.1million in the second half of 2023. When all the proposed works are complete in 2025, the Ringsend Wastewater Treatment Plant will be able to treat wastewater for up to 2.4 million population equivalent.

These upgrade works (described in section 3.4 below) have commenced and comprise a number of phases and are ongoing and expected to be fully completed by 2025.

(iv) There is no bulk fuel or chemical storage included in the development design.

3.2 Assessment of Pathways

The following pathways have been considered within this assessment with the impact assessment presented in Section 3.4:

The potential for offsite migration due to any construction discharges is moderate as there would be pathway through land ditches/ streams within or surrounding the site.

(i) Vertical migration to the underlying limestone is minimised due to the recorded '*Low*' vulnerability present at the site resulting in good aquifer protection from any localised diesel/ fuel oil spills during either construction or operational phases. The site is underlain by calcareous shale and limestone conglomerate which is a '*Locally Important Aquifer*' characterised by discrete local fracturing with little connectivity rather than large connected fractures which are more indicative of Regional Aquifers. As such, flow paths are generally local.

(ii) There is no direct hydrological linkage for construction and operation run-off or any small hydrocarbon leaks from the site to Baldoyle Bay. There is an indirect connection as stormwater discharges which in turn discharges to the Mayne River and ultimately to Baldoyle Bay.

(iii) There is no 'direct' pathway for foul sewage to any receiving water body. There is however an 'indirect pathway' through the public sewer which ultimately discharges to the Irish Water WWTP at Ringsend prior to discharge to Dublin Bay post treatment.

3.3 Assessment of Receptors

The receptors considered in this assessment include the following:

(i) Underlying limestone aquifer;
(ii) Mayne River and Baldoyle Bay; and
(iii) South Dublin Bay.

3.4 Assessment of Source Pathway Receptor Linkages

Table 3.1 below summarises the plausible pollutant linkages (S-P-R) considered as part of the assessment and a review of the assessed risk is also summarised below.

The potential for impact on the aquifer is low based on the absence of any bulk chemical storage on site. The overburden thickness, low permeability nature of till and a lack of fracture connectivity within the limestone will minimise the rate of off-site migration for any indirect discharges to ground at the site. As such there is no potential for a change in the groundwater body status or significant source pathway linkage through the aquifer to any Natura 2000 site.

There is no direct open-water pathway between the site and Baldoyle and Dublin Bays during construction. However, there is an indirect pathway with Baldoyle Bay through the existing stormwater drainage during construction which in turn discharges to the Mayne River and ultimately to Baldoyle Bay.

Should any silt-laden stormwater from construction or hydrocarbon-contaminated water from a construction vehicle leak/tank leak manage to enter into the mentioned watercourses (Mayne River and Baldoyle Bay), the suspended solids will naturally settle within the wetland area and the Mayne River; however, in the event of a worst case hydrocarbon leak of 1,000 litres this would be diluted to background levels (water quality objectives as outlined in S.I. No. 272 of 2009, S.I. No. 386 of 2015 and S.I. No. 77 of 2019) by the time the stormwater reaches the nearest Natura 2000 Sites (Baldoyle Bay, 350m downgradient).

There is no direct open-water pathway between the site and Baldoyle and Dublin Bays during operation There is an indirect pathway with Baldoyle Bay through the newly constructed wetland which in turn discharges to the Mayne River and ultimately to Baldoyle Bay.

During operation, the potential for a release is low as there is no bulk fuel/chemical storage and no silt laden run-off. Stormwater will be collected by a drainage system which includes SuDS measures, an attenuation system and oil/ petrol interceptors prior to discharge off-site (albeit these measures have been disregarded for this analysis). In addition, the potential for hydrocarbon discharge is quite minimal based on an individual vehicle (70 litres) leak being the only source for hydrocarbon release. However, even if the operation of the proposed SuDS and interceptor systems are excluded from consideration, there is no likely impact above water quality objectives as outlined in S.I. No. 272 of 2009, S.I. No. 386 of 2015 and S.I. No. 77 of 2019) in the worst case scenarios described above at section 3.2 2 and there will be no significant effect on any European site. The volume of contaminant release is low and combined with the significant attenuation within the wetland area and the Mayne

River, hydrocarbons will dilute to background levels with no likely impact above water quality objectives as outlined in S.I. No. 272 of 2009, S.I. No. 386 of 2015 and S.I. No. 77 of 2019 at any Natura 2000 sites.

In respect of substantial developments that may result in in-combination effects in respect of material assets are the adjacent residential development GA1 (ABP Reg. Ref.:311018-21) and GA3 (ABP Reg. Ref.:311016-21) are the relevant projects considered in detail. The projected wetland area will have the capacity to serve the proposed GA1 and GA3 in addition to the proposed GA2. Therefore, the in-combination effects of surface water arising from the Proposed Development taken together with that of other developments will not be significant based on the low potential chemical and sediment loading as the projected wetland area will provide sufficient capacity to contain and dilute any potential contamination prior to discharge into the Mayne River. Therefore, based on the possible loading of any hazardous material during construction and operation there is subsequently no potential for impact on downgradient Natura 2000 habitats (Baldoyle Bay, which is located 350 m from the site).

The peak wastewater discharge is calculated at 32.7 l/s (Barry & Partners, 2021). The sewage discharge will be licensed by Irish Water and will be separated from stormwater on the site, collected in the public sewer, and treated ultimately Irish Water's WWTP at Ringsend prior to discharge to Dublin Bay. As outlined in section 3.1 (iv), upgrade works have commenced in 2018 and are expected to be fully completed by 2025. The upgrade works will result in treatment of sewage to a higher quality than current, thereby ensuring effluent discharge to Dublin Bay will comply with the Urban Wastewater Treatment Directive by Q4 2023.

The project is being progressed in stages to ensure that the plant continues to treat wastewater to the current treatment levels throughout the delivery of the upgrade. The project comprises three key elements and underpinning these is a substantial programme of ancillary works:

- Provision of additional secondary treatment capacity with nutrient reduction (400,000 population equivalent);
- Upgrade of the 24 existing secondary treatment tanks to provide additional capacity and nutrient reduction, which is essential to protect the nutrient-sensitive Dublin Bay area; and
- Provision of a new phosphorous recovery process.

In February 2018, the work commenced on the first element, the construction of a new 400,000 population equivalent extension at the Ringsend Wastewater Treatment Plant. These works are at an advanced stage with testing and commissioning stages expected to be completed in the second half of 2021.

The 2019 planning permission facilitated upgrading works to meet nitrogen and phosphorus standards set out in the licence, which are temporarily exceeded currently. Works on the first of four contracts to retrofit the existing treatment tanks with aerobic granular sludge technology commenced in November 2020. Award of the second contract is due in Q3 2021 and the third and fourth contracts are scheduled to commence in late 2021 and mid 2023 respectively.

The application for the upgrade of the WWTP in 2012 and the revised upgrade in 2018 was supported by a detailed EIAR. As outlined in the EIAR, modelling of water quality in Dublin Bay has shown that the upgrades (which are now currently underway) will result in improved water quality within Dublin Bay. The 2018 EIAR

predicts that the improvement in effluent quality achieved by the upgrade will compensate for the increase in flow through the plant. The ABP inspector's report summarises the positive findings of the modelling for the post WWTP upgrade scenario on Dublin Bay water quality in sections 12.3.5 and 12.3.12 of his report and the overall positive impact for human health and the environment in his conclusions in section 12.9.1.

In addition, the EIAR report acknowledges that under the do-nothing scenario "*the areas in the Tolka Estuary and North Bull Island channel will continue to be affected by the cumulative nutrient loads from the river Liffey and Tolka and the effluent from the Ringsend WWTP*", which could result in a deterioration of the biological status of Dublin Bay (Irish Water, 2018). Nevertheless, these negative impacts of nutrient over-enrichment are considered "unlikely" (Irish Water, 2018). This is because historical data suggests that pollution in Dublin Bay has had little or no effect on the composition and richness of the benthic macroinvertebrate fauna. Therefore, the do-nothing scenario predicts that nutrient and suspended solid loads from the WWTP will "continue at the same levels and the impact of these loadings should maintain the same level of effects on marine biodiversity". Therefore, it can be concluded that significant effects on the current status of the European sites within Dublin Bay from the current operation of Ringsend WWTP are unlikely. This conclusion is not dependent upon any future works to be undertaken at Ringsend.

Even without treatment at the Ringsend WWTP, the peak effluent discharge, calculated for the proposed development as 32.7 l/s (which would equate to 0.29% of the licensed discharge at Ringsend WWTP [peak hydraulic capacity]), would not have a measurable impact on the overall water quality within Dublin Bay and therefore would not have an impact on the current Water Body Status (as defined within the Water Framework Directive). This assessment is supported by hydrodynamic and chemical modelling within Dublin Bay which has shown that there is significant dilution for contaminants of concern (DIN and MRP) available quite close to the outfall for the treatment plant (Ringsend WWTP 2012 EIS, Ringsend WWTP 2018 EIAR; refer to Section 12.4.22, ABP-301798-18 Inspector's report). The most recent water quality assessment of Dublin Bay WFD Waterbody undertaken by the EPA (Water Quality in 2020: An Indicator Report, 2021) also shows that Dublin Bay on the whole, currently has an 'Unpolluted' water quality status (refer to www.catchments.ie).

With regard to bathing waters in Dublin Bay, as mentioned above the Proposed Development will have no impact on the water quality in any overflow situation apart from a minor contribution (0.29% of the peak hydraulic capacity at Ringsend WWTP) from foul sewage.

It should be noted that the Ringsend WWTP upgrades has experienced capacity issues during rainfall events and therefore overflows can occur following periods of heavy rainfall. These overflows occur as a result of the impact on treatment capacity during heavy rainfall events due to surges primarily caused by the historical combined drainage system in Dublin. As the Proposed Development will not contribute any additional stormwater drainage to the WWTP, the development will therefore have no measurable impact on the water quality in any overflow situation.

The assessment has also considered the effect of cumulative events, such as release of sediment laden water combined with a hydrocarbon leak on site (1,000 litres as a worst case scenario during the construction phase). As there is adequate assimilation and dilution between the site and the Natura 2000 sites (Baldoyle Bay, which is c. 350m from the site), it is concluded that no perceptible impact on water quality would occur at the Natura 2000 sites as a result of the construction or operation of this Proposed Development. It can also be concluded that the cumulative or in-

combination effects of effluent arising from the Proposed Development with that of other permitted proposed developments, or with development planned pursuant to statutory plans in the greater Dublin, Meath and Kildare areas, which will be discharged into Ringsend WWTP will not be significant having regard to the size of the calculated discharge from the Proposed Development and having regard to the following:

- Recent water quality assessment for Irish Sea Dublin and Dublin Bay shows that they currently continue to meet the criteria for 'Unpolluted' water quality status (EPA, data until July 2021).
- The Ringsend WWTP upgrade which is currently being constructed will result in improved water quality by Q4 2023 to ensure compliance with Water Framework Directive requirements.
- All new developments are required to comply with SuDS which ensures management of run-off rate within the catchment of Ringsend WWTP.
- The natural characteristics of Dublin Bay result in enriched water rapidly mixing and degrading such that the plume has no appreciable effect on water quality at Natura sites.

As the Proposed Development will have no additional stormwater run-off during a stormwater event over and above the current level, surface water run-off from the development in the operational phase will therefore have no impact on the current water quality in any overflow situation at Baldoyle and Dublin bays.

It should also be noted that the bathing status has no direct relevance to the water quality status of the Natura 2000 sites due to rapid mixing and dilution resulting in no measurable change in water quality within the overall water body.

In addition, there is no long term discharge planned which could have an impact on the status of the water body. In the scenario of an accidental release (unmitigated leaks mentioned above) there is potential for a temporary impact only which would not have an impact on the water body status.

Finally, in a worst-case scenario of an unmitigated leak and not considering the operation of the SuDS and interceptor already included in the design, no perceptible risk to any Natura 2000 Sites is anticipated given the distance from source to Baldoyle Bay protected areas (c. 350m). Potential contaminant loading will be attenuated, diluted and dispersed near source area.

Table 3.1 below presents a summary of the risk assessment undertaken.

Source	Pathways	Receptors considered	Risk of Impact
Construction Impacts (Summary)			
Unmitigated leak from an oil tank to ground/ unmitigated leak from construction vehicle (1,000 litres worst case scenario).	Bedrock protected by >10m low permeability overburden. Migration within weathered/ less competent limestone is low (limestone has discrete local fracturing rather than large connected fractures).	Limestone bedrock aquifer (Locally Important Aquifer)	Low risk of migration through poorly connected fracturing within the limestone rock mass (Locally Important Aquifer). No likely impact on the status of the aquifer/off site migration due to low potential loading, natural attenuation within overburden and discrete nature of fracturing reducing off site migration.
Discharge to ground of runoff water with High pH from cement process/ hydrocarbons from construction vehicles/run-off containing a high concentration of suspended solids	Indirect pathway through stormwater drainage to Baldoyle Bay water course (distance source-receptor: 350 m)	Baldoyle Bay SAC/SPA/pNHA	Potential for local temporary exceedances of statutory water quality standards at outfall. However, no perceptible risk to water requirements for the Natura 2000 sites in Baldoyle Bay based on loading and high level of dilution in the Mayne River and on the distance of c. 350 m between the source and Baldoyle Bay.
Discharge of stormwater run-off containing a high concentration of suspended solids.	Indirect pathway through stormwater drainage to Baldoyle Bay water course (distance source-receptor: 350 m)	Baldoyle Bay SAC/SPA/pNHA	Potential for local temporary exceedances of statutory water quality standards at outfall. However, no perceptible risk to water requirements for the Natura 2000 sites in Baldoyle Bay based on loading and high level of dilution in the Mayne River and on the distance of c. 350 m between the source and Baldoyle Bay.
Operational Impacts (Summary)			
Foul effluent discharge to sewer	Indirect pathway to Dublin Bay through public sewer	South Dublin Bay SAC/SPA/pNHA	No perceptible risk – Even without treatment at Ringsend WWTP, the average effluent discharge (32.7 l/s which would equate to 0.29% of the peak hydraulic capacity at Ringsend WWTP), would not impact on the overall water quality within Dublin Bay and therefore would not have an impact on the current Water Body Status (as defined within the Water Framework Directive).
Unmitigated discharge to ground or surface water of hydrocarbons from car leak (70 litres worst case scenario)	Indirect pathway through stormwater drainage to Baldoyle Bay waterbody (distance source-receptor 350 m)	Baldoyle Bay SAC/SPA/pNHA	No perceptible risk – Taking into account the extent of loading of contaminant, distance between the source and Baldoyle Bay is c. 350 m and significant dilution in the projected wetland and Mayne

			River will ensure any released hydrocarbons are at background levels (i.e., with no likely impact above water quality objectives as outlined in S.I. No. 272 of 2009, S.I. No. 386 of 2015 and S.I. No. 77 of 2019).

Table 3.1 Pollutant Linkage Assessment *(without mitigation)*

4.0 CONCLUSIONS

A conceptual site model (CSM) has been prepared following a desk top review of the site and surrounding environs. Based on this CSM, plausible Source-Pathway-Receptor linkages have been assessed assuming an absence of any measures intended to avoid or reduce harmful effects of the proposed project (i.e. mitigation measures) in place at the proposed development site.

Construction Phase

During construction there is no direct source pathway linkage between the proposed development site and open waters. There is no direct source pathway linkage between the Proposed Development site and any Natura 2000 sites (i.e. Baldoyle Bay SAC/SPA/pNHA). There are indirect source pathway linkage from the Proposed Development through the stormwater drainage which discharges into Mayne River.

In line with good practice, appropriate and effective mitigation measures will be included in the construction design, management of construction programme and during the operational phase of the proposed development. With regard the construction phase, adequate mitigation measures are incorporated in the Construction Environmental Management Plan (CEMP), and Surface Water Management Plan (SWMP). These specific measures will provide protection to the receiving soil and water environments.

It is concluded that there are no pollutant linkages as a result of the construction of the Proposed Development which could result in a water quality impact which could alter the habitat requirements of the Natura 2000 sites within Baldoyle Bay or Dublin Bay.

Operational Phase

During operation phases there is no direct source pathway linkage between the proposed development site and open waters. There is no direct source pathway linkage between the Proposed Development site and any Natura 2000 sites (i.e. Baldoyle Bay SAC/SPA/pNHA). There are indirect source pathway linkage from the Proposed Development through the stormwater drainage which discharges into the Baldoyle-Stapolin Local Area Plan (LAP) wetland and Mayne River.

There is also an indirect connection through the foul sewer which will eventually discharge to the Ringsend WWTP and ultimately discharges to South Dublin Bay SAC/SPA/pNHA. The future development has a peak foul discharge that would equate to 0.29% of the licensed discharge at Ringsend WWTP (peak hydraulic capacity).

Even disregarding the operation of design measures including the attenuation system and petrol interceptors, it is concluded that there will be imperceptible impacts from

the proposed development to the water bodies due to emissions from the site stormwater drainage infrastructure to the wider drainage network. It should be noted the proposal also includes an attenuation system and petrol interceptors as part of best practice project design, and these features will provide additional filtration from the site to the drainage network. It should also be noted that the projected wetland will be sized to serve also the adjacent residential developments GA1 and GA3.

It is concluded that there are no pollutant linkages as a result of the operation of the Proposed Development which could result in a water quality impact which could alter the habitat requirements of the Natura 2000 sites within Baldoyle Bay or Dublin Bay.

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Barry & Partners (2021). Water Services Report. Residential Development Baldoyle GA2.

Barry & Partners (2021). Flood Risk Assessment. Residential Development Baldoyle GA2.

Appendix 7.4

Construction Surface Water Management Plan

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CONSTRUCTION SURFACE WATER MANAGEMENT PLAN FOR PROPOSED DEVELOPMENT AT BALDOYLE-STAPOLIN, DUBLIN 13

Technical Report Prepared For

Lismore Homes Ltd.

Prepared By

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Environmental Consultant

Our Reference

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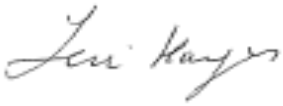
Signature		
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Title	Environmental Consultant	Director
Date	23 March 2022	23 March 2022

CONTENTS

1.0 INTRODUCTION

This Construction Surface Water Management Plan ('SWMP') has been prepared by AWN Consulting ('AWN') on behalf of Lismore Homes Ltd. for a proposed residential development. The proposed development consists of the construction of 1,007 residential apartments, communal residential community rooms, and a ground floor creche in 16 no. buildings with heights varying from 4 to 12 storeys, basement and surface level car parking, secure bicycle parking, landscaping, water supply connection at Red Arches Road, and all ancillary site development works on a site located in the townland of Stapolin, Coast Road, Baldoyle, Dublin.

During construction run-off into excavations/earthworks cannot be prevented entirely and is largely a function of prevailing weather conditions. The purpose of the plan is to set out clear guidelines on the management of surface water during construction works to prevent impact on receiving drainage and waterbodies.

2.0 SCOPE OF THE SURFACE WATER MANAGEMENT PLAN

The following Surface Water Management Plan (here after referred to as 'SWMP') provides the water management measures to be implemented by the construction Contractor(s) to ensure that work is carried out with to protect water quality. The mitigation and control measures outlined in the SWMP will be employed on site during the construction phase.

This report describes briefly the existing hydrological and hydrogeological setting of the site, and then sets out the proposed measures required for surface water management during the construction phase of the proposed development. All mitigation measures outlined within this SWMP will be implemented during the construction phase, as well as any additional measures required pursuant to planning conditions which may be imposed.

Contamination of the receiving surface water environment during the construction phase has the potential to cause environmental damage mainly through the movement of silt either directly or indirectly into receiving waters. Non-sediment contaminants consist of general site and materials management measures that directly or indirectly discharge into receiving environments from site activities. Other possible construction impacts include accidental release of oils and diesel, or discharge of alkaline water during cementing works. The main aim of the surface water management plan is to ensure protection of the local receiving water and compliance with current guidance documents. This is to be achieved through the following measures:

- Understanding of the local receiving water environment, pollutant linkage pathways and the legislative requirements;
- Implementation of measures to protect the receiving water environment;
- Set out a monitoring schedule, check list and training programme.

The main areas of water related concerns covered by this document are:

- Pre-Construction, Construction Phase drainage controls;
- Management of Earthworks and Materials Storage;
- Surface water runoff protection (sit fences, silt traps, diversion channels);
- Prevention of Accidental Releases (concrete, fuel, and chemical handling); and
- Surface Water Treatment and Discharge, and

- Foul Water And Onsite Sanitation.

The SWMP a live document and will be modified over time as detailed contractor methods of work are developed. If the development is permitted an updated version of this document will be issued to all parties involved in the construction process when appropriate changes are deemed necessary.

2.1 RELEVANT LEGISLATION

It is proposed that all surface water control measures relating to the proposed development will be constructed using best practice and in conformance with the requirements of the relevant regulatory authorities.

The key legislation which will be adhered to are defined as follows:

- Water Framework Directive (2000/60/EC);
- Local Government (Water Pollution) Act, 1977–1990;
- Water Quality (Dangerous Substances) Regulations, 2000;
- Arterial Drainage Act, 1945;
- S.I. No. 41 of 1999 Protection of Groundwater Regulations, resulting from EU
- Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);
- S.I. No. 272 of 2009 and amendments European Communities Environmental
- Objectives (Surface Waters) Regulations; and,
- S.I. No. 9 of 2010 and amendments European Communities Environmental Objectives (Groundwater) Regulations.

The key drainage and water quality guidance documentation relevant to this site are defined set out as follows:

- Guidelines on protection of fisheries during construction works in and adjacent to waters Inland Fisheries Ireland (2016).
- Dublin City Council (2005) Greater Dublin Strategic Drainage Study (GDSDS):
- Technical Documents of Regional Drainage Policies. Dublin: Dublin City Council;
- Construction Industry Research and Information Association (CIRIA):
    - CIRIA Report C502 Environmental Good Practice on Site;
    - CIRIA Report C532 Control of Water Pollution from Construction Sites;
    - CIRIA Report C648 Control of Pollution from Linear Construction Project; Technical Guidance;
    - CIRIA Handbook C650 Environmental good practice on site;
    - CIRIA Handbook C651 Environmental good practice on site checklist;
    - CIRIA Report C609 - SUDS – hydraulic, structural & water quality advice; and,
    - CIRIA Report C697 – The SUDS Manual

As Baldoyle Bay (the final receptor of the Mayne River and site catchment waters) is designated an SAC, it comes under the protection of the Habitats Directive 92/43/EEC which are implemented in Irish legislation as S.I. No 233/1998 – European Communities (Birds & Natural Habitats) Regulations 2011.

3.0 EXISTING ENVIRONMENT

The proposed development is located within the previously defined Eastern River Basin District (ERBD), now the Ireland River Basin District, in Hydrometric Area No. 09 of the Irish River Network. It is within the River Liffey catchment and mayne Sub-catchment (Mayne_SC_010). The River Liffey catchment encompasses an area of approximately 1,369 km2. The River Liffey extends from the mountains of Kippure and Tonduff in County Wicklow to the sea at Dublin Bay. The main channel covers a distance of c. 120 km west to east. The Snugborough Stream lies 650 m to the east and the Mayne River lies 550 m to the north (EPA designations). The Snugborough rises to the south and is culverted between Seagrange Park and the Red Arches Road (refer to Figure 3.1 below).

According to the NPWS (2021) online database, the following area of conservations are located closest to the Site:

- Baldoyle Bay Special Area of Conservation (SAC) (Site Code 000199) – c. 350 m east of the site. (Both the bay itself and saltwater marshland which is part of the old Baldoyle Racecourse).
- Baldoyle Bay Special Protection Area (SPA) (Site Code 004016) – c. 700 m east of the site.
- Baldoyle Bay proposed Natural Heritage Area (pNHA) – c. 400 m east of the site.

The North Dublin Bay SAC is c. 1.8 km south of the site.

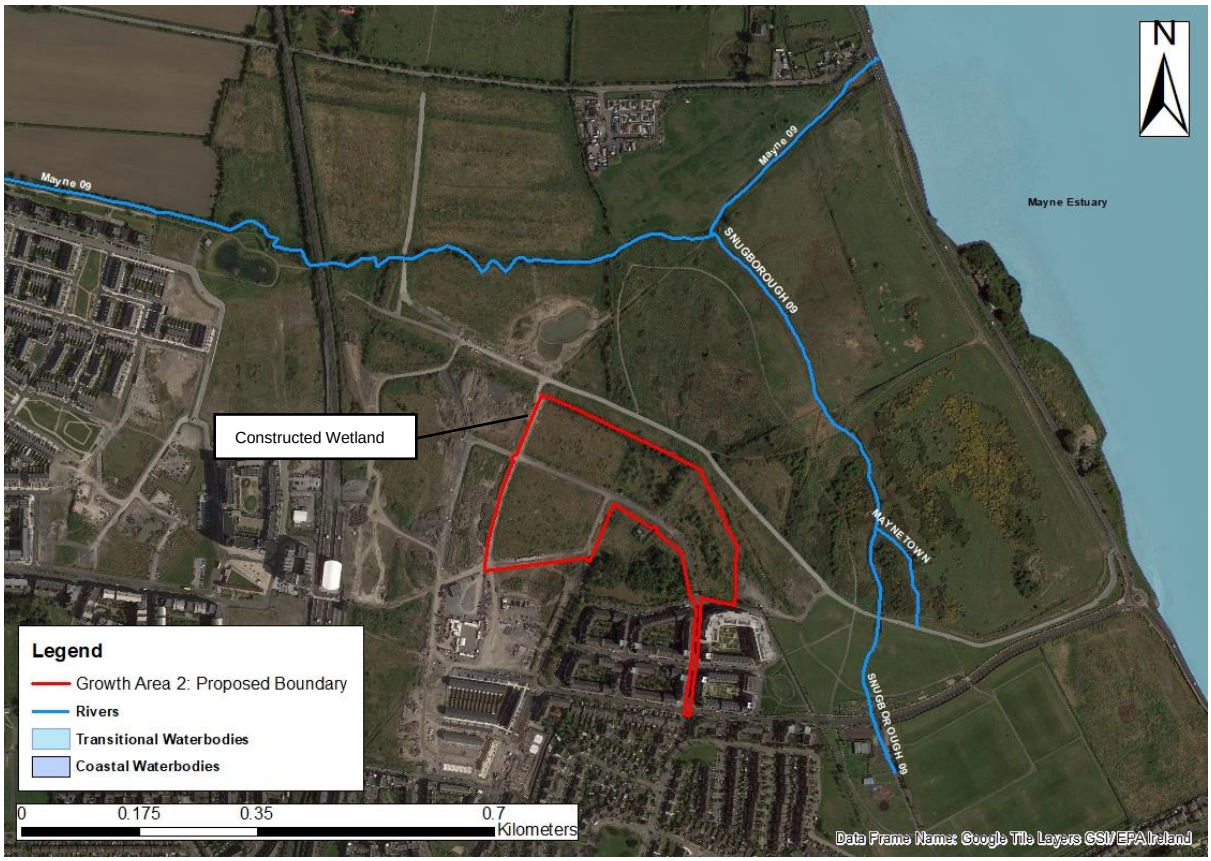

Figure 7.3.1 Local Hydrological Environment

Currently, storm water run-off discharges through an existing 1500 mm stormwater culvert passing underneath the north Fringe Sewer, flowing south to north, which discharges into the Mayne River.

There is an indirect hydraulic connection via the stormwater system which is discharged to the Mayne River. The Mayne River ultimately discharges to the Baldoyle Estuary.

In accordance with the WFD, each river catchment within the former Eastern River Basin District (ERBD) was assessed by the EPA and a Water Management Plan detailing the programme of measures was put in place for each. Currently, the EPA classifies the WFD River Waterbody risk score of 1a, 'At risk of not achieving good status'. The WFD Status for the Mayne River waterbody was previously denoted as 'Poor' (2nd Cycle Status 2013-2018). The transitional waterbodies of the Mayne Estuary and North Bull Island WFD status is currently 'under review' and these were not assigned a status in the previous cycle (2013 – 2015). The Irish Sea Dublin (HA 09) and the Dublin Bay Coastal Waterbodies to the east and south-east of the Site have a 'Good Status' and are listed as 'Not at Risk' by the EPA.

The EPA assesses the water quality of rivers and streams across Ireland using a biological assessment method (Q-Value), which is regarded as a representative indicator of the status of such waters and reflects the overall trend in conditions of the watercourse. The biological indicators range from Q5 – Q1. Level Q5 denotes a watercourse with good water quality and high community diversity, whereas Level Q1 denotes very low community diversity and bad water quality.

The surface water quality data for the nearest monitoring station (Hole in the Wall Bridge) to the Site of the proposed development (upstream) for the Mayne River (including the Snugborough Stream) shows a Q rating of Q2-3 denoting a poor (moderately polluted) status (refer to Chapter 7 of the EIAR for further details).

The proposed project development was subject to Site Specific Flood Risk Assessment (SSFRA) undertaken by JBA Consulting Ltd in accordance with OPW Flood Risk Management Guidelines and is included as in the present EIAR Appendix 7.2.

This Flood Risk Assessment, contains a hydraulic study of the Mayne River, has been carried out (as required by Objective FRM3 of the Baldoyle-Stapolin LAP). Reference to the basements is contained in Section 5.3 of the Flood Risk Assessment as required by Objective FRM4 of the Baldoyle-Stapolin LAP.

A review of the historic flood information does not provide any evidence of flooding at the site. The nearest flood event is situated along Coast Road, 600 m east of the site, Review of the FEM FRAM (Fingal East Meath Flood Risk Assessment and Management Study) predictive flood maps confirms that the majority of the site is not at risk of flooding. In summary, the SSFRA states that all residential properties are located in Flood Zone C and are protected from inundation up to the 0.1% AEP Mid-Range Future Scenario (MRFS) flooding event. The Flood Risk Assessment was undertaken in accordance with OPW's 'The Planning System and Flood Risk Management' guidelines. The FRA is in agreement with the core principles contained within the Planning Guidelines.

Reference to the GSI Bedrock Geology Map indicates that the site is underlain by Lower Carboniferous (Courceyan Stage) Limestones which is referred to as Malahide Formation (Rock Unit code: CDMALH). This geological formation comprises argillaceous bioclastic limestone and shale.

In addition, the GSI National Draft Bedrock Aquifer Map indicates that the site is underlain by a Locally Important Bedrock Aquifer (LI), which is described by the GSI as bedrock as being "moderately productive only in local zones".

Aquifer vulnerability is a term used to represent the intrinsic geological and hydrological characteristics that determine the ease with which groundwater may be contaminated generally by human activities. The GSI presently classifies the aquifer vulnerability in the region of the site as 'Low' (L) which indicates that an overburden depth of >10 m of low permeability soil is present. This was confirmed in 2019 and 2020 investigations undertaken by GII (refer to Chapter 6 of the EIAR for further details). The aquifer vulnerability class in the region of the site is presented below as Figure 3.2.

Figure 7.3.2 Aquifer Vulnerability Map with the proposed site layout (Source: GSI, 2022)

4.0 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

The development will consist of the construction of 1,007 apartments (consisting of 58 no. studio units (38.1 – 52.3 sq.m.), 247 no. 1 bedroom units (48.9 – 79.7 sq.m.), 94 no. 2 bedroom 3 person units (67.3 – 80.42 sq.m.), 563 no. 2 bedroom 4 person units (77.7 – 106.1 sq.m.), and 45 no. 3 bedroom units (93.5 – 130.66 sq.m.), 6 no. communal residential community rooms, and a ground floor creche in 16 no. buildings with heights varying from 4 to 12 storeys, basement and surface level car parking, secure bicycle parking, landscaping, water supply connection at Red Arches Road, and all ancillary site development works on a c. 6.1 hectare site.

A full description of the proposed development can be found in the EIAR, Chapter 2 - Description of the Proposed Development. Construction activities associated with the proposed development which are relevant to the surface water environment are presented below. These activities primarily pertain to the site preparation, excavation, levelling and infilling activities required to facilitate construction of the proposed development, and ancillary services.

4.1 SITE PREPARATION, EXCAVATION, LEVELLING AND INFILLING ACTIVITIES

Land clearing, earthworks and excavations will be required for construction phase operations to facilitate site clearance, construction of new building, basements, foundations and installation of services. This will include site levelling, construction, and building foundation excavation, this will necessitate the removal of vegetation cover and the excavation of soil and subsoils.

The volume of material to be excavated has been estimated by the project engineers at c. 135,000 m3. It is envisaged that 129,000 m3 of the excavated material will be required to be removed from site as either a waste or by-product.

No significant dewatering will be required during the construction phase which would result in the localised lowering of the water table. There may be localised pumping of surface run-off from the excavations during and after heavy rainfall events to ensure that the excavation is kept relatively dry.

4.2 STORAGE OF HAZARDOUS CONSTRUCTION MATERIALS

Construction activities will include the storage of fuel and use of machinery, and temporary storage of fuel required for on site for construction traffic. Liquid materials i.e., fuel storage will be located within temporary bunded areas, doubled skinned tanks or bunded containers (all bunds will conform to standard bunding specifications - BS8007-1987) to prevent spillage. These will be stored within the contractor yard.

4.3 FOUL DRAINAGE DURING CONSTRUCTION

Welfare facilities will be provided for the contractors via portable sanitary facilities within the construction compound site during the construction works. It is an anticipated that initially, waste collected by tanker and disposed of appropriately, and that temporary connections to the existing services will be established to provide service and utilities subject to relevant applications and approvals.

There shall not be discharge of ***untreated***, silty, or contaminated water from the works to any watercourse or stormwater network. Should any discharge of ***untreated*** construction water be required during the construction phase, the discharge will be to foul sewer following agreement with Fingal County Council / Irish Water.

4.4 SURFACE WATER DISCHARGE DURING CONSTRUCTION

There shall not be discharge of ***untreated***, silty, or contaminated water from the works to any watercourse or stormwater network. Should any discharge of ***untreated*** construction water be required during the construction phase, the discharge will be to foul sewer following agreement with Fingal County Council / Irish Water.

There is no significant dewatering will be required during the construction phase which would result in the localised lowering of the water table. There may be localised pumping of surface run-off from the excavations during and after heavy rainfall events to ensure that the excavation is kept relatively dry.

The discharge of ***treated*** construction water from rainfall into excavated areas, or from any localised dewatering may be required during construction. This ***treated*** construction water will be discharged to the existing 1500 diameter concrete stormwater main, that traverses underneath the north fringe sewer and discharges to the Mayne River.

5.0 SURFACE WATER MANAGEMENT MEASURES

5.1 PRE-CONSTRUCTION

Prior to the commencement of construction works and site mobilisation the Main Contractor shall undertake an assessment of the site identifying areas of concern at the earliest possible stage to anticipate and plan for how to address those concerns.

A preconstruction meeting is a key point of communication between the Main Contractor, Project Ecologist (Ecological Clerk of Works), Project Arborist and Landscape Architect, Environmental Health and Safety Staff and Subcontractors. This where potential problem areas can be discussed. The meeting provides an opportunity to interact face-to-face with key representatives where project expectations can be established along with a good working relationship.

This is preconstruction meeting will:

- Clarify the objectives of surface water management plan where specific project requirements can be discussed.
- Designate a contact person for surface water management plan
- Be sure that all parties go over the surface water management plan so they know what is expected. Discuss any needed field changes to the plan. Always ensure that the approved plan is available on site.
- Discuss time frames for initiation of mitigation measures for sediment controls, site clearing, grading and stabilisation.
- The sediment control measures will be implemented prior to the commencement of earthworks.
- Discuss the maintenance and monitoring requirement set out in this plan requirements so it is clearly understood that practice maintenance is an ongoing obligation.

5.2 ESTABLISHMENT OF STABILISED ENTRANCE WAY AND WHEEL WASH

In order to prevent site access points becoming sources of sediment and then tracking sediments offsite the following measures will be employed:

- A stabilised entranceway consisting of an aggregate on a filter cloth base that is located at any entry or exit point of the construction site.
- Place aggregate from the construction site boundary extending for at least 10m according to the specifications and contour the aggregate to suit the entrance point.
- All points of construction site entry and exit with a view to limit traffic to these entrances only.
- The site entrance will be located so that vehicles cannot bypass these devices. Perimeter silt fences or bunds may assist in achieving this requirement.
- Any hard surface site roads will be swept to remove mud and aggregate materials from their surface while any unsurfaced roads shall be restricted to essential site traffic only.
- A power washing facility or wheel cleaning facility will be installed near to the site compound for use by vehicles exiting the site when appropriate,
- In the case of a wet wheel wash it is recommended that a designated bunded and impermeable wheel wash area is provided and that the resultant waste water is diverted to a settlement pond for settling out of suspended solids.
- This also assist in minimising dust generation and disturbance of areas adjacent to the road frontage by providing a defined entry and exit point.

Figure 5.1 Example of Wheel Washing System

5.3 MANAGEMENT OF EXCAVATIONS, EARTHWORKS AND MATERIALS STORAGE

The volume of material to be excavated has been estimated by the project engineers at c. 135,000 m3. It is envisaged that 129,000 m3 of the excavated material will be required to be removed from site.

The construction contractor will be required to reused on-site excavated material where possible, this can be used for site levelling, roads, car parking areas and other landscaping purposes.

The amount of exposed ground will be kept to a minimum by maintaining existing vegetation that would otherwise be prone to erosion. Rather than stripping the entire site months in advance, topsoil extraction will be deferred until just before work begins. All exposed soil surfaces will be within the main excavation site which limits the potential for any offsite impacts.

Earthwork operations will be carried out such that surfaces, as they are being raised, shall be designed with adequate drainage, falls and profile to control run-off and prevent ponding and flowing. Correct management will ensure that there will be minimal inflow of shallow / perched groundwater into any excavation. Due to the very low permeability of the overburden and the relative shallow nature for foundation excavations, infiltration to the underlying aquifer is not anticipated.

Movement of material will be minimised to reduce the degradation of soil structure and generation of dust. Excavations will remain open for as little time as possible before the placement of fill. This will help to minimise the potential for water ingress into excavations. Soil from works will be stored away from existing drainage features to avoid any potential impact.

Weather conditions will be considered when planning construction activities to minimise the risk of run-off from the site.

Any temporary storage of soil, hardcore or similar material on the site will be carefully managed in such a way as to prevent any potential negative impact on the receiving environment.

The material will be stored away from any surface water drains(minimum 20 m buffer zones) and also stored in receptacles where possible.. The movement of material will be minimised to reduce degradation of soil structure and generation of dust (See the CEMP for further details). Stockpiles will be tightly compacted to reduce run-off and graded to aid in run-off collection, and materials will be stored away from any surface water drains.

While it is acknowledged that there will be waste materials generated from the excavation of soil and stones to facilitate site clearance, construction of new building, basements, foundations and installation of services. Any waste soils will be managed in accordance with the site specific Construction and Demolitions Waste Management Plan (See the CEMP for further details).

In order to minimise the risk of contamination, any stockpiled material designated for removal will be removed off-site as soon as possible. Surface water drain gratings in areas near or close to where stockpiles are located will be covered by appropriate durable polyurethane covers or similar.

5.3.1 Material Handling and Storage

Key materials which will be ordered by specific order for the project, a ‘Just in Time’ delivery system will operate to minimise storage of materials, the quantities of which are unknown at this stage.

Where possible it is proposed to source general construction materials from the Dublin area to minimise transportation distances.

Aggregate materials such as sands and gravels will be stored in clearly marked receptacles in the compound area within the site. Liquid materials will be stored within temporary bunded areas, doubled skinned tanks or bunded containers (all bunds will conform to standard bunding specifications – BS EN 1992-3:2006) to prevent spillage.

Construction materials will be brought to site by road. Construction materials will be transported in clean vehicles. Lorries/trucks will be properly enclosed or covered during transportation of friable construction materials and spoil to prevent the escape material along the public roadway.

The majority of construction waste materials generated will be soil from excavation works. Material will be removed from site regularly to ensure there is minimal need for stockpiling.

5.4 SURFACE WATER DRAINAGE AND RUNOFF PROTECTION

On the site, a site drainage and protection system will be built to reduce run-off from the site, prevent soil erosion, and protect water quality in the area of conservations closest to the Site.

5.4.1 Establishment of Silt Fences

A silt fence is a woven geotextile fabric barrier that is used as a temporary barrier to trap mostly coarse sediments carried in surface water sheet flow. Silt fences temporarily impound sediment-laden runoff, slowing it down and allowing it to settle out of the water.

Silt fences will be installed around the perimeter of the site where construction is proposed to detain flows from runoff so that deposition of transported sediment can occur through settlement.

Inspection and maintenance of the silt fences during construction phase is crucial to ensuring that they work as intended. They will remain in place throughout the entire construction phase.

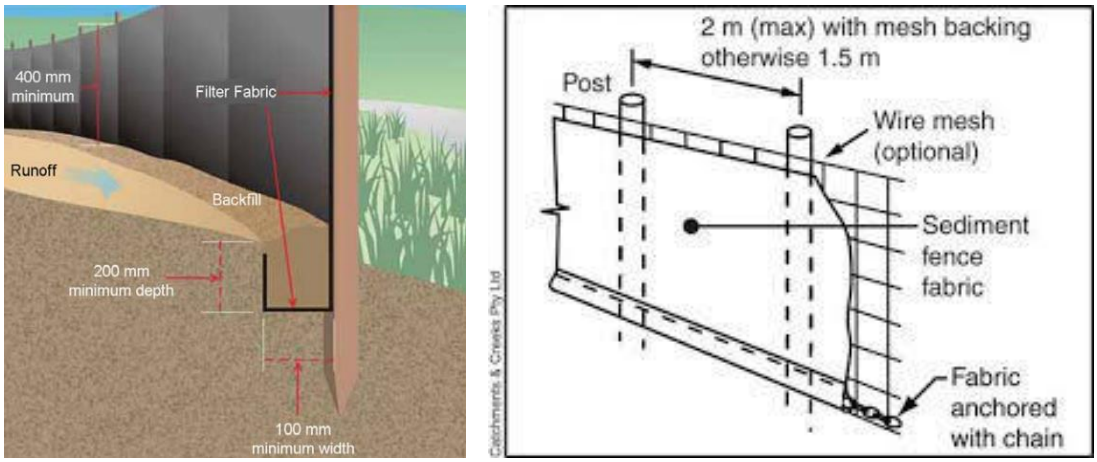

Figure 5.2 Still Fence Installation

Figure 5.3 Example of Silt Fencing

5.4.2 Use of perimeter drains, diversion channels/bunds

Temporary excavated channels, bunds or ridges or a combination of the three, may be constructed to divert sediment-laden water to an appropriate sediment retention structure.

These may be installed to provide permanent diversion of clean stormwater away from erosion exposed soil areas, or to provide a barrier between exposed areas and unexposed areas of the construction site.

Runoff diversion channels/bunds need regular maintenance to keep functioning throughout their life.

5.4.3 Silt Dewatering Bags / Dewatering Socks

Where small to medium volumes of water need to be pumped from temporary excavations, silt dewatering bags or socks will be employed. Silt Dewatering bags are designed to trap sediment and silt while allowing clean water to flow freely back into the environment. When water is pumped into the bag, the geotextile fabric traps most of the silt when water is pumped to the bag, allowing the treated water to pass through.

Figure 5.4 Example of Silt Dewatering Bag

5.4.4 Settlement Systems/ Settlement Tanks / Ponds

The main aim of settling tanks is to hold water for an extended period of time, allowing suspended solids to settle to the tank's bottom and leave treated water. Engineered concrete structures or simple clay-lined ponds can be used.

Settlement systems promote sediment deposition and reduce hydraulic loading by slowing flow velocities allowing sediment to settle.

Early in the site establishment capture and settlement systems should be constructed to store construction water for reuse or to allow for additional treatment procedures prior to discharge.

Earthwork operations will be carried out such that surfaces, as they are being raised, shall be designed with adequate drainage, falls and profile to control run-off and prevent ponding and flowing.

Sediment entrapment facilities will be installed to reduce overland sediment discharges to downgradient properties and receiving waters. All run-off leaving a disturbed area should pass through a sediment entrapment facility before it exits the site and flows downgradient such as straw bales, silt fencing, silt barriers and diversion dams.

It is envisaged that a number of geotextile lined settling basins and temporary mounding's and/or silt fences will be installed to ensure silts do not flow off site during the construction stage. This temporary surface water management facility will throttle runoff and allow suspended solids to be settled out and removed. All inlets to the settling basins will be 'riprapped' to prevent scour and erosion in the vicinity of the inlet.

5.5 PREVENTION OF ACCIDENTAL RELEASES

5.5.1 Prevention of Concrete Run-off

Concreting operations carried out near surface water drainage points during construction activities could lead to discharges to a watercourse.

No wash-down or wash-out of ready-mix concrete vehicles during the construction works will be carried out at the site within 10 meters of an existing surface water drainage point. Wash-outs will only be allowed to take place in designated areas with an impervious surface.

A suitable risk assessment for wet concreting will be completed prior to works being carried out, which will include measures to prevent discharge of alkaline waste waters or contaminated storm water to the underlying subsoil. Wash-down and washout of concrete transporting vehicles will take place at an appropriate facility off-site.

5.5.2 Fuel and Chemical Handling

The following mitigation measures will be implemented during the construction phase in order to prevent any spillages to ground of fuels and prevent any resulting to surface water systems:

- Designation of bunded refuelling areas on the Site;
- Provision of spill kit facilities across the Site;
- Where mobile fuel bowsers are used, the following measures will be taken:
    - Any flexible pipe, tap or valve will be fitted with a lock and will be secured when not in use;
    - The pump or valve will be fitted with a lock and will be secured when not in use;
    - All bowsers to carry a spill kit and operatives must have spill response training;
    - Portable generators or similar fuel containing equipment will be placed on suitable drip trays.

In the case of drummed fuel or other potentially polluting substances which may be used during the construction phase, the following measures will be adopted:

- Secure storage of all containers that contain potential polluting substances in a dedicated internally bunded chemical storage cabinet unit or inside a concrete bunded area;
- Clear labelling of containers so that appropriate remedial measures can be taken in the event of a spillage;
- All drums to be quality approved and manufactured to a recognised standard;
- If drums are to be moved around the Site, they will be secured and on spill pallets; and
- Drums will be loaded and unloaded by competent and trained personnel using appropriate equipment.

5.5.3 Other Chemical Storage

No bulk chemicals will be stored within the active construction areas. Temporary oil and fuel storage tanks will be kept in the material storage area in suitable containers and will be appropriately bunded as required. Refuelling of vehicles and the addition of hydraulic oils or lubricants to vehicles will take place in designated areas of the site, where possible, which will be kept away from any surface water drains (minumum 20 m buffer zone).

Spill protection equipment such as absorbent mats, socks and sand will be available to be used in the event of an accidental release during refuelling. Training will be given to appropriate site workers in how to manage a spill event.

The construction contractor will be required to implement emergency response procedures, and these will be in line with industry guidance. All personnel working on the Site will be suitably trained in the implementation of the procedures.

5.6 SURFACE WATER TREATMENT AND DISCHARGE

There shall not be discharge of ***untreated***, silty, or contaminated water from the works to any watercourse or stormwater network. Should any discharge of ***untreated*** construction water be required during the construction phase, the discharge will be to foul sewer following agreement with Fingal County Council / Irish Water.

The discharge of ***treated*** construction water from rainfall into excavated areas, or from any localised dewatering may be required during construction. This ***treated*** construction water will be discharged to the existing 1,500 diameter concrete stormwater main, that traverses underneath the north fringe sewer and discharges to the Mayne River.

Surface water discharge from the site will be managed and controlled for the duration of the construction works until the permanently attenuated surface water drainage system of the proposed site is complete. A temporary drainage system shall be established prior to the commencement of the construction works to collect, and discharge any treated construction water during construction.

The pre-treatment and silt reduction measures on-Site will include a combination of the measures proposed in Section 5.5 above.

Run-off water containing silt will be contained on-site via settlement tanks and treated to ensure adequate silt removal. Silt reduction measures on site will include a combination of silt fencing, settlement measures (silt traps, silt sacks and settlement tanks / ponds).

Any contaminated construction water that requires removal from site will be contained on-site and treated to ensure adequate silt and contaminant removal prior to discharge.

The implementation of an multistage-active treatment system such as a siltbuster or similar will be adopted to treat construction waters to ensure it will be safely discharged to the existing surface water network. The multistage treatment system will be designed to remove silt, and hydrocarbons.

Measures to control surface water will be in compliance with the relevant CIRIA guidance documents referenced above.

5.7 FOUL WATER AND ONSITE SANITATION

Welfare facilities will be provided for the contractors via portable sanitary facilities within the construction compound site during the construction works. It is an anticipated that initially, waste collected by tanker and disposed of appropriately, and that temporary connections to the existing services will be established to provide service and utilities subject to relevant applications and approvals.

6.0 MONITORING AND MAINTENANCE

Weekly checks will be carried out to ensure surface water drains are not blocked by silt, or other items, and that all storage is located at least 20 m from surface water receptors.

Regular inspection of surface water run-off and any sediment control measures (e.g. silt traps) will be carried out during the construction phase especially rainfall or storms a. Regular maintenance will occur to repair or reinstate if destroyed or damaged by machinery movement or from rainfall.

Regular auditing of construction / mitigation measures will be undertaken, e.g. concrete pouring, refuelling in designated areas, etc.

A log the regular inspections will be maintained, and any significant blockage or spill incidents will be recorded for root cause investigation purposes and updating procedures to ensure incidents do not reoccur.

An example inspection log form is included as Appendix A to this SWMP.

7.0 REVIEW

The Main Contractor appointed representative will review the inspection forms on a weekly basis to confirm that the checks, and subsequent required maintenance works are being carried out. Additional inspections will be required after significant changes in site changes, or system maintenanceas construction progresses.

Regular meetings will be held on site by key personnel to discuss the results of the daily, weekly and monthly site monitoring.

Should inspections indicate that any environmental protection and controls measures are not functioning as intended, the Contractor will instigate a review of the CEMP or relevant sub-plan, as required.

8.0 TRAINING

Site training should include at minimum:

- Induction training including environmental requirements for all operatives and subcontractors;
- More detailed training for staff or subcontractors with specific responsibilities e.g. Waste Rep;
- Toolbox talks, depending on the type of works being undertaken and the environmental impacts that may result from these activities e.g. training on water pollution prevention before works near watercourses. Training to be given will include:
    - Protected species/habitats
    - Environmental incidents
    - Invasive plants
    - Water pollution prevention
    - Waste management
    - Spill control & spill kits
    - Dust and Air Quality
    - Storage and use of petrol diesel and oils

Contact specific information should be displayed on notice boards and briefed to all staff.

9.0 KEY CONTACTS

A list of personnel that should be contacted in the requirement for further information or to be notified of a breakdown in the mitigation measures should be prepared and communicated within this SWMP prior to the commencement of construction

Main Contractor Contacts

Position Title:	Name:	Phone:
Main Contractor		
Project Manager		
Construction Manager		
Design Engineer		
Environmental Manager		
Safety Officers		
Site Emergency Number		
Project Ecologist		
Project Archaeologist		
Project Arborist		
Waste Management Coordinator		

Emergency Services and Third Party Contacts

Organisation:	Position:	Phone:
Inland Fisheries Ireland	Eastern River Basin District	(01) 2787022
National Parks and Wildlife Service	North Eastern Region	(076) 1002594
Environmental Protection Agency (EPA)	EPA	(053) 9160600
Department of Culture, Heritage and the Gaeltacht	National Monuments Service	(01) 8882000
Health and Safety Authority	Health and Safety Authority	(01) 6147000
Emergency Services	Ambulance and Fire Service	999 or 112

Appendix A

Inspection Checklist						
Name of Inspector:						
Construction Project:				Contractor:		
Location:						
Date of Inspection:		Time	Start:			
			Finish:			
Weather Conditions :						
Description of current phase of construction:						
Construction Element	Maintenance Required			Comments on the effectiveness of sediment control measure		
	Yes	No	N/A			
French drain clear?						
Swale – level of water?						
Silt pond/ silt fences required?						
Integrity of spoil heaps						
Gully protection in place						
Mobile Treatment Tanks:						
De-sludging required?						
Other:						
Additional Comments:						
Inspector			Supervisor			
Signed			Signed			
Date			Date			

Appendix 7.5

Construction Environmental Management Plan

AWN Consulting

OUTLINE CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN FOR A PROPOSED RESIDENTIAL DEVELOPMENT

BALDOYLE-STAPOLIN, DUBLIN 13.

"GROWTH AREA 2"

Report Prepared For

Lismore Homes Ltd.

Report Prepared By

Chonaill Bradley, Principal Environmental Consultant

Our Reference

CB/21/12473WMR03

Date of Issue

23 March 2022

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Details	Written by	Approved by
Signature		
Name	Chonaill Bradley	Fergal Callaghan
Title	Principal Environmental Consultant	Director
Date	23 March 2022	23 March 2022

CONTENTS **PAGE**

1.0 INTRODUCTION

This Outline Construction Environmental Management Plan (CEMP) has been prepared by AWN Consulting (AWN) on behalf of Lismore Homes Ltd. for a proposed residential development. The proposed development consists of the construction of 1,007 residential apartments, communal residential community rooms, and a ground floor creche in 16 no. buildings with heights varying from 4 to 12 storeys, basement and surface level car parking, secure bicycle parking, landscaping, water supply connection at Red Arches Road, and all ancillary site development works on a site located in the townland of Stapolin, Coast Road, Baldoyle, Dublin

The outline CEMP provides a framework from which a more detailed CEMP will be developed to implement the mitigation measures described below which are designed to avoid, minimise or mitigate adverse construction effects on the environment prior to commencement on site.

This Outline CEMP has been prepared to account for activities at the site during the excavation and construction phase of the project.

The main issues that have been considered within this document are as follows;

- Description of works;
- Construction programme and phasing;
- Site logistics;
- Workforce;
- Public relations and community liaison;
- Construction traffic and access; and
- Safety, health and environmental management.

2.0 DESCRIPTION OF THE PROJECT

The site of the proposed development ('the site') is c. 5.9 hectares located at Baldoyle-Stapolin, Dublin 13. The site located 8km northeast of Dublin city centre, the site forms part of the overall Coast residential community that has been planned on c. 41 hectares of residential zoned land around Clongriffin DART station. The proposed development site and surrounding site context is shown on Figure 2.1 below.

The site is located on the southern boundary of the Fingal County Council (FCC) administrative area and is subject to the Fingal County Council Development Plan (CDP) 2017-2023 and Baldoyle-Stapolin Local Area Plan (LAP) 2013. The Dublin City Council administrative boundary is located just beyond the Dublin-Belfast / DART railway line and Clongriffin rail station. To the west of the railway lies the developing mixed use area of Clongriffin within Dublin City Council's wider North Fringe Area encompassing Northern Cross/Clare Hall/Belmayne to Clongriffin.

The wider area is characterised by a predominantly residential uses as the site surrounded by the residential centres of Donaghmede, Bayside and Clongriffin. The coastal towns of Portmarnock and Malahide are located further to the north. The Mayne Marsh Conservation Area and Baldoyle Estuary Nature Reserve is located beyond the future Racecourse Regional Park; these areas, including the bay itself), from part of the Baldoyle Bay Special Protection Area (SPA),Special Area of Conservation (SAC), proposed Natural Heritage Area (pNHA), and Ramsar Convention Wetland.

Figure 2.1 *Proposed location of site*

The proposed development consists of the construction of 1,007 residential apartments (consisting of 58 no. studio units, 247 no. 1 bedroom units, 94 no. 2 bedroom 3 person units, 563 no. 2 bedroom 4 person units, and 45 no. 3 bedroom units), communal residential community rooms, and a ground floor creche in 16 no. buildings with heights varying from 4 to 12 storeys, basement and surface level car parking, secure bicycle parking, landscaping, water supply connection at Red Arches Road, and all ancillary site development works.

The residential development will comprise a mix of 1,007 residential apartment types and sizes as follows apartments units. A ground floor creche facility is proposed to serve the proposed development. It is shown at ground level within Sector 8A, Block 1 and it includes a dedicated creche outdoor area and set down car parking.

3.0 CONSTRUCTION PROGRAMME AND PHASING

The construction works associated with the development will be undertaken in one phase. There will be no demolition required as part of this development, there will however be excavations required to accommodate site levelling, services and foundations.

Subject to detailed planning at the construction stage, it is currently envisaged that the construction compound, offices and storage areas will be located at one location and can be viewed in Figure 3.1.

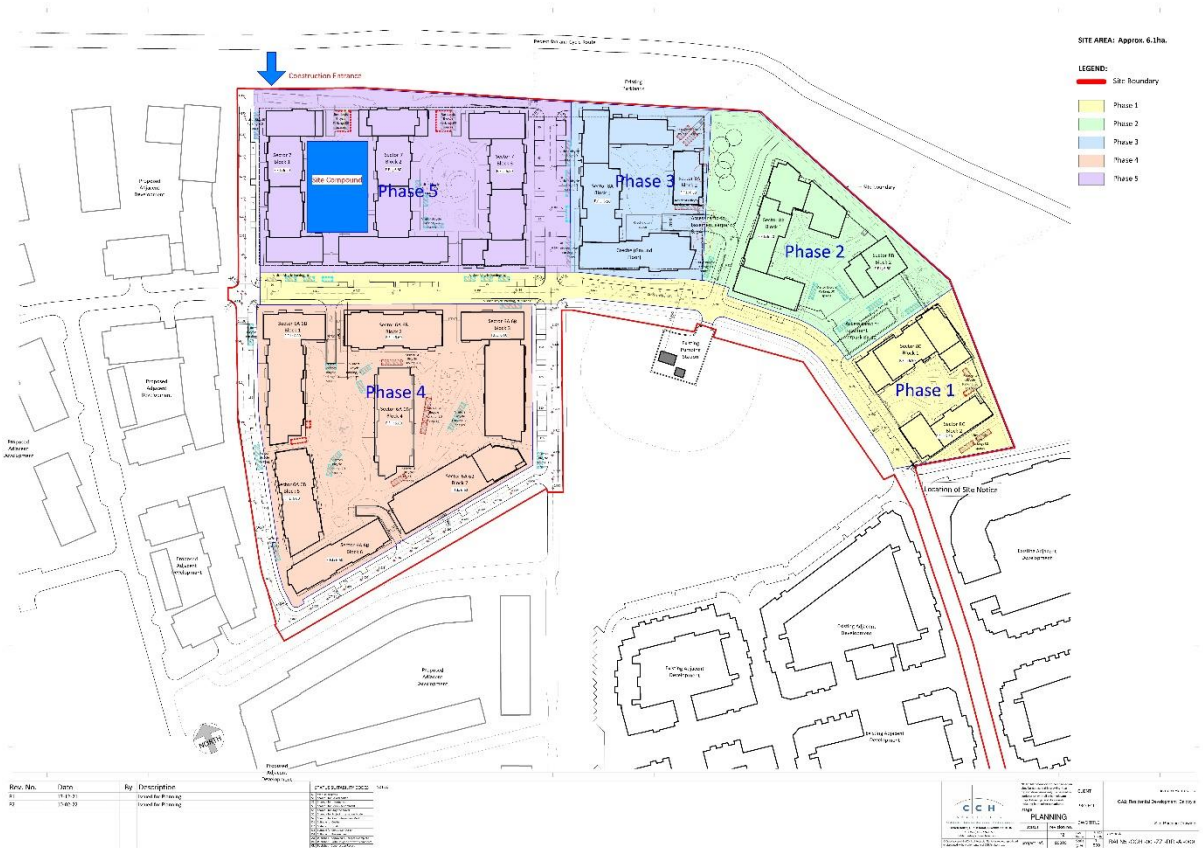

Figure 3.1 *Proposed Site Phasing and Potential Compound & Staff Parking Location Options*

3.1 DEMOLITION PHASE

There will be no demolition required as part of this development.

3.2 EXCAVATION & CONSTRUCTION PHASE

The project excavations will involve excavations for new foundations, site levelling and excavations for roads and services. The Construction and Demolition Waste Plan prepared by AWN Consulting (ref CB21_12473WMR01), for the development will be updated by the main contractor and will be in compliance with the requirements of the "Best Practice Guidelines for the Preparation of Waste Management Plans for the Construction and Demolition Projects" published by the Department of the Environment Heritage and Local Government and the 'Best Practice Guidelines for the Preparation of Resource Management Plans for Construction & Demolition Projects' will identify and categorise any waste arising from the development.

The plan will also contain the proposals for the minimisation, re-use and re-cycling of site generated waste. As part of this plan separate storage areas will be designated on the site for various types of material in order to maximise the re-use and re-cycling potential. Procedure will also be put in place to ensure that all sub-contractors fulfil the requirements of the Waste Management Plan.

Estimates for the duration of the construction works are included in the table below. The overall start-to-finish duration is estimated to be 48 months with some development and fit out aspects overlapping.

The scheme is split into 5 phases generally moving from East to West across the site. Following the numbering as shown in figure 4.1.

Table 3.1 *Estimated Construction Duration*

Development Element	Sector	Estimated Construction Duration
Phase 1	8B	12
Phase 2	8C	12
Phase 3	8A	12
Phase 4	6A, 6B	12
Phase 5	7	12

The works will include:

- Site set up, welfare facilities and compound establishment, decommissioning and movement of site compound and facilities as needed.
- Set up of hoarding around compound and the site boundary.
- Erection of safety signage to all areas and implementation of traffic/pedestrian management plan.

4.0 EXCAVATIONS

4.1 ARCHAEOLOGICAL AND ARCHITECTURAL HERITAGE

To set the proposed development within its wider archaeological, architectural and cultural heritage landscape, and to assess the potential of encountering such features on the site, a paper survey of archaeological, architectural heritage, historical and cartographic sources was undertaken.

As the proposed development lands were previously in agricultural use, there is the possibility of sub-surface archaeological features surviving within the site boundary. In order to mitigate against the potential impacts of the proposed development on such features, should they exist, the following mitigation measures will be undertaken.

Given the level of disturbance of the land, it is likely that a geophysical survey would be of value in identifying potential sub-surface features.

Therefore, a programme of archaeological testing will be undertaken across the greenfield areas of the proposed development lands prior to the commencement of construction works, under license to the National Monuments Service of the Department of Culture, Heritage and the Gaeltacht.

Should any features of archaeological potential be identified, then they will be assessed, and following consultation with the National Monuments Service, should it not be possible to preserve these in-situ, then they will be excavated in full (preservation by record) under license to the National Monuments Service.

4.2 GROUND CONDITIONS

Ground Investigations Ireland (GII) carried out an environmental site investigation directly to the east of the proposed development site between October 2019 and February 2020 (BSM, 2021). The scope of works included trial pitting, borehole drilling, subsoil sampling, interpretation of chemical data and reporting. Site investigation works also entailed Geotechnical & Environmental Laboratory testing (12 No in total for environmental testing).

During the 2019 and 2020 site investigations, samples were recovered from the on-site trial pit and borehole locations and sent for analysis. In order to assess materials, which may be excavated and removed from Site, in terms of waste classification, a

selection of samples collected were analysed for a suite of parameters which allows for the assessment of the soils in terms of total pollutant content for classification of materials as hazardous or non-hazardous referred to as the 'RILTA Suite'. The parameter list for the RILTA suite includes analysis of the solid samples for arsenic, barium, cadmium, chromium, copper, cyanide, lead, nickel, mercury, zinc, speciated aliphatic and aromatic petroleum hydrocarbons, pH, sulphate, sulphide, moisture content, soil organic matter and an asbestos screen. The total pollutant content analysis also provides analytical data which can be used to assess the quality of the subsoils underlying the Site and allow an assessment of their suitability for a range of proposed uses against generic assessment criteria.

The RILTA Suite also includes those parameters specified in the EU Council Decision Establishing Criteria for the Acceptance of Waste at Landfills (Council Decision 2003/33/EC), referred to as Waste Acceptance Criteria (WAC), which for the solid samples are pH; total organic carbon (TOC); speciated aliphatic and aromatic petroleum hydrocarbons; benzene, toluene, ethylbenzene and xylene (BTEX); phenol; polychlorinated biphenyls (PCB); and polycyclic aromatic hydrocarbons (PAH).

In line with the requirement of Council Decision 2003/33/EC, leachate was generated from the solid samples, which was in turn analysed for antimony, arsenic, barium, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, chloride, fluoride, soluble sulphate, sulphide, phenols, dissolved organic carbon (DOC) and total dissolved solids (TDS). The suite was selected due to the unknown origin of the material underlying the Site and no evidence of specific contaminants of concern highlighted in the Site history. The laboratory testing was competed by Element Materials Technology (EMT) in the UK; EMT is a UKAS accredited laboratory(BSM, 2021)

The laboratory analysis did not identify any asbestos containing materials (ACMs) in any of the samples tested.

All of the samples collected at the site were categorised as inert (as per Council Decision annex 2003/33/EC). There was no evidence of waste deposited on-site during Site investigation works (BSM, 2021).

If any potentially contaminated material is encountered, it will need to be segregated from clean/inert material, tested and classified as either non-hazardous or hazardous in accordance with the EPA publication entitled *'Waste Classification: List of Waste & Determining if Waste is Hazardous or Non-Hazardous'* [12] using the *HazWasteOnline* application (or similar approved classification method). The material will then need to be classified as clean, inert, non-hazardous or hazardous in accordance with the *EC Council Decision 2003/33/EC* [13], which establishes the criteria for the acceptance of waste at landfills.

In the event that Asbestos Containing Materials (ACMs) are found, the removal will only be carried out by a suitably permitted waste contractor, in accordance with *S.I. No. 386 of 2006 Safety, Health and Welfare at Work (Exposure to Asbestos) Regulations 2006-2010.* All asbestos will be taken to a suitably licensed or permitted facility.

In the event that hazardous soil, or historically deposited waste is encountered during the construction phase, the contractor will notify FCC and provide a Hazardous/Contaminated Soil Management Plan, to include estimated tonnages, description of location, any relevant mitigation, destination for disposal/treatment, in addition to information on the authorised waste collector(s).

5.0 SITE LOGISTICS

5.1 SITE SAFETY COMPLIANCE

The Contractor shall be responsible for overall management of the site for the duration of the proposed works and must progress their works with reasonable skill, care, diligence and to proactively manage the works in a manner most likely to ensure the safety and welfare of those carrying out construction works.

The Contractor shall comply with all relevant Statutory requirements such as the 2005 Safety Health and Welfare at Work Act, The Construction Regulations (SI 291 of 2013), the General Application Regulations (SI 299 of 2007), etc. (and any amendments thereof).

In addition, the Contractor shall comply with all the reasonable safety requirements of the Client, the Project Supervisor for the Design Process and the Project Supervisor for the Construction Stage.

5.2 SITE ESTABLISHMENT AND SECURITY

The first activity to be carried out at the site will be the establishment of site facilities and security. It is anticipated that site establishment works will take approximately four weeks. The site office and welfare facilities will be confirmed in advance of the commencement of site works and agreed with Fingal County Council. Figure 3.1 point shows the proposed locations of the site compounds.

All of the sub-contractors as well as the main contractor and project managers will occupy offices within the construction compounds. The site parking for all staff, contractors and visitors will also be located in this area.

Site access will be restricted by dedicated security personnel who will check all incoming and outgoing vehicles and workers.

5.3 CONSENTS AND LICENSES

All statutory consents and licences required to commence on-site construction activities will be obtained ahead of works commencing, allowing for the appropriate notice period. These will include, but are not limited to:

- Site notices;
- Construction commencement notices; and
- Licence to connect to existing utilities and mains sewers, where required;

5.4 SERVICES AND UTILITIES

Welfare facilities (canteens, toilets etc.) will be available within the construction compound and this will remain in place for the construction of the proposed development. The offices and site amenities will initially need to have their own power supply (generator), water deliveries and foul water collection until connections are made to the mains networks.

Electrical connections will be made by suitably qualified personnel following consultation with the relevant authorities and will be cognisant of subsequent construction works. High voltage connections will be established for heavy duty equipment and site facilities, as required.

The current electricity facilities on the site of the proposed development are supplied by the ESB through a ring network. All electrical works, including connection to the ESB network will be carried out by a suitably qualified contractor.

Water will be required for welfare facilities, dust suppression and general construction activities. There will also be foul waste water requirements associated portable sanitary facilities within the construction compound.

The welfare facilities (canteens, toilets etc.) will be available within the construction compound on site. The site office and welfare facilities will be situated on site at an agreed location within the site boundary with one of the potential locations being in Phase 5 as shown in figure 3.1.

The Main Contractor will require a water source for the duration of the construction works. A temporary connection for water supply from Irish Water will not be requested. Instead a combination of tankered water and bottled water will be used. Water will be required for Contractor welfare facilities and construction activities. A combination of tankered water and bottled water will be used in the early phase of construction. Temporary connections to the existing estate services in the existing estate road will be utilised by the Main Contractor to provide service and utilities subject to relevant applications and approvals.

While there is existing surface and foul water infrastructure within the site this is to be grubbed up and removed during site preparation works. Wastewater generated at the welfare facilities in the construction compound will be managed in the early phase by means of a temporary sealed storage tank, with all wastewater being tankered off-site to an appropriately licensed facility for disposal. Temporary connections to the existing wastewater services in the existing estate road will be utilised to provide service and utilities subject to relevant applications and approvals.

5.5 MATERIAL HANDLING AND STORAGE

Key materials which will be ordered by specific order for the project, a ‘Just in Time’ delivery system will operate to minimise storage of materials, the quantities of which are unknown at this stage.

Where possible it is proposed to source general construction materials from the Dublin area to minimise transportation distances.

Aggregate materials such as sands and gravels will be stored in clearly marked receptacles in the compound area within the site. Liquid materials will be stored within temporary bunded areas, doubled skinned tanks or bunded containers (all bunds will conform to standard bunding specifications – BS EN 1992-3:2006) to prevent spillage.

Construction materials will be brought to site by road. Construction materials will be transported in clean vehicles. Lorries/trucks will be properly enclosed or covered during transportation of friable construction materials and spoil to prevent the escape material along the public roadway.

The majority of construction waste materials generated will be soil from excavation works. Material will be removed from site regularly to ensure there is minimal need for stockpiling.

5.6 VISITOR MANAGEMENT

Visitors will only be allowed to enter the main site compound via the designated pedestrian access gate. A dedicated, secured footpath to the site office is established at the gate for registration and obtaining PPE prior to entering the site. A log will be maintained by security to control access to the site. Visitors will be required to attend a site-specific induction to allow access to the compound and/or construction site unless being accompanied by an inducted member of the site team.

Visitors will then be taken by an inducted member of the construction team to the required area of the site.

5.7 SITE WORKING HOURS

Site development and building works will only be carried out between the hours of 0800 to 1900 Mondays to Fridays inclusive and between 0800 and 1300 hours on Saturdays There will be no construction works carried out on Sundays or public holidays. Deviation from these times will only take place when written approval is granted by FCC in exceptional circumstances.

5.8 EMPLOYMENT AND MANAGEMENT WORKFORCE

It is estimated that there will initially be 80-100 staff on site on a typical day, however during peak construction periods this is expected to fluctuate up to 200-250 staff and contractors on site per day.

It is anticipated that the key project managers and main contractor representatives will maintain a presence on site for the whole duration of the project and the labour workforce will be determined by the specialist contractors required on site.

All employees working on the site will be required to have a SafePass Card (or similar approved Construction Health & Safety card), manual handling training, CIF COVID 19 training and the necessary certificates to operate machinery as required. The details of training required, records maintained, and induction procedures will be outlined in the Main Contractor's Health and Safety Plan(s).

6.0 CONSTRUCTION TRAFFIC AND SITE ACCESS

6.1 TRAFFIC MANAGEMENT

Traffic will be managed in accordance with the principles outlined below and shall comply at all times with the requirements of:

- Department of Transport Traffic Signs Manual 2010 – Chapter 8 Temporary Traffic Measures and Signs for Roadworks
- Department of Transport Guidance for the Control and Management of Traffic at Road Works (2010)
- Any additional requirements detailed in Design Manual for Urban Roads & Streets (DMURS)

Construction traffic operation would be limited to 0800 to 1900 from Monday to Friday and 0800 to 1300 on Saturday for the off-road construction. These times may vary to facilitate specific site requirements and/or construction activities associated with the site.

A Construction Manager will be appointed to liaise directly with the various sections of Fingal County Council. The Construction Traffic Management Plan will take into account construction vehicle routing and timing to mitigate any issues with vehicles on the public road network.

Excavated material will be reused as part of the site development works where possible to minimise truck movements to and from the site (e.g. use as non-structural fill under green areas).

All parking areas for operatives and visitors will be clearly marked.

Internal routes for construction traffic will be clearly marked and temporary lighting provided as necessary.

Speed limits imposed will be strictly adhered to during the construction of the works.

Separated pedestrian traffic routes within the site will be clearly marked, have appropriate lighting and be guarded. All vehicle crossing points will have appropriate signage to alert pedestrians of possible interaction. All site operatives will be given a specific site induction, giving information on the pedestrian access routes.

Wheel wash facilities will be provided from the start of the project to the completion of the project. The wheel wash will be stationed before site egress. The cleaning of vehicles will be carried out by the gateman onsite. This will be used for all heavy goods vehicles leaving the site daily. A road sweeper will also be utilised as required on Moyne Road at the vehicular access / egress point.

This Construction Traffic Management Plan will be revised by the Construction contractor will include, inter alia, any conditions of planning, a detailed construction programme for the works, hours of operation, details of a truck wheel wash at the site entrance, and details of entrance signage, and construction lighting.

6.2 SITE ACCESS AND EGRESS ARRANGEMENTS

It is proposed that the accesses and haul roads for vehicles will utilising the existing north-south haul road from Mayne Road via a road bridge over the River Mayne (see Figure 7.1 below). The existing dedicated access road for all construction vehicles is present which links the proposed development site Growth Area 2 (‘GA2’) site (and the adjacent development sites GA1 and GA3) directly to Moyne Road. A junction is formed with Moyne Road which includes appropriate construction signage. The access road is for construction traffic only and has no traffic impact on the existing residences in the Baldoyle Stapolin LAP lands.

All construction traffic will use the haulage route to the north. Construction traffic will not be permitted to use Red Arches Road, Red Arches Park or Grange Road/Longfield Road unless permission is obtained from Fingal County Council.

Figure 6.1 *Site Location and Context; indicative site boundary in red (Source: Google Maps)*

During the execution of the construction works, only site operatives and authorised visitors will be permitted to enter the works areas with appropriate PPE safety gear via the existing Moyne Road access point. Only authorised vehicles will be permitted on site. The Main Contractor Site Manager is responsible for managing access for site operatives, authorised visitors and vehicles.

The Main Contractor Site Manager will be responsible for managing the delivery of materials and equipment to minimise disruptions to other road users and residents. Deliveries of materials and equipment will be limited to off peak times.

Vehicles will be directed to the delivery points for holding/off-loading/storage. These deliveries will be controlled by a dedicated person on site allocated to overseeing all deliveries and controlling the entrance.

Certain trades will require parking on site for vehicles due to transportation of specialist equipment/plant requirements. A specially designated parking area located beside the site compound and storage area will be allocated for this. Parking of Heavy Goods Vehicles, if required, will be within the site and in designated areas which will be clearly marked out. Heavy Goods Vehicles will generally only be carrying out deliveries to site.

6.3 HEAVY GOODS VEHICLE (HGV) ACCESS ROUTE AND TRAFFIC QUEUEING

Material deliveries and collections from site will be planned, scheduled and staggered to avoid any unnecessary build-up of construction works related traffic.

Heavy Goods Vehicle (HGV) access routes on the wider road network will be restricted to specified routes and incorporated into training and induction for drivers. The access

routes will lead to the existing construction access point on Moyne Road. A potential access route for Heavy Goods Vehicles, subject to the approval of Fingal County Council, is shown below. This route endeavours to avoid residential areas as much as possible. Note that trucks cannot negotiate the rail bridge at Moyne Road.

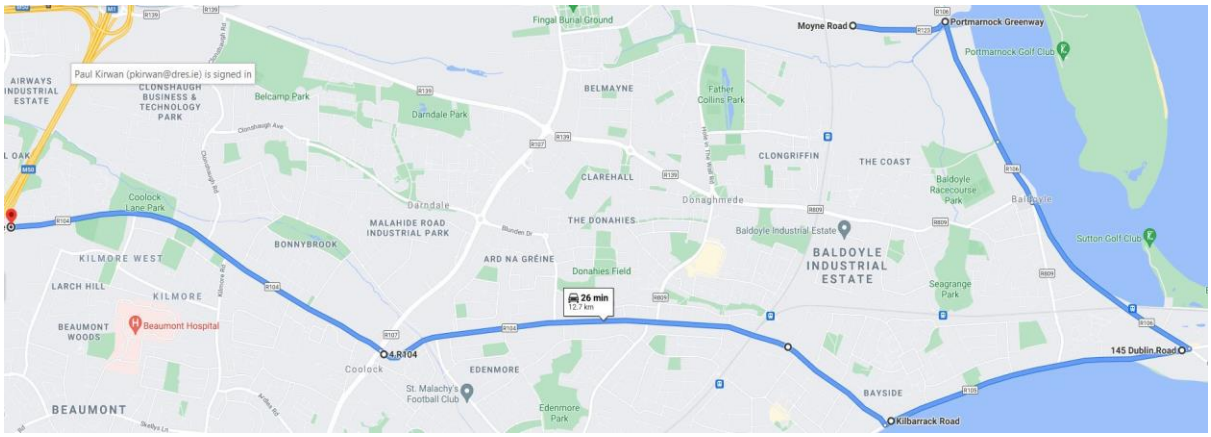

Figure 6.2 *Access route for Heavy Goods Vehicles*

6.4 LANE / ROAD CLOSURES

Road closures are not anticipated, however if they are required for the delivery of large items of plant or materials then such temporary road closures will be planned and approved by the Local Authority and other relevant authorities.

Two-way traffic will be maintained throughout the project. Advanced warning signs will be placed at sufficient distances to taper off the entry and exit points. Pedestrian marshals will be used as and when required.

7.0 SAFETY, HEALTH AND ENVIRONMENTAL CONSIDERATIONS DURING CONSTRUCTION WORKS

The appointed main contractor will be required to prepare a Construction Health & Safety Plan which will be put in place prior to commencement of the works. At a minimum, this plan will include:

- Construction Health & Safety training requirements;
- Covid 19 guidelines;
- Induction procedures;
- Emergency protocols; and
- Details of welfare facilities.

7.1 CONSTRUCTION LIGHTING

Construction work will generally be confined to daylight hours and lightning will generally not be required for the construction phase. There will however be occasions where the provision of portable lighting will be required (works on roadways and power floating floors as examples). Where possible and without jeopardising site safety lights will be pointed down at a 45-degree angle and away from sensitive receptors. The site compound will have external lights for safety and security. These lights will be pointed down at a 45-degree angle and away from sensitive receptors where possible.

7.2 AIR QUALITY

This section describes the site policy with regard to dust management and the specific mitigation measures which will be put in place during construction works. The objective of dust control at the site is to ensure that no significant nuisance occurs at nearby sensitive receptors. In order to develop a workable and transparent dust control strategy, the measures set out below have been formulated by drawing on best practice guidance from Ireland, the UK and the US, such as:

- Department of Environment, Heritage and Local Government (DOEHLG), *Quarries and Ancillary Activities, Guidelines for Planning Authorities* (2004) [1];
- US Environment Protection Agency (USEPA), *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition* (periodically updated) (1986) [2];
- The Scottish Office – Development Department, *Planning Advice Note PAN50 Controlling the Environmental Effects Of Surface Mineral Workings Annex B: The Control of Dust at Surface Mineral Workings* (1996) [3]; and
- Institute of Air Quality Management (IAQM), *Guidance on the Assessment of Dust from Demolition and Construction* (2014) [4].

7.2.1 Site Management

The site activities will be undertaken with due consideration of the surrounding environment and the close proximity of sensitive receptors such as residents and pedestrians. Dust management during the construction phase will be the most important aspect in terms of minimising the impacts of the project on the surrounding air quality. The following measures will also be implemented to ensure impacts are minimised:

- Complaint registers will be kept detailing all telephone calls and letters of complaint received in connection with construction activities, together with details of any remedial actions carried out;
- Equipment and vehicles used on site will be in good condition such that emissions from diesel engines etc. are not excessive; and
- Pre-start checks will be carried out on equipment to ensure they are operating efficiently and that emission controls installed as part of the equipment are functional.

Dust deposition levels will be monitored on a regular basis in order to assess the impact that site activities may have on the local ambient air quality. The following procedure will be implemented:

- The dust deposition rate will be measured by positioning Bergerhoff Dust Deposit Gauges at strategic locations near the boundaries of the site for a period of 30 (+/- 2) days if required. Monitoring should be conducted as required during periods when the highest levels of dust are expected to be generated i.e., during site preparation works and soil stripping activities.
- The exact locations will be determined after consideration of the requirements of Method VDI 2119 with respect to the location of the samplers relative to obstructions, height above ground and sample collection and analysis procedures.
- After each 30 (+/- 2 days) exposure period, the gauges will be removed from the sampling location, sealed and the dust deposits in each gauge will be determined gravimetrically by an accredited laboratory and expressed as a dust deposition rate in mg/m^2/day in accordance with the relevant standards.

- Technical monitoring reports detailing all measurement results, methodologies and assessment of results shall be subsequently prepared and maintained by the Site Manager.

A limit value of 350 mg/m^2/day will be used in comparison with recorded values.

7.2.2 Dust Control Measures

The aim is to ensure good site management by avoiding dust becoming airborne at source. This will be done through good design, planning and effective control strategies. The siting of construction activities and the limiting of stockpiling will take note of the location of sensitive receptors and prevailing wind directions in order to minimise the potential for significant dust nuisance. In addition, good site management will include the ability to respond to adverse weather conditions by either restricting operations on-site or using effective control measures quickly before the potential for nuisance occurs.

- During working hours, technical staff will be available to monitor dust levels as appropriate; and
- At all times, the dust management procedures put in place will be strictly monitored and assessed.

The dust minimisation measures should be reviewed at regular intervals during the construction phase to ensure the effectiveness of the procedures in place and to maintain the goal of minimisation of dust generation. In the event of dust nuisance occurring outside the site boundary, site activities should be reviewed, and procedures implemented to rectify the problem. Specific dust control measures to be employed are presented below.

Site Routes

Site access routes (particularly unpaved areas) can be a significant source of fugitive dust from construction sites if control measures are not in place. The most effective means of suppressing dust emissions from unpaved roads is to apply speed restrictions. Studies show that these measures can have a control efficiency ranging from 25% to 80% [5].

- A speed restriction of 20 km/hr will be applied as an effective control measure for dust for on-site vehicles or delivery vehicles within the vicinity of the site;
- Access gates to the site shall be located at least 10m from sensitive receptors where possible;
- Bowsers will be available during periods of dry weather throughout the construction period. Research shown found that the effect of surface watering is to reduce dust emissions by 50% [6]. The bowser will operate during dry periods to ensure that unpaved areas are kept moist. The required application frequency will vary according to soil type, weather conditions and vehicular use; and
- Any hard surface roads will be swept to remove mud and aggregate materials from their surface while any unsurfaced areas shall be restricted to essential site traffic only.

Excavation

Excavation works during periods of high winds and dry weather conditions can be a significant source of dust.

- During dry and windy periods, and when there is a likelihood of dust nuisance, watering shall be conducted to ensure moisture content of materials being moved is high enough to increase the stability of the soil and thus suppress dust;
- During periods of very high winds (gales), activities likely to generate significant dust emissions should be postponed until the gale has subsided.

The movement of truck containing materials with a potential for dust generation to an off-site location will be enclosed or covered.

Stockpiling

The location and moisture content of rubble stockpiles are important factors which determine their potential for dust emissions. The following measures will be put in place:

- Overburden material will be protected from exposure to wind by storing the material in sheltered parts of the site, where possible;
- Regular watering will take place during dry/windy periods to ensure the moisture content is high enough to increase the stability of the soil and suppress dust;
- Where feasible, hoarding will be erected around site boundaries to reduce visual impact. This will also have an added benefit of preventing larger particles from impacting on nearby sensitive receptors.

Site Traffic on Public Roads

Spillage and blow-off of debris, aggregates and fine material onto public roads will be reduced to a minimum by employing the following measures:

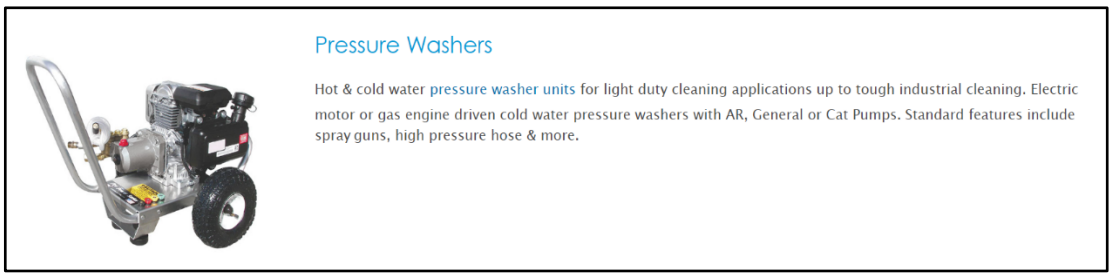

Figure 7.1 Example of Proposed wheel cleaning equipment example

- Vehicles delivering material with potential for dust emissions to an off-site location shall be enclosed or covered at all times to restrict the escape of dust;
- Any hard surface site roads will be swept to remove mud and aggregate materials from their surface while any unsurfaced roads shall be restricted to essential site traffic only.
- A power washing facility or wheel cleaning facility will be installed near to the site compound for use by vehicles exiting the site when appropriate, and an example of the washing equipment can be seen in Figure 7.1;
- The site entrance will be located so that vehicles cannot bypass these devices. Perimeter silt fences or bunds may assist in achieving this requirement; and
- Road sweepers will be employed to clean the site access route as required.

General

- The pro-active control of fugitive dust will ensure that the prevention of significant emissions, rather than an inefficient attempt to control them once they have been released, will contribute towards the satisfactory management of dust by the construction contractor.

7.3 ECOLOGY

The key strategies to be undertaken to minimise impact on the local flora and fauna during site clearing and construction are as follows.

- The noise management mitigation measures contained in Section 8.4 will ensure that construction noise wont impact on ecology.
- The surface water management and mitigation measures contained in Section 8.6 including the provision of the surface water management plan will ensure that silt run-off and potential flooding risks are minimised which will protect any ecological receptors associated with the site.
- Relevant guidelines and legislation (Section 40 of the Wildlife Acts, 1976 to 2012) in relation to the removal of trees and timing of nesting birds will need be followed (i.e. do not remove trees or shrubs during the nesting season (1 March to 31 August, inclusive)). Snipe will be protected on site with the presence on ecologist during initial site clearance.
- Pre-construction inspections will be carried out for bats and terrestrial mammals of conservation importance. Appropriate derogation licences will be acquired and conditions implemented if roosting bats or resting/breeding places of terrestrial mammals are noted on site or impacted by the proposed development.
- Boundary vegetation, treelines and hedgerows may serve as commuting corridors for bats (and other wildlife) and will remain unlit during the construction phase.
- The use of appropriate water-based dust suppression systems will greatly reduce the amount of dust and windborne particulates as a result of the construction process. The main Contractor will be responsible for the coordination, implementation and ongoing monitoring of the Dust Management Plan mitigation measures outlined in Section 8.2 and in the Dust Management Plan (Appendix 9.3) shall be implemented.
- Construction lighting will be designed so as to be sensitive to the potential presence of nocturnal wildlife within and external to the site. Construction lighting will adhere to the following guidance:
    - Bats & Lighting: Guidance Notes for Planners, engineers, architects and developers (Bat Conservation Trust, 2010);
    - Guidance Notes for the Reduction of Obtrusive Light GN01 (Institute of Lighting Professionals, 2011);
    - Bats and Lighting in the UK – Bats and the Built Environment Series (Bat Conservation Trust UK, January 2008).

7.4 NOISE AND VIBRATION

Noise impacts arising from earthworks and construction activities have the potential to cause annoyance or nuisance to local residents and businesses in the area.

The earthworks will generate typical construction activity related noise and vibration sources from use of a variety of plant and machinery such as rock breakers (if required), excavators, lifting equipment, dumper trucks, compressors and generators.

The noise limits to be applied for the duration of the infrastructure works are those specified in the B Category of BS 5228. These limits are summarised below and will be applied at the nearest sensitive receptors to the works.

- Night (23:00-07:00) = 55dB $L_{Aeq,1hr}$
- Evening (19:00-23:00) = 65dB $L_{Aeq,1hr}$
- Day (07:00-19:00) = 70dB $L_{Aeq,1hr}$

The total construction noise ($L_{Aeq,1hr}$) which should not be exceeded during daytime is therefore 70dB.

General Noise Mitigation

The earthworks will generate typical construction activity related noise and vibration sources from use of a variety of plant and machinery such as rock breakers (if required), excavators, lifting equipment, dumper trucks, compressors and generators.

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- Day (07:00-19:00) = 70dB $L_{Aeq,1hr}$

The total construction noise ($L_{Aeq,1hr}$) which should not be exceeded during daytime is therefore 70dB.

Following the same approach, BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Vibration recommends that, for soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak component particle velocity (in frequency range of predominant pulse) of 15mm/s at 4Hz increasing to 20mm/s at 15Hz and 50mm/s at 40Hz and above.

The standard also notes that below 12.5 mm/s PPV the risk of damage tends to zero. The recommended construction vibration criteria;

- Less than 15Hz - 15mm/s
- 15 to 40 Hz - 20mm/s
- 40 Hz and above - 50mm/s

Any noise complaints related to activities at the site will be logged and investigated and, where required, measures taken to ameliorate the source of the noise complaint.

A designated noise liaison should be appointed to site during construction works. Any complaints should be logged and followed up in a prompt fashion. In addition, prior to particularly noisy construction activity, e.g. excavation close to a property, etc., the site contact should inform the nearest noise sensitive locations of the time and expected duration of the works.

All works on site shall comply with BS 5228 2009+ A1 2014 (Parts 1 & 2) which gives detailed guidance on the control of noise and vibration from construction activities. In general, the contractor shall implement the following mitigation measures during the proposed infrastructure works:

- Avoid unnecessary revving of engines and switch off equipment when not required.
- Keep internal haul roads well maintained and avoid steep gradients.
- Minimise drop height of materials.
- Start-up plant sequentially rather than all together

More specifically the Contractor shall ensure that:

- In accordance with "Best Practicable Means", plant and activities to be employed on site are reviewed to ensure that they are the quietest available for the required purpose.
- Where required, improved sound reduction methods are used e.g. enclosures.
- Site equipment is located away from noise sensitive areas, as much as physically possible.
- Regular and effective maintenance by trained personnel is carried out to reduce noise and / or vibration from plant and machinery.
- Hours are limited during which site activities likely to create high levels of noise and vibration are carried out.
- A site representative responsible for matters relating to noise and vibration will be appointed prior to construction on site.

External noise and vibration monitoring will be undertaken at locations on the site boundary closest to sensitive locations. It is considered that it will be appropriate to amend the monitoring program as the works progress. Accordingly, monitors may be added, removed or relocated as necessary.

The noise monitoring terminals should provide the following at minimum:

- Logging at hourly intervals; and
- Daily CIC automated calibrations.

Vibration monitoring terminals should continually log vibration levels using the Peak Particle Velocity parameter (PPV, mm/s) in the X, Y and Z directions, in accordance with BS ISO 4866: 2010: *Mechanical vibration and shock – Vibration of fixed structures – Guidelines for the measurement of vibrations and evaluation of their effects on structures.*

The mounting of the transducer to the vibrating structure, by way of resin fixings only, will need to comply with BS EN ISO 5348: 1998: *Mechanical vibration and shock – Mechanical mounting of accelerometers*. In summary, the following ideal mounting conditions apply:

- The transducer and its mountings should be as rigid as possible;
- The mounting surfaces should be as clean and flat as possible;
- Simple symmetric mountings are best, and;
- The mass of the mounting should be small in comparison to that of the structure under test.

7.5 WASTE MANAGEMENT

This section outlines the measures that will be undertaken to minimise the quantity of waste produced at the site and the measures to handle the waste in such a manner as to minimise the effects on the environment. A site-specific Construction and Demolition Waste Management Plan has been prepared by AWN Consulting. and will be employed to ensure sustainable and effective waste management throughout the construction and excavation phases of the project.

Adherence to the C&D WMP prepared for the construction works will ensure that the management of waste arising is dealt with in compliance with the provisions of the *Waste Management Acts 1996 – 2011* as amended [7], associated Regulations [7], the *Litter Pollution Act of 1997*-2009 as amended [8] and the *Eastern-Midlands Region Waste Management Plan 2015 – 2021* [9], and that it will achieve optimum levels of waste reduction, re-use and recycling.

Typical waste materials that will be generated from the construction works will include:

- Soil and stones;
- Concrete, bricks, tiles and ceramics;
- Wood, glass and plastics;
- Metals;
- Gypsum-based construction material;
- Paper and cardboard;
- Mixed C&D waste;
- Chemicals (solvents, paints, adhesives, detergents etc.) ; and

The management of all hazardous waste arisings, if they occur, shall be coordinated in liaison with Health and Safety Management.

1.1.1 Waste Minimisation

Waste minimisation measures proposed are summarised as follows (and are described in more detail in the C&D WMP):

- Materials will be ordered on an 'as needed' basis to prevent over supply;
- Materials will be correctly stored and handled to minimise the generation of damaged materials;
- Materials will be ordered in appropriate sequence to minimise materials stored on site;
- A waste tracking log will be established;
- Sub-contractors will be responsible for similarly managing their wastes; and
- All wood waste generated by site works will be inspected and examined and will be segregated as re-useable wood and scrap wood waste.

1.1.2 Waste Storage

The main waste storage area will be located in the site compound. A dedicated and secure area containing bins, and/or skips, and storage areas, into which all waste materials generated by construction site activities, will be established within the development see figure 3.1.

Waste materials generated will be segregated on at the site compound, where it is practical. Where the on-site segregation of certain wastes types is not practical, off-site segregation will be carried out. There will be skips and receptacles provided to facilitate segregation at source. All waste receptacles leaving site will be covered or enclosed. The appointed waste contractor will collect and transfer the wastes as receptacles are filled. There are numerous waste contractors in the Dublin Region that provide this service.

The site construction manager will ensure that all staff are informed of the requirements for segregation of waste materials by means of clear signage and verbal instruction. Appointed employees will be made responsible for ensuring good site housekeeping.

1.1.3 Pest Management

A pest control operator will be appointed as required to manage pest onsite during the construction phase of the project.

Organic and food wastes generated by staff will not be stored in open skips, but in closed waste receptacles. Any waste receptacles will be carefully managed to prevent leaks, odours and pest problems.

7.5.1.1 Responsibility

It will be the responsibility of the construction manager to ensure that a written record of all quantities and natures of wastes removed from the site are maintained on-site in a waste file (in hardcopy or electronically).

It is the responsibility of the project manager or his/her delegate that all contracted waste haulage drivers hold an appropriate waste collection permit for the transport of waste loads and that all waste materials are delivered to an appropriately licensed or permitted waste facility in compliance with the relevant Regulations as outlined in the C&D WMP.

The contractor, as part of regular site inspection audits, will determine the effectiveness of the waste management strategy and will assist the project manager in implementing the measures under the C&D WMP and in determining the best methods for waste minimisation, reduction, re-use, recycling and disposal as the construction phase progresses and waste materials are generated.

Prior to commencement of the excavation and construction activity and removal of any waste off-site, details of the proposed destination of each waste stream will be provided to FCC, along with waste collection permit numbers.

7.6 PREVENTION OF ACCIDENTAL RELEASES

7.6.1 Prevention of Concrete Run-off

Concreting operations carried out near surface water drainage points during construction activities could lead to discharges to a watercourse.

No wash-down or wash-out of ready-mix concrete vehicles during the construction works will be carried out at the site within 10 meters of an existing surface water drainage point. Wash-outs will only be allowed to take place in designated areas with an impervious surface.

A suitable risk assessment for wet concreting will be completed prior to works being carried out, which will include measures to prevent discharge of alkaline waste waters or contaminated storm water to the underlying subsoil. Wash-down and washout of concrete transporting vehicles will take place at an appropriate facility off-site.

7.6.2 Fuel and Chemical Handling

The following mitigation measures will be implemented during the construction phase in order to prevent any spillages to ground of fuels and prevent any resulting to surface water systems:

- Designation of bunded refuelling areas on the Site;
- Provision of spill kit facilities across the Site;
- Where mobile fuel bowsers are used, the following measures will be taken:
    - Any flexible pipe, tap or valve will be fitted with a lock and will be secured when not in use;
    - The pump or valve will be fitted with a lock and will be secured when not in use;
    - All bowsers to carry a spill kit and operatives must have spill response training;
    - Portable generators or similar fuel containing equipment will be placed on suitable drip trays.

In the case of drummed fuel or other potentially polluting substances which may be used during the construction phase, the following measures will be adopted:

- Secure storage of all containers that contain potential polluting substances in a dedicated internally bunded chemical storage cabinet unit or inside a concrete bunded area;
- Clear labelling of containers so that appropriate remedial measures can be taken in the event of a spillage;
- All drums to be quality approved and manufactured to a recognised standard;
- If drums are to be moved around the Site, they will be secured and on spill pallets; and
- Drums will be loaded and unloaded by competent and trained personnel using appropriate equipment.

7.6.3 Other Chemical Storage

No bulk chemicals will be stored within the active construction areas. Temporary oil and fuel storage tanks will be kept in the material storage area in suitable containers and will be appropriately bunded as required. Refuelling of vehicles and the addition of hydraulic oils or lubricants to vehicles will take place in designated areas of the site, where possible, which will be kept away from any surface water drains (minumum 20 m buffer zone).

Spill protection equipment such as absorbent mats, socks and sand will be available to be used in the event of an accidental release during refuelling. Training will be given to appropriate site workers in how to manage a spill event.

The construction contractor will be required to implement emergency response procedures, and these will be in line with industry guidance. All personnel working on the Site will be suitably trained in the implementation of the procedures.

7.7 SURFACE WATER MANAGEMENT

During construction the contamination of surface waters, and run-off from excavations/earthworks cannot be prevented entirely and is largely a function of prevailing weather conditions.

The Construction Surface Water Management Plan prepared by AWN (Appendix 7.X) aims to set out the proposed procedures and operations to be utilised on the proposed construction site to protect water quality. The mitigation and control measures outlined in the SWMP will be employed on site during the construction phase. All mitigation measures outlined within the SWMP will be implemented during the construction phase, as well as any additional measures required pursuant to planning conditions which may be imposed.

The main areas of water related concerns covered by the SWMP document are:

- Pre-Construction, Construction Phase drainage controls;
- Management of Earthworks and Materials Storage;
- Surface water runoff protection (sit fences, silt traps, diversion channels);
- Prevention of Accidental Releases (concrete, fuel, and chemical handling); and
- Surface Water Treatment and Discharge, and
- Foul Water And Onsite Sanitation.

The SWMP is live document and will be modified over time as detailed contractor methods of work are developed. If the development is permitted an updated version of

this document will be issued to all parties involved in the construction process when appropriate changes are deemed necessary.

There shall not be discharge of ***untreated***, silty, or contaminated water from the works to any watercourse or stormwater network. Should any discharge of ***untreated*** construction water be required during the construction phase, the discharge will be to foul sewer following agreement with Fingal County Council / Irish Water.

There is no significant dewatering will be required during the construction phase which would result in the localised lowering of the water table. There may be localised pumping of surface run-off from the excavations during and after heavy rainfall events to ensure that the excavation is kept relatively dry.

The discharge of ***treated*** construction water from rainfall into excavated areas, or from any localised dewatering may be required during construction. This ***treated*** construction water will be discharged to the existing 1500 diameter concrete stormwater main, that traverses underneath the north fringe sewer and discharges to the Mayne River.

8.0 SUMMARY

This Outline CEMP sets out the overall management strategy for excavation and construction works for the proposed development. The Outline CEMP aims to ensure the management of excavation and construction activity is carried out in a planned, structured and considerate manner which minimises the impacts of the works on the local environment, residents and commercial activities in the vicinity of the site. Due to the nature of construction works, there may be unforeseen events which occur at the site and the project team will actively manage any changes and discuss with the relevant authorities, where required.

The project team are committed to ensuring that the construction activities to be carried out are pro-actively managed so as to minimise potential impacts.

9.0 REFERENCES

1. Department of Environment, Heritage and Local Government (DOEHLG), *Quarries and Ancillary Activities, Guidelines for Planning Authorities* (2004).
2. Department of Transport Traffic Signs Manual 2010 – Chapter 8 Temporary Traffic Measures and Signs for Roadworks (2010)
3. Department of Transport Guidance for the Control and Management of Traffic at Road Works (2010)
4. Design Manual for Roads and Bridges & Design Manual for Urban Roads & Streets (2019)
5. US Environment Protection Agency (USEPA), *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition (periodically updated)* (1986).
6. The Scottish Office – Development Department, *Planning Advice Note PAN50 Controlling the Environmental Effects Of Surface Mineral Workings Annex B: The Control of Dust at Surface Mineral Workings* (1996).
7. Institute of Air Quality Management (IAQM), *Guidance on the Assessment of Dust from Demolition and Construction* (2014).
8. UK Office of Deputy Prime Minister, *Controlling the Environmental Effects of Recycled and Secondary Aggregates Production Good Practice Guidance* (2002).
9. USEPA, *Fugitive Dust Technical Information Document for the Best Available Control Measures* (1997).
10. *Waste Management Acts 1996 – 2011* Litter Pollution Act 1997 (No. 12 of 1997) as amended
11. *Eastern-Midlands Region Waste Management Plan 2015 – 2021* (2015)
12. Construction Industry Research and Information Association (CIRIA) *Control of Water Pollution from construction Sites, Guidance for consultants and contractors (C532)*.
13. CIRIA, *Environmental Good Practice on Site* (3rd edition) (C692).

Appendix 8.1

Winter Bird Survey Report 2019/2020

Prepared for GA1 (ABP ref. TA06F.310418) and GA3 (ABP ref. TA06F.311016)

Project Shoreline Bird Surveys, Baldoyle, North Co. Dublin

MKO Planning and Environmental Consultants

Winter Bird Survey Report 2019/2020

Project Shoreline Bird Surveys, Baldoyle, North Co. Dublin

DOCUMENT DETAILS

Client:	**The Shoreline Partnership**
Project Title:	**Project Shoreline Bird Surveys, Baldoyle, North Co. Dublin**
Project Number:	**191203**
Document Title:	**Winter Bird Survey Report 2019/2020**
Document File Name:	**191203– F – Winter Bird Survey Report 2019/2020 – 2020.05.21**
Prepared By:	**MKO** **Tuam Road** **Galway** **Ireland** **H91 VW84**

Planning and Environmental Consultants

Rev	Status	Date	Author(s)	Approved By
01	Draft	20/04/2020	PM/IH	PC
01	Final	21/05/2020	PM/IH	DO'D

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1. INTRODUCTION

McCarthy Keville O'Sullivan (MKO) was appointed to carry out bird survey works at Baldoyle, north County Dublin during the period from December 2019 to March 2020 inclusive. The proposed development scheme consists of a large housing development on a greenfield site dominated by agricultural grassland. The site is approximately 50.7 ha in area and is located between Clongriffin Dart Station to the west and the Coast Road to the east. Figure 1 (Appendix 2) provides a map of the location of the proposed development boundary.

This report describes the ornithological survey methods employed and survey data collected at Baldoyle, north County Dublin for the period from December 2019 to March 2020 inclusive. This report also contains information compiled during the desktop study. Particular attention has been paid to species of conservation importance and identified target species. See Figure 1 and Figure 2 in Appendix 2 for a map of the areas surveyed between December 2019 and March 2020.

The report is supported by Technical Appendix 1 which contains the raw data from the winter bird surveys in 2019/2020. This includes detail on survey times, weather conditions, surveyors, survey results and other additional information. Flight lines and significant flocks recorded during surveys are shown in Appendix 2.

The report is structured as follows:

- An introduction providing a description of the background and statement of authority regarding ornithological works.
- A description of the desktop study carried out with regards to the site.
- A comprehensive description of survey methods.
- A full description of results for all ornithological surveys conducted.
- A discussion of the potential impacts.

The following defines terms used in this report

- "Zones of Influence" (ZOI) for potential ornithological receptors refers to the zone within which potential effects are anticipated. ZOIs were assigned following best available guidance (SNH 2016 and McGuinness et.al 2015).

1.1 Statement of Authority

This report has been prepared by Patrick Manley (B.Sc.) an Ornithologist with MKO, Ian Hynes (B.Sc.) and Senior Ornithologist, Padraig Cregg (M.Sc.). The field surveys were undertaken in the 2019 breeding season by Padraig Cregg, Eric Dempsey and Susan Doyle, all of whom are competent experts in bird surveying.

CVs for the authors of this report and all personnel who carried out survey work are provided in Appendix 3.

2. DESK STUDY

2.1 Desk Study Methods

A comprehensive desk study was undertaken prior to surveys in winter 2019 to search for any relevant information on species of conservation concern which may potentially make use of the study area. The assessment included a thorough review of the available ornithological data including:

- Review of online web-mappers: National Parks and Wildlife Service (NPWS), Irish Wetland Bird Survey I-WeBS.
- Review of Birds of Conservation Concern (BoCCI) in Ireland 2014-2019 (Colhoun & Cummins, 2013)

2.2 Desk Study Results

2.2.1 Identification of Designated Sites within the Likely Zone of Influence

Using GIS software, sites designated for nature conservation within the potential ZOI of the proposed development were identified. Baldoyle SPA is located directly to the east of the proposed development opposite the R106. The SPA is a narrow estuary totalling 262ha in area and is separated from the sea by sand dunes on its eastern boundary. Two small rivers, the Mayne River and the Sluice River, flow into the inner part of the estuary. The Mayne River runs from west to east along the northern boundary of the proposed development site. At low tide, large areas of intertidal mud flats are exposed. These mud flats comprise mostly of sands but grade to muds in the more sheltered parts of the estuary.

In addition, and in the absence of any specific European or Irish guidance, the Scottish Natural Heritage (SNH) Guidance, 'Assessing Connectivity with Special Protection Areas (SPA)' (2016) was consulted. This document provides guidance in relation to the identification of connectivity between proposed development proposals and Special Protection Areas. The guidance takes into consideration the distances some species may travel beyond the boundary of their SPAs and outlines information on dispersal and foraging ranges of bird species which are frequently encountered when considering plans and projects.

Designated sites located within the Likely Zone of Influence are listed below in Table 2-1 and illustrated in Appendix 2, Figure 2.

Table 2-1 Designated sites within likely zone of influence

Designated site and code	Distance from proposed development (Km)	Qualifying Interests/Special Conservation Interests for which the European Site has been designated (https://www.npws.ie, last viewed 20/04/2020)	Conservation Objectives	Zone of Influence Determination & Identification of Pathways for Effect
Special Protection Areas (SPA)				
Baldoyle Bay SPA (004016)	0.07m to the east of the proposed development site	› Light-bellied Brent Goose *(Branta bernicla hrota)* [A046] › Shelduck *(Tadorna tadorna)* [A048] › Ringed Plover (*Charadrius hiaticula*) [A137] › Golden Plover (*Pluvialis apricaria*) [A140] › Grey Plover (*Pluvialis squatarola*) [A141] › Bar-tailed Godwit (*Limosa lapponica*) [A157]	This site has detailed conservation objectives for each species listed as Qualifying Interests of the SPA: "To maintain the favourable conservation condition of the bird species listed as Special Conservation Interests of this SPA." This site also has a second conservation objective: "To maintain the favourable conservation condition of the wetland habitat in Baldoyle Bay SPA." (NPWS (2013) Conservation objectives: Baldoyle Bay SPA [004016]. Version 1.	The proposed development site is directly adjacent to the Baldoyle SPA and is therefore located within the potential foraging range of all the SCI species associated with the SPA.

2.2.2 Irish Wetland Bird Survey (IWeBS) Records

The study area is not covered by an I-WeBS site, but the nearest site is located directly adjacent to the proposed development site to the east at Baldoyle Bay SPA. Data from this I-WeBS site has been used to estimate the population of waterbirds in the area surrounding the proposed development area. The dataset for Baldoyle Bay SPA was downloaded from www.birdwatchireland.ie and reviewed. The most recent 5-season period and mean counts for this period are presented in Table 2-2. I-WeBS surveys for the 2011/12 and the 2012/13 survey seasons were not undertaken and no data is available for these years.

Table 2-2 IWeBS data for Baldoyle Bay SPA

Species	2011/12	2012/13	2013/14	2014/15	2015/16	5-season mean (2011/12-2015/16)
Mute Swan	-	-			2	2
Light-bellied Brent Goose	-	-	580	588	342	503
Egyptian Goose	-	-			1	1
Shelduck	-	-	52	97	88	79
Wigeon	-	-	54	54	32	47
Teal	-	-	145	160	108	138
Mallard	-	-	67	102	106	92
Pintail	-	-	4	4		4
Common Scoter	-	-	16	7		12
Red-breasted Merganser	-	-	6	5	2	4
Red-throated Diver	-	-	14	64		39
Great Northern Diver	-	-	1	2		2
Little Grebe	-	-	1			1
Great Crested Grebe	-	-	124	189		156
Cormorant	-	-	10	4	3	6
Shag	-	-	7			7
Little Egret	-	-	18	3	7	9
Grey Heron	-	-	5	7	7	6
Moorhen	-	-				
Oystercatcher	-	-	277	1113	219	536
Ringed Plover	-	-	34	59	123	72
Golden Plover	-	-	2500	450	2000	1650
Grey Plover	-	-	55	28	8	30
Lapwing	-	-	372	300	137	270
Knot	-	-	553		19	286
Sanderling	-	-	6			6
Dunlin	-	-	750	233	300	428
Snipe	-	-				
Black-tailed Godwit	-	-	389	139	296	275
Bar-tailed Godwit	-	-	162	150	48	120
Curlew	-	-	90	61	106	86
Greenshank	-	-	6	11	3	7

Species	2011/12	2012/13	2013/14	2014/15	2015/16	5-season mean (2011/12-2015/16)
Redshank	-	-	144	152	125	140
Turnstone	-	-	17	12	13	14
Black-headed Gull	-	-	242	281	52	192
Common Gull	-	-	64	11	4	26
Lesser Black-backed Gull	-	-	4	18	1	8
Herring Gull	-	-	47	91	58	65
Great Black-backed Gull	-	-	7	15	10	11

'-' indicates where no data was available.

2.2.3 Method of Identification of Target Species

Following a comprehensive desk study by MKO, initial site visit and consultation, a list of "Target species" likely to occur at the site was compiled. The survey work carried out on the site was specifically designed to survey for these identified target species in accordance with relevant survey guidance, e.g. I-WeBS methods. The target species list was drawn from:

- Annex I of the Birds Directive,
- Special Conservation Interests (SCI) of Special Protection Areas (SPA) within the zone of likely significant effects,
- Red listed birds of Conservation Concern in Ireland.

All species within these categories were considered as target species for the purpose of these surveys.

3. FIELD SURVEYS

3.1 Field Survey Methods

This section of the report describes the various field survey methods employed. Field surveys were undertaken from December 2019 – March 2020 inclusive. Field survey methodologies have been devised to survey for the bird species composition and assemblages that occur within the study area.

3.1.1 Initial Site Assessment

Based on the results of the desk study, the likely importance of the study area for bird species was determined. Based on the collated information available from the above preliminary assessment and adopting a precautionary approach, a site-specific scope for the ornithological surveys was developed.

3.1.2 Walkover Surveys

Winter walkover surveys were undertaken to determine the presence of bird species of high conservation concern within areas of potential suitable habitat in the study area. The walkover survey was undertaken within the redline boundary.

Transect routes were devised to ensure coverage of different habitat complexes within the study area, during each survey visit. The survey was undertaken (onsite) within two hours of high tide, as this is the period when birds from the estuary are most likely to make use of terrestrial habitats, such as those present within the proposed development area.The main aim of the survey was to identify if SCIs from the adjacent SPA were utilising areas onsite for foraging or roosting. Along with target species, all additional species observed were recorded to inform the evaluation of supporting habitat.

Survey effort, including details of survey duration and weather condition, is presented in Appendix 1, Table 1-1. Figure 1 in Appendix 1 shows the survey study area.

3.1.3 Baldoyle Bay SPA Surveys

Surveys of Balydoyle Bay SPA were broadly based on I-WeBS methodology. On each survey of the SPA a total count of each water bird species present was recorded. Information on behaviour (i.e. foraging or roosting) and habitat was also collected. During these surveys, estuarine habitats were described as intertidal, subtidal, supratidal or terrestrial.

Survey effort, including details of survey duration and weather conditions, is presented in Appendix 1, Table 1-1. Figure 2 in Appendix 1 shows the surveyed area.

3.1.4 Survey Justification

A comprehensive suite of bird surveys was undertaken at the site between December 2019 and March 2020, as detailed in this report.

The surveys undertaken provide the information necessary to allow a complete, comprehensive and robust assessment of the potential impacts of the proposed development on avian receptors.

3.2 Field survey results

3.2.1 Survey Effort

Surveys were undertaken between the 18th of December 2019 and 24th of March 2020. Two visits a month were undertaken during this period. Table 3-1 shows the survey effort for the 2019/2020 winter season.

Table 3-1 Survey Effort

Survey Date	Survey Location	Survey Duration	Surveyor
18/12/2019	Site and SPA	05:00 starting at 09:30	PC
23/12/2019	Site and SPA	02:35 starting at 09:20	ED
15/01/2020	SPA	02:20 starting at 10:00	SD
15/01/2020	Site	01:20 starting at 13:10	SD
28/01/2020	SPA	02:35 starting at 08:40	SD
28/01/2020	Site	01:45 starting at 11:40	SD
10/02/2020	Site	02:00 starting at 10:00	SD
10/02/2020	SPA	02:05 starting at 12:10	SD
24/02/2020	Site	02:00 starting at 09:55	SD
24/02/2020	SPA	02:00 starting at 12:30	SD
11/03/2020	SPA	01:55 starting at 12:45	SD
11/03/2020	Site	02:00 starting at 10:20	SD
24/03/2020	SPA	02:15 starting at 11:45	SD
24/03/2020	Site	02:00 starting at 09:30	SD

3.2.2 Walkover Survey Results

Walkover surveys were undertaken at the site between December 2019 and March 2020 inclusive. Summary results from the walkover surveys are presented below in Table 3-2 and discussed in further detail in Section 4 of this report. Figure numbers refer to figures provided in Appendix 2.

Table 3-2 Total number of each species recorded on site during walkover surveys (Peak Counts for each species are presented in bold)

Species	Conservation Status	December		January		February		March		Figure No.
		18th	23rd	15th	28th	10th	24th	11th	24th	
Bar-tailed Godwit (SCI of Baldoyle SPA)	Annex I; BoCCI Amber Listed (Wintering Populations)						**35**			
Light-bellied Brent Goose (SCI of Baldoyle SPA)	BoCCI Amber Listed (Wintering Populations)	12	40	49	7	11	**80**			1.1
Shelduck (SCI of Baldoyle SPA)	BoCCI Amber Listed						2		**4**	1.2
Black-headed Gull	BoCCI Red Listed (Breeding Populations)		1	13	15	8	**68**	1		1.3
Black-tailed Godwit	BoCCI Amber Listed (Wintering Populations)		12						**35**	1.4
Common Gull	BoCCI Amber Listed (Breeding Populations)	**24**							1	1.5
Common Snipe	BoCCI Amber Listed	4	1		**6**	4	3	3	5	1.6
Cormorant	BoCCI Amber Listed						**1**			
Great Black-backed Gull	BoCCI Amber Listed (Breeding Populations)					**1**				
Grey Heron	BoCCI Green Listed	**2**	1		1	1			1	1.7
Herring Gull	BoCCI Red Listed (Breeding Populations)		8	14	**21**	8	2	7	10	1.8
Lapwing	BoCCI Red Listed					**100**	30			1.9
Lesser Black-backed Gull	BoCCI Amber Listed (Breeding Populations)						**1**			
Little Egret	Annex I; BoCCI Green Listed								**1**	1.10
Mallard	BoCCI Green Listed				2	**20**	6	2	8	1.11
Moorhen	BoCCI Green Listed	**3**							1	1.12
Oystercatcher	BoCCI Amber Listed	**86**								1.13
Teal	BoCCI Amber Listed								**4**	1.14

3.2.3 SPA Survey Results

The SPA surveys were undertaken at Baldoyle Bay SPA between December 2019 and March 2020 inclusive. Summary results from there surveys are presented below. Table 3-3 shoes the total number of each SCI species during each survey. Table 3-4 shows the total number of birds present for all species within the SPA and Table 3-5 shows the total number of each non-SCI species recorded during the SPA surveys. These results are discussed in further detail in Section 4 of this report.

Table 3-3 Total number of each SCI species recorded within the Baldoyle Bay SPA during the SPA surveys (Peak Counts for each species are presented in bold)

Species and Conservation Status	Conservation Status	December		January		February		March	
		18th	23rd	15th	28th	10th	24th	11th	24th
Bar-tailed Godwit (SCI of Baldoyle SPA)	Annex I; BoCCI Amber Listed (Wintering Populations)	**47**			18	1			
Golden Plover (SCI of Baldoyle SPA)	Annex I; BoCCI Red Listed	**50**							
Grey Plover (SCI of Baldoyle SPA)	BoCCI Amber Listed (Wintering Populations)	**4**							
Light-bellied Brent Goose (SCI of Baldoyle SPA)	BoCCI Amber Listed (Wintering Populations)	69		29	398	227	167	**891**	538
Ringed Plover (SCI of Baldoyle SPA)	BoCCI Green Listed			12	**50**				
Shelduck (SCI of Baldoyle SPA)	BoCCI Amber Listed	53	26	47	**122**	45	41	30	12

Table 3-4 Overall number of birds per month within the Baldoyle Bay SPA

Survey Date	All Species	SCI Species
18th December	890	223
23rd December	76	26
15th January	685	88
28th January	1859	588
10th February	612	273
24th February	432	208
11th March	1236	937
24th March	1078	552

Table 3-5 Total number of each non-SCI species recorded within the Baldoyle Bay SPA during the SPA surveys (Peak Counts for each species are presented in bold)

Species	Conservation Status	December		January		February		March	
		18th	23rd	15th	28th	10th	24th	11th	24th
Black-headed Gull	BoCCI Red Listed (Breeding Populations)	32	6	47	**129**	63	101	16	2
Black-tailed Godwit	BoCCI Amber Listed (Wintering Populations)								**126**
Common Gull	BoCCI Amber Listed (Breeding Populations)	**9**	1		1				1
Cormorant	BoCCI Amber Listed			2	1	**6**	1		
Curlew	BoCCI Red Listed	35		57	**67**	1	3	6	4
Dunlin	Annex I; BoCCI Red Listed	**20**							
Gannet	BoCCI Amber Listed (Breeding Populations)								**6**
Great Black-backed Gull	BoCCI Amber Listed (Breeding Populations)	**16**	2	2	11			1	1
Great Crested Grebe	BoCCI Amber Listed				2	**6**	1	1	1
Greenshank	BoCCI Green Listed	1		1	**2**				
Grey Heron	BoCCI Green Listed	**1**	**1**						
Herring Gull	BoCCI Red Listed (Breeding Populations)	**136**		41	101	23	14	22	51
Knot	BoCCI Amber Listed (Wintering Populations)				**160**	53		25	
Lapwing	BoCCI Red Listed	1	7	38	**144**	11			
Lesser Black-backed Gull	BoCCI Amber Listed (Breeding Populations)				1	**2**			
Little Egret	Annex I; BoCCI Green Listed		1			1		6	**8**
Little Grebe	BoCCI Amber Listed			**1**					
Long-tailed Duck	BoCCI Red Listed (Wintering Populations)	1				**3**			
Mallard	BoCCI Green Listed	**53**		2	14	2	12	33	19
Oystercatcher	BoCCI Amber Listed	155		244	**538**	15	21	49	250
Red-breasted Merganser	BoCCI Green Listed	10	1	7	3	**15**	1	5	7
Redshank	BoCCI Red Listed	80	3	108	65	**115**	48	**115**	29

Species	Conservation Status	December		January		February		March	
		18th	23rd	15th	28th	10th	24th	11th	24th
Teal	BoCCI Amber Listed	15	11	14	28	16	22	**32**	16
Turnstone	BoCCI Green Listed	**22**		21	2	7			
Whooper Swan	Annex I; BoCCI Amber Listed (Wintering Populations)	**1**							
Wigeon	BoCCI Red Listed (Wintering Populations)	**79**	17	12	2			4	7

3.2.4 Other Observations

A number of observations of non-target species were recorded during the survey period. The most significant of these observations are detailed in Table 3-6 below and discussed in further detail in Section 4 of this report.

Table 3-6 Other observations during surveys

Species	Survey Type	Observations recorded during surveys	Activity of note
Buzzard	Walkover Survey	5	Calling from treeline, at potential nest site
Kestrel	Walkover Survey	1	None
Buzzard	SPA Survey	1	None

4. DISCUSSION

The following provides a synopsis of the findings of the surveys undertaken between December 2019 and March 2020.

Within the proposed development site and/or within 500m of the site, there were six main areas of importance to birds. These areas are presented in Appendix 2, Figure 3 and listed below:

- There was a roost site (including lapwing, black-tailed godwit, black-headed gull and teal) along the north-eastern margins of the proposed development area. This roost was partially within the proposed development site and extended to 160m from the proposed development site boundary.
- Light-bellied brent geese were observed foraging in two amenity areas adjacent to the proposed development site. One area was immediately adjacent to the proposed development site and the second area was within 30m of the proposed development site. There was one observation of this species at each amenity area.
- A potential buzzard nest site was located within mature trees along the boundary of the proposed development area.
- There were two areas in which common snipe were regularly observed within the proposed development site boundary.

During the SPA surveys, significant flocks were mapped during each survey; these maps are presented in Appendix 2, Figures 2.1 to 2.4, with one map per month of survey. From these maps, four areas of importance for birds were identified. These areas are presented in Appendix 2, Figure 4 and listed below:

- There was an area frequently used by light-bellied brent goose at the southern end of the Baldoyle Bay SPA. This location was particularly used in very windy conditions. This site was located 1.5 km to the south-east of the proposed development area at its closet point.
- Large flocks of light-bellied brent geese were found in an area on the western side of Baldoyle Bay SPA within 170m of the proposed development site, at its closest point.
- Oystercatcher and curlew were observed roosting along the eastern shoreline of the Baldoyle Bay SPA on multiple occasions.
- At the north-western edge of the Baldoyle Bay SPA, there is an important area for roosting waders (including lapwing, redshank and black-tailed godwits), that has been observed being utilised on multiple occasions. This site is located approximately 850m from the proposed development site at its closet point.

Key impacts that could result from the proposed development for local avian receptors include habitat loss, disturbance/displacement and water pollution.

The site consists of amenity grassland, improved agricultural grassland and areas of scrub. Of the SCI species from the Baldoyle Bay SPA, brent geese are considered the most likely to make use of the proposed development site. However, during the survey period much of grassland onsite was overgrown and did not offer the short grazing favoured by this species. There are two light-bellied brent goose foraging areas within close proximity (1m and 30m, at its closest point) of the development area to the south within amenity grassland habitats. Within the Baldoyle Bay SPA, there is one area of importance for light-bellied brent goose within 300m of the development site. This is a large area of mudflats frequently used by this species which is approximately 170m from the development boundary at its closest point. There is potential for disturbance during the construction phase of the proposed development at these locations.

A wader roost to the north-east of the proposed development site, at the mouth of the Mayne River, lies partially within the development site boundary. Habitat loss for this roost site can therefore not be ruled out and should be considered further in the EIAR.

In addition, the site was found to be utilized by wintering snipe and may contain a buzzard nest in a treeline along the site boundary. Direct habitat loss for these species cannot be ruled out.

5. CONCLUSION

As previously discussed, the proposed development area is not within the Baldoyle Bay SPA, however given the proximity of the SPA to the development, there is potential for impacts to result during construction and operational phases of the proposed development. These potential impacts could include:

- Loss of roosting habitat within/along the boundary of the redline at the mouth of the Mayne River.
- Disturbance during construction works and the operational phase to Special Conservation Interest of the SPA including through movement of machinery, personnel, noise, vibration and/or noise associated with domestic dwellings.
- Pollution of surface water through accidental spillage or discharge of polluting substances, or via elevated suspended solids and siltation through run-off to watercourses.

The maximum likely distance at which disturbance will impact SCIs from the Baldoyle Bay SPA is 300m (Cutts et al., 2013). The magnitude of this impact and its potential significance will require further consideration at the assessment stage of any future planning application.

The proposed housing scheme may result in disturbance of SCI's of the adjacent SPA. However, it is likely that habituation will occur to this new source of disturbance given that the SCIs of the SPA are already accustomed to the disturbance associated with Baldoyle village and existing surrounding housing developments. This should be considered in further detail at the assessment stage of any future planning application.

A wide range of environmental factors are required to support water bird species including good water quality and clarity and a good supply of food resources. Thus, water quality impacts resulting from the proposed development (i.e. during the construction and operational phases) could result in a reduction in the availability of suitable habitat for water bird species. The effect of such a reduction in water quality has the potential to be ecologically significant. However, it is likely that best practice design and mitigation can be implemented that would avoid or reduce such impacts. This should be considered in greater detail at the assessment stage of any future planning application.

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APPENDIX 1

TECHNICAL APPENDIX

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1. APPENDIX 1 (SURVEY DATA)

Table 1-1 Survey Effort

Date	Survey Method	Survey Area	Survey Duration	Weather Conditions	Comments	Surveyor
18/12/2019	Walkover	Site and SPA	05:00 starting at 09:30	Wind Speed and Direction: Strong Breeze, SE; Visibility: Moderate (1-2km); Cloud Height: 150-500m; Cloud Cover %: 90 Rain: Heavy Showers; Frost: None; Snow: None	Onsite area overgrown agri fields suboptimal for foraging geese	PC
23/12/2019	Walkover	Site and SPA	02:35 starting at 09:20	Light w winds - no rain		ED
15/01/2020	Walkover	SPA	02:20 starting at 10:00	Wind Speed and Direction: Gentle Breeze, W; Visibility: Good (>2km); Cloud Height: >500m; Cloud Cover %: 33 Rain: None; Frost: None; Snow: None		SD
15/01/2020	Walkover	Site	01:20 starting at 13:10	Wind Speed and Direction: Fresh Breeze, W; Visibility: Moderate (1-2km); Cloud Height: >500m; Cloud Cover %: 33 Rain: None; Frost: None; Snow: None		SD
28/01/2020	Walkover	SPA	02:35 starting at 08:40	Wind Speed and Direction: Fresh Breeze, NE; Visibility: Good (>2km); Cloud Height: 150-500m; Cloud Cover %: 66 Rain: Drizzle Mist; Frost: None; Snow: Ground		SD
28/01/2020	Walkover	Site	01:45 starting at 11:40	Wind Speed and Direction: Fresh Breeze, NE; Visibility: Good (>2km); Cloud Height: 150-500m; Cloud Cover %: 66 Rain: None; Frost: None; Snow: None		SD
10/02/2020	Walkover	Site	02:00 starting at 10:00	Wind Speed and Direction: Strong Breeze, W; Visibility: Good (>2km); Cloud Height: 150-500m; Cloud Cover %: 66 Rain: None; Frost: None; Snow: None		SD
10/02/2020	Walkover	SPA	02:05 starting at 12:10	Wind Speed and Direction: Strong Breeze, W; Visibility: Good (>2km); Cloud Height: 150-500m; Cloud Cover %: 66 Rain: Heavy Showers; Frost: None; Snow: Ground		SD

Date	Survey Method	Survey Area	Survey Duration	Weather Conditions	Comments	Surveyor
24/02/2020	Walkover	Site	02:00 starting at 09:55	Wind Speed and Direction: Moderate Gale, NW; Visibility: Good (>2km); Cloud Height: 150-500m; Cloud Cover %: 33 Rain: None; Frost: None; Snow: None		SD
24/02/2020	Walkover	SPA	02:00 starting at 12:30	Wind Speed and Direction: Moderate Gale, NW; Visibility: Good (>2km); Cloud Height: 150-500m; Cloud Cover %: 33 Rain: None; Frost: None; Snow: None		SD
11/03/2020	Walkover	SPA	01:55 starting at 12:45	Wind Speed and Direction: Moderate Breeze, W; Visibility: Good (>2km); Cloud Height: 150-500m; Cloud Cover %: 33 Rain: Heavy Showers; Frost: None; Snow: None		SD
11/03/2020	Walkover	Site	02:00 starting at 10:20	Wind Speed and Direction: Moderate Breeze, W; Visibility: Good (>2km); Cloud Height: 150-500m; Cloud Cover %: 33 Rain: Light Showers; Frost: None; Snow: None		SD
24/03/2020	Walkover	SPA	02:15 starting at 11:45	Wind Speed and Direction: Gentle Breeze, W; Visibility: Good (>2km); Cloud Height: >500m; Cloud Cover %: 33 Rain: None; Frost: None; Snow: None		SD
24/03/2020	Walkover	Site	02:00 starting at 09:30	Wind Speed and Direction: Gentle Breeze, W; Visibility: Good (>2km); Cloud Height: >500m; Cloud Cover %: 33 Rain: None; Frost: None; Snow: None		SD

Table 1-2 Walkover Survey Data

Map Ref	Survey Date	Species	Number of birds	Habitat and Activity	Comments	Surveyor
MH001	18/12/2019	Moorhen	3	FW2, (Depositing/upland rivers) foraging		PC
H001	18/12/2019	Grey heron	1	FW2, (Depositing/upland rivers) foraging		PC
OC001	18/12/2019	Oystercatcher	30	GA2, (Amenity grassland (improved)) foraging		PC
CM001	18/12/2019	Common Gull	24	GA2, (Amenity grassland (improved)) foraging		PC
PB001	18/12/2019	Brent Goose	12	GA2, (Amenity grassland (improved)) foraging		PC
OC002	18/12/2019	Oystercatcher	56	GA2, (Amenity grassland (improved)) foraging		PC
H002	18/12/2019	Grey heron	1	GS2, (Dry meadows and grassy verges) foraging in pool		PC
SN001	18/12/2019	Common Snipe	1	GS2, (Dry meadows and grassy verges) foraging in pool		PC
SN002	18/12/2019	Common Snipe	3	GS2, (Dry meadows and grassy verges) foraging in pool		PC
BH001	23/12/2019	Black-headed Gull	1			ED
H003	23/12/2019	Grey Heron	1			ED
HG001	23/12/2019	Herring Gull	6			ED
BW001	23/12/2019	Black-tailed Godwit	12		flight oversite	ED
PB002	23/12/2019	Brent Goose	40		flight oversite Light bellied brent geese	ED
SN003	23/12/2019	Common Snipe	1			ED
HG002	23/12/2019	Herring Gull	2			ED
HG003	15/01/2020	Herring Gull	14	ED2, (Spoil and bare ground) loafing near construction area		SD
BH002	15/01/2020	Black-headed Gull	13	ED2, (Spoil and bare ground) loafing near construction area		SD

Map Ref	Survey Date	Species	Number of birds	Habitat and Activity	Comments	Surveyor
	15/01/2020	Hooded Crow	14	GS2, (Dry meadows and grassy verges) ED2, (Spoil and bare ground) ED3, (Recolonising bare ground) flyover		SD
	15/01/2020	Magpie	19	WL1, (Hedgerows) ED2, (Spoil and bare ground) foraging		SD
	15/01/2020	Buzzard	1	ED3, (Recolonising bare ground) hunting		SD
PB003/PB004	15/01/2020	Brent Goose	49	GS2, (Dry meadows and grassy verges) 41 flying south then north. 8 flying east to west. Flying over site as the tide in SPA rises, but not landing		SD
	15/01/2020	Wren	3	WS1, (Scrub) foraging		SD
	15/01/2020	Song Thrush	2	GS2, (Dry meadows and grassy verges) foraging		SD
	15/01/2020	Kestrel	1	GS2, (Dry meadows and grassy verges) hunting		SD
	15/01/2020	Jackdaw	2	ED3, (Recolonising bare ground) foraging		SD
BH003	28/01/2020	Black-headed Gull	15	ED2, (Spoil and bare ground) loafing near construction area		SD
HG004	28/01/2020	Herring Gull	9	ED2, (Spoil and bare ground) loafing near construction area		SD
	28/01/2020	Herring Gull	12	ED2, (Spoil and bare ground) ED3, (Recolonising bare ground) GS2, (Dry meadows and grassy verges) flyover		SD
PB005	28/01/2020	Brent Goose	7	GS2, (Dry meadows and grassy verges) fly over site towards SPA. Do not land		SD
	28/01/2020	Song Thrush	3	GS2, (Dry meadows and grassy verges) ED2, (Spoil and bare ground) foraging		SD
	28/01/2020	Magpie	7	WL2, (Treelines) ED2, (Spoil and bare ground) foraging		SD
	28/01/2020	Robin	1	WS1, (Scrub) foraging		SD
	28/01/2020	Jackdaw	2	ED2, (Spoil and bare ground) ED3, (Recolonising bare ground) flyover		SD

Map Ref	Survey Date	Species	Number of birds	Habitat and Activity	Comments	Surveyor
	28/01/2020	Raven	1	ED2, (Spoil and bare ground) mobbed by Jackdaws		SD
	28/01/2020	Goldfinch	1	GS2, (Dry meadows and grassy verges) foraging		SD
	28/01/2020	Hooded Crow	2	ED3, (Recolonising bare ground) ED2, (Spoil and bare ground) WL1, (Hedgerows) foraging		SD
	28/01/2020	Wren	1	WL1, (Hedgerows) foraging		SD
MA001	28/01/2020	Mallard	2	FW2, (Depositing/upland rivers) swimming in river		SD
	28/01/2020	Blackbird	2	WS1, (Scrub) foraging		SD
H004	28/01/2020	Grey Heron	1	FW2, (Depositing/upland rivers) GS2, (Dry meadows and grassy verges) moving around site		SD
SN004	28/01/2020	Common Snipe	6	GS4, (Wet grassland) flushed from wet grassland		SD
	10/02/2020	Herring Gull	8	GS2, (Dry meadows and grassy verges) ED2, (Spoil and bare ground) ED3, (Recolonising bare ground) flying		SD
	10/02/2020	Magpie	11	ED2, (Spoil and bare ground) ED3, (Recolonising bare ground) foraging		SD
	10/02/2020	Hooded Crow	4	GS2, (Dry meadows and grassy verges) ED2, (Spoil and bare ground) foraging		SD
SN005	10/02/2020	Common Snipe	1	GS2, (Dry meadows and grassy verges) flushed		SD
MA002	10/02/2020	Mallard	5	GS2, (Dry meadows and grassy verges) fly over site E to W		SD
H005	10/02/2020	Grey Heron	1	ED2, (Spoil and bare ground) at pool in spoil		SD
PB006	10/02/2020	Brent Goose	11	GS2, (Dry meadows and grassy verges) fly over site E to W	look disturbed from SPA	SD
	10/02/2020	Robin	2	WS1, (Scrub) foraging		SD
	10/02/2020	Great Black-backed Gull	1	GS2, (Dry meadows and grassy verges) flying		SD
	10/02/2020	Buzzard	1	GS2, (Dry meadows and grassy verges) hunting		SD
	10/02/2020	Blackbird	2	WL1, (Hedgerows) foraging		SD
	10/02/2020	Rook	9	GS2, (Dry meadows and grassy verges) foraging		SD

Map Ref	Survey Date	Species	Number of birds	Habitat and Activity	Comments	Surveyor
L001	10/02/2020	Lapwing	100	FS1, (Reed and large sedge swamps) roosting	attempting to roost in pond adjacent to site. Frequently disturbed but do not fly over site	SD
	10/02/2020	Mallard	15	FS1, (Reed and large sedge swamps) flying	flying around reedbed adjacent to site but do not fly over site	SD
SN006	10/02/2020	Common Snipe	3	GS4, (Wet grassland) flushed		SD
	10/02/2020	Dunnock	1	WS1, (Scrub) singing		SD
	10/02/2020	Starling	30	GS2, (Dry meadows and grassy verges) foraging		SD
	10/02/2020	Black-headed Gull	8	GS2, (Dry meadows and grassy verges) ED2, (Spoil and bare ground) flying		SD
	10/02/2020	Wood Pigeon	8	BL3, (Buildings and artificial surfaces) foraging on road		SD
	10/02/2020	Blue Tit	1	WS1, (Scrub) alarm calls		SD
PB007	24/02/2020	Brent Goose	~80	GS2, (Dry meadows and grassy verges) foraging	foraging in park adjacent to site	SD
	24/02/2020	Buzzard	1	GS2, (Dry meadows and grassy verges) hunting		SD
	24/02/2020	Black-headed Gull	14	GS2, (Dry meadows and grassy verges) flying		SD
	24/02/2020	Robin	2	WS1, (Scrub) foraging		SD
	24/02/2020	Robin	2	WS1, (Scrub) singing		SD
	24/02/2020	Hooded Crow	5	GS2, (Dry meadows and grassy verges) WS1, (Scrub) foraging		SD
	24/02/2020	Lesser Black-backed Gull	1	GS2, (Dry meadows and grassy verges) flying		SD
	24/02/2020	Meadow Pipit	15	WS1, (Scrub) GS2, (Dry meadows and grassy verges) ED2, (Spoil and bare ground) foraging and displaying		SD
	24/02/2020	Blue Tit	4	WS1, (Scrub) singing and calling		SD
	24/02/2020	Herring Gull	1	ED2, (Spoil and bare ground) roosting		SD

Map Ref	Survey Date	Species	Number of birds	Habitat and Activity	Comments	Surveyor
	24/02/2020	Magpie	6	WL1, (Hedgerows) WS1, (Scrub) ED2, (Spoil and bare ground) foraging		SD
	24/02/2020	Blackbird	3	WL1, (Hedgerows) foraging		SD
	24/02/2020	Skylark	2	GS2, (Dry meadows and grassy verges) displaying		SD
	24/02/2020	Dunnock	1	WS1, (Scrub) singing		SD
	24/02/2020	Greenfinch	1	WS1, (Scrub) calling		SD
	24/02/2020	Goldfinch	1	GS2, (Dry meadows and grassy verges) flying		SD
	24/02/2020	Chaffinch	1	WL1, (Hedgerows) calling		SD
L002	24/02/2020	Lapwing	~30	FS1, (Reed and large sedge swamps) roosting	roosting in flooded area adjacent to site	SD
	24/02/2020	Cormorant	1	GS2, (Dry meadows and grassy verges) fly over site W to E		SD
SU001	24/02/2020	Shelduck	2	GA1, (Improved agricultural grassland) roosting	roosting near flooded area adjacent to site	SD
BH004	24/02/2020	Black-headed Gull	4	GA1, (Improved agricultural grassland) roosting	roosting near flooded area adjacent to site	SD
	24/02/2020	Wood Pigeon	5	WL1, (Hedgerows) roosting		SD
	24/02/2020	Wren	1	WS1, (Scrub) calling		SD
MA003	24/02/2020	Mallard	6	GS2, (Dry meadows and grassy verges) fly over site E to W		SD
BH005	24/02/2020	Black-headed Gull	50+	GA1, (Improved agricultural grassland) roosting	roosting on farmland adjacent to site	SD
SN007	24/02/2020	Common Snipe	1	GS2, (Dry meadows and grassy verges) flushed		SD
SN008	24/02/2020	Common Snipe	2	GS4, (Wet grassland) flushed		SD
	24/02/2020	Rook	2	GS2, (Dry meadows and grassy verges) foraging		SD
	24/02/2020	Herring Gull	1	GS2, (Dry meadows and grassy verges) flying		SD
	24/02/2020	Bar-tailed Godwit	35	GS2, (Dry meadows and grassy verges) fly over site N to S	flock flies high over site but does not land or use site	SD

Map Ref	Survey Date	Species	Number of birds	Habitat and Activity	Comments	Surveyor
	11/03/2020	Rook	2	GS2, (Dry meadows and grassy verges) ED2, (Spoil and bare ground) foraging		SD
	11/03/2020	Magpie	11	GS2, (Dry meadows and grassy verges) WL1, (Hedgerows) WS1, (Scrub) foraging		SD
	11/03/2020	Skylark	1	GS2, (Dry meadows and grassy verges) breeding display		SD
	11/03/2020	Herring Gull	7	GS2, (Dry meadows and grassy verges) flying over site		SD
	11/03/2020	Hooded Crow	3	WL1, (Hedgerows) WL2, (Treelines) nest building		SD
	11/03/2020	Meadow Pipit	18	GS2, (Dry meadows and grassy verges) WL2, (Treelines) foraging		SD
	11/03/2020	Wren	1	WL1, (Hedgerows) singing		SD
SN009	11/03/2020	Common Snipe	1	GS2, (Dry meadows and grassy verges) flushed		SD
	11/03/2020	Skylark	5	GS2, (Dry meadows and grassy verges) foraging		SD
	11/03/2020	Meadow Pipit	2	GS2, (Dry meadows and grassy verges) breeding display		SD
	11/03/2020	Buzzard	1	WL2, (Treelines) calling from treeline on site boundary - potential site for nesting		SD
	11/03/2020	Robin	3	WL1, (Hedgerows) foraging		SD
	11/03/2020	Wood Pigeon	10	WL1, (Hedgerows) WS1, (Scrub) foraging		SD
	11/03/2020	Dunnock	1	WS1, (Scrub) singing		SD
SN010	11/03/2020	Common Snipe	2	GS4, (Wet grassland) flushed		SD
	11/03/2020	Blackbird	2	WL1, (Hedgerows) foraging		SD
	11/03/2020	Greenfinch	1	WL1, (Hedgerows) foraging		SD
	11/03/2020	Goldfinch	12	WL1, (Hedgerows) foraging		SD
	11/03/2020	Pheasant	1	GS2, (Dry meadows and grassy verges) flushed		SD
	11/03/2020	Buzzard	4	GS2, (Dry meadows and grassy verges) WL2, (Treelines) soaring and calling high over site		SD

Map Ref	Survey Date	Species	Number of birds	Habitat and Activity	Comments	Surveyor
	11/03/2020	Black-headed Gull	1	GS2, (Dry meadows and grassy verges) flying over site		SD
MA004	11/03/2020	Mallard	2	FW, (Watercourses) fly into site towards river		SD
	24/03/2020	Magpie	14	WL1, (Hedgerows) WL2, (Treelines) ED2, (Spoil and bare ground) foraging		SD
	24/03/2020	Herring Gull	10	GS2, (Dry meadows and grassy verges) scattered individuals flying around site		SD
	24/03/2020	Skylark	4	GS2, (Dry meadows and grassy verges) displaying		SD
	24/03/2020	Hooded Crow	3	GS2, (Dry meadows and grassy verges) foraging		SD
	24/03/2020	Dunnock	1	WS1, (Scrub) singing		SD
	24/03/2020	Stonechat	2	GS2, (Dry meadows and grassy verges) pair foraging		SD
	24/03/2020	Rook	12	GS2, (Dry meadows and grassy verges) WL2, (Treelines) foraging		SD
	24/03/2020	Meadow Pipit	15	GS2, (Dry meadows and grassy verges) foraging		SD
	24/03/2020	Robin	4	WL1, (Hedgerows) WL2, (Treelines) singing		SD
	24/03/2020	Wren	1	WS1, (Scrub) singing		SD
MA005/MA006/MA007	24/03/2020	Mallard	6	GS2, (Dry meadows and grassy verges) FW, (Watercourses) flying over; 2 may have landed in river		SD
	24/03/2020	Wood Pigeon	21	WL1, (Hedgerows) foraging		SD
	24/03/2020	Blackbird	2	WL1, (Hedgerows) foraging		SD
	24/03/2020	Jackdaw	6	ED2, (Spoil and bare ground) foraging		SD
	24/03/2020	Goldfinch	1	WL1, (Hedgerows) singing		SD
	24/03/2020	Greenfinch	1	WL1, (Hedgerows) calling		SD
SN011	24/03/2020	Common Snipe	2	GS4, (Wet grassland) flushed		SD
	24/03/2020	Goldfinch	4	WL1, (Hedgerows) foraging		SD

Map Ref	Survey Date	Species	Number of birds	Habitat and Activity	Comments	Surveyor
ET001	24/03/2020	Little Egret	1	mixed flock roosting adjacent to site, overlapping site boundary at far NE corner		SD
MA008	24/03/2020	Mallard	3	mixed flock roosting adjacent to site, overlapping site boundary at far NE corner	partially within site boundary	SD
SU002	24/03/2020	Shelduck	4	mixed flock roosting adjacent to site, overlapping site boundary at far NE corner	partially within site boundary	SD
BW002	24/03/2020	Black-tailed Godwit	35	mixed flock roosting adjacent to site, overlapping site boundary at far NE corner	partially within site boundary	SD
T001	24/03/2020	Teal	4	foraging in river adjacent to site		SD
MA009	24/03/2020	Mallard	2	FW, (Watercourses) foraging in river		SD
MH002	24/03/2020	Moorhen	1	FW, (Watercourses) foraging on river's edge		SD
CM002	24/03/2020	Common Gull	1	flies over		SD
H006	24/03/2020	Grey Heron	1	ED2, (Spoil and bare ground) standing in flooded area		SD

Table 1-3 SPA Survey Data

Map Ref	Date	Species	Notes on Habitat and Activity	Comments	Surveyor
FL001	18/12/2019	Herring Gull	Intertidal; Roosting		PC
FL001	18/12/2019	Great Black-backed Gull	Intertidal; Roosting		PC
FL001	18/12/2019	Oystercatcher	Intertidal; Feeding		PC
FL001	18/12/2019	Curlew	Intertidal; Feeding		PC
FL001	18/12/2019	Mallard	Intertidal; Feeding		PC
FL001	18/12/2019	Teal	Intertidal; Feeding		PC
FL001	18/12/2019	Redshank	Intertidal; Feeding		PC
FL001	18/12/2019	Black-headed Gull	Supratidal; Feeding		PC
FL002	18/12/2019	Mallard	Intertidal; Feeding		PC
FL002	18/12/2019	Oystercatcher	Intertidal; Feeding		PC
FL002	18/12/2019	Herring Gull	Intertidal; Feeding		PC
FL002	18/12/2019	Black-headed Gull	Intertidal; Feeding		PC
FL002	18/12/2019	Bar-tailed Godwit	Intertidal; Feeding		PC
FL002	18/12/2019	Grey Plover	Intertidal; Feeding		PC
FL002	18/12/2019	Shelduck	Intertidal; Feeding		PC
FL002	18/12/2019	Lapwing	Intertidal; Feeding		PC
FL002	18/12/2019	Common Gull	Intertidal; Feeding		PC
FL002	18/12/2019	Curlew	Intertidal; Feeding		PC
FL002	18/12/2019	Redshank	Intertidal; Feeding		PC
FL002	18/12/2019	Brent Goose	Intertidal; Feeding		PC
FL003	18/12/2019	Brent Goose	Terrestrial; Feeding	Foraging in golf course	PC
FL004	18/12/2019	Red-breasted Merganser	Subtidal; Feeding		PC
FL004	18/12/2019	Common Gull	Intertidal; Feeding		PC
FL004	18/12/2019	Herring Gull	Intertidal; Feeding		PC
FL004	18/12/2019	Oystercatcher	Supratidal; Roosting		PC
FL004	18/12/2019	Curlew	Supratidal; Roosting		PC

Map Ref	Date	Species	Notes on Habitat and Activity	Comments	Surveyor
FL004	18/12/2019	Long-tailed Duck	Subtidal; Feeding		PC
FL005	18/12/2019	Redshank	Intertidal; Feeding		PC
FL005	18/12/2019	Turnstone	Intertidal; Feeding		PC
FL005	18/12/2019	Herring Gull	Intertidal; Feeding		PC
FL005	18/12/2019	Grey Heron	Intertidal; Feeding		PC
FL005	18/12/2019	Curlew	Intertidal; Feeding		PC
FL005	18/12/2019	Teal	Intertidal; Feeding		PC
FL006	18/12/2019	Curlew	Intertidal; Feeding		PC
FL006	18/12/2019	Oystercatcher	Intertidal; Feeding		PC
FL006	18/12/2019	Dunlin	Intertidal; Feeding		PC
FL006	18/12/2019	Redshank	Intertidal; Feeding		PC
FL006	18/12/2019	Bar-tailed Godwit	Intertidal; Feeding		PC
FL007	18/12/2019	Black-headed Gull	Intertidal; Feeding		PC
FL007	18/12/2019	Herring Gull	Intertidal; Feeding		PC
FL007	18/12/2019	Turnstone	Intertidal; Feeding		PC
FL007	18/12/2019	Curlew	Intertidal; Feeding		PC
FL007	18/12/2019	Bar-tailed Godwit	Intertidal; Feeding		PC
FL007	18/12/2019	Redshank	Intertidal; Feeding		PC
FL007	18/12/2019	Oystercatcher	Intertidal; Feeding		PC
FL008	18/12/2019	Bar-tailed Godwit	Intertidal; Feeding		PC
FL008	18/12/2019	Curlew	Intertidal; Feeding		PC
FL008	18/12/2019	Oystercatcher	Intertidal; Feeding		PC
FL008	18/12/2019	Redshank	Intertidal; Feeding		PC
FL008	18/12/2019	Shelduck	Intertidal; Feeding		PC
FL008	18/12/2019	Turnstone	Intertidal; Feeding		PC
FL008	18/12/2019	Greenshank	Intertidal; Feeding		PC

Map Ref	Date	Species	Notes on Habitat and Activity	Comments	Surveyor
FL008	18/12/2019	Herring Gull	Intertidal; Feeding		PC
FL008	18/12/2019	Black-headed Gull	Intertidal; Feeding		PC
FL008	18/12/2019	Great Black-backed Gull	Intertidal; Feeding		PC
FL008	18/12/2019	Dunlin	Intertidal; Feeding		PC
FL008	18/12/2019	Brent Goose	Intertidal; Feeding		PC
FL008	18/12/2019	Golden Plover	Intertidal; Roosting		PC
FL009	18/12/2019	Teal	Intertidal; Roosting		PC
FL009	18/12/2019	Wigeon	Intertidal; Roosting		PC
FL009	18/12/2019	Whooper Swan	Intertidal; Roosting		PC
FL010	23/12/2019	Lapwing	Above Water; Roosting		ED
FL010	23/12/2019	Redshank	Above Water; Roosting		ED
FL011	23/12/2019	Shelduck	On Water; feeding		ED
FL012	23/12/2019	Wigeon	On Water; feeding		ED
FL012	23/12/2019	Shelduck	On Water; Feeding		ED
FL012	23/12/2019	Teal	On Water; Feeding		ED
FL012	23/12/2019	Wigeon	On Water; Feeding		ED
FL012	23/12/2019	Great Black-backed Gull	Above Water; Roosting		ED
FL012	23/12/2019	Black-headed Gull	Above Water; Roosting		ED
FL012	23/12/2019	Common Gull	Above Water; Roosting		ED
FL012	23/12/2019	Redshank	Above Water; Roosting		ED
FL012	23/12/2019	Little Egret	Above Water; Feeding		ED
FL012	23/12/2019	Red-breasted Merganser	Above Water; Roosting		ED
FL012	23/12/2019	Grey Heron	Above Water; Feeding		ED
	15/01/2020	Oystercatcher	Intertidal; Feeding		SD
	15/01/2020	Herring Gull	Intertidal; Feeding	also 15+ HG following fishing boat outside SPA boundary	SD
	15/01/2020	Curlew	Intertidal; Feeding		SD

Map Ref	Date	Species	Notes on Habitat and Activity	Comments	Surveyor
	15/01/2020	Redshank	Intertidal; Feeding		SD
	15/01/2020	Hooded Crow	Intertidal; Feeding		SD
	15/01/2020	Cormorant	Subtidal; Feeding		SD
	15/01/2020	Great Black-backed Gull	Intertidal; Feeding		SD
	15/01/2020	Brent Goose	Flying		SD
	15/01/2020	Red-breasted Merganser	Subtidal; Feeding		SD
	15/01/2020	Herring Gull	Intertidal; Feeding		SD
	15/01/2020	Oystercatcher	Intertidal; Feeding		SD
	15/01/2020	Brent Goose	Subtidal; Feeding		SD
	15/01/2020	Curlew	Intertidal; Feeding		SD
	15/01/2020	Redshank	Intertidal; Feeding		SD
	15/01/2020	Redshank	Intertidal; Roosting		SD
	15/01/2020	Black-headed Gull	Intertidal; Roosting		SD
	15/01/2020	Red-breasted Merganser	Subtidal; Feeding		SD
	15/01/2020	Teal	Intertidal; Roosting		SD
	15/01/2020	Hooded Crow	Intertidal; Feeding		SD
	15/01/2020	Herring Gull	Subtidal; Roosting		SD
	15/01/2020	Herring Gull	Intertidal; Roosting		SD
	15/01/2020	Herring Gull	Intertidal; Feeding		SD
	15/01/2020	Black-headed Gull	Intertidal; Feeding		SD
	15/01/2020	Shelduck	Intertidal; Feeding		SD
	15/01/2020	Redshank	Intertidal; Feeding		SD
	15/01/2020	Turnstone	Supratidal; Feeding		SD
	15/01/2020	Curlew	Intertidal; Feeding		SD
FL013	15/01/2020	Curlew	Intertidal; Roosting		SD
FL013	15/01/2020	Oystercatcher	Intertidal; Feeding		SD

Map Ref	Date	Species	Notes on Habitat and Activity	Comments	Surveyor
	15/01/2020	Oystercatcher	Intertidal; Roosting		SD
	15/01/2020	Oystercatcher	Terrestrial; Roosting		SD
	15/01/2020	Ringed Plover	Intertidal; Feeding		SD
	15/01/2020	Great Black-backed Gull	Intertidal; Feeding		SD
	15/01/2020	Red-breasted Merganser	Subtidal; Feeding		SD
	15/01/2020	Starling	Supratidal; Feeding		SD
	15/01/2020	Brent Goose	Intertidal; Feeding		SD
	15/01/2020	Wigeon	Subtidal; Feeding		SD
	15/01/2020	Herring Gull	Subtidal; Feeding		SD
	15/01/2020	Herring Gull	Intertidal; Feeding		SD
	15/01/2020	Oystercatcher	Intertidal; Feeding		SD
	15/01/2020	Turnstone	Intertidal; Feeding		SD
	15/01/2020	Redshank	Intertidal; Roosting		SD
	15/01/2020	Shelduck	Subtidal; Feeding		SD
	15/01/2020	Shelduck	Intertidal; Feeding		SD
	15/01/2020	Curlew	Intertidal; Feeding		SD
	15/01/2020	Brent Goose	Intertidal; Feeding		SD
	15/01/2020	Brent Goose	Subtidal; Feeding		SD
	15/01/2020	Black-headed Gull	Subtidal; Roosting		SD
	15/01/2020	Black-headed Gull	Intertidal; Feeding		SD
	15/01/2020	Little Grebe	Supratidal; Feeding		SD
FL014	15/01/2020	Lapwing	Supratidal; Roosting		SD
	15/01/2020	Redshank	Intertidal; Feeding		SD
	15/01/2020	Redshank	Supratidal; Roosting		SD
FL015	15/01/2020	Black-headed Gull	Intertidal; Feeding	also 30+ foraging in park adjacent to SPA	SD
	15/01/2020	Greenshank	Intertidal; Feeding		SD

Map Ref	Date	Species	Notes on Habitat and Activity	Comments	Surveyor
	15/01/2020	Herring Gull	Flying		SD
	15/01/2020	Wigeon	Subtidal; Feeding		SD
	15/01/2020	Mallard	Subtidal; Feeding		SD
FL015	15/01/2020	Brent Goose	Subtidal; Feeding	also 60+ foraging in park adjacent to SPA	SD
	15/01/2020	Brent Goose	Flying		SD
	15/01/2020	Wigeon	Subtidal; Feeding		SD
	15/01/2020	Herring Gull	Intertidal; Feeding		SD
	15/01/2020	Curlew	Supratidal; Roosting	in reeds	SD
	15/01/2020	Redshank	Intertidal; Roosting		SD
	15/01/2020	Teal	Subtidal; Feeding		SD
	15/01/2020	Brent Goose	Subtidal; Feeding		SD
FL016	15/01/2020	Black-headed Gull	Subtidal; Roosting		SD
	28/01/2020	Hooded Crow	Intertidal; Feeding		SD
	28/01/2020	Black-headed Gull	Intertidal; Feeding		SD
	28/01/2020	Herring Gull	Intertidal; Feeding		SD
	28/01/2020	Great Black-backed Gull	Intertidal; Feeding		SD
	28/01/2020	Oystercatcher	Intertidal; Feeding		SD
	28/01/2020	Oystercatcher	Intertidal; Roosting		SD
	28/01/2020	Curlew	Intertidal; Feeding		SD
	28/01/2020	Red-breasted Merganser	Subtidal; Feeding		SD
	28/01/2020	Common Gull	Intertidal; Feeding		SD
	28/01/2020	Redshank	Intertidal; Feeding		SD
	28/01/2020	Ringed Plover	Intertidal; Feeding		SD
	28/01/2020	Hooded Crow	Intertidal; Feeding		SD
	28/01/2020	Curlew	Intertidal; Feeding		SD
	28/01/2020	Great Black-backed Gull	Intertidal; Feeding		SD

Map Ref	Date	Species	Notes on Habitat and Activity	Comments	Surveyor
	28/01/2020	Redshank	Intertidal; Feeding		SD
	28/01/2020	Oystercatcher	Intertidal; Feeding		SD
FL017	28/01/2020	Oystercatcher	Intertidal; Roosting		SD
	28/01/2020	Shelduck	Intertidal; Feeding		SD
	28/01/2020	Herring Gull	Intertidal; Feeding		SD
	28/01/2020	Black-headed Gull	Intertidal; Feeding		SD
FL018	28/01/2020	Oystercatcher	Intertidal; Feeding		SD
FL018	28/01/2020	Oystercatcher	Intertidal; Roosting		SD
	28/01/2020	Redshank	Intertidal; Feeding		SD
	28/01/2020	Black-headed Gull	Intertidal; Feeding		SD
	28/01/2020	Black-headed Gull	Intertidal; Roosting		SD
	28/01/2020	Shelduck	Subtidal; Feeding		SD
	28/01/2020	Hooded Crow	Intertidal; Feeding		SD
	28/01/2020	Curlew	Intertidal; Feeding		SD
	28/01/2020	Curlew	Intertidal; Roosting		SD
	28/01/2020	Bar-tailed Godwit	Intertidal; Feeding		SD
	28/01/2020	Herring Gull	Intertidal; Feeding		SD
	28/01/2020	Herring Gull	Intertidal; Roosting		SD
	28/01/2020	Turnstone	Intertidal; Feeding		SD
	28/01/2020	Great Black-backed Gull	Intertidal; Feeding		SD
	28/01/2020	Greenshank	Intertidal; Feeding		SD
	28/01/2020	Great Crested Grebe	Subtidal; Feeding		SD
	28/01/2020	Brent Goose	Intertidal; Feeding		SD
FL019	28/01/2020	Brent Goose	Subtidal; Feeding		SD
FL019	28/01/2020	Brent Goose	Intertidal; Feeding		SD
	28/01/2020	Redshank	Intertidal; Feeding		SD

Map Ref	Date	Species	Notes on Habitat and Activity	Comments	Surveyor
	28/01/2020	Black-headed Gull	Intertidal; Feeding		SD
	28/01/2020	Shelduck	Intertidal; Feeding		SD
	28/01/2020	Oystercatcher	Intertidal; Feeding		SD
	28/01/2020	Oystercatcher	Intertidal; Roosting		SD
	28/01/2020	Curlew	Intertidal; Feeding		SD
	28/01/2020	Curlew	Intertidal; Roosting		SD
	28/01/2020	Great Black-backed Gull	Intertidal; Feeding		SD
	28/01/2020	Red-breasted Merganser	Subtidal; Feeding		SD
FL020	28/01/2020	Knot	Intertidal; Feeding		SD
	28/01/2020	Bar-tailed Godwit	Intertidal; Feeding		SD
	28/01/2020	Herring Gull	Intertidal; Feeding		SD
	28/01/2020	Lapwing	Intertidal; Roosting		SD
	28/01/2020	Bar-tailed Godwit	Intertidal; Feeding		SD
	28/01/2020	Brent Goose		in park adjacent to SPA	SD
	28/01/2020	Black-headed Gull		in park adjacent to SPA	SD
	28/01/2020	Mallard		in park adjacent to SPA	SD
	28/01/2020	Shelduck	Intertidal; Feeding		SD
	28/01/2020	Curlew	Intertidal; Feeding		SD
	28/01/2020	Great Black-backed Gull	Intertidal; Roosting		SD
	28/01/2020	Cormorant	Subtidal; Roosting		SD
	28/01/2020	Black-headed Gull	Intertidal; Feeding		SD
	28/01/2020	Mallard	Intertidal; Feeding		SD
	28/01/2020	Oystercatcher	Intertidal; Feeding		SD
	28/01/2020	Redshank	Intertidal; Feeding		SD
	28/01/2020	Lapwing	Intertidal; Feeding		SD
	28/01/2020	Lapwing	Intertidal; Roosting		SD

Map Ref	Date	Species	Notes on Habitat and Activity	Comments	Surveyor
	28/01/2020	Lesser Black-backed Gull	Intertidal; Feeding		SD
	28/01/2020	Teal	Subtidal; Feeding		SD
	28/01/2020	Herring Gull	Intertidal; Roosting		SD
	28/01/2020	Lapwing	Intertidal; Roosting		SD
	28/01/2020	Shelduck	Subtidal; Roosting		SD
	28/01/2020	Shelduck	Intertidal; Roosting		SD
	28/01/2020	Curlew	Intertidal; Roosting		SD
	28/01/2020	Curlew	Terrestrial; Roosting	some roosting within grass	SD
	28/01/2020	Black-headed Gull	Intertidal; Feeding		SD
	28/01/2020	Black-headed Gull	Intertidal; Roosting		SD
	28/01/2020	Herring Gull	Intertidal; Roosting		SD
	28/01/2020	Wigeon	Subtidal; Feeding		SD
	28/01/2020	Oystercatcher	Intertidal; Feeding		SD
	28/01/2020	Great Crested Grebe	Subtidal; Feeding		SD
	28/01/2020	Redshank	Intertidal; Feeding		SD
	28/01/2020	Bar-tailed Godwit	Intertidal; Feeding		SD
	28/01/2020	Great Black-backed Gull	Intertidal; Feeding		SD
	28/01/2020	Bar-tailed Godwit	Intertidal; Feeding		SD
	10/02/2020	Black-headed Gull	Intertidal; Feeding		SD
	10/02/2020	Cormorant	Subtidal; Feeding		SD
	10/02/2020	Great Crested Grebe	Subtidal; Feeding		SD
	10/02/2020	Herring Gull	Intertidal; Feeding		SD
FL021	10/02/2020	Brent Goose	Intertidal; Feeding		SD
	10/02/2020	Turnstone	Supratidal; Feeding		SD
	10/02/2020	Herring Gull		flying	SD
	10/02/2020	Black-headed Gull	Subtidal; Feeding		SD

Map Ref	Date	Species	Notes on Habitat and Activity	Comments	Surveyor
	10/02/2020	Teal	Subtidal; Feeding		SD
	10/02/2020	Redshank	Intertidal; Feeding		SD
	10/02/2020	Black-headed Gull	Subtidal; Roosting		SD
	10/02/2020	Red-breasted Merganser	Subtidal; Feeding		SD
	10/02/2020	Great Crested Grebe	Subtidal; Feeding		SD
	10/02/2020	Herring Gull	Subtidal; Roosting		SD
	10/02/2020	Rook		flying	SD
	10/02/2020	Knot	Intertidal; Roosting		SD
	10/02/2020	Oystercatcher	Terrestrial; Feeding		SD
	10/02/2020	Brent Goose		flying	SD
	10/02/2020	Starling	Intertidal; Feeding		SD
	10/02/2020	Long-tailed Duck	Subtidal; Roosting		SD
	10/02/2020	Knot	Supratidal; Roosting		SD
	10/02/2020	Shelduck	Subtidal; Feeding		SD
	10/02/2020	Brent Goose		flying	SD
	10/02/2020	Oystercatcher	Supratidal; Roosting		SD
	10/02/2020	Teal	Subtidal; Feeding		SD
	10/02/2020	Brent Goose	Subtidal; Feeding		SD
	10/02/2020	Red-breasted Merganser	Subtidal; Feeding		SD
	10/02/2020	Herring Gull		flying	SD
	10/02/2020	Cormorant	Subtidal; Roosting		SD
	10/02/2020	Lesser Black-backed Gull		flying	SD
	10/02/2020	Curlew	Terrestrial; Roosting		SD
FL022	10/02/2020	Redshank	Supratidal; Roosting		SD
	10/02/2020	Black-headed Gull	Intertidal; Feeding		SD
	10/02/2020	Shelduck	Intertidal; Feeding		SD

Map Ref	Date	Species	Notes on Habitat and Activity	Comments	Surveyor
	10/02/2020	Lapwing	Supratidal; Roosting		SD
	10/02/2020	Mallard	Subtidal; Feeding		SD
	10/02/2020	Little Egret	Intertidal; Feeding		SD
	10/02/2020	Redshank	Intertidal; Feeding		SD
	10/02/2020	Starling	Supratidal; Feeding		SD
	10/02/2020	Shelduck	Terrestrial; Roosting		SD
	10/02/2020	Brent Goose	Subtidal; Feeding		SD
	10/02/2020	Brent Goose		in park adjacent to SPA	SD
	10/02/2020	Black-headed Gull		in park adjacent to SPA	SD
	10/02/2020	Bar-tailed Godwit	Supratidal; Roosting		SD
	10/02/2020	Teal	Subtidal; Feeding		SD
	10/02/2020	Teal		flying	SD
	10/02/2020	Herring Gull		flying	SD
	10/02/2020	Black-headed Gull	Subtidal; Roosting		SD
	10/02/2020	Herring Gull		flying	SD
	10/02/2020	Shelduck	Subtidal; Feeding		SD
	24/02/2020	Cormorant	Subtidal; Feeding		SD
	24/02/2020	Red-breasted Merganser	Subtidal; Feeding		SD
	24/02/2020	Hooded Crow	Intertidal; Feeding		SD
FL023	24/02/2020	Brent Goose	Terrestrial; Feeding		SD
	24/02/2020	Teal	Intertidal; Feeding		SD
	24/02/2020	Hooded Crow	Terrestrial; Feeding		SD
	24/02/2020	Herring Gull	Subtidal; Feeding		SD
	24/02/2020	Brent Goose	Terrestrial; Feeding		SD
	24/02/2020	Herring Gull		flying	SD
	24/02/2020	Brent Goose	Subtidal; Feeding		SD

Map Ref	Date	Species	Notes on Habitat and Activity	Comments	Surveyor
	24/02/2020	Shelduck	Intertidal; Roosting		SD
	24/02/2020	Oystercatcher	Intertidal; Roosting		SD
	24/02/2020	Great Crested Grebe	Subtidal; Feeding		SD
	24/02/2020	Brent Goose	Terrestrial; Feeding		SD
	24/02/2020	Brent Goose	Intertidal; Feeding		SD
	24/02/2020	Oystercatcher	Terrestrial; Feeding		SD
FL024	24/02/2020	Redshank	Supratidal; Roosting		SD
	24/02/2020	Curlew	Supratidal; Roosting		SD
	24/02/2020	Mallard	Supratidal; Roosting		SD
	24/02/2020	Brent Goose		in park adjacent to SPA	SD
	24/02/2020	Mallard		in park adjacent to SPA	SD
	24/02/2020	Black-headed Gull		in park adjacent to SPA	SD
	24/02/2020	Shelduck	Intertidal; Roosting		SD
	24/02/2020	Teal	Intertidal; Roosting		SD
	24/02/2020	Herring Gull		flying	SD
	24/02/2020	Black-headed Gull	Terrestrial; Feeding		SD
	24/02/2020	Herring Gull		flying	SD
	24/02/2020	Teal	Intertidal; Feeding		SD
	24/02/2020	Shelduck	Intertidal; Feeding		SD
	24/02/2020	Shelduck	Intertidal; Roosting		SD
	11/03/2020	Oystercatcher	Intertidal; Roosting		SD
	11/03/2020	Hooded Crow	Intertidal; Feeding		SD
	11/03/2020	Knot		flyover	SD
	11/03/2020	Red-breasted Merganser	Subtidal; Feeding		SD
	11/03/2020	Great Crested Grebe	Subtidal; Feeding		SD
	11/03/2020	Herring Gull		flyover	SD

Map Ref	Date	Species	Notes on Habitat and Activity	Comments	Surveyor
	11/03/2020	Hooded Crow	Terrestrial; Feeding		SD
FL025	11/03/2020	Brent Goose	Intertidal; Feeding		SD
	11/03/2020	Redshank	Intertidal; Feeding		SD
	11/03/2020	Herring Gull	Terrestrial; Roosting		SD
	11/03/2020	Oystercatcher	Terrestrial; Roosting		SD
	11/03/2020	Brent Goose	Terrestrial; Feeding		SD
	11/03/2020	Curlew	Terrestrial; Roosting		SD
	11/03/2020	Black-headed Gull	Terrestrial; Feeding		SD
	11/03/2020	Shelduck	Intertidal; Roosting		SD
	11/03/2020	Brent Goose	Subtidal; Roosting		SD
	11/03/2020	Shelduck	Subtidal; Roosting		SD
	11/03/2020	Black-headed Gull	Subtidal; Roosting		SD
	11/03/2020	Black-headed Gull		flyover	SD
	11/03/2020	Red-breasted Merganser	Subtidal; Feeding		SD
	11/03/2020	Redshank	Supratidal; Roosting		SD
	11/03/2020	Oystercatcher	Terrestrial; Feeding		SD
	11/03/2020	Shelduck	Subtidal; Feeding		SD
	11/03/2020	Red-breasted Merganser	Subtidal; Feeding		SD
	11/03/2020	Herring Gull	Subtidal; Roosting		SD
	11/03/2020	Black-headed Gull	Subtidal; Roosting		SD
	11/03/2020	Wigeon	Subtidal; Feeding		SD
	11/03/2020	Mallard		on grass at church adjacent to SPA roosting	SD
FL026	11/03/2020	Brent Goose	Intertidal; Feeding		SD
FL026	11/03/2020	Redshank	Supratidal; Roosting		SD
	11/03/2020	Great Black-backed Gull	Intertidal; Roosting		SD
	11/03/2020	Shelduck	Subtidal; Feeding		SD

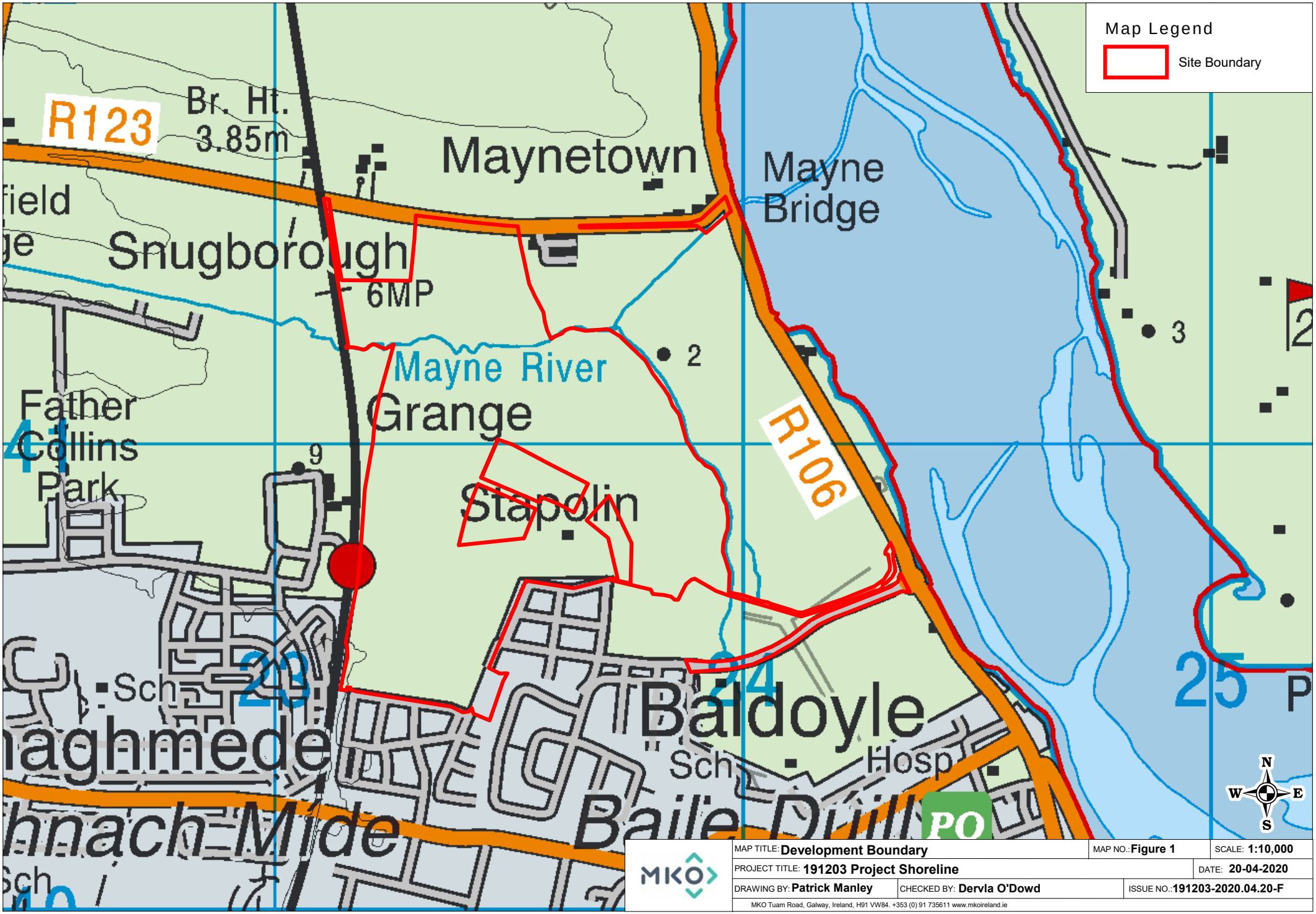
Map Ref	Date	Species	Notes on Habitat and Activity	Comments	Surveyor
FL027	11/03/2020	Brent Goose	Subtidal; Roosting		SD
	11/03/2020	Little Egret	Intertidal; Feeding		SD
	11/03/2020	Mallard		in park adjacent to SPA roosting	SD
	11/03/2020	Black-headed Gull		in park adjacent to SPA roosting	SD
	11/03/2020	Herring Gull		in park adjacent to SPA roosting	SD
FL028	11/03/2020	Brent Goose	Intertidal; Feeding		SD
	11/03/2020	Mallard	Terrestrial; Feeding		SD
	11/03/2020	Redshank	Intertidal; Roosting		SD
FL029	11/03/2020	Brent Goose	Intertidal; Feeding		SD
	11/03/2020	Little Egret	Intertidal; Feeding		SD
	11/03/2020	Herring Gull		flyover	SD
	11/03/2020	Redshank	Intertidal; Feeding		SD
	11/03/2020	Teal	Subtidal; Feeding		SD
	11/03/2020	Shelduck	Intertidal; Feeding		SD
	11/03/2020	Curlew	Intertidal; Roosting		SD
	11/03/2020	Herring Gull	Subtidal; Roosting		SD
	11/03/2020	Teal	Subtidal; Feeding		SD
	24/03/2020	Hooded Crow	Intertidal; Feeding		SD
	24/03/2020	Herring Gull	Subtidal; Roosting		SD
	24/03/2020	Red-breasted Merganser	Subtidal; Feeding		SD
	24/03/2020	Gannet	Subtidal; Feeding		SD
	24/03/2020	Brent Goose	Intertidal; Feeding		SD
	24/03/2020	Black-tailed Godwit	Intertidal; Roosting	mixed flock roosting	SD
	24/03/2020	Redshank	Intertidal; Roosting	mixed flock roosting	SD
	24/03/2020	Black-headed Gull	Subtidal; Roosting		SD
	24/03/2020	Common Gull	Subtidal; Roosting		SD

Map Ref	Date	Species	Notes on Habitat and Activity	Comments	Surveyor
	24/03/2020	Herring Gull	Subtidal; Roosting		SD
	24/03/2020	Red-breasted Merganser	Subtidal; Feeding		SD
FL030	24/03/2020	Oystercatcher	Supratidal; Roosting		SD
	24/03/2020	Brent Goose	Intertidal; Feeding		SD
	24/03/2020	Great Crested Grebe	Subtidal; Feeding		SD
	24/03/2020	Great Black-backed Gull	Subtidal; Roosting		SD
	24/03/2020	Brent Goose	Intertidal; Feeding		SD
	24/03/2020	Shelduck	Intertidal; Feeding		SD
	24/03/2020	Mallard	Terrestrial; Roosting		SD
	24/03/2020	Brent Goose		fly north to south	SD
	24/03/2020	Mallard		fly north to south	SD
	24/03/2020	Brent Goose	Intertidal; Feeding		SD
	24/03/2020	Herring Gull	Supratidal; Roosting		SD
FL032	24/03/2020	Black-tailed Godwit	Supratidal; Roosting		SD
	24/03/2020	Little Egret	Supratidal; Roosting		SD
	24/03/2020	Curlew	Intertidal; Feeding		SD
	24/03/2020	Shelduck	Subtidal; Feeding		SD
	24/03/2020	Mallard	Intertidal; Feeding		SD
	24/03/2020	Gannet	Subtidal; Feeding		SD
	24/03/2020	Redshank	Supratidal; Roosting		SD
	24/03/2020	Wigeon	Intertidal; Feeding		SD
	24/03/2020	Buzzard	Intertidal; Feeding	hunting over reedbed; number 3 on map	SD
	24/03/2020	Herring Gull	Intertidal;	mobbing BZ	SD
	24/03/2020	Shelduck	Subtidal; Feeding		SD
	24/03/2020	Hooded Crow	Terrestrial; Feeding		SD
	24/03/2020	Herring Gull		in park adjacent to SPA foraging	SD

Map Ref	Date	Species	Notes on Habitat and Activity	Comments	Surveyor
	24/03/2020	Redshank	Supratidal; Roosting		SD
	24/03/2020	Black-headed Gull		flyover	SD
	24/03/2020	Teal	Subtidal; Feeding		SD
	24/03/2020	Little Egret	Intertidal; Feeding		SD
	24/03/2020	Brent Goose	Subtidal; Feeding		SD
	24/03/2020	Teal	Subtidal; Feeding		SD
	24/03/2020	Herring Gull		flyover	SD
	24/03/2020	Herring Gull	Intertidal; Feeding		SD
FL031	24/03/2020	Brent Goose	Subtidal; Feeding	large, loosely dispersed flock	SD
	24/03/2020	Teal	Subtidal; Feeding		SD
	24/03/2020	Herring Gull	Subtidal; Feeding		SD
	24/03/2020	Little Egret	Intertidal; Feeding		SD

APPENDIX 2

FIGURES



MAP TITLE: **Development Boundary**		MAP NO.: **Figure 1**	SCALE: **1:10,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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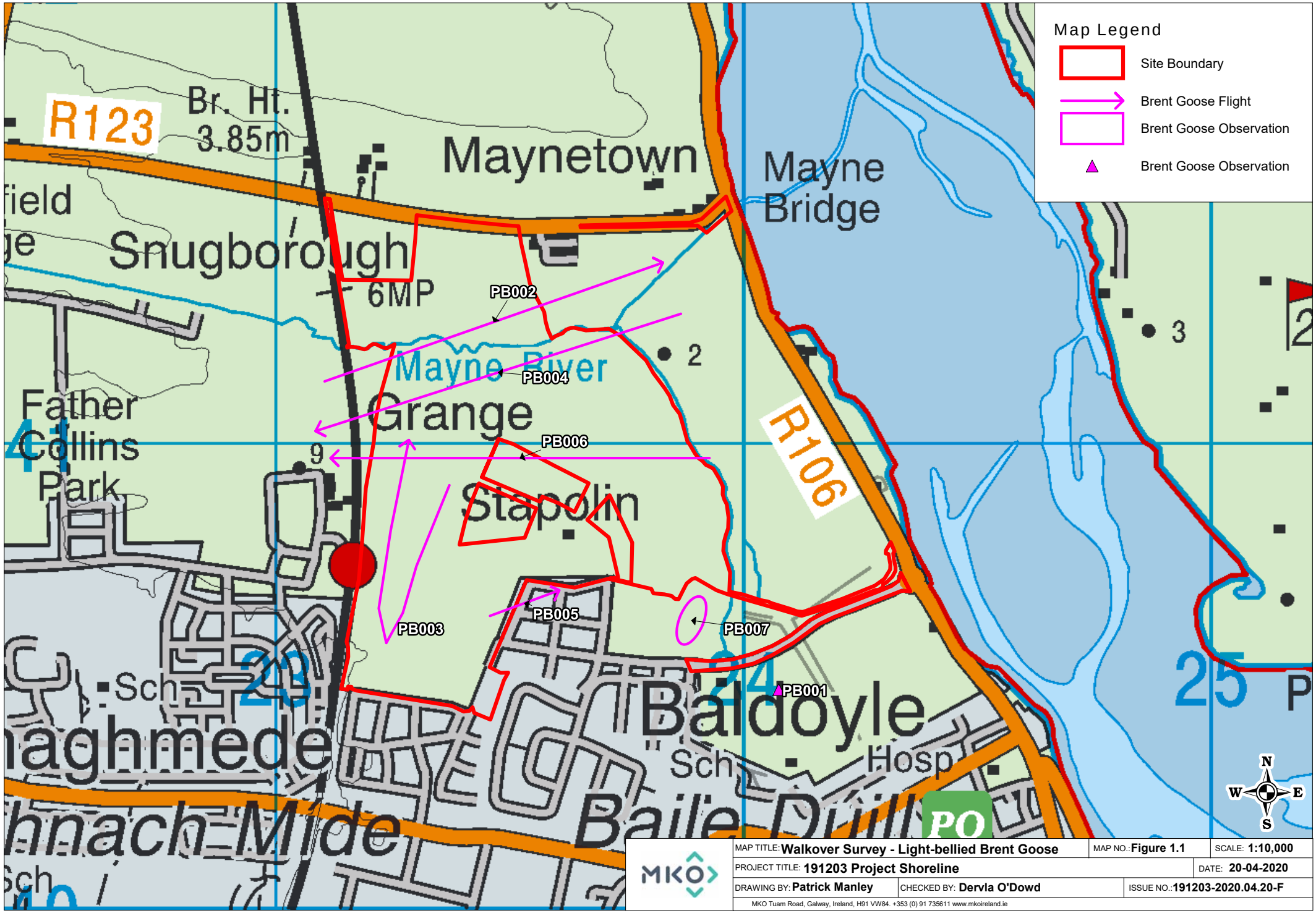

MAP TITLE: **Walkover Survey - Light-bellied Brent Goose**		MAP NO.: **Figure 1.1**	SCALE: **1:10,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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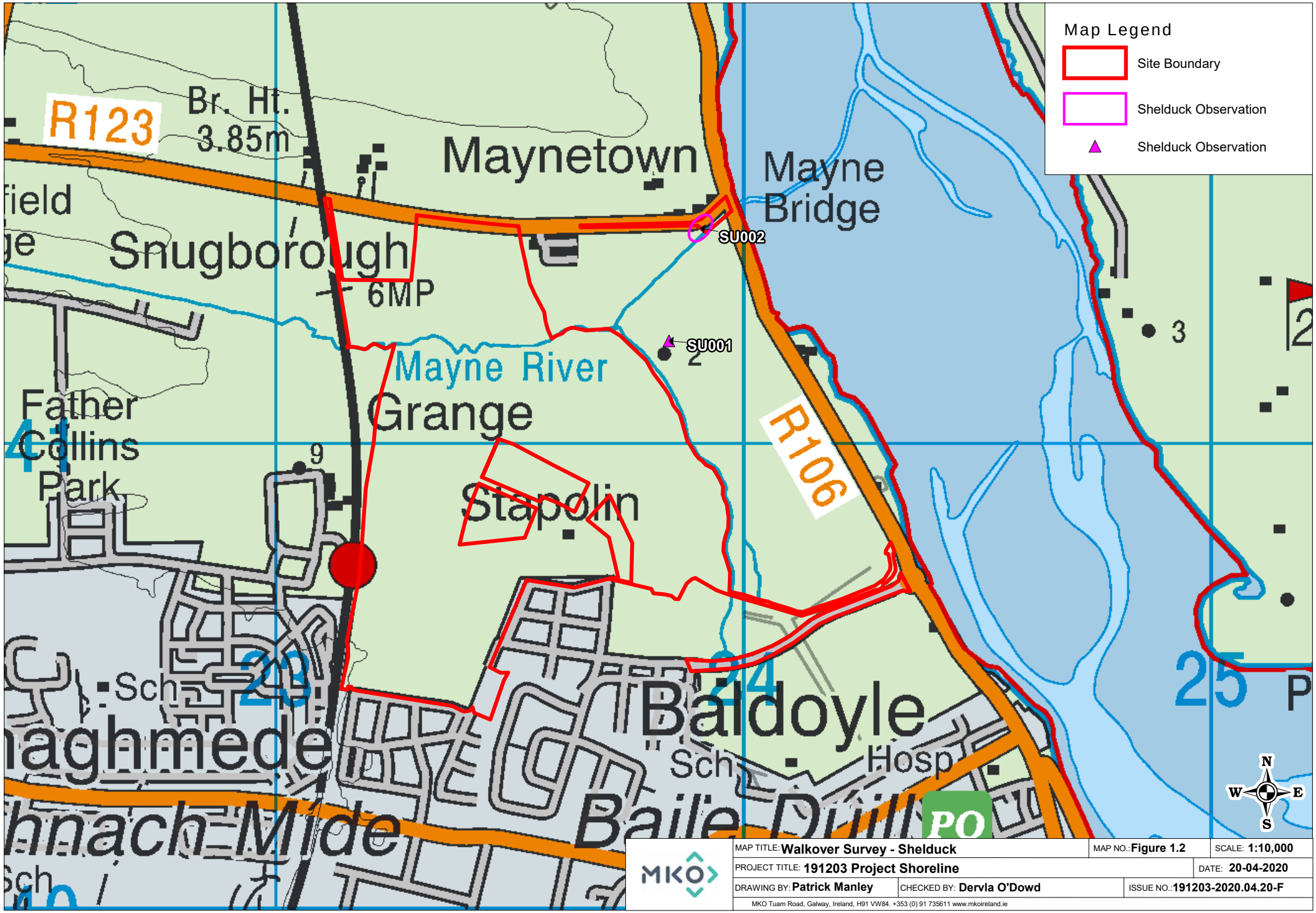

MAP TITLE: **Walkover Survey - Shelduck**		MAP NO.: **Figure 1.2**	SCALE: **1:10,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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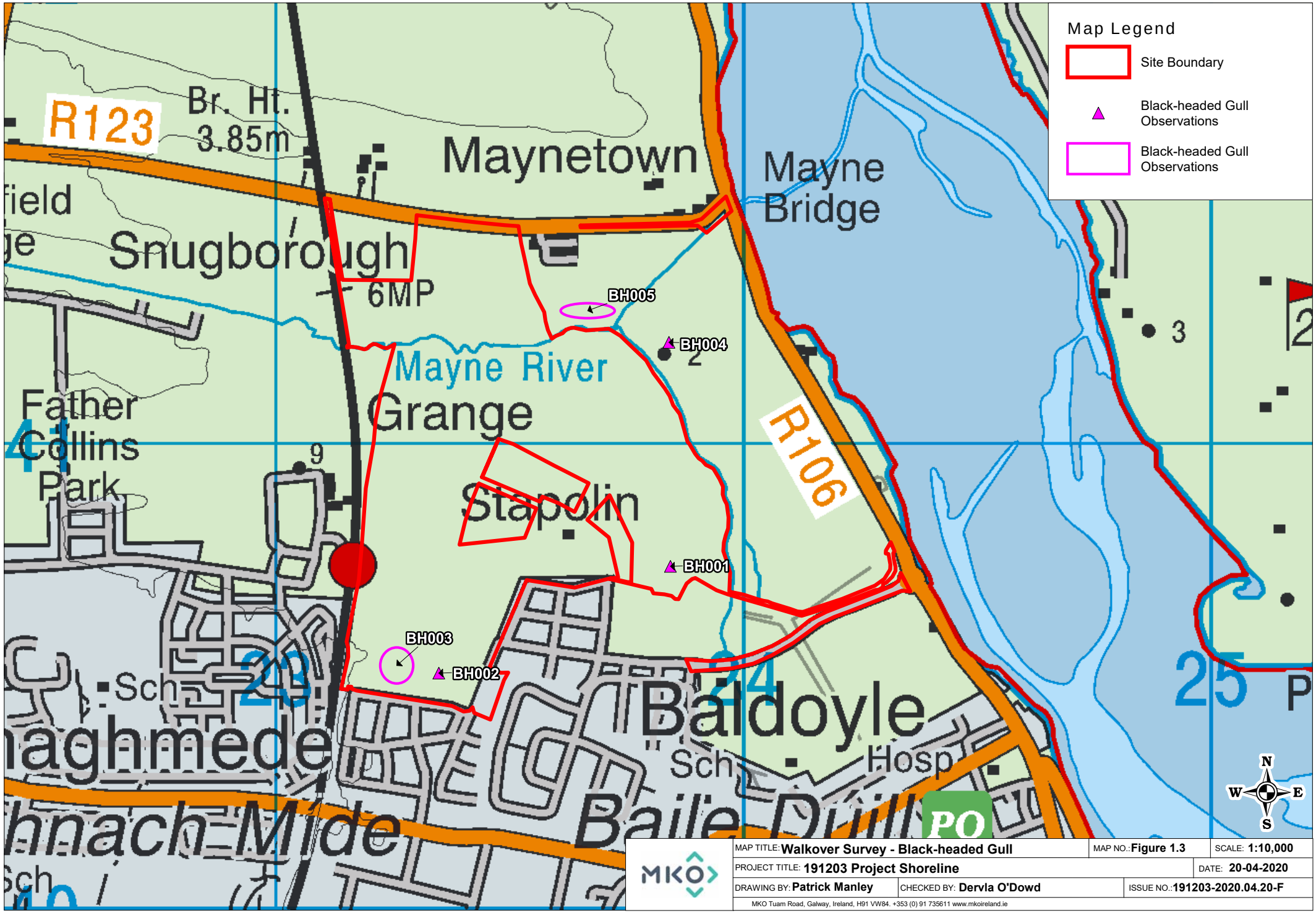

MAP TITLE: **Walkover Survey - Black-headed Gull**		MAP NO.: **Figure 1.3**	SCALE: **1:10,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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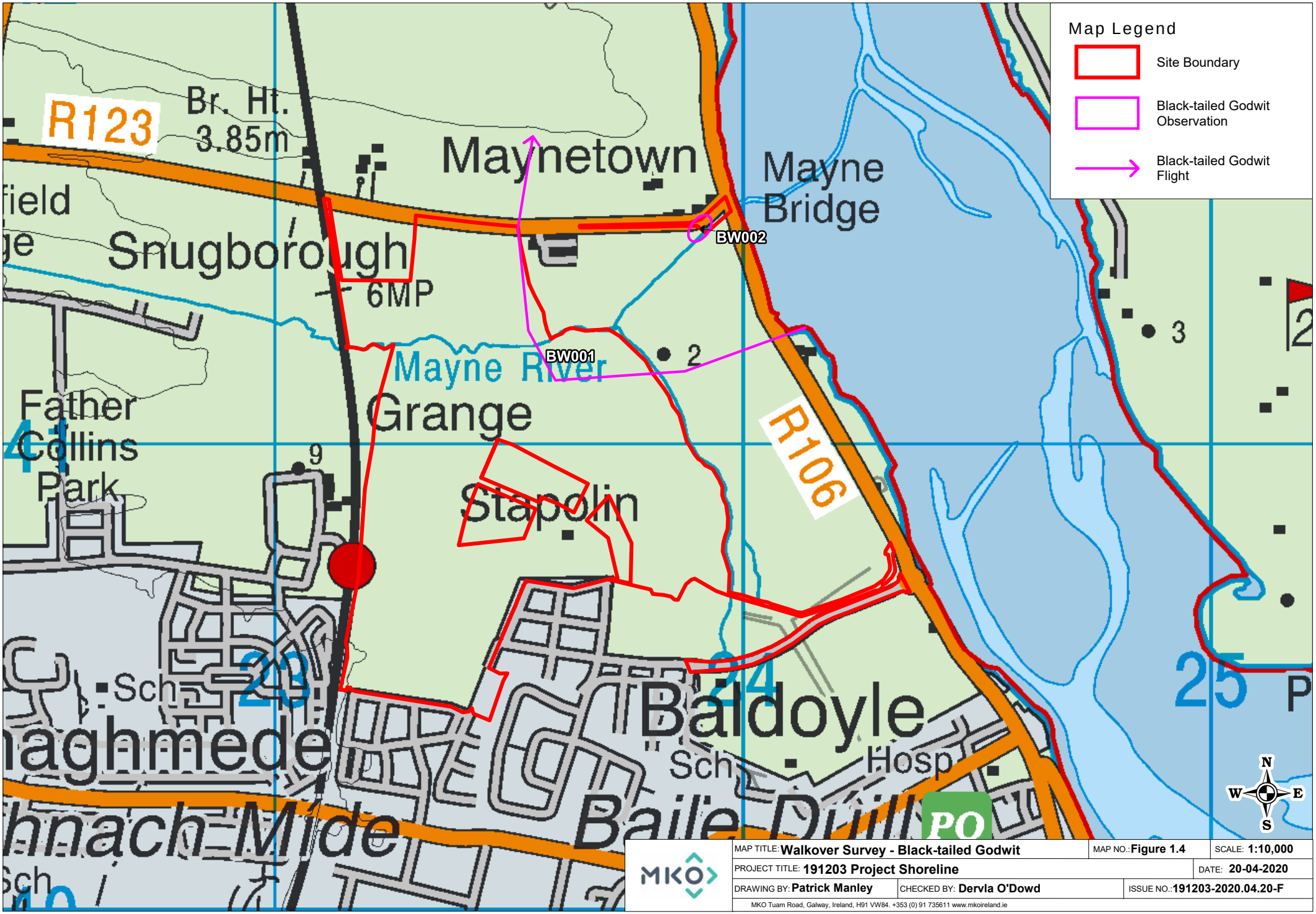

MAP TITLE: **Walkover Survey - Black-tailed Godwit** | MAP NO.: **Figure 1.4** | SCALE: **1:10,000**

PROJECT TITLE: **191203 Project Shoreline** | DATE: **20-04-2020**

DRAWING BY: **Patrick Manley** | CHECKED BY: **Dervla O'Dowd** | ISSUE NO.: **191203-2020.04.20-F**

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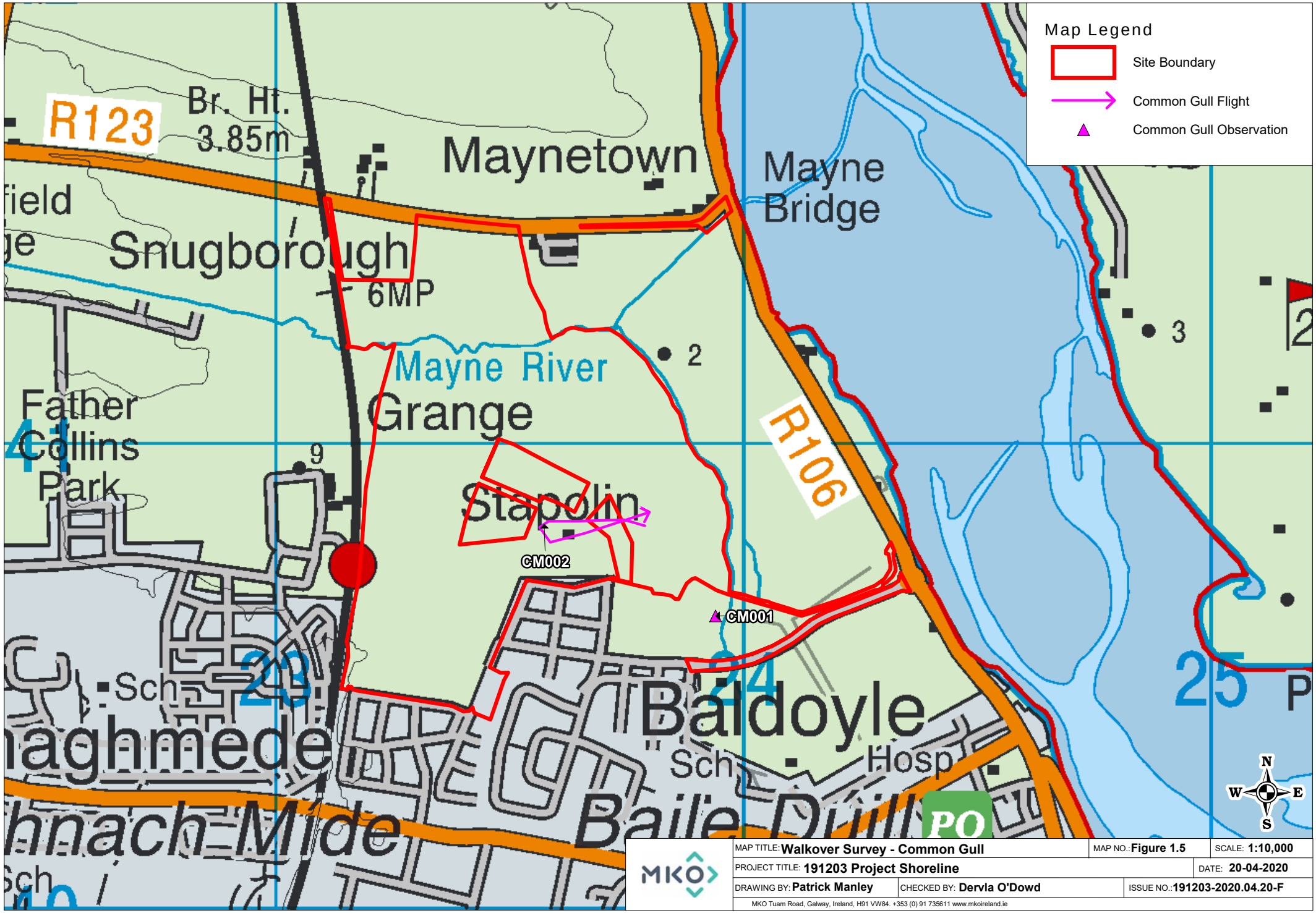

MAP TITLE: **Walkover Survey - Common Gull**		MAP NO.: **Figure 1.5**	SCALE: **1:10,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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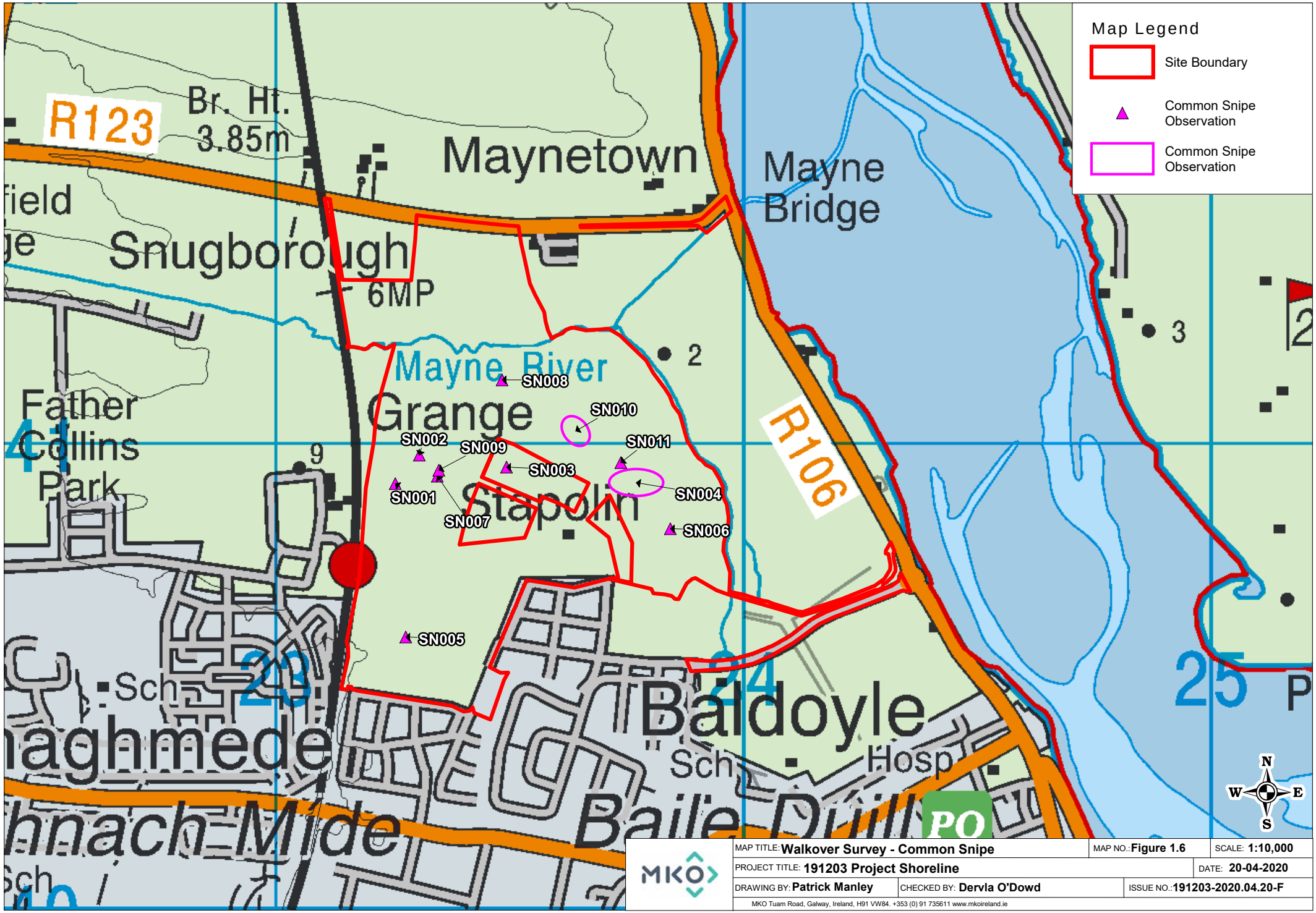

MAP TITLE: **Walkover Survey - Common Snipe**		MAP NO.: **Figure 1.6**	SCALE: **1:10,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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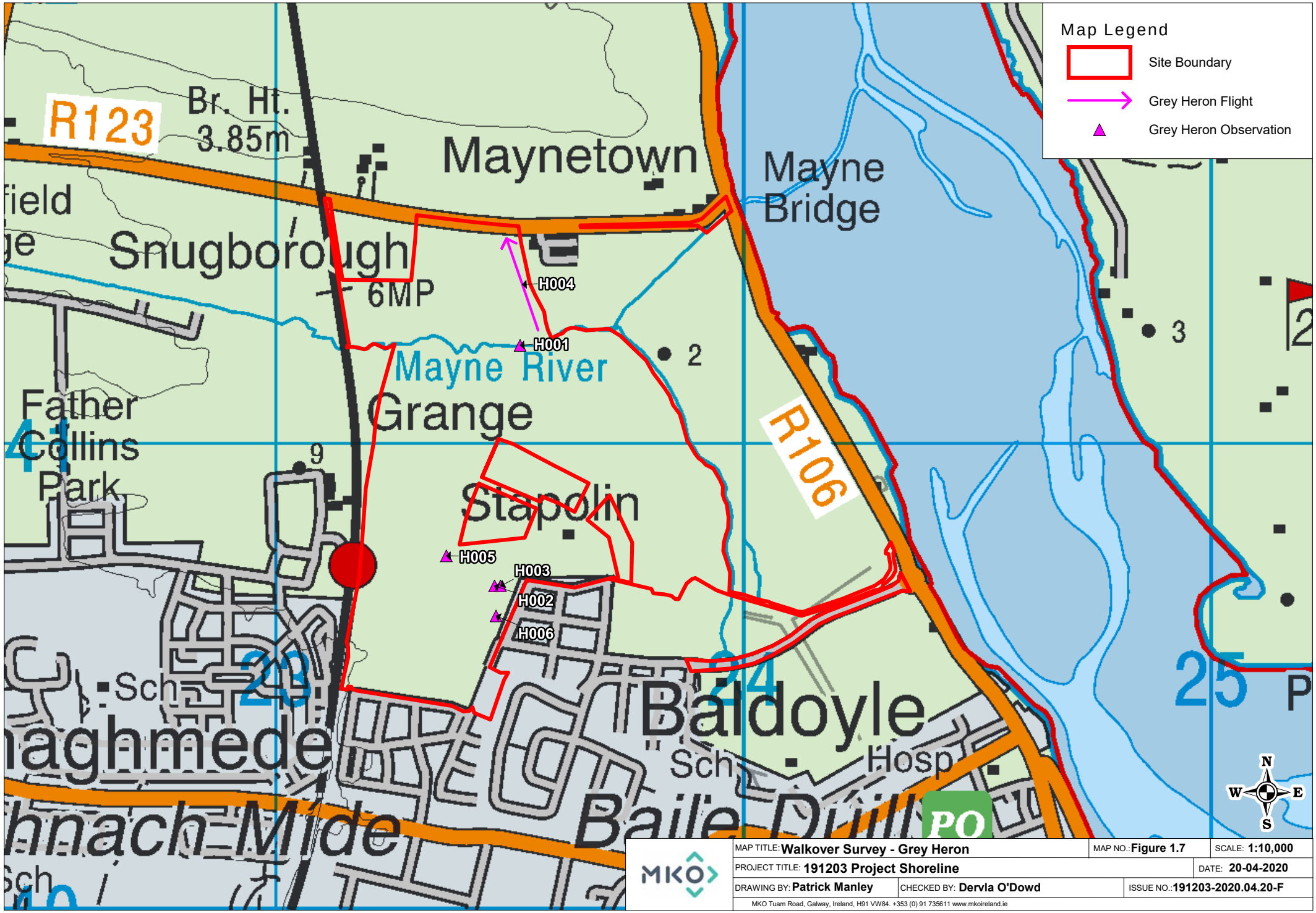

MAP TITLE: **Walkover Survey - Grey Heron**		MAP NO.: **Figure 1.7**	SCALE: **1:10,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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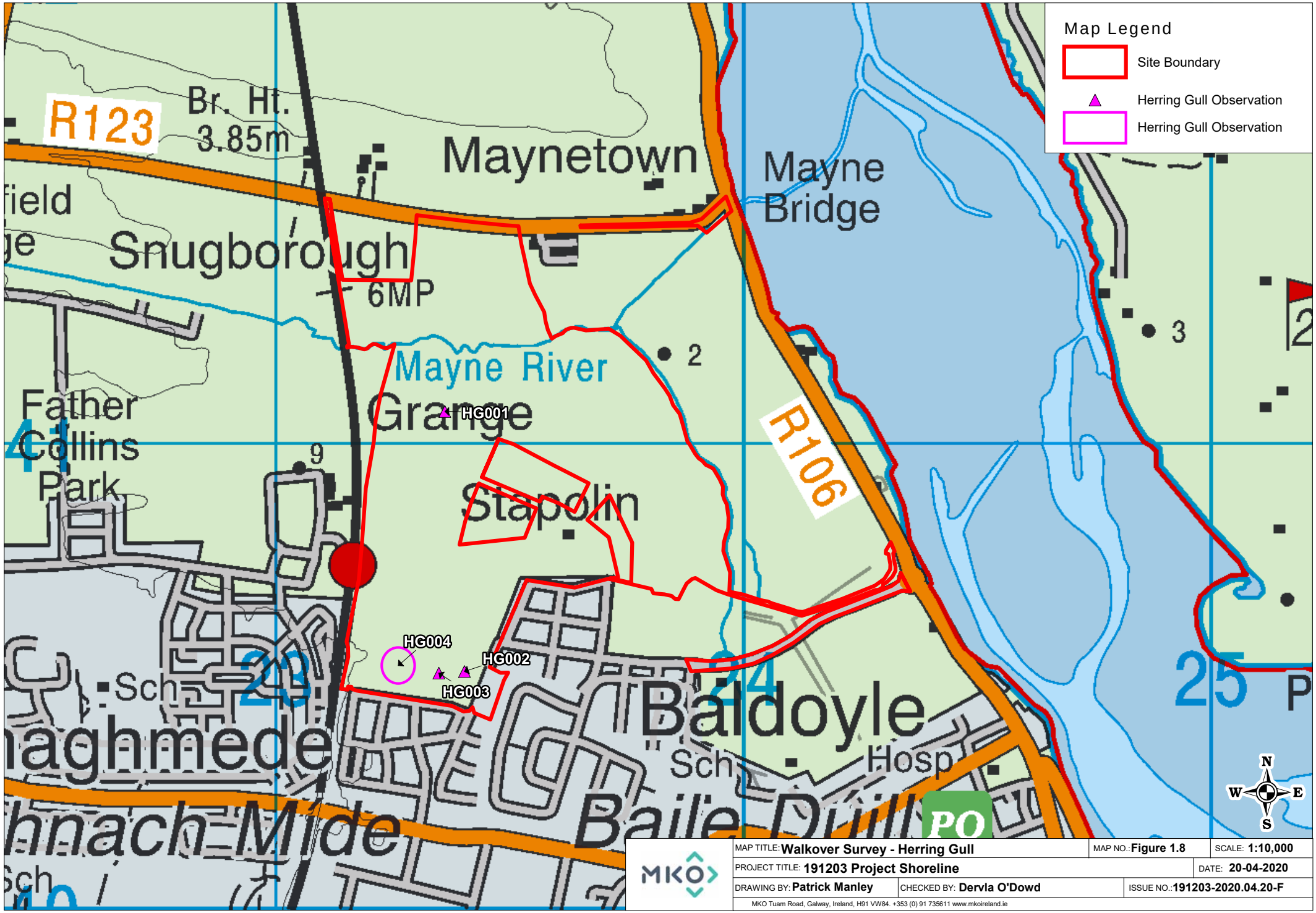

MAP TITLE: **Walkover Survey - Herring Gull**		MAP NO.: **Figure 1.8**	SCALE: **1:10,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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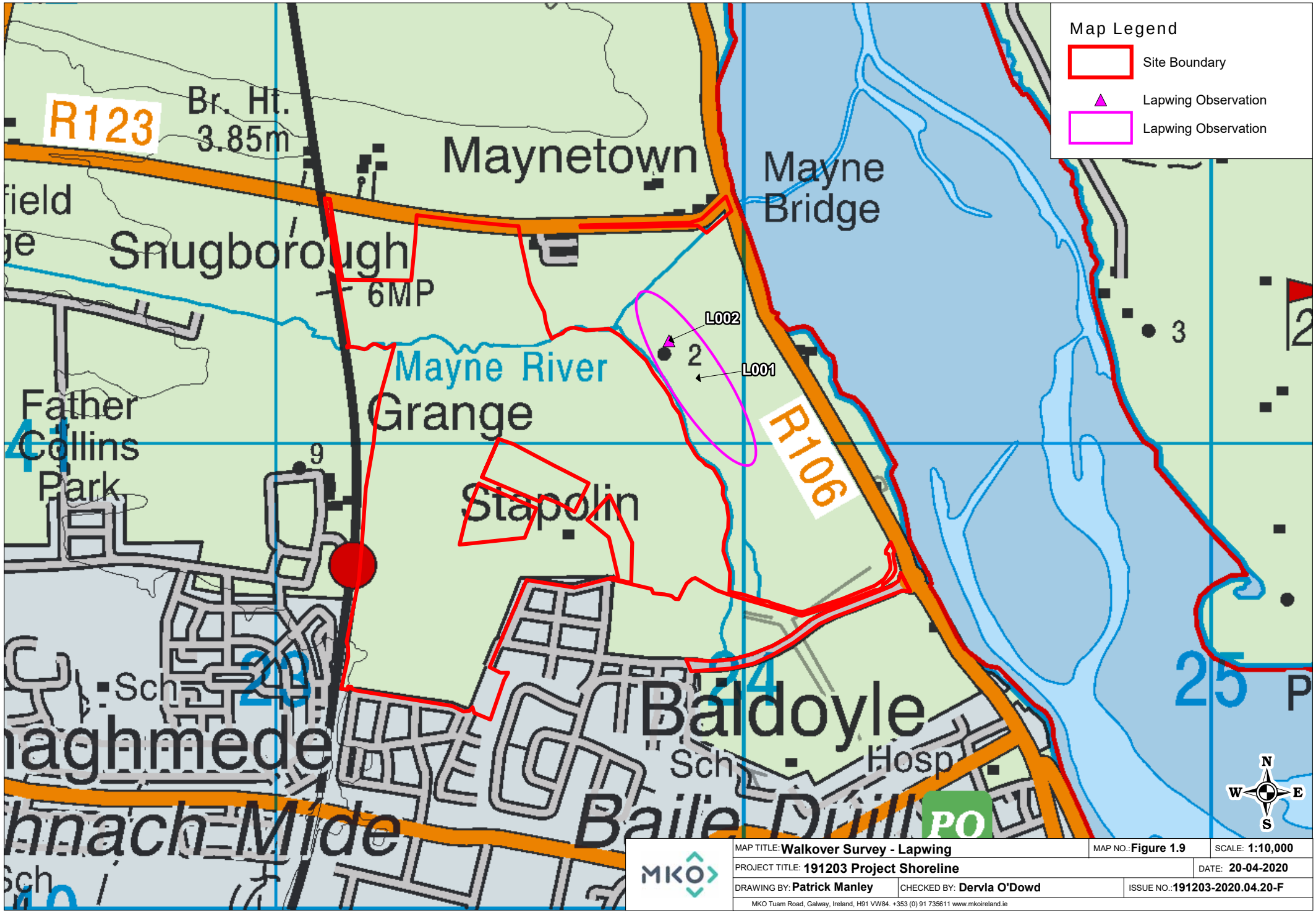

MAP TITLE: **Walkover Survey - Lapwing**		MAP NO.: **Figure 1.9**	SCALE: **1:10,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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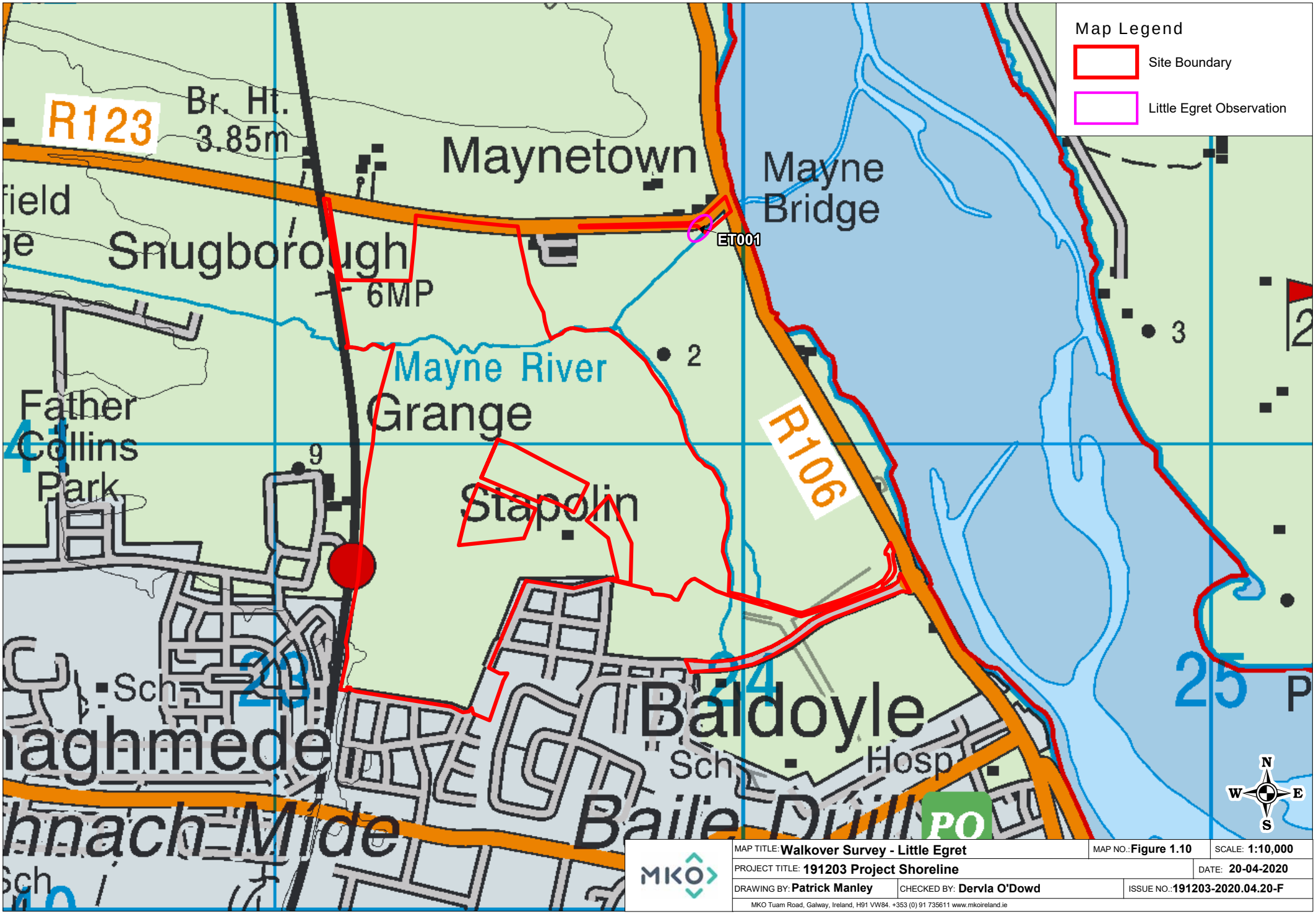

MAP TITLE: **Walkover Survey - Little Egret**		MAP NO.: **Figure 1.10**	SCALE: **1:10,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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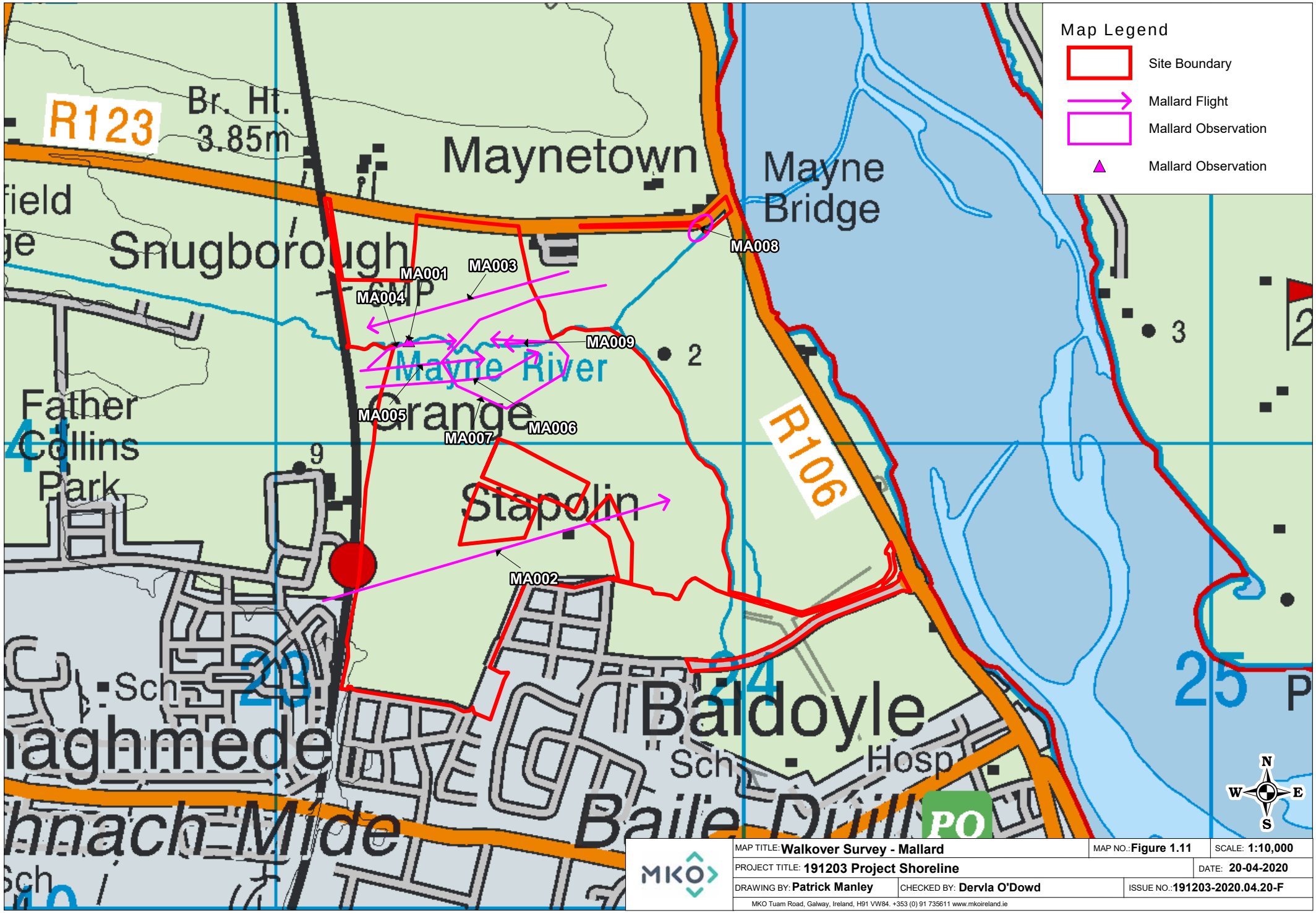

MAP TITLE: **Walkover Survey - Mallard**		MAP NO.: **Figure 1.11**	SCALE: **1:10,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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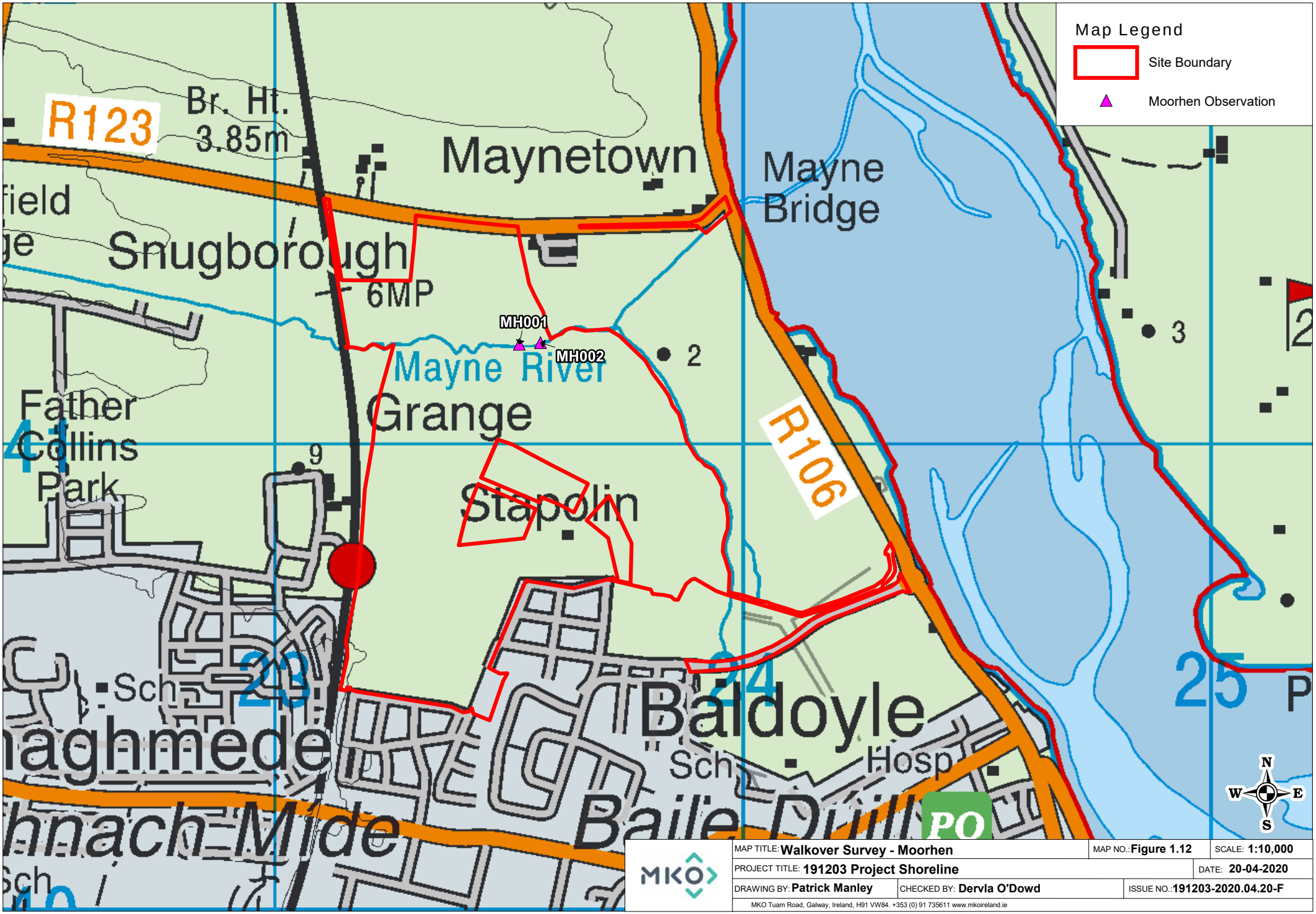

MAP TITLE: **Walkover Survey - Moorhen**		MAP NO.: **Figure 1.12**	SCALE: **1:10,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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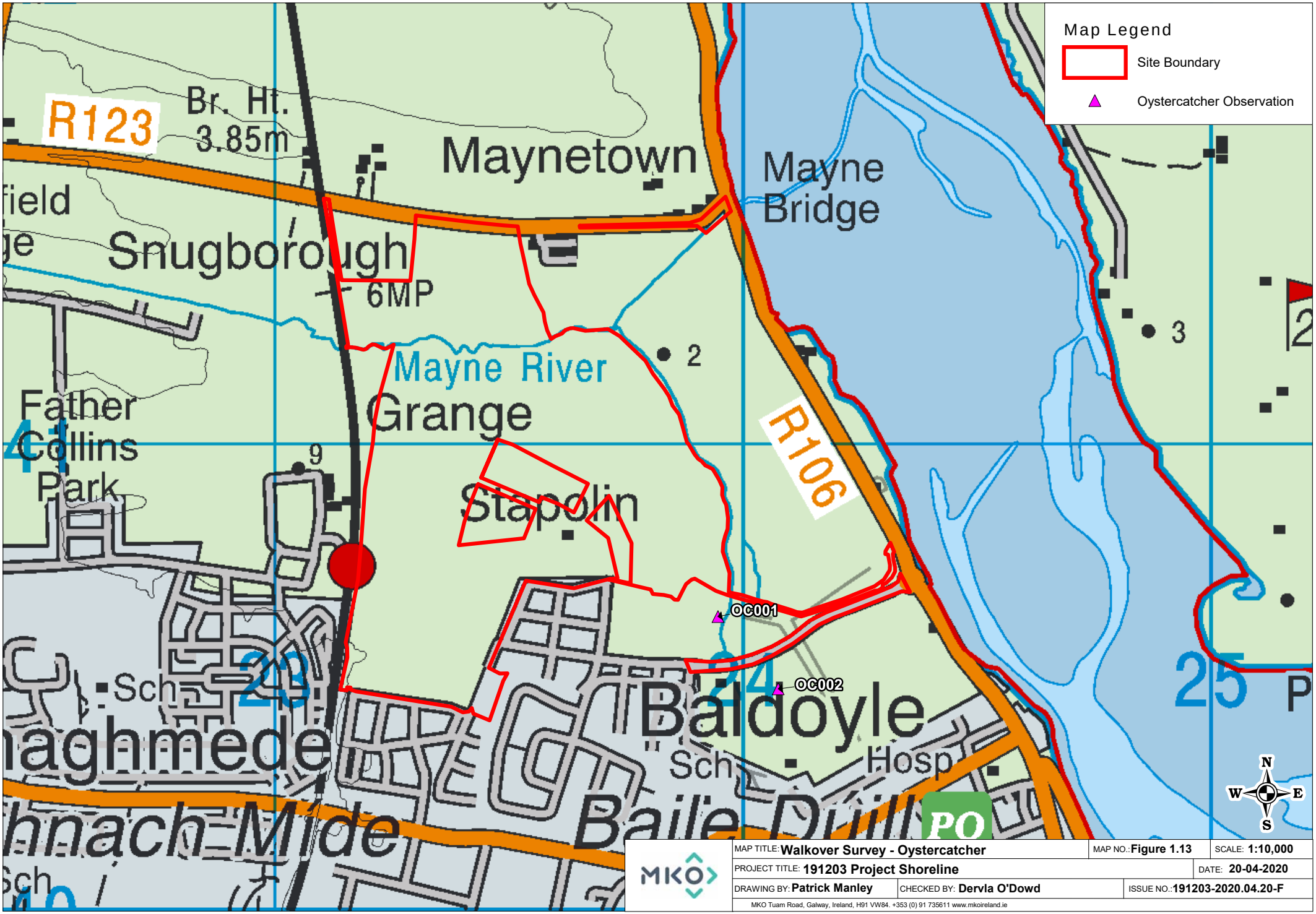

MAP TITLE: **Walkover Survey - Oystercatcher**		MAP NO.: **Figure 1.13**	SCALE: **1:10,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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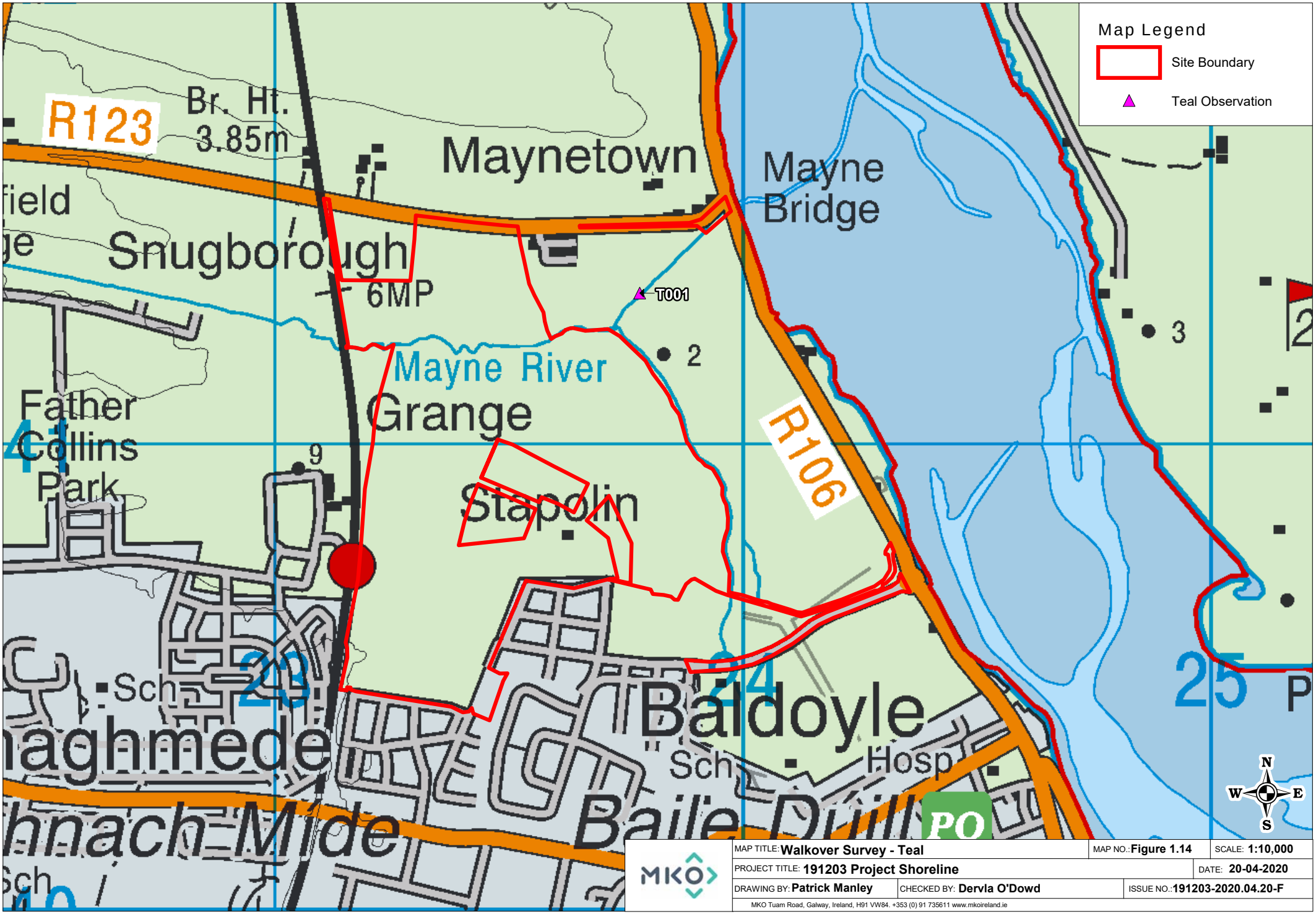

MAP TITLE: **Walkover Survey - Teal**		MAP NO.: **Figure 1.14**	SCALE: **1:10,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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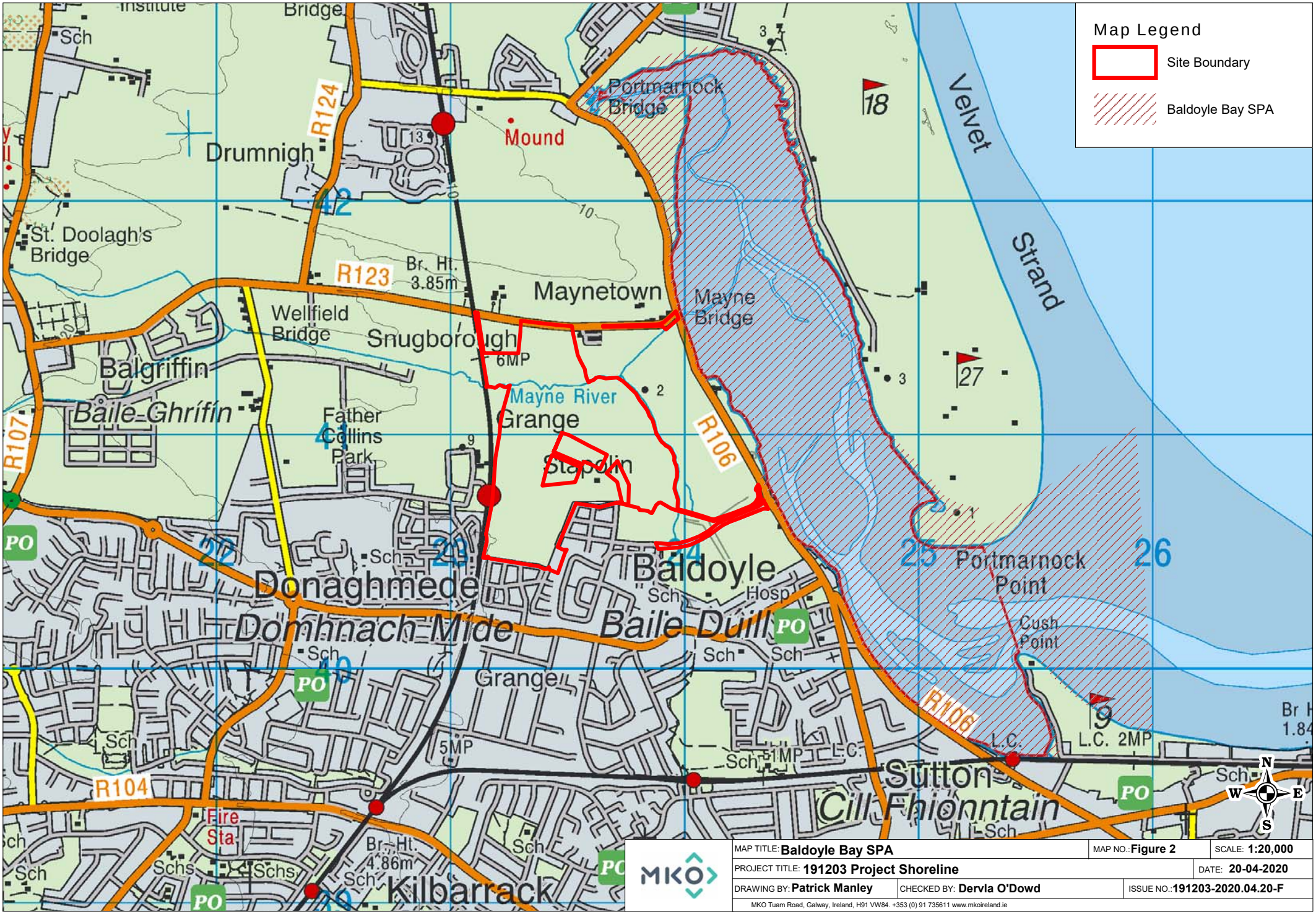

MAP TITLE: **Baldoyle Bay SPA**		MAP NO.: **Figure 2**	SCALE: **1:20,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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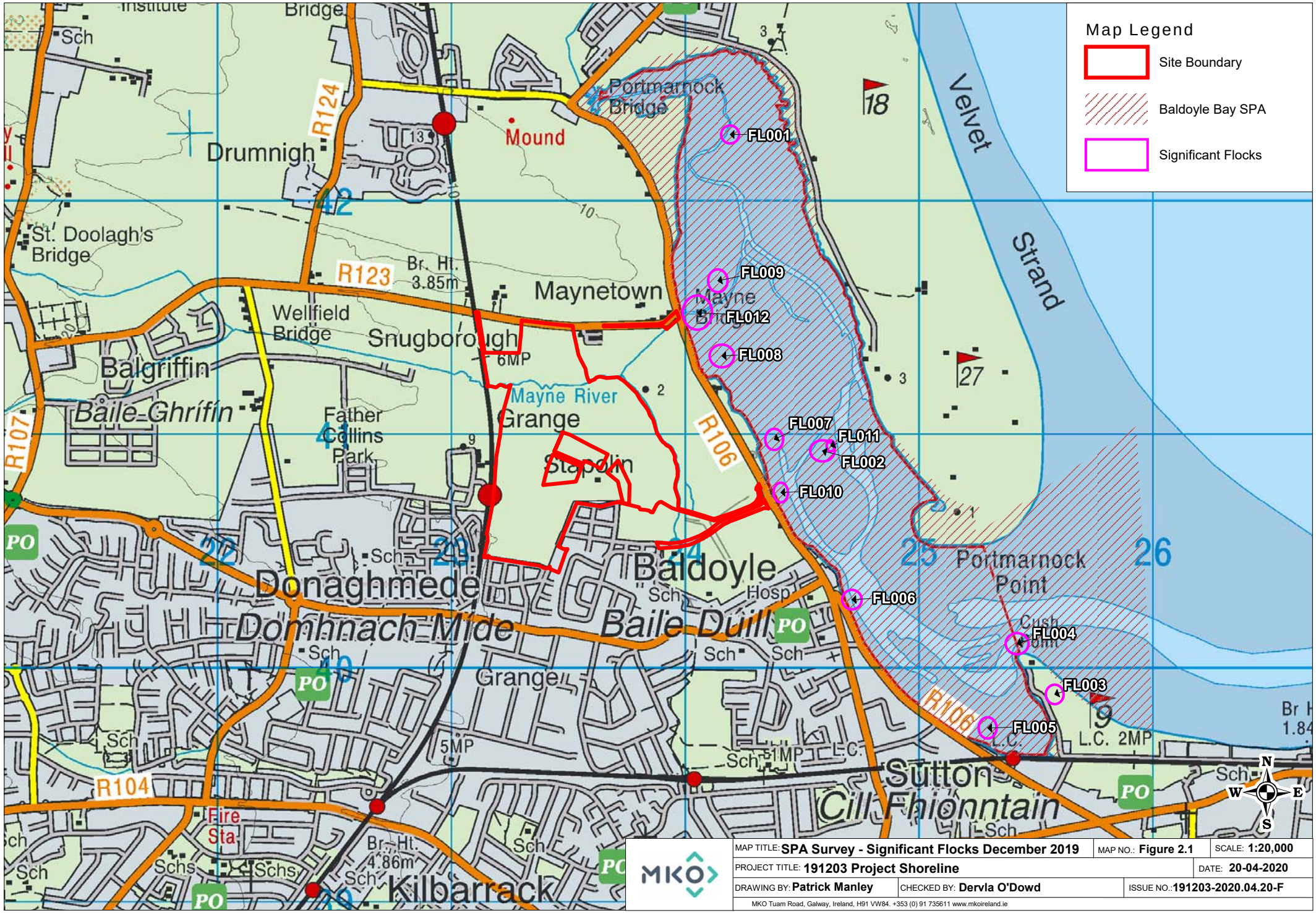
Table 1 December 2019 Flock Map

Map Ref	Date	Species	Number of birds	Notes on Habitat and Activity	Comments	Surveyor
FL001	18/12/2019	Herring Gull	96	Intertidal; Roosting		PC
FL001	18/12/2019	Great Black-backed Gull	12	Intertidal; Roosting		PC
FL001	18/12/2019	Oystercatcher	26	Intertidal; Feeding		PC
FL001	18/12/2019	Curlew	2	Intertidal; Feeding		PC
FL001	18/12/2019	Mallard	2	Intertidal; Feeding		PC
FL001	18/12/2019	Teal	2	Intertidal; Feeding		PC
FL001	18/12/2019	Redshank	12	Intertidal; Feeding		PC
FL001	18/12/2019	Black-headed Gull	10	Supratidal; Feeding		PC
FL002	18/12/2019	Mallard	51	Intertidal; Feeding		PC
FL002	18/12/2019	Oystercatcher	35	Intertidal; Feeding		PC
FL002	18/12/2019	Herring Gull	6	Intertidal; Feeding		PC
FL002	18/12/2019	Black-headed Gull	5	Intertidal; Feeding		PC
FL002	18/12/2019	Bar-tailed Godwit	4	Intertidal; Feeding		PC
FL002	18/12/2019	Grey Plover	4	Intertidal; Feeding		PC
FL002	18/12/2019	Shelduck	36	Intertidal; Feeding		PC
FL002	18/12/2019	Lapwing	1	Intertidal; Feeding		PC
FL002	18/12/2019	Common Gull	5	Intertidal; Feeding		PC
FL002	18/12/2019	Curlew	10	Intertidal; Feeding		PC
FL002	18/12/2019	Redshank	11	Intertidal; Feeding		PC
FL002	18/12/2019	Brent Goose	18	Intertidal; Feeding		PC
FL003	18/12/2019	Brent Goose	45	Terrestrial; Feeding	Foraging in golf course	PC
FL004	18/12/2019	Red-breasted Merganser	10	Subtidal; Feeding		PC
FL004	18/12/2019	Common Gull	4	Intertidal; Feeding		PC
FL004	18/12/2019	Herring Gull	5	Intertidal; Feeding		PC
FL004	18/12/2019	Oystercatcher	10	Supratidal; Roosting		PC
FL004	18/12/2019	Curlew	2	Supratidal; Roosting		PC

Map Ref	Date	Species	Number of birds	Notes on Habitat and Activity	Comments	Surveyor
FL004	18/12/2019	Long-tailed Duck	1	Subtidal; Feeding		PC
FL005	18/12/2019	Redshank	18	Intertidal; Feeding		PC
FL005	18/12/2019	Turnstone	2	Intertidal; Feeding		PC
FL005	18/12/2019	Herring Gull	4	Intertidal; Feeding		PC
FL005	18/12/2019	Grey Heron	1	Intertidal; Feeding		PC
FL005	18/12/2019	Curlew	1	Intertidal; Feeding		PC
FL005	18/12/2019	Teal	7	Intertidal; Feeding		PC
FL006	18/12/2019	Curlew	1	Intertidal; Feeding		PC
FL006	18/12/2019	Oystercatcher	1	Intertidal; Feeding		PC
FL006	18/12/2019	Dunlin	4	Intertidal; Feeding		PC
FL006	18/12/2019	Redshank	3	Intertidal; Feeding		PC
FL006	18/12/2019	Bar-tailed Godwit	8	Intertidal; Feeding		PC
FL007	18/12/2019	Black-headed Gull	4	Intertidal; Feeding		PC
FL007	18/12/2019	Herring Gull	9	Intertidal; Feeding		PC
FL007	18/12/2019	Turnstone	16	Intertidal; Feeding		PC
FL007	18/12/2019	Curlew	3	Intertidal; Feeding		PC
FL007	18/12/2019	Bar-tailed Godwit	8	Intertidal; Feeding		PC
FL007	18/12/2019	Redshank	6	Intertidal; Feeding		PC
FL007	18/12/2019	Oystercatcher	21	Intertidal; Feeding		PC
FL008	18/12/2019	Bar-tailed Godwit	27	Intertidal; Feeding		PC
FL008	18/12/2019	Curlew	16	Intertidal; Feeding		PC
FL008	18/12/2019	Oystercatcher	62	Intertidal; Feeding		PC
FL008	18/12/2019	Redshank	30	Intertidal; Feeding		PC
FL008	18/12/2019	Shelduck	17	Intertidal; Feeding		PC
FL008	18/12/2019	Turnstone	4	Intertidal; Feeding		PC
FL008	18/12/2019	Greenshank	1	Intertidal; Feeding		PC

Map Ref	Date	Species	Number of birds	Notes on Habitat and Activity	Comments	Surveyor
FL008	18/12/2019	Herring Gull	16	Intertidal; Feeding		PC
FL008	18/12/2019	Black-headed Gull	13	Intertidal; Feeding		PC
FL008	18/12/2019	Great Black-backed Gull	4	Intertidal; Feeding		PC
FL008	18/12/2019	Dunlin	16	Intertidal; Feeding		PC
FL008	18/12/2019	Brent Goose	6	Intertidal; Feeding		PC
FL008	18/12/2019	Golden Plover	50	Intertidal; Roosting		PC
FL009	18/12/2019	Teal	6	Intertidal; Roosting		PC
FL009	18/12/2019	Wigeon	79	Intertidal; Roosting		PC
FL009	18/12/2019	Whooper Swan	1	Intertidal; Roosting		PC
FL010	23/12/2019	Lapwing	7	Above Water; Roosting		ED
FL010	23/12/2019	Redshank	1	Above Water; Roosting		ED
FL011	23/12/2019	Shelduck	12	On Water; feeding		ED
FL012	23/12/2019	Wigeon	1	On Water; feeding		ED
FL012	23/12/2019	Shelduck	14	On Water; Feeding		ED
FL012	23/12/2019	Teal	11	On Water; Feeding		ED
FL012	23/12/2019	Wigeon	16	On Water; Feeding		ED
FL012	23/12/2019	Great Black-backed Gull	2	Above Water; Roosting		ED
FL012	23/12/2019	Black-headed Gull	6	Above Water; Roosting		ED
FL012	23/12/2019	Common Gull	1	Above Water; Roosting		ED
FL012	23/12/2019	Redshank	2	Above Water; Roosting		ED
FL012	23/12/2019	Little Egret	1	Above Water; Feeding		ED
FL012	23/12/2019	Red-breasted Merganser	1	Above Water; Roosting		ED
FL012	23/12/2019	Grey Heron	1	Above Water; Feeding		ED



MAP TITLE: **SPA Survey - Significant Flocks December 2019**		MAP NO.: **Figure 2.1**	SCALE: **1:20,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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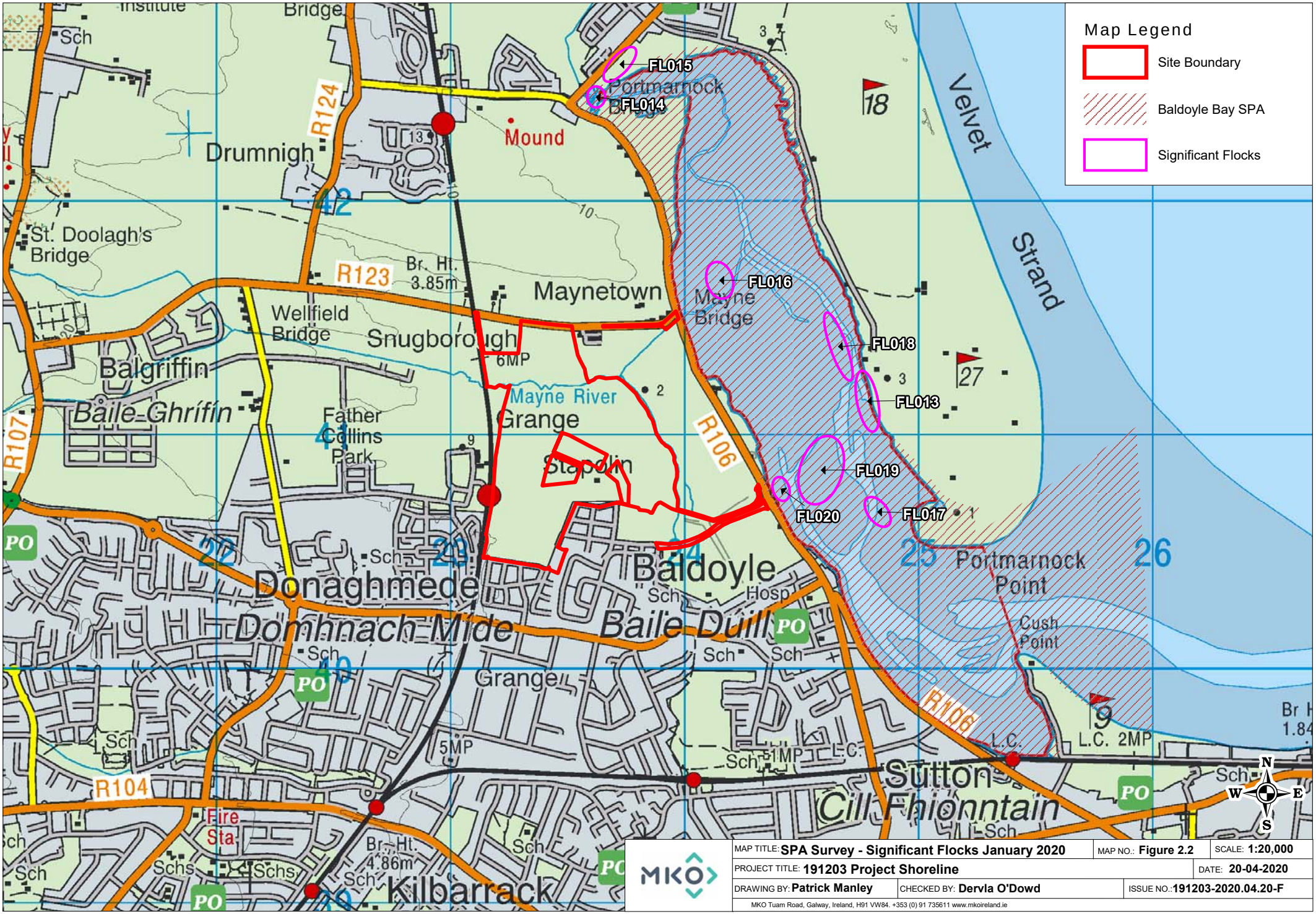
Table 2 January 2020 Flock Map

Map Ref	Date	Species	Number of birds	Notes on Habitat and Activity	Comments	Surveyor
FL013	15/01/2020	Curlew	36	Intertidal; Roosting		SD
FL013	15/01/2020	Oystercatcher	77	Intertidal; Feeding		SD
FL014	15/01/2020	Lapwing	38	Supratidal; Roosting		SD
FL015	15/01/2020	Black-headed Gull	5	Intertidal; Feeding	30+ foraging in park adjacent to SPA	SD
FL015	15/01/2020	Brent Goose	4	Subtidal; Feeding	60+ foraging in park adjacent to SPA	SD
FL016	15/01/2020	Black-headed Gull	29	Subtidal; Roosting		SD
FL017	28/01/2020	Oystercatcher	138	Intertidal; Roosting		SD
FL018	28/01/2020	Oystercatcher	32	Intertidal; Feeding		SD
FL018	28/01/2020	Oystercatcher	45	Intertidal; Roosting		SD
FL019	28/01/2020	Brent Goose	50	Subtidal; Feeding		SD
FL019	28/01/2020	Brent Goose	303	Intertidal; Feeding		SD
FL020	28/01/2020	Knot	160	Intertidal; Feeding		SD



MAP TITLE: **SPA Survey - Significant Flocks January 2020**		MAP NO.: **Figure 2.2**	SCALE: **1:20,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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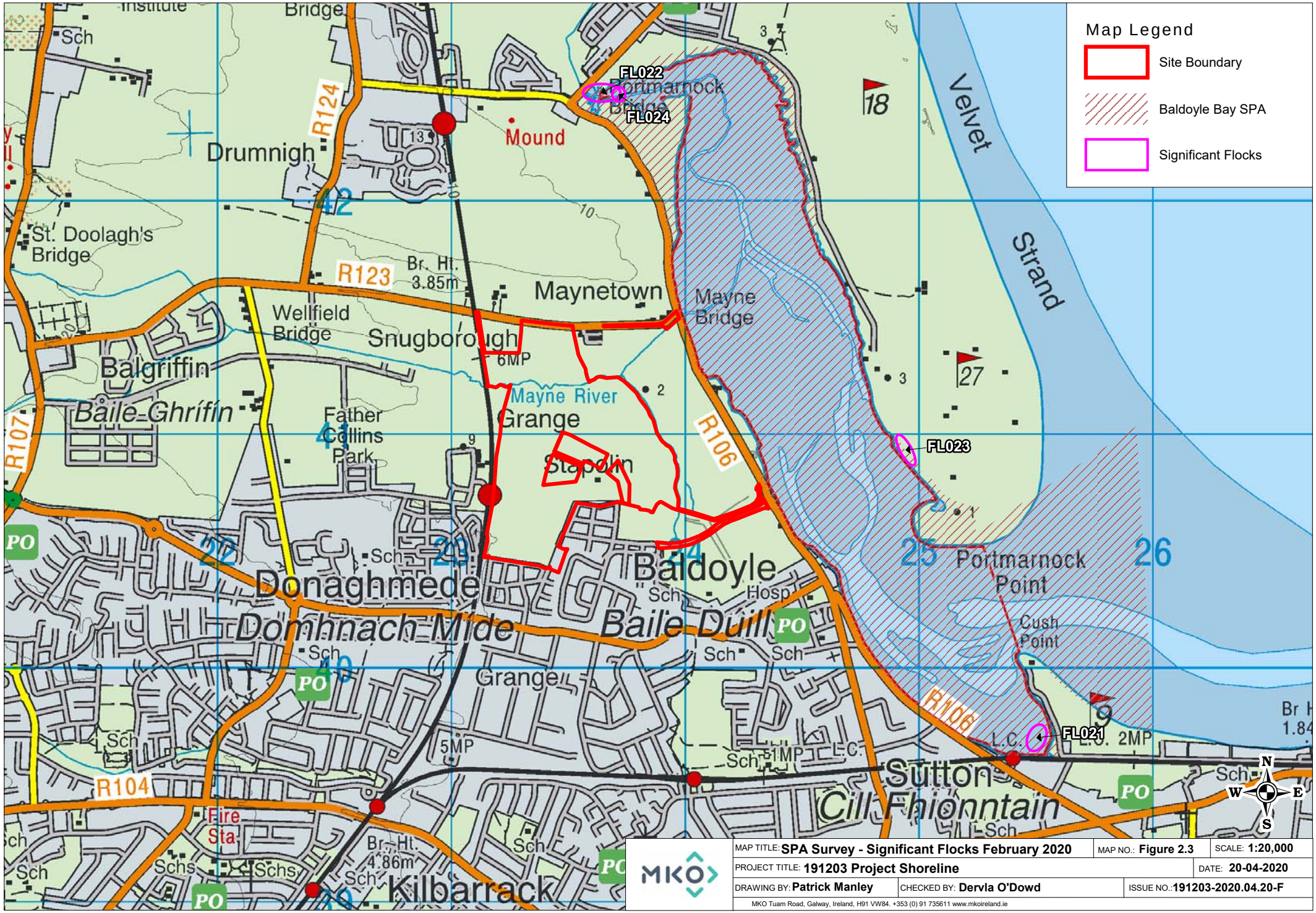
Table 3 February 2020 Flock Map

Map Ref	Date	Species	Number of birds	Notes on Habitat and Activity	Comments	Surveyor
FL021	10/02/2020	Brent Goose	119	Intertidal; Feeding		SD
FL022	10/02/2020	Redshank	111	Supratidal; Roosting		SD
FL023	24/02/2020	Brent Goose	40	Terrestrial; Feeding		SD
FL024	24/02/2020	Redshank	48	Supratidal; Roosting		SD



MAP TITLE: **SPA Survey - Significant Flocks February 2020**		MAP NO.: **Figure 2.3**	SCALE: **1:20,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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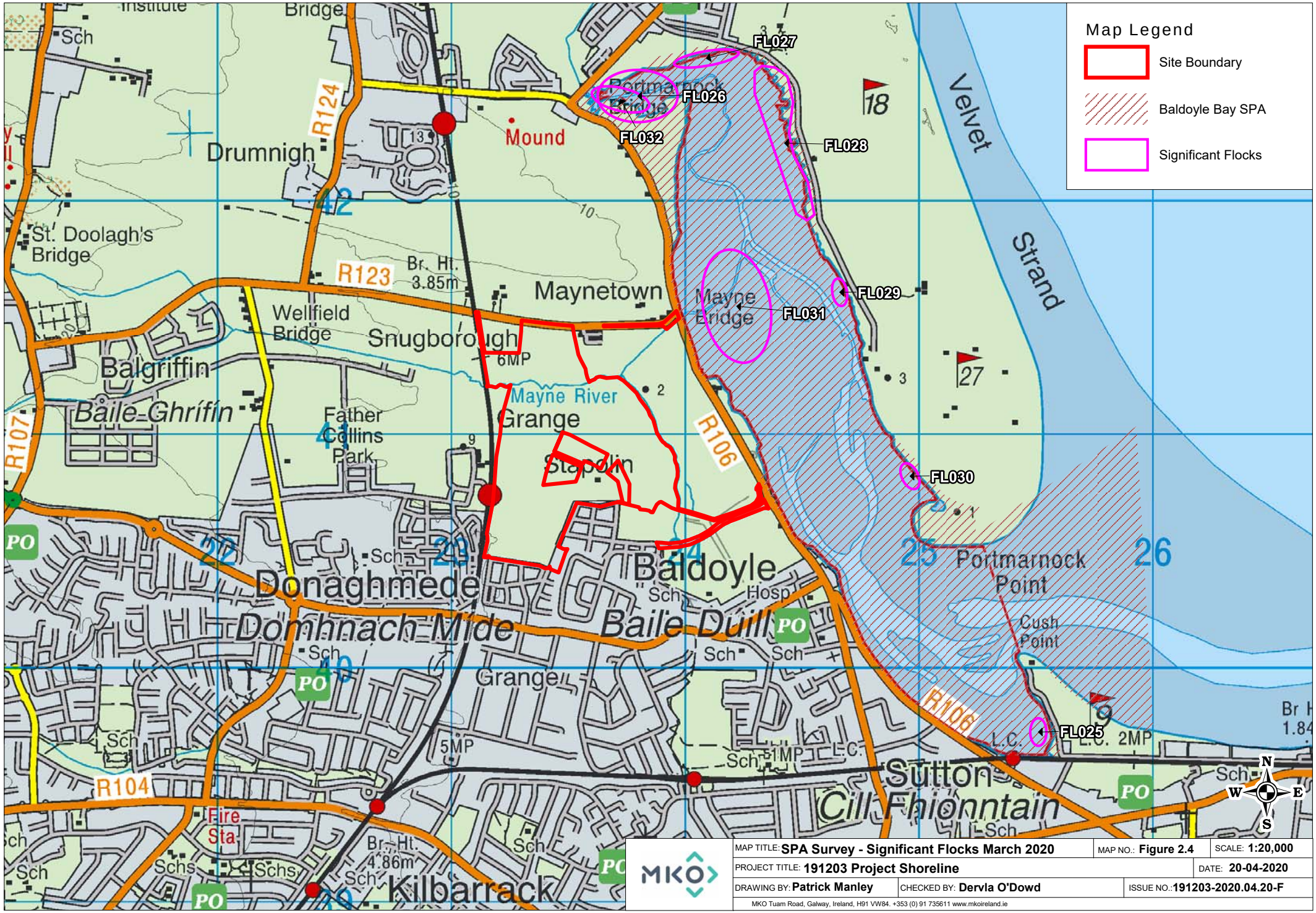
Table 4 March 2020 Flock Map

Map Ref	Date	Species	Number of birds	Notes on Habitat and Activity	Comments	Surveyor
FL025	11/03/2020	Brent Goose	62	Intertidal; Feeding		SD
FL026	11/03/2020	Brent Goose	110	Intertidal; Feeding		SD
FL026	11/03/2020	Redshank	73	Supratidal; Roosting		SD
FL027	11/03/2020	Brent Goose	114	Subtidal; Roosting		SD
FL028	11/03/2020	Brent Goose	470	Intertidal; Feeding		SD
FL029	11/03/2020	Brent Goose	101	Intertidal; Feeding		SD
FL030	24/03/2020	Oystercatcher	250	Supratidal; Roosting		SD
FL032	24/03/2020	Black-tailed Godwit	82	Supratidal; Roosting		SD
FL031	24/03/2020	Brent Goose	382	Subtidal; Feeding	large, loosely dispersed flock	SD



MAP TITLE: **SPA Survey - Significant Flocks March 2020**		MAP NO.: **Figure 2.4**	SCALE: **1:20,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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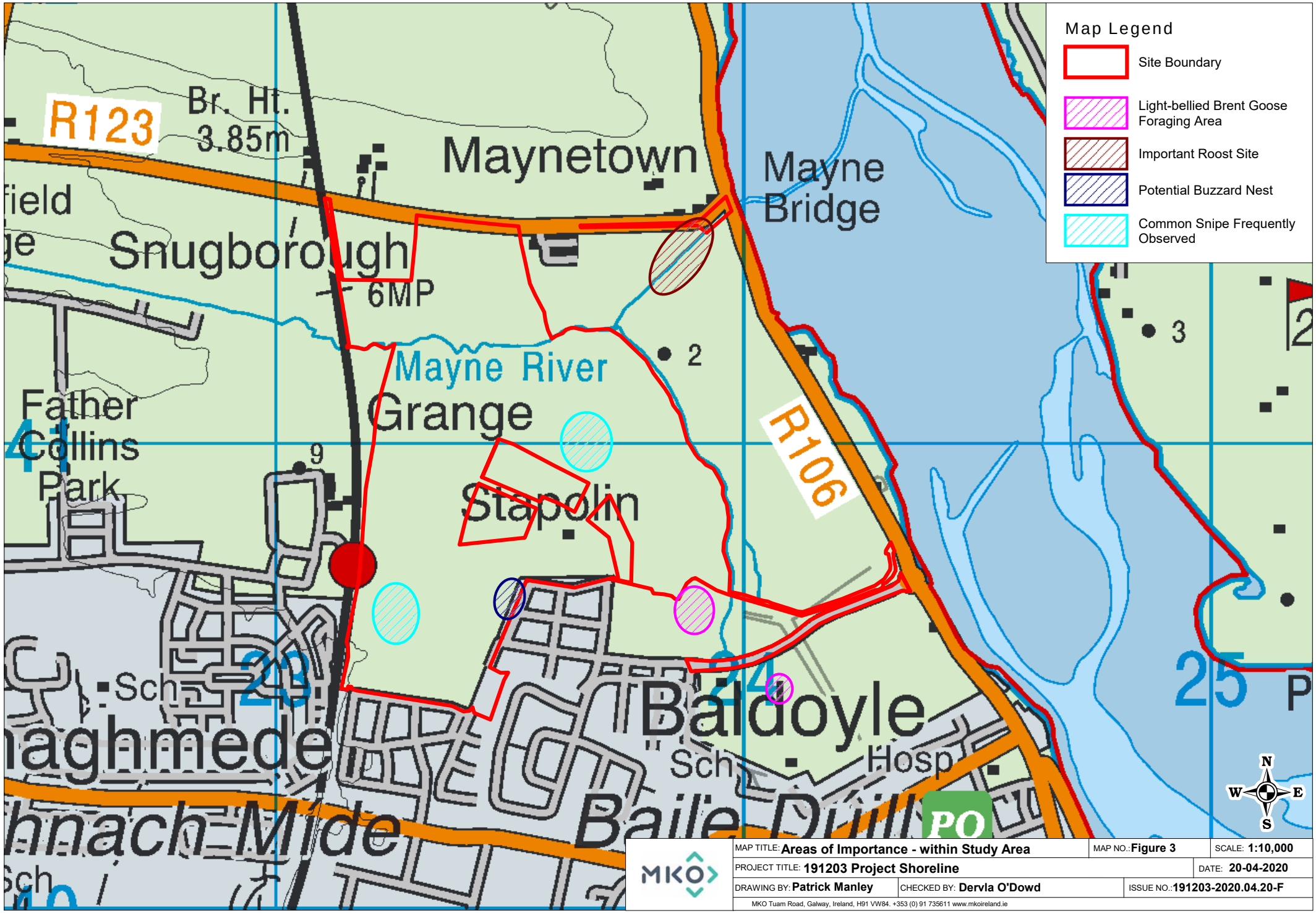

MAP TITLE: **Areas of Importance - within Study Area**		MAP NO.: **Figure 3**	SCALE: **1:10,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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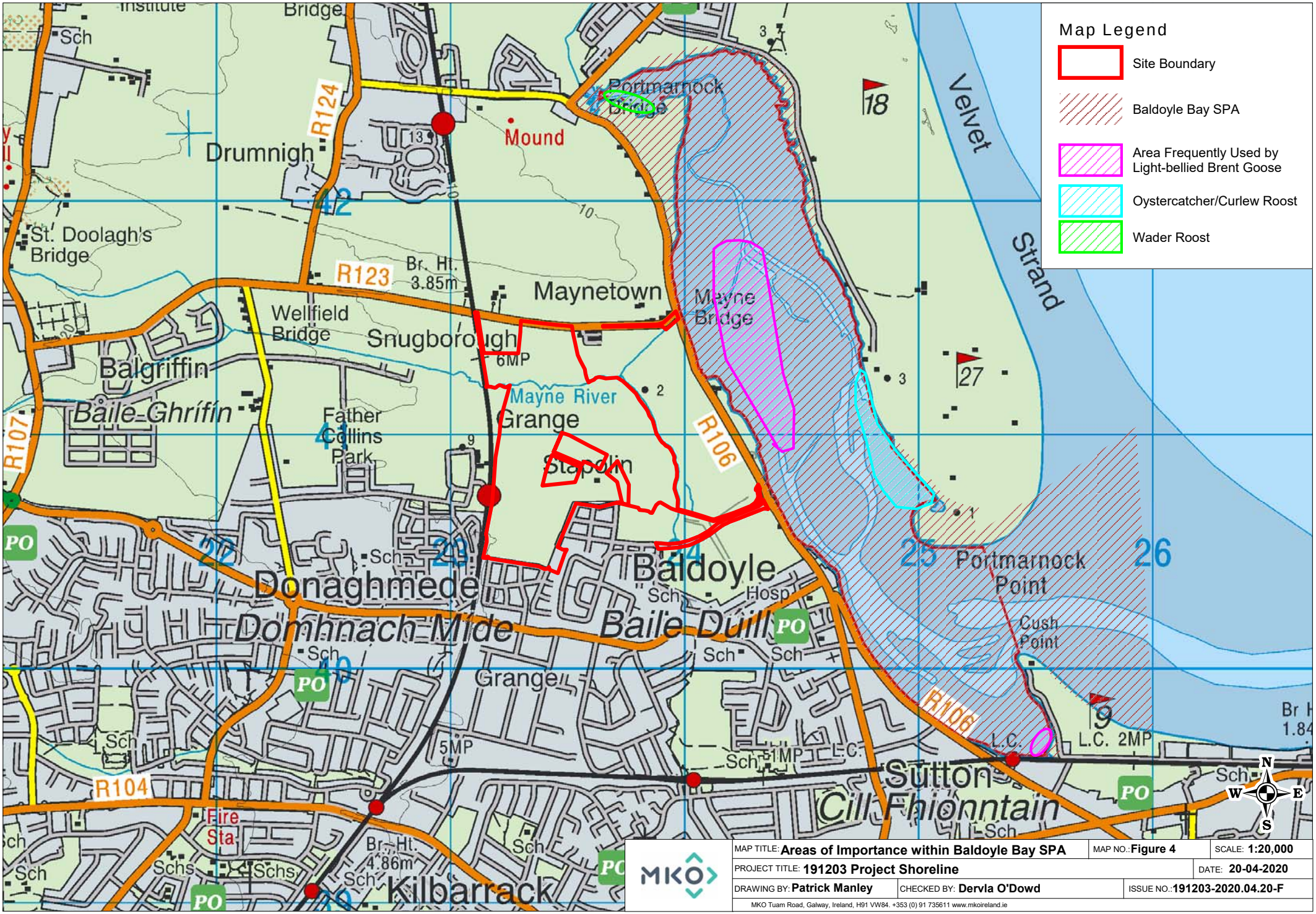

MAP TITLE: **Areas of Importance within Baldoyle Bay SPA**		MAP NO.: **Figure 4**	SCALE: **1:20,000**
PROJECT TITLE: **191203 Project Shoreline**			DATE: **20-04-2020**
DRAWING BY: **Patrick Manley**	CHECKED BY: **Dervla O'Dowd**		ISSUE NO.: **191203-2020.04.20-F**

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APPENDIX 3

CURRICULUM VITAE

Planning and Environmental Consultants

CURRICULUM VITAE

Padraig Cregg

Padraig Cregg is a Senior Ornithologist with MKO with over 8 years of experience in both private practice and NGOs. Padraig holds a BSc (Hons) in Zoology and Masters in Evolutionary and Behavioural Ecology. Prior to taking up his position with MKO in December 2018, Padraig worked as a Senior Ornithologist and held previous posts with TOBIN Consulting Engineers, Energised Environments Ltd in Scotland, WSP Environment and Energy Ltd in Scotland and BirdWatch Ireland. Padraig has specialist knowledge in designing, executing and project managing ornithological assessments, primarily in the renewable industry. Padraig's key strengths and areas of expertise are in ornithology and ecology surveying and in writing Natura Impact Statements (NIS) and the Biodiversity chapter of Environmental Impact Assessment Reports (EIAR) to accompany planning applications. Since joining MKO Padraig has been involved in designing, executing and project managing the ornithological assessment on over 20 proposed wind farm developments. He has played a key role in project managing these planning applications through the statutory planning system, with more projects in the pipeline. Within MKO Padraig plays a large role in the management and confidence building of junior members of staff and works as part of a large multi-disciplinary team to produce EIAR and NIS Reports. Padraig has project managed a range of infrastructure projects, with an emphasis on wind and solar energy projects across the Ireland and the UK.

Current Role	Senior Ornithologist
Qualifications	› M.Sc Evolutionary and Behavioural Ecology (University of Exeter, 2008). › B.Sc Zoology (National University of Ireland, Galway, 2007).
Years of Experience	› Padraig has over seven years' experience working in both the UK and Ireland primarily in the renewable industry. Padraig has a strong technical background in ornithology and ecology surveying and in writing Natura Impact Statements (NIS) and sections of Environmental Impact Assessment Reports (EIAR) to accompany planning applications.
Relevant Experience	› Wind Farm Projects. Padraig has worked on over 40 wind farm projects in both Ireland and the UK. From his time working in the UK, Padraig provides expert experience in interpreting and implementing Scottish ornithological guidance documents (SNH, 2017) for the surveying of wind farms in an Irish context. Padraig's key responsibilities included: managing the in-house team and sub-consultants, directly liaising with the client and landowner, consulting with the Planning Departments and the Development Applications Unit (DAU), writing sections of and reviewing the Environmental Impact Assessment Reports and Appropriate Assessment (AA) Screening and Natura Impact Statements (NIS) Reports (as appropriate), reviewing GIS mapping and Planning Application drawings. › Solar Farm Projects. Padraig has acted as Senior Ecologist and Project Manager for several Solar Farm Planning Applications. Key responsibilities include liaising directly with client, attending preplanning meetings with local county council, consulting with Development Application Unit (DAU), designing surveys, writing sections of the Planning and Environmental Considerations Reports and Appropriate Assessment (AA) Screening Report and Natura Impact Statement, as appropriate. › Water Supply Project Eastern and Midlands Region (Irish Water). Padraig acted as the Senior Ornithologist for the Water Supply Project. He was responsible for the review and design of breeding and wintering bird surveys for this project: October 2016 to October 2018. He has undertaken consultation with Development Application Unit

	(DAU) and wrote sections of the Environmental Impact Assessment Report and Natura Impact Statement. › Mining Projects. Padraig was the Natura Impact Statement Expert Witness at Boliden Tara Mines Oral Hearing for a tailings extension and integrated constructed wetland for which Planning Permission was partially granted. › Road Projects. Padraig has acted as Senior Ecology on several roads projects in both Ireland and the UK. Project work included the design and execution of various ecological surveys, e.g. badger and bat surveys. The resultant outputs from this work include environment impact assessments and appropriate assessment reports.
Key Strengths & Areas of Expertise	› Padraig has a strong technical background in ornithology and ecology surveying and in writing Natura Impact Statements (NIS) and the Biodiversity chapter of Environmental Impact Assessment Reports (EIAR) to accompany planning applications.
Practical Skills & Aptitudes	**Field Skills:** › Padraig's ornithological experience has involved carrying out a diverse catalogue of bird surveys throughout Ireland including multi-year studies (breeding, migratory and winter) for various environmental projects. In Scotland he spent two and a half years implementing bird surveys using Scottish Natural Heritage guidance documents to complete his survey work to best scientific practice. Many of his studies involved designing surveys to capture the seasonal change in avian communities at a site. Examples of this include; Breeding Raptor Surveys (following SNH & Hardey methods for species including Hen Harrier, Merlin, Peregrine, Barn Owl, White-tailed Eagle & Golden Eagle), Breeding Wader Surveys (following SNH, Brown & Shepherd and O'Brien & Smith for species including Golden Plover, Curlew, Lapwing, Dunlin & Snipe), Breeding Woodcock (following Gilbert methods), Migratory/Wintering Waterfowl (Following SNH and I-WeBS methods for species including (but not limited to) Whooper Swan, Greenland White-fronted Goose and wintering waders), Red Grouse Tape Lure Survey (following NPWS & BWI methods) Breeding diver species (following SNH & Gilbert methods) Woodland and Coastal species (following SNH and Gilbert methods). › Padraig also has experience of habitat surveying: Phase 1 habitat survey. Padraig has ecological assessment experience in undertaking mammal surveys (common & protected) including bat species, badger, otter and reptiles. Habitats present are also assessed in terms of their potential to support Irish mammals.
Management/ Supervision	› Project manager and lead ecologist on large scale ecological projects. › Accustomed to working effectively as part of larger multidisciplinary project design teams. › Supervision of a team of ten internal ornithologist and the management of sub-consultants to coordinate the bird survey programme at MKO. › Within MKO Padraig plays a key role in mentoring junior members of staff.
Interpersonal & Communication Skills	› Extensive experience in successful consulting with statutory ecological consultees including NPWS, Birdwatch Ireland and Inland Fisheries Ireland usually regarding sensitive ecological sites.

	➢ Significant experience coordinating approach to sensitive ecological sites between client and ecological consultees and on-site contractors, etc. ➢ Development of technical working methodologies on behalf of contractors requiring understanding of both proposed works and sensitivities of site.
Licenses Held	➢ Padraig has been a licence holder for the surveying of protected avian species on both the Red List of Bird of Conservation Concern in Ireland and Annex 1 of the EU Birds Directive, e.g. Red Grouse tape lure licence.
Physical / Other	➢ Full Clean Driving Licence ➢ Current Safe Pass Holder

Planning and Environmental Consultants

CURRICULUM VITAE

Patrick Manley

Patrick Manley is an Ornithologist with MKO with extensive practical experience in field research. Patrick holds a BSc (Hons) in Geology. Prior to taking up his position with MKO in September 2016, Patrick worked as part of the conservation team in BirdWatch Ireland, on projects such as the Dublin bay birds project, Kilcoole Little Tern conservation project and the results based agri-environmental scheme for breeding waders. Patrick's key strengths and areas of expertise are in bird ecology & identification, GIS, project planning and fieldwork skills. Since joining MKO Patrick has been involved as an Ornithologist on several wind and solar energy developments, utilising a broad range of bird survey methodologies including breeding raptor, adapted brown & shepherd and waterfowl distribution. Patrick was also part of a team of bird usage surveyors working on the Shannon/Fergus Estuary. Within MKO Patrick plays an important role as part of the Ornithology team, working independently and planning field surveys in accordance with required standards. Patrick has managed the ornithological surveying at wind energy developments, engaging with sub-contractors and management.

Current Role	Ornithologist
Qualifications	BSc Geology, University College Dublin (2013).
Years of Experience	5 years post graduate experience in wildlife conservation and monitoring.
Relevant Experience	**Relevant Work Experience** Field ornithologist as part of the Little Tern Conservation Project with BirdWatch Ireland for two breeding seasons (2015 & 2016). Patrick gained experience in monitoring and protecting a vulnerable species and in the collection, collation and analyses of large data sets. He was also responsible for liaising with the public, the writing of weekly reports and full technical reports at the end of each breeding season. Agri-Environmental Liaison Officer for the Results Based Agri-Environmental Payment Scheme with BirdWatch Ireland. Patrick gained experience in liaising with land owners, coordinating and finalizing terms with participants of the scheme. He also gained skills in the ecological applications for GIS, in training landowners in land management for breeding birds and in carrying out breeding bird surveys. Conservation Team Intern with the Dublin Bay Birds Project for BirdWatch Ireland. Patrick gained experience in compiling, proofing and analysing large datasets, as well as waterbird monitoring during various tidal and weather conditions and writing technical reports. Field Assistant with the Dublin Bay Birds Project with BirdWatch Ireland. Patrick gained experience doing waterbird surveys, radio tracking surveys and the tracking of colour ringed waders. He also gained experience in collating, proofing and validating large datasets. He was also responsible for fitting colour rings to waders during multiple catching sessions. Volunteer Bird Surveyor on various projects including the Irish wetlands bird survey, the Inishmurray all-island breeding bird survey, the national Hen Harrier survey and the countryside bird survey. **Relevant Surveys for MKO:** Derrryadd Windfarm, County Longford (Client: Bord na Mona) Carried out Vantage point surveys, waterfowl surveys and breeding raptor surveys for this site. Timahoe Solar, County Laois (Client: Bord na Mona) Carried out breeding walkover surveys for this site. Lissinagroagh Windfarm, County Leitrim (Client: Coillte) Carried out Vantage point surveys for this site Slieve Rusheen Windfarm, County Cavan (Client: Coillte) Carried out Vantage point surveys, winter walkovers, hen harrier roost surveys and red grouse surveys for this site.

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	- Cullenagh Windfarm, County Laois (Client: Coillte) Carried out Vantage point, breeding walkover and breeding raptor surveys for this site. - Carrownagowan Windfarm, County Clare (Client: Coillte) Carried out Vantage point surveys, waterfowl surveys, hen harrier roost surveys and winter walkovers for this site. - Glenard Windfarm, County Donegal (Client: Coillte) Carried out Vantage point surveys for this site. - Cahermurphy Windfarm, County Clare (Client: Mid Clare Renewable Energy Ltd.) Carried out Vantage point surveys for this site - Coole Windfarm, County Westmeath (Site located on raised bogs) Carried out Vantage point surveys, breeding walkovers, breeding raptor surveys, breeding woodcock surveys and waterfowl distribution surveys for this site. - Clonbern Windfarm, County Galway Carried out Vantage point surveys, and waterfowl surveys for this site. - Ardderroo Windfarm, County Galway (Client: Enerco) Carried out Vantage point surveys, hen harrier/white-tailed eagle roost surveys and waterfowl surveys for this site. - Boolynaghleragh Windfarm, County Clare (Client: Enerco) Carried out pre-commencement hen harrier surveys for this site.
Practical Skills & Aptitudes	- Planning and carrying out ornithological surveys. - Working Independently and effectively in the field. - Planning surveys with sub-contractors and management. - Data presentation. - Proficient in MS Office, GIS and MapInfo software. - Adhering to required guidelines and SOP's on bird survey methodologies. - Experience surveying birds using line transects, vantage point counts, flush counts, mist netting, radio tracking and GSM trackers
Management/ Supervision	- Management of all bird surveys carried out on site. - Demonstrated ability to manage workload and plan surveys based on own initiative. - Experience managing field sites and coordinating large teams of volunteers for the Little Tern Conservation Projects 2015 and 2016 - Experience coordinating and supervising volunteers during the all-island seabird survey on Inishmurray. - Experience coordinating and liaising with volunteers/surveyors with BirdWatch Ireland and Irish Midlands Ringing Group on various projects.
Interpersonal & Communication Skills	- Extensive dealings with ecology team in planning of bird survey work and standard operating procedures. - Effective and clear communicator. - Proven ability to manage extensive survey requirements and collation of data upon completion. - Planning surveys with team members and sub-contractors. - Experience coordinating workloads and delegating tasks as a member of both large and small teams of volunteers on a number of different projects with BirdWatch Ireland and the Irish Midlands Ringing Group, often in challenging fieldwork environments. - Experience as lead author or co-author on technical project reports. - Managed public relations and public outreach for the Little Tern Conservation Project in 2015 and 2016 (including an appearance on RTE series "EcoEye" in January 2016).

	➢ Experience giving bird ringing demonstrations to various groups including BirdWatch Ireland branch members, Dublin Field Naturalist club and during heritage week.
Licenses Held	➢ Full Clean Driving Licence. ➢ Safe Pass.
Physical / Other	➢ Ability to plan and organize fieldwork in line with published survey methodologies and company SOP's. ➢ Qualified bird ringer and ringing trainer with British Trust for Ornithology

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CURRICULUM VITAE

Ian Hynes

Ian Hynes is a Graduate Ecologist with MKO. Ian Graduated with an Honours Degree in Environmental Science from National University of Ireland, Galway in 2017 and joined the Ornithology team in December of the same year. Ian has a broad knowledge of ecology ranging from invertebrate sampling and identification, habitat classification and vegetation surveys. In his time with MKO he has developed a broad understanding of SNH Guidance and its application to bird surveys for wind farm developments. Ian has over two years of experience in using GIS software. Ian has also gained experience in report writing through his final year thesis and assisting in the production of EIARs and ornithological reports.

Current Role	Ecologist
Qualifications	› B.Sc. (Hons) Environmental Science from National University of Ireland, Galway
Years of Experience	› 1-2 years
Relevant Experience	› June-September 2016 – Thesis, Inis Oirr, Aran Islands – Investigated the contribution of habitat patches to invertebrates on HNV farmland using a rapid biodiversity assessment. Worked alongside members of AranLIFE and the Applied Ecology Unit, NUIG. › Attended BCI Training course on the identification of bats, use of detectors and interpretation of results (30th June-1st July 2018). › Undertook surveys as part of the Breeding Woodcock surveys 2019 (UCC Woodcock Research Group) in Galway and Kildare.
Practical Skills & Aptitudes	› Proficient in using ArcGIS software to produce maps representing ecological data, also has extensive experience in QGIS and Map Info. › Proficient in Microsoft Office programs (Word, Excel, PowerPoint, Visio). › Good knowledge of Python programming language (QQI Level 5) › Experience in invertebrate sampling and identification, habitat classification and plant identification. › Experience in producing a Habitat Management Plan. › Good knowledge of EIS/EIAR and Appropriate Assessment. › Bat surveys – acoustic sampling and analysis of results. › Involved in the preparation of desk study's, GIS maps and bird data for use in ornithology reports/EIARs. › Experience in using 'Windfarm' and ZVI to produce Viewshed Analysis on Vantage Points and ground truthing Vantage Points in the field.
Interpersonal & Communication Skills	› Presented findings of final year thesis to members of staff at National University of Ireland, Galway in 2016. › Liaised with members of the AranLIFE project and local landowners on Inis Oirr, Aran Islands over the course of his final year thesis. › Works as part of a multi-disciplinary team within MKO and regularly liaises with surveyors/clients and other in-house teams daily.
Licenses Held	› Current Safe Pass Holder. › Current Driver's Learner Permit holder.

Physical/Other	• Member of Bat Conservation Ireland • Member of Birdwatch Ireland • Attended NBDC workshop on improving land for pollinators (13/04/2019) • Attended NBDC workshop on identifying Irelands pollinators (12/05/2019) • Attended 2-day Irish Crayfish Seminar on identification of NICS and biosecurity methods (21&22/05/2019)

Curriculum Vitae

Eric Dempsey

Address:	Sycamore Hill Tiglin Newcastle Co. Wicklow	Email: Website: Telephone:	birdsireland@gmail.com www.birdsireland.com 087 907 5669

Born in Dublin and now living in Co. Wicklow, I am a professional bird guide, writer, broadcaster, photographer, consultant and speaker. I have over 40 years birdwatching field experience in Ireland and am the author of many bird and wildlife books. I am a Heritage Expert with the Heritage Council, and a team member and advisor to the Mooney Goes Wild Show on RTE Radio 1

Employment & Relevant Expertise

2015 - Present: Engaged in a wide variety of environmental bird surveys requiring the implementation of all survey methodologies, in-depth knowledge on bird identification, the submission of maps and spreadsheets, and a commitment to accurate and timely reporting. My recent survey experience includes:

- Ongoing twice monthly Dublin Bay Wetland counts
- VP surveys on Hen Harrier breeding sites
- Breeding bird transects and walk-throughs
- Hinterland breeding raptor surveys
- Woodcock breeding surveys
- Winter bird surveys
- Hen Harrier Winter roost surveys
- High tide wader roost surveys – Dublin Bay
- Evening gull roost surveys – Dublin Bay
- Bio-diversity surveys for OPW

I am currently commissioned by Dublin City Council to do bird surveys along the River Camac from November 2018 to December 2019

*

1990 - Present: Director of the Birds of Ireland News Service (BINS Ltd), promoting an awareness of Irelands birdlife through educational workshops and acting in an advisory role to a wide selection of environmental groups and media organisations.

2002 – Present: Ireland's first professional bird tour guide and advisor to eco-tourism initiatives.

2003 – Present:	Heritage Expert - working with the Heritage Council to educate and promote bird awareness in National Schools throughout Ireland.
2013 - Present:	Patron and Chief Advisor to Dublin Swift Conservation Group – advising and presenting on Swift Conservation to city planners (including DCC) and a wide variety of concerned environmental and residence groups.
2014 – Present:	Ireland's first 'Swarovski Ambassador' in recognition of my dedication to the promotion of an interest in Ireland's rich birdlife and habitats.

Other Positions

1979 - 2009:	Chairman of Dublin Branch, Irish Wildbird Conservancy, and Founder and Chairman of Tolka Branch of Birdwatch Ireland.
1988- 1992:	Member of the Executive Board of Directors with Birdwatch Ireland (Irish Wildbird Conservancy)
1983 – 1988:	Irish Representative to Birdlife International
1990- 1995:	Editor/Publisher - Irish Birding News,
1998-2000:	Co-editor of the Irish Bird Report

Books Published

1993:	The Complete Guide to Ireland's Birds
1995:	The Pocket Guide to the Common Birds of Ireland
2002:	The Complete Guide to Ireland's Birds (2nd edition)
2007:	Finding Birds in Ireland
2008:	Birdwatching in Ireland with Eric Dempsey
2010:	The Complete Field Guide to Ireland's Birds
2011:	Ireland's Wildlife Year
2012:	The New Pocket Guide to the Common Birds of Ireland
2014:	Finding Birds in Ireland (2nd edition)
2015:	Don't Die in Autumn – a memoir

Susan Doyle

Susan is a freelance ornithologist for MKO. She is currently a final-year PhD candidate at University College Dublin, conducting research into the population demography and movements of Arctic-breeding birds. She completed her primary degree in Zoology at Trinity College Dublin and went on to complete her masters in Ecological Assessment at University College Cork. Susan has extensive field survey skills, including winter and breeding bird survey, bat survey, small mammal survey, terrestrial and freshwater macroinvertebrate sampling and animal GPS and radio tracking, as well as plant surveys, habitat identification and mapping. She also has experience in Annex I habitat quality assessment, Ecological Impact Assessment and Appropriate Assessment (including Natura Impact Statements).

Proposed Role	Field ornithologist
Qualifications	MSc Ecological Assessment, University College Cork, 2014 BA Zoology, Trinity College Dublin, 2013
Years of Experience	5 years post-graduate experience as an ecologist
Relevant Experience	**Professional experience in bird survey** Violet Hill Wind Farm, Co. Clare: breeding bird vantage point surveys Shannon-Fergus estuary, Co. Clare and Co. Kerry: co-ordinated bird counts and mapping Oatfield Wind Farm, Co. Clare: breeding and winter bird vantage point surveys and habitat evaluation Cloncreen Wind Farm, Co. Offaly: breeding and winter bird vantage point surveys and transects and wetland waterbird counts Ardderoo Wind Farm, Co. Galway: breeding and winter bird vantage point surveys Ship Street development, Co. Dublin: breeding Swift surveys Lisbeg Wind Farm, Co. Galway: pre-construction raptor surveys Coole Wind Farm, Co. Westmeath: winter bird vantage point surveys Lettergull Wind Farm, Co. Donegal: bird transect surveys Lough Derg Canoe trail, Co. Tipperary: site survey of birds for Natura Impact Statement Residential development, Knocknacarra, Co. Galway: appropriate assessment screening **Research experience in birds** GPS tracking Barnacle Geese from Ireland to Iceland and Greenland 2018 international census of Greenland Barnacle Geese in Ireland Review of anthropogenic impacts to Arctic breeding birds Novel parasitic infection in Goldfinch and Greenfinch of the Irish midlands Post-breeding movements of Lesser Black-back and Black-headed Gull Conservation of breeding Little Terns in Co. Louth and Co. Wicklow Radio-tracking Oystercatcher in Dublin Bay Breeding seabird survey and mapping of Inishmurray Island Behavioural variation of Lemon-bellied White-eyes on the Wakatobi Archipelago, Indonesia
Licences Held	Full driving licence Safe pass British Trust of Ornithology Bird Ringing Licence

A8.2 Japanese Knotweed Survey Report

KNOTWEED CONTROL IRELAND
REMOVING THE ROOT OF THE PROBLEM

Invasive Plant Survey Report –
Project Shoreline

Ronnie Murphy BSc Forestry H-Dip Hort
Knotweed Control Ireland 09/Aug/2019

Table of Contents

1. Introduction

An Invasive Plant Survey (Japanese Knotweed) was carried out on the 9th August 2019 by Knotweed Surveyor Ronnie Murphy of Knotweed Control Ireland. This included a walkover survey of the entire site (Areas A & B), and around part of the outside perimeter. Japanese Knotweed invasive plant species were recorded in two locations within and adjacent to the property boundary.

The aims of the survey and follow-up report are to:

• Survey all areas within the site and within 7m around the outside perimeter.

• If recorded, measure all stands of Japanese knotweed within the site;

• Identify any areas of Japanese knotweed adjacent to the site;

• Provide recommendations of treatment strategies for the eradication of Japanese knotweed within the site; and

• Provide recommendations for monitoring Japanese knotweed following treatment.

2. SITE ASSESSMENT

The site comprises approx. 50 ha and is made up of several different habitat types. Most of the site is made up of bare ground and improved grassland, there are large areas of hedgerows on field boundaries and a small mixed woodland on the East boundary, some areas of the site are reverting to scrub as the site is mainly left unmanaged. The Mayne River runs through the northern part of the site. Japanese Knotweed was found in areas to the North and East of the site. The Knotweed to the North of the site is currently under-going a treatment program carried out by Dublin City Council. Knotweed on the edge of woodland to the East of the site has been treated over the last 4 years and there is no sign of any live growth. This area however will need to be excavated and included in an eradication program as it is highly likely that Knotweed will re-emerge when this area is disturbed due to on-site construction works.

Note: Soil contaminated with live or dead Japanese Knotweed rhizomes is deemed as controlled waste and must not be moved off-site unless under license from National Parks and Wildlife Service. (S.I. 477, 2011).

Site Address: Stapolin Fields, Stapolin, Baldoyle, Dublin 13.

Managing land infested with Japanese knotweed in an appropriate and efficient manner can avoid:

- potential prosecution and/or compensation claims;
- planning permission refusals;
- reductions in land value;
- physical damage to buildings and hard surfaces;
- harm to the environment; and
- Excessive cost.

2. Methodology

The Knotweed survey was undertaken by experienced Knotweed surveyor Ronnie Murphy from Knotweed Control Ireland on the 9th of August 2019 during which, 2 areas of Japanese knotweed were recorded on site.

4. Survey Results/Recommendations

Japanese Knotweed a highly invasive plant species was recorded in two locations on site. See Map 1 & 2 for more details.

Where possible it is KCI practice to also survey around the outside perimeter and adjacent properties when carrying out invasive plant surveys. Were access permitted we surveyed most of the outside perimeter around the site, however due to limited access we did not survey the entire outside perimeter. Knotweed was recorded growing outside the perimeter to the North of the site.

Efforts should be made with the suppliers of any soil, sand or hard-core material coming onto site, to ensure these supplies are free from invasive plant material.

If soil has recently arrived on site and is believed to be infested with invasive plant material like Knotweed this should be left undisturbed on till checked by a specialist.

The Knotweed to the north of the site (**Area A**) can be left in situ and continued to be treated with herbicide only if this area does not fall onto the construction footprint of the site.

The Knotweed to the East of the site (**Area B**) can be disposed off-site using the Dig and Dump method. This would be the most practical and bio-secure method most suited for this area of the site.

Monitoring: In all situations it will be necessary to observe a minimum of two years without regrowth before it is possible to consider that the eradication/control program has been affective or that the site is clear of Japanese Knotweed. (PCA - The Management of Japanese knotweed, 2014)

Biosecurity safeguards and controls should be put in place by an invasive plant specialist before any work commences onsite. For example, install fencing around the Knotweed areas and alert all contractors working in the area to avoid any ground disturbance within 7m to the Knotweed plants.

Note: No work of any kind should commence on site without first having an invasive plant specialist prepare a site-specific invasive plant management plan. Works on site should follow guidance within the invasive plan management plan.

Note: Knotweed Control Ireland can typically hand over a Knotweed clean site in 4-5 weeks from being appointed. This includes soil sampling results and National Parks & Wildlife License waiting period.

5. Legislative Framework

At an international level Ireland has signed up to a number of treaties and conventions, including the **Convention on Biological Diversity**. Such treaties and conventions require the Irish Government to address issues of invasive alien species. This has been implemented through the **Wildlife Act 1976 and 2000** and further regulated through the **European Communities (Birds and Natural Habitats) Regulations 2011 (SI 477 of 2011).**

Regulations 49 and 50 of these regulations include legislative measures to deal with the dispersal and introduction of invasive alien species:

Regulation 49

'a person shall be guilty of an offence if they: plant; disperse; allow or cause to disperse; spread or cause to grow the plant in the Republic of Ireland'. The list of species in the Third Schedule includes Japanese Knotweed, Giant Knotweed and their hybrid Bohemian Knotweed'.

Regulation 50

'an offence to or intend to; import; buy; sell; breed; reproduce or propagate; offer or expose for sale; advertise; publish a price list; transport; and distribute any plant species or vector material listed in the Third Schedule'. Non-native species subject to restrictions under Regulations 49 and 50 are included in the third schedule of the European Communities (Birds and Natural Habitats)

Regulations 2011 (S.I. 477 of 2011). The Third Schedule, Invasive species in this list include: Japanese Knotweed, Giant Hogweed, Giant Knotweed, Giant Rhubarb, Himalayan Balsam, Himalayan Knotweed, Bohemian Knotweed and Rhododendron.

The vector which applies to Knotweed species is: ''Soil or spoil taken from places infested with Japanese knotweed material (i.e. facilitates spread), referred to in the regulations (Third Schedule Part 3), Giant knotweed or their hybrid Bohemian knotweed''.

6. REFERENCES

The Environment Agency, Managing Knotweed on Development Sites, Knotweed Code of Practice, 2013

National Action Plan for the sustainable use of pesticides (Ireland)

Property Care Association, Code of Practice for the Management of Japanese Knotweed, 2015

SEPA Technical Guidance Note On-site management of Japanese Knotweed and associated contaminated soils, V1.5 - 2008

7. KNOTWEED FLOWCHART

Managing Knotweed on Development Sites – Knotweed Code of Practice, Environment Agency - 2013

Map 1


Project Shoreline Site Map
Map shows both areas infested with J. Knotweed on site.
Knotweed Area A
Knotweed Area B
Red Arches Ave
Legend
A Knotweed Area A
B Knotweed Area B
N
Google Earth
©2018 Google
300 m

Map 2

Figure 1 Map prepared for 2018 survey (AREA B)

A9.1 Impact Ratings & Assessment Criteria

Table 1 Glossary of Impacts following EPA Guidance Documents (Draft 2017 Guidelines)

Impact Characteristic	Term	Description
Quality	Positive	A change which improves the quality of the environment
	Neutral	A change which does not affect the quality of the environment
	Negative/ Adverse	A change which reduces the quality of the environment
Significance	Imperceptible	An effect capable of measurement but without noticeable consequences
	Not significant	An effect which causes noticeable changes in the character of the environment but without noticeable consequences
	Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
	Moderate Effects	An effect that alters the character of the environment in a manner consistent with existing and emerging baseline trends
	Significant Effects	An effect, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
	Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters the majority of a sensitive aspect of the environment
	Profound Effects	An impact which obliterates sensitive characteristics
Extent & Context	Extent	Describe the size of the area, the number of sites, and the proportion of a population affected by an effect
	Context	Describe whether the extent, duration or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?)
Probability	Likely Effects	The effects that can reasonably be expected to occur as a result of the planned project if all mitigation measures are properly implemented
	Unlikely Effects	The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented.
Duration	Momentary	Effects lasting from seconds to minutes
	Brief	Effects lasting less than a day
	Temporary	Effects lasting less than a year
	Short-term	Effects lasting one to seven years
	Medium-term	Effects lasting seven to fifteen years
	Long-term	Effects lasting fifteen to sixty years
	Permanent	Effects lasting over sixty years
	Reversible Effects	Effects that can be undone, for example through remediation or restoration
	Frequency of Effects	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly daily, weekly, monthly, annually.
Type	Indirect Effects (a.k.a. Secondary Effects)	Impact on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway.
	Cumulative	The addition of many small impacts to create one larger, more significant impact
	'Do Nothing'	The environment as it would be in the future should no development of any kind be carried out
	Worst case Effects	The effects arising from a project in the case where mitigation measures substantially fail.
	Indeterminable	When the full consequences of a change in the environment cannot be described
	Irreversible	When the character, distinctiveness, diversity, or

	reproductive capacity of an environment is permanently lost
Residual	The degree of environmental change that will occur after the proposed mitigation measures have taken effect
Synergistic	Where the resultant effect is of greater significance than the sum of its constituents

Appendix 8.2

Bat Fauna Survey for a proposed development at Baldoyle-Stapolin Growth Area (GA2), Baldoyle, Dublin 13

Altemar Marine and Environmental Consultancy

ALTEMAR
Marine & Environmental Consultancy

Bat Fauna Survey for a proposed development at Baldoyle-Stapolin Growth Area (GA2), Baldoyle, Dublin 13

20th January 2022

Prepared by: Bryan Deegan (MCIEEM) of Altemar Ltd.
On behalf of: Lismore Homes Ltd.

Altemar Ltd., 50 Templecarrig Upper, Delgany, Co. Wicklow. 00-353-1-2010713. info@altemar.ie
Directors: Bryan Deegan and Sara Corcoran
Company No.427560 VAT No. 9649832U
www.altemar.ie

SUMMARY

Structure:	The development is part of the proposed Coast Development within the Baldoyle Stapolin area, located on major bus line and adjacent to the Clongriffin Dart Station
Location:	Baldoyle- Stapolin Growth Area (GA2), Baldoyle, Dublin 13
Bat species present:	No bat species recorded on site (according to the National Biodiversity Data Centre). A tree with bat roosting potential was noted on site. No bats were observed emerging from on site trees. There are no buildings on site. However, a single Soprano Pipistrelle (*Pipistellus pygmaeus*) was noted briefly in the vicinity of the treeline on site.
Proposed work:	Proposed development at Baldoyle- Stapolin Growth Area (GA2), Baldoyle, Dublin 13. This development comprises of the construction of 1,007 residential apartments.
Impact on bats:	No significant impact on bats is foreseen. The treeline on site is to be retained.
Survey by:	Bryan Deegan MCIEEM
Survey date:	11/09/2021

Receiving Environment

Background

This development comprises of the construction of 1,007 residential apartments (GFA: 92,280 sq.m.) in 16 no. 4 to 9 storey buildings comprising 56 no. studio apts., 281 no. one bed apts., 605 no. two bed apts., and 65 no. three beds with a ground floor creche (c. 820 sq.m.), 723 no. car parking spaces (604 no. spaces at basement level and 119 no. surface level spaces for visitors), 1,740 no. bicycles spaces at basement and ground floor levels, and 724 no. storage rooms; along with the landscape proposals described herein, and ancillary site development works. The site is located in the townland of Stapolin, 1 km northwest of the town of Baldoyle, situated in the south-eastern part of Fingal County. The development is part of the proposed Coast Development within the Baldoyle Stapolin area, located on major bus line and adjacent to the Clongriffin Dart Station. The area is zoned R1 for new residential developments, as are the sites to the south of this application. To the north is a large area of greenbelt, and east is Baldoyle Bay, which is an SAC and SPA.

The proposed site outline and location is demonstrated in Figure 1.

Landscape

A Landscape Design Report has been prepared by Murray & Associates Landscape Architecture. The report states that: '*The design of the landscape and open spaces is inspired by the varying coastal landscapes in the surrounding context. This part of Dublin's coastline contains a wide variety of coastal landscape types, including estuarine, mudflats, sand spits, cliffs, intertidal zones, sand dunes and beaches. This area is very diverse in a relatively small geographical area from Howth to Portmarnock, including Baldoyle. As a result it is rich in biodiversity and landscape value. The landscape is constantly changing with the tides, revealing and concealing forms and elements in the coastal landscape. The relatively flat landscape gives a 'big sky', particularly looking towards the sea. This is also a fringe area, with the edge of the more densely populated city area interfacing with the more sensitive landscape areas of the Moyne River valley and the associated green belt, separating this area from the wider city. The landscape design looks to capture some of this variety and diversity and to add to the richness of the landscape to the benefit of the residents and locals for whom these streets may form part of their daily commute or their leisure opportunity as the area is formed for a high quality of life, with close contact to the natural coastal and high amenity landscapes, together with the new parks that are being created at the old Baldoyle racecourse and in the Moyne valley.'*

The proposed landscape masterplan is demonstrated in Figure 2

Arboricultural Assessment & Impact Report

An Arboricultural Inventory and Impact Assessment which incorporates a Tree Protection Strategy was composed by Murray & Associates Landscape Architecture. The report states the following:

'***Tree Survey Results***: *The trees within the site area are in predominantly fair condition. There are no category A trees on site. Trees to be removed are: five category B and two C, consisting of all Sycamore species. The application includes the planting of additional trees in the areas where these trees are set to be removed and across the site, there will be an overall net increase in tree cover in this area, The remainder of the trees on the site are Sycamore (Acer Pseudoplatanus), as well as a single failing Italian Alder. It is recommended that these remaining trees be maintained for maturity of the planting scheme on site, however due to their condition be monitored and replaced where necessary as the proposed planting establishes.'*

Category	Number of trees	Trees to be removed
A	0	-
B	9	5
C	10	2
U	1	-

Table 1. Category of the Trees surveyed (BS 5837:2012, Item 4.5 Tree categorisation method)

Figure 1. Outline of proposed site. Soprano pipistrelle (yellow). Tree of bat roosting potential (orange circle).

The report also states:

*'**Tree Protection Details:** Trees that are destined to be retained must be protected by barriers, signage and/or ground protection prior to any materials or machinery being brought on site and prior to any development, demolition or soil stripping takes place. Areas that are designated for new plantings should be similarly protected. Barriers should be fit for the purpose of excluding construction activity.*

A notice 'Construction Exclusion Zone' shall be placed on tree protection fencing at regular intervals along the protective fencing. This notice shall include contact details for the Site Arborist. The noticed should say 'Strictly no access should be permitted to the R.P.A. unless instructed by the Site Arborist.', 'No materials of any kind are to be stored within the R.P.A.', 'No "Spilling out" of materials shall take place within the R.P.A.' and, 'No fires are to be lit within the R.P.A.'. The Contractor is to maintain the protective fencing in good condition to the satisfaction of the Site Arborist for the duration of the contract. Any damage to fencing is to be reported to the Site Arborist immediately. Damaged fencing is to be repaired within 2 hours of the damage occurring. All works within the vicinity of the damaged fencing are to be suspended until the fencing is repaired.'

In conclusion the report notes that:

'*The proposed development will have some impact on the existing tree cover on the site, where 7 trees are marked for removal, however additional replanting will works will mitigate any loss of trees as a result of the development, and will be a net positive to the tree cover in this particular location. Final numbers of trees to be removed will be subject to detailed landscape design. Due to the condition of the trees to be retained it is recommended that they are monitored as the scheme develops and are replaced where appropriate after the proposed planting establishes.'*

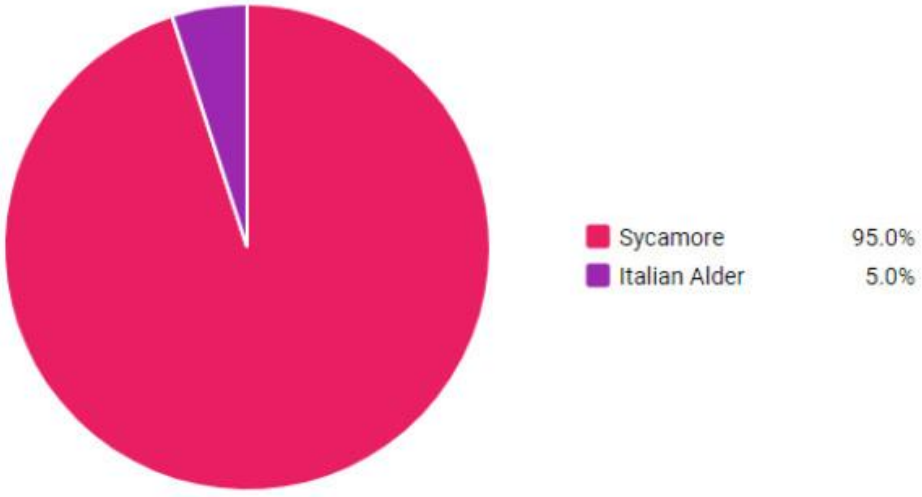

Fig.2 Species composition of the tree cover on site as a %

The tree inventory plan is seen in Figure 3-4.

Figure 2. Landscape masterplan

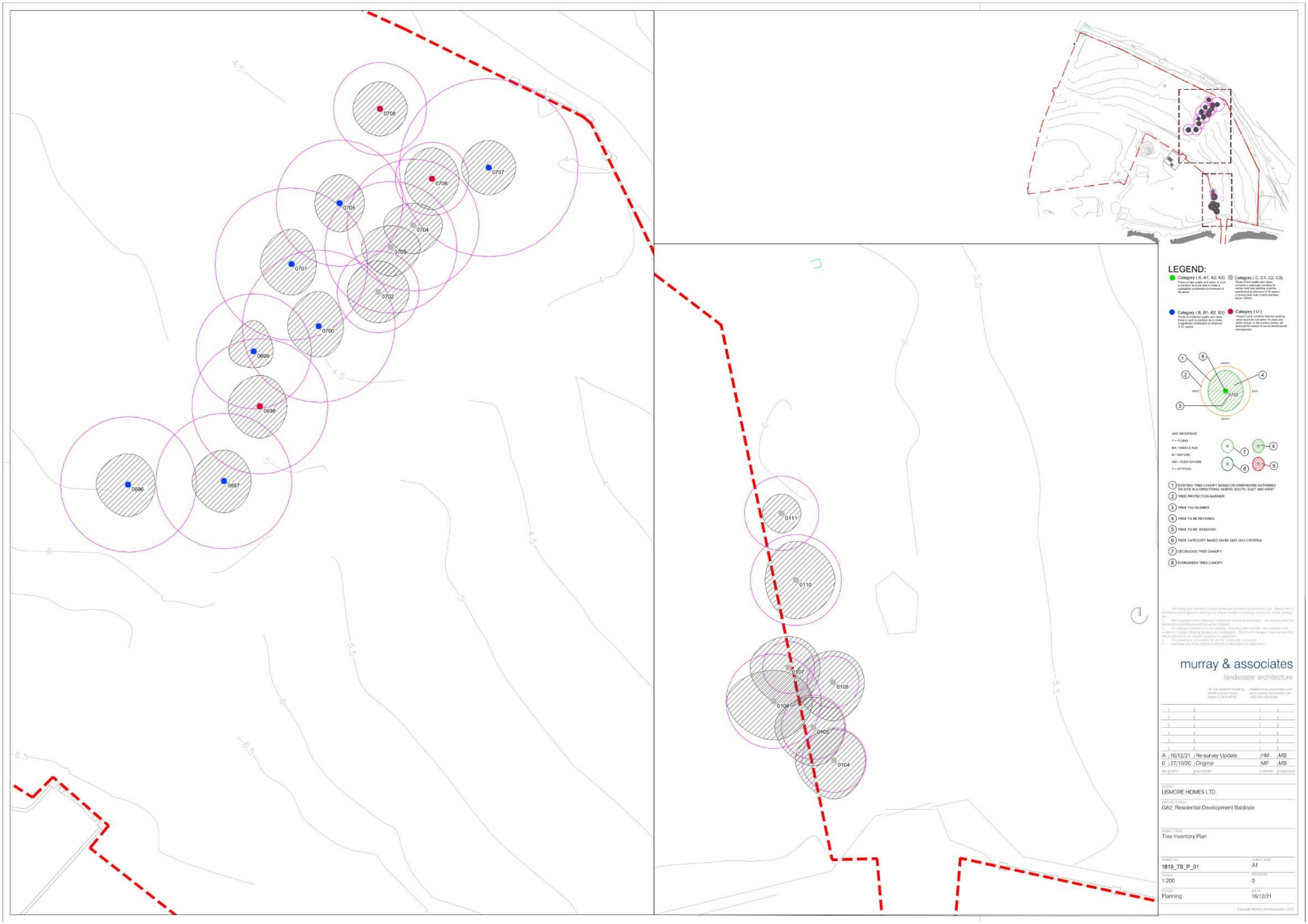

Figure 3. Tree inventory plan (Sheet 1 of 2)

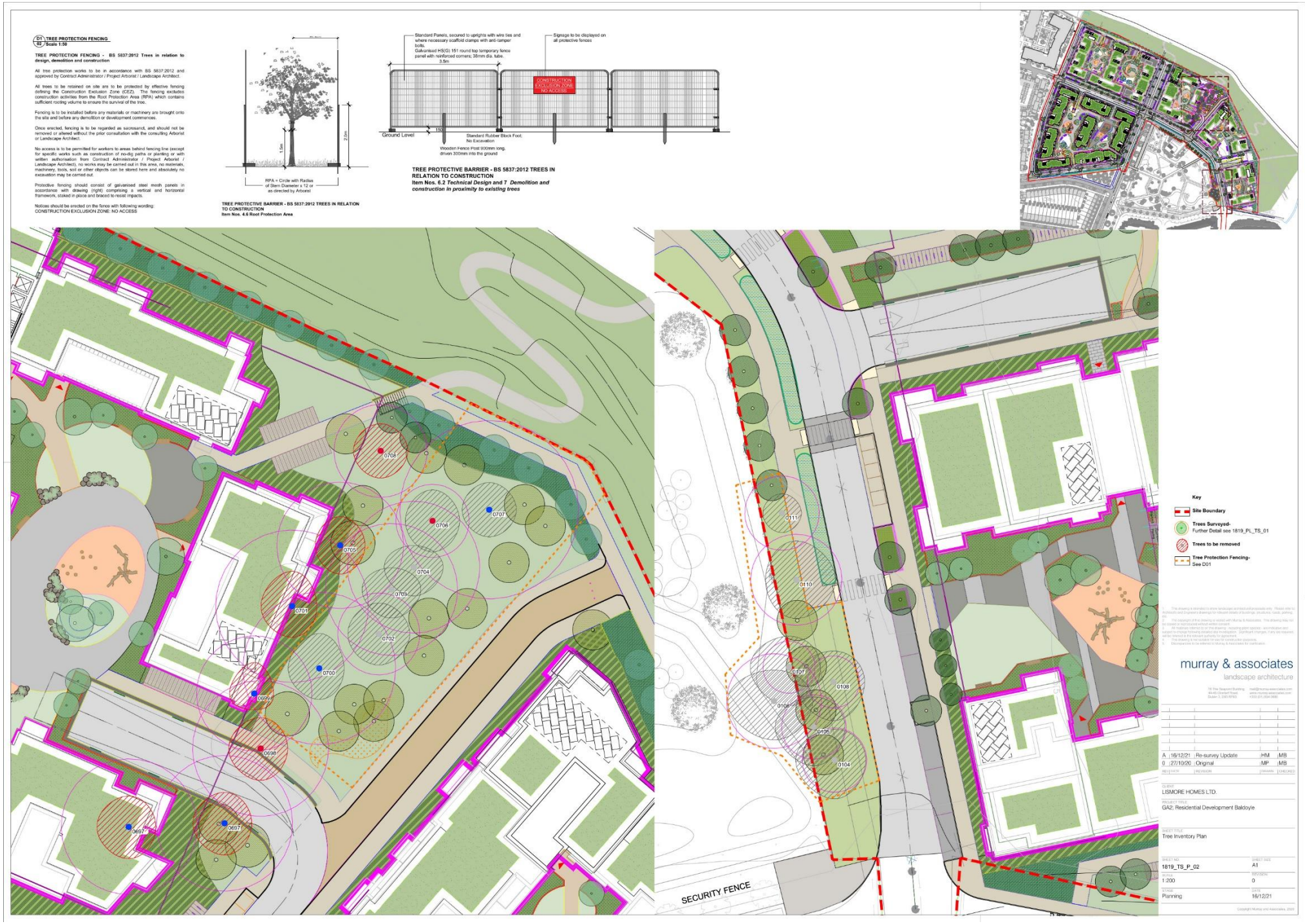

Figure 4. Tree inventory plan (Sheet 2 of 2)

Lighting

A Site Lighting Analysis Report was composed by Ethos Engineering. The report states the following:

'*The following guidelines were used in the design of the external site lighting.*

1. *No white light or other lighting with a UV component will be permitted in the vicinity of the Bat habitat;*
    - *Lighting with little or no UV will be utilised*
    - *Lighting with a narrow spectrum will be permitted to reduce impact*
    - *LED lighting with a broad spectrum will not be used*
2. *Minimum lux levels to be used or as required by Health & Safety*
3. *An Amber LED has been shown to have a reduced impact on Bats due to its narrow spectrum properties*
    - *Fingal County Council public lighting guidance document, all roadways are to be designed to conform to required lux levels.*
    - *Lighting Classification: - P2 8M columns for roadways*
    - *White neutral light (4000K) has been utilised in this design.*
    - *It is recommended that the actual overall uniformity of illuminance (Uo) be as high as reasonably practicable.*
4. *The lighting will be directional on to the development roads with no significant spillage of light to adjoining habitats. To reduce light spillage from luminaires, lights that are designed not to emit light at angles greater than 70 Deg from the vertical plane.*

Consequently, a flat glass protector is often used to reduce light spillage. Other methods to control light spillage is as follows: Cowls/Shields: these can be mounted on lamps to control direction of the light.

- *Masking: part of the luminaries is painted to block light to control the direction of the light.*
- *Louvres: either as internal or external slates organized in rows or at angles depending on the direction of light control.*

5. *The lights are designed to meet Fingal County Council approved tubular column complete with accessible door 385mm above ground level.*
6. *Lighting designed incorporates" constant light output" and "dimming and trimming" requirements by incorporating a 35/18 SELC 8482 mini photocell and an "Dusk and Dawn" individual driver that dims the luminaire to 75% between the hrs of 12am – 6am.*

The proposed external lighting design uses a Fingal County Council approved high efficiency LED luminaire. The lighting design incorporates an 8-metre-high tubular lamppost with overhang outreach to provide directional light output direct to the road surface. This is selected to ensure compliance with guidelines and standards noted in Electrical Design Standards Section 3.1. 8-metre-high lamp posts have been selected due their characteristics enabling a lower quantity of luminaires to provide an even spread of luminance along the road. This report also defines the external lighting design criteria and summarise the results of lighting calculations. Specific results are included for light spill from the site lighting to preserve neighbouring residential amenity & conform to BS, IS and EN guidelines in relation to minimum light pollution requirements. Ethos carried out calculations regarding lighting level on the development roadways and adjoining proposed residential properties so as to limit any excessive light trespass, which may impinge upon the residential amenity of housing units within the development, several preventative measures have been taken;

7. *The lighting columns have been consciously positioned to limit negative light spill, whilst also maintaining the required lux levels and uniformly across the proposed development. This has positively negated excess spill levels across areas containing the local Bat habitat.*
8. *Narrow beam optics have also been used to contain unnecessary light spill. This provision allows for a maximum level of light to be delivered to the roadway, as opposed to illuminated outside the boundary area.*

The proposed lighting layout, and proposed lighting layout including isolines, are demonstrated in Figures 5-8.

Figure 5. External site lighting layout (Sheet 1 of 4)

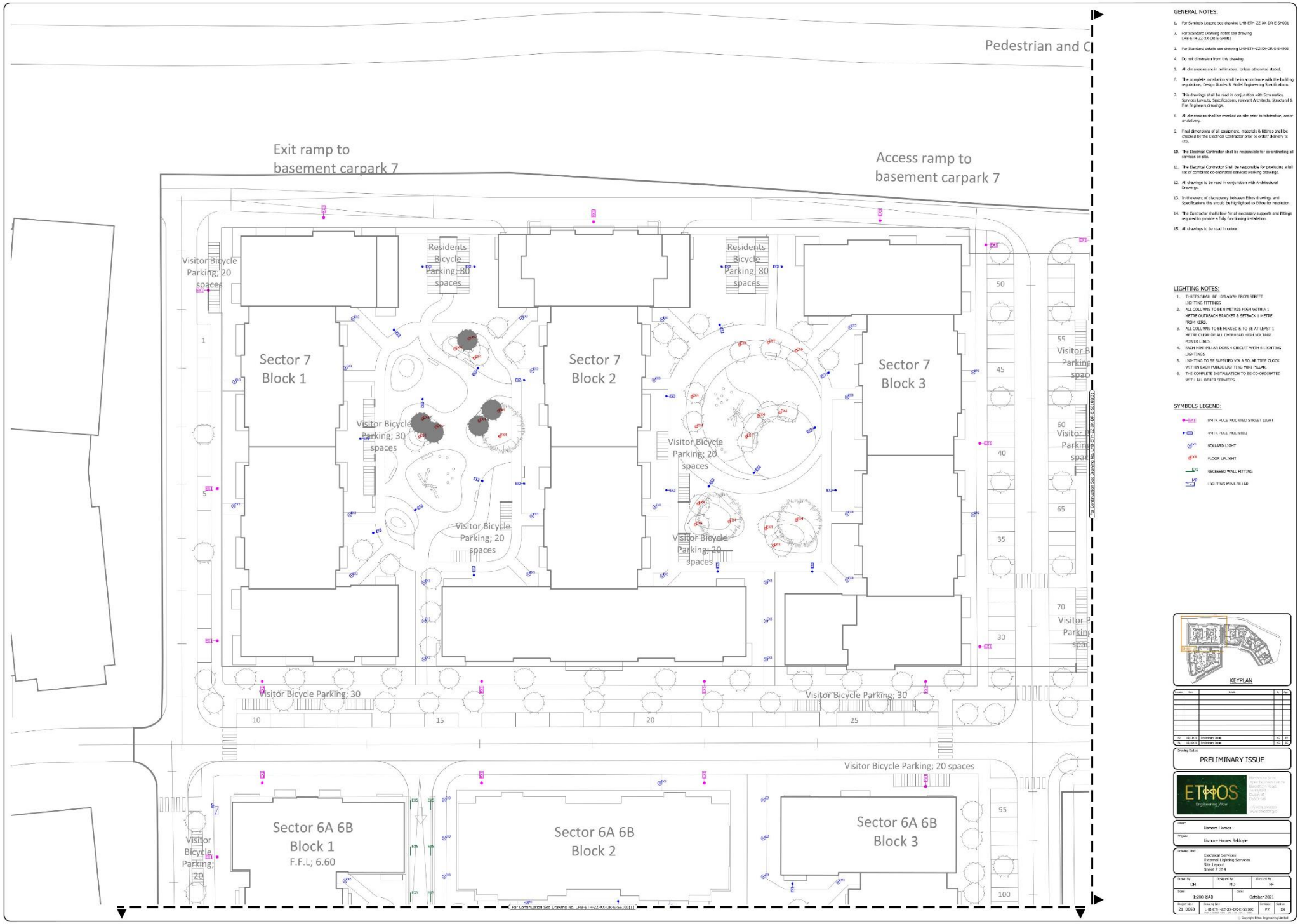

Figure 6. External site lighting layout (Sheet 2 of 4)

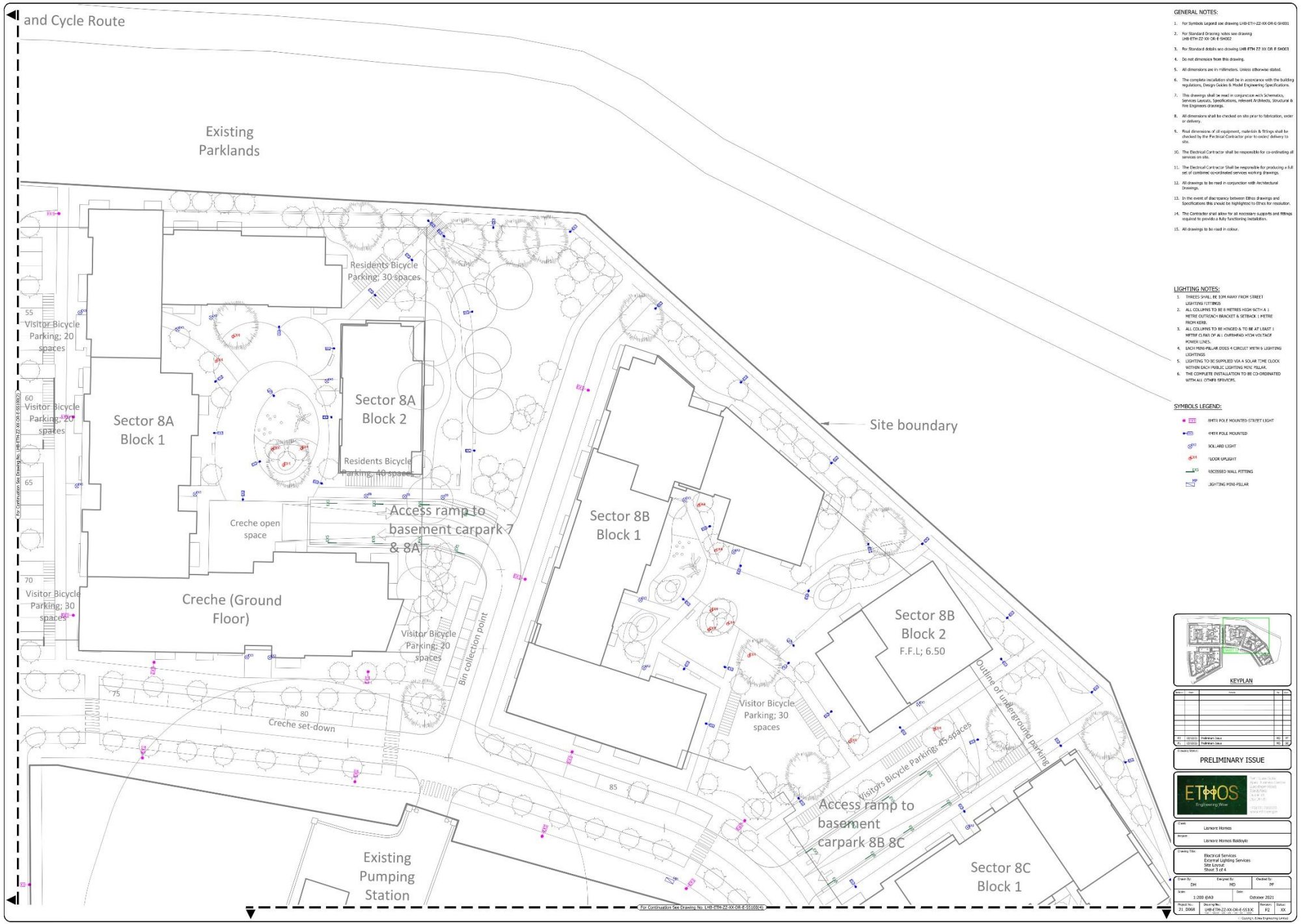

Figure 7. External site lighting layout (Sheet 3 of 4)

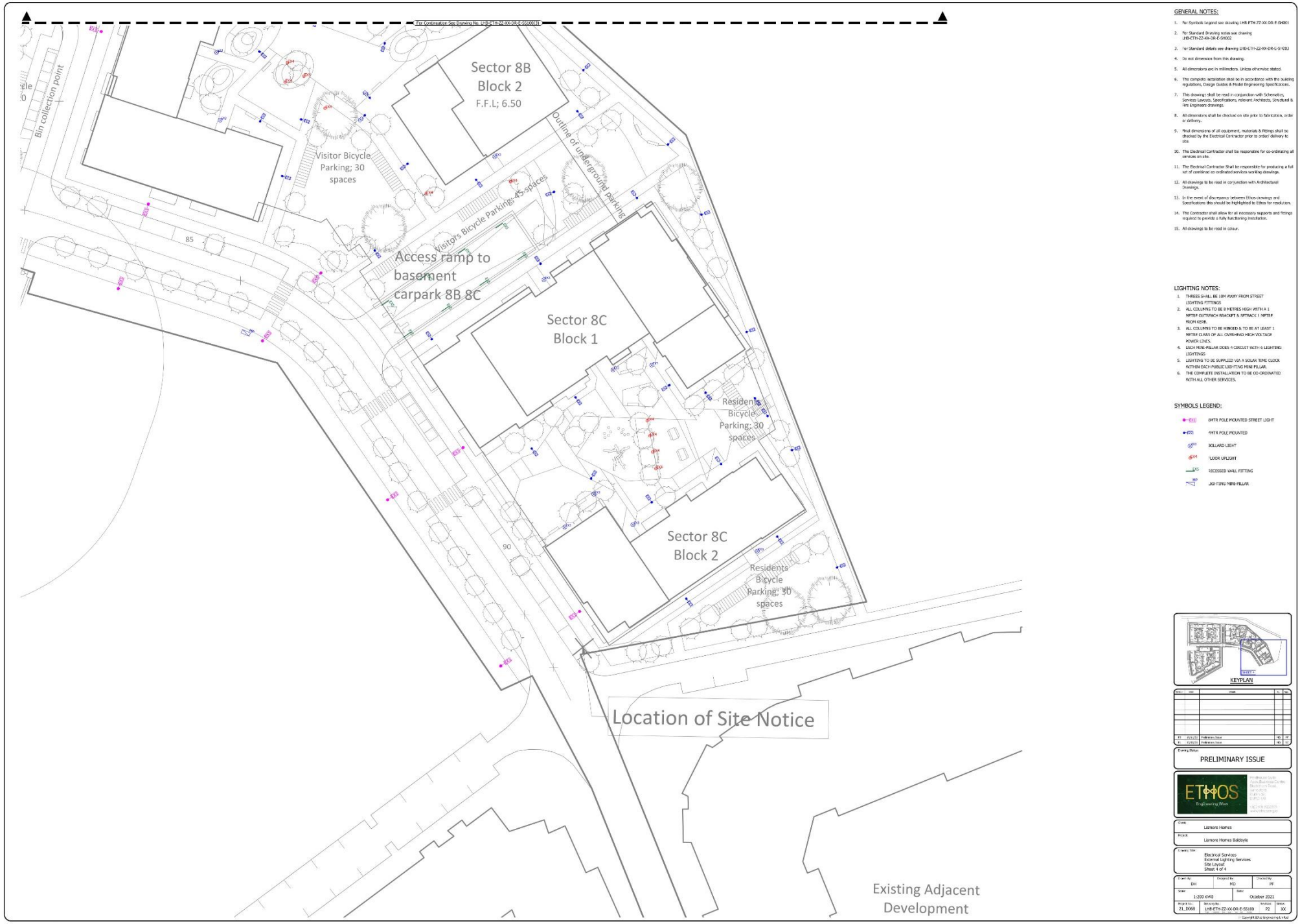

Figure 8. External site lighting layout (Sheet 4 of 4)

Competency of Assessor

This report has been prepared by Bryan Deegan MSc, BSc (MCIEEM). Bryan has over 27 years of experience providing ecological consultancy services in Ireland. He has extensive experience in carrying out a wide range of bat surveys including dusk emergence, dawn re-entry and static detector surveys. He also has extensive experience reducing the potential impact of projects that involve external lighting on Bats. Bryan trained with Conor Kelleher author of the Bat Mitigation Guidelines for Ireland (Kelleher and Marnell (2007)) and Bryan is currently providing bat ecology (impact assessment and enhancement) services to Dun Laoghaire Rathdown County Council primarily on the Shanganagh Park Masterplan. The desk and field surveys were carried out having regard to the guidance: Bat Surveys for Professional Ecologists – Good Practice Guidelines 3rd Edition (Collins, J. (Ed.) 2016) and Kelleher and Marnell (2007), Bat Mitigation Guidelines for Ireland.

Legislative Context

Wildlife (Amendment) Act 2000.

Bats in Ireland are protected by the Wildlife (Amendment) Act 2000. Based on this legislation it is an offence to wilfully interfere with or destroy the breeding or resting place of any species of bat. Under this legislation it is an offence to "*Intentionally kill, injure or take a bat, possess or control any live or dead specimen or anything derived from a bat, wilfully interfere with any structure or place used for breeding or resting by a bat, wilfully interfere with a bat while it is occupying a structure or place which it uses for that purpose. "*

Habitats Directive- Council Directive 92/43/EEC 1992 on the conservation of natural habitats and of wild fauna and flora transposed into Irish Law i.e. European Communities (Natural Habitats) Regulations, 1997 (SI No. 64/1997).

Annex II of the Council Directive 92/43/EEC 1992 on the conservation of natural habitats and of wild fauna and flora (EC Habitats Directive) lists animal and plant species of Community interest, the conservation of which requires the designation of Special Areas of Conservation (SACs); Annex IV lists animal and plant species of Community interest in need of strict protection. All bat species in Ireland are listed on Annex IV of the Directive, while the Lesser Horseshoe Bat (*Rhinolophus hipposideros*) is protected under Annex II which related to the designation of Special Areas of Conservation for a species.

Under section 23 of SI No. 64/1997 all bats are listed under the first schedule of Section 23 which makes it an offence to:

- deliberately capture a bat
- deliberately disturb a bat,
- damage or destroy a breeding site or resting place of a bat.

Bat survey

This report presents the results of site visits by Bryan Deegan (MCIEEM) on the 11th September 2021 (bat emergent and detector survey) during which the on site treeline was assessed for bat roosting potential. No buildings are present on site. At dusk, a bat detector survey was carried out onsite using an Echo Meter Touch 2 Pro division detector to determine bat activity.

Tree Roosting Potential Survey

No buildings or structures of roosting potential were present within the development site. In relation to bat roosting potential, the site comprised of a single treeline. The treeline is to be retained. A single tree at the eastern end of the treeline was deemed to have moderate potential for bat roosting due to the presence of thick ivy on the trunk. In the event of a tree of bat roosting potential is required to be felled a derogation licence is not required to fell the trees of roosting potential, as no actual bats were actually observed emerging from the trees. However, it recommended that a pre-construction survey is carried out and the tree is inspected in detail to ensure that roosts are not present at the time of felling if required. If a bat roost is found to be present during the pre-construction inspection the tree must not be felled until a derogation licence had been granted and conditions carried out.

Survey constraints

The detector survey was undertaken during the active bat season. Weather conditions were good with mild temperatures of greater than 10°C. Winds were light and there was no rainfall during the survey.

Bat assessment findings

Review of local bat records

The review of existing bat records (sourced from Bat Conservation Ireland's National Bat Records Database) within a 2km^2 grids (Reference grid O24F) encompassing the study area reveals that none of the nine known Irish species have been observed locally within grid 024F. The National Biodiversity Data Centre's online viewer was consulted in order to determine whether there have been recorded bat sightings in the wider area. This is visually represented in Figures 9-10. The following species were noted in the wider area: Brown Long-eared Bat (*Plecotus auratus*), Daubenton's Bat (*Myotis daubentonii*), Nathusius's Pipistelle (*Pipistrellus nathusii*), Pipistrelle (*Pipistrellus pipistrellus sensu lato*) (Species aggregate), Natterer's Bat (*Myotis nattereri*), Soprano Pipistrelle (*Pipistrellus pygmaeus*) (Figures 9-10).

Figure 9. Brown Long-eared Bat (*Plecotus auratus*) (yellow) and Soprano Pipistrelle (*Pipistellus pygmaeus*) (purple) and both Brown Long-eared Bat and Soprano Pipistrelle (orange) (Site- red circle) (Source NBDC)

Figure 10. Pipistrelle (*Pipistrellus pipistrellus sensu lato*) (Species aggregate) (purple) (Site- red circle) (Source NBDC)

Detector Survey

As seen in Figure 1 bat activity on site was relatively low in in the vicinity of the treeline on site. A single Soprano pipistrelle (*Pipistrellus pygmaeus*) was noted briefly foraging on site. No bats were detected emerging from any of the onsite trees.

Potential impacts of proposed redevelopment on bats

No buildings are noted on site. No bats emerging onsite trees were observed. The treeline on site is to be retained.

Mitigation measures

A pre-construction survey of trees to be felled should be carried out and a derogation licence acquired if a bat roost is present. Light spill from the dwellings and public lighting should if possible, follow the Bat Conservation Ireland "Bats & Lighting Guidance.

Predicted and residual impact of the proposal

No bat species recorded on site (according to the National Biodiversity Data Centre). A tree with bat roosting potential was noted on site. No bats were observed emerging from on site trees. There are no buildings on site. However, a single Soprano Pipistrelle (Pipistellus pygmaeus) was noted briefly in the vicinity of the treeline on site. The treeline is to be retained. Foraging is expected to continue on site. Therefore, no significant negative impacts on the roosting of these animals are expected to result from the proposed Project. The proposed Project will result in increased roosting opportunities for bats, but would also see an increase in lighting in the area. The buildings are solid structures with strong reflective properties and would be expected to be clearly visible to bats. Bat collisions with the buildings would not be expected.

Impacts: ***Negative, slight, long-term, likely, localised, Not significant.***

Legal status and conservation issues – bats

All Irish bat species are protected under the Wildlife Act (1976) and Wildlife Amendment Acts (2000 and 2010). Also, the EC Directive on The Conservation of Natural habitats and of Wild Fauna and Flora (Habitats Directive 1992), seeks to protect rare species, including bats, and their habitats and requires that appropriate monitoring of populations be undertaken. All Irish bats are listed in Annex IV of the Habitats Directive and the lesser horseshoe bat *Rhinolophus hipposideros* is further listed under Annex II. Across Europe, they are further protected under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention 1982), which, in relation to bats, exists to conserve all species and their habitats. The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention 1979, enacted 1983) was instigated to protect migrant species across all European boundaries. The Irish government has ratified both these conventions.

All Irish bats are listed in Annex IV of the Habitats Directive and the lesser horseshoe bat is further listed under Annex II.

The current status and legal protection of the known bat species occurring in Ireland is given in the following table.

Common and scientific name	Wildlife Act 1976 & Wildlife (Amendment) Acts 2000/2010	Irish Red List status	Habitats Directive	Bern & Bonn Conventions
Common pipistrelle *Pipistrellus pipistrellus*	Yes	Least Concern	Annex IV	Appendix II
Soprano pipistrelle *P. pygmaeus*	Yes	Least Concern	Annex IV	Appendix II
Nathusius pipistrelle *P. nathusii*	Yes	Not referenced	Annex IV	Appendix II
Leisler's bat *Nyctalus leisleri*	Yes	Near Threatened	Annex IV	Appendix II
Brown long-eared bat *Plecotus auritus*	Yes	Least Concern	Annex IV	Appendix II
Lesser horseshoe bat *Rhinolophus hipposideros*	Yes	Least Concern	Annex II Annex IV	Appendix II
Daubenton's bat *Myotis daubentonii*	Yes	Least Concern	Annex IV	Appendix II
Natterer's bat *M. nattereri*	Yes	Least Concern	Annex IV	Appendix II
Whiskered bat *M. mystacinus*	Yes	Least Concern	Annex IV	Appendix II
Brandt's bat *M. brandtii*	Yes	Data Deficient	Annex IV	Appendix II

Also, under existing legislation, the destruction, alteration or evacuation of a known bat roost is a notifiable action and a derogation licence has to be obtained from the *National Parks and Wildlife Service* before works can commence.

It should also be noted that any works interfering with bats and especially their roosts, including for instance, the installation of lighting in the vicinity of the latter, may only be carried out under a licence to derogate from Regulation 23 of the Habitats Regulations 1997, (which transposed the EU Habitats Directive into Irish law) issued by NPWS. The details with regards to appropriate assessments, the strict parameters within which derogation licences may be issued and the procedures by which and the order in relation to the planning and development regulations such licences should be obtained, are set out in Circular Letter NPWS 2/07 "*Guidance on Compliance with Regulation 23 of the Habitats Regulations 1997 - strict protection of certain species/applications for derogation licences*" issued on behalf of the Minister of the Environment, Heritage and Local Government on the 16th of May 2007.

Furthermore, on 21st September 2011, the Irish Government published the European Communities (Birds and Natural Habitats) Regulations 2011 which include the protection of the Irish bat fauna and further outline derogation licensing requirements re: European Protected Species.

References

Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) 1982

Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) 1979

EC Directive on The Conservation of Natural habitats and of Wild Fauna and Flora (Habitats Directive) 1992

European Communities (Birds and Natural Habitats) Regulations 2011 Government of Ireland, Dublin

Kelleher, C. and Marnell, F. 2007 *Bat Mitigation Guidelines for Ireland – Irish Wildlife Manuals No. 25*. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin

Marnell, F., Kingston, N. and Looney, D. 2009 *Ireland Red List No. 3: Terrestrial Mammals.* National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin

Wildlife Act 1976 and Wildlife Amendment Acts 2000 and 2010. Government of Ireland

Bat Surveys for Professional Ecologists: Good Practice Guidelines (Collins, 2016)
https://cdn.bats.org.uk/pdf/Resources/Bat_Survey_Guidelines_2016_NON_PRINTABLE.pdf?mtime=20181115113931&focal=none

Bat Mitigation Guidelines for Ireland (NPWS, 2006)
https://www.npws.ie/sites/default/files/publications/pdf/IWM25.pdf

Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes (NRA, 2006).

https://www.tii.ie/technical-services/environment/planning/Best_Practice_Guidelines_for_the_Conservation_of_Bats_in_the_Planning_of_National_Road_Schemes.pdf

Appendix 9.1

Ambient Air Quality Standards

Ambient Air Quality Standards

National standards for ambient air pollutants in Ireland have generally ensued from Council Directives enacted in the EU (& previously the EC & EEC). The initial interest in ambient air pollution legislation in the EU dates from the early 1980s and was in response to the most serious pollutant problems at that time which was the issue of acid rain. As a result of this sulphur dioxide, and later nitrogen dioxide, were both the focus of EU legislation. Linked to the acid rain problem was urban smog associated with fuel burning for space heating purposes. Also apparent at this time were the problems caused by leaded petrol and EU legislation was introduced to deal with this problem in the early 1980s.

In recent years the EU has focused on defining a basis strategy across the EU in relation to ambient air quality. In 1996, a Framework Directive, Council Directive 96/62/EC, on ambient air quality assessment and management was enacted. The aims of the Directive are fourfold. Firstly, the Directive's aim is to establish objectives for ambient air quality designed to avoid harmful effects to health. Secondly, the Directive aims to assess ambient air quality on the basis of common methods and criteria throughout the EU. Additionally, it is aimed to make information on air quality available to the public via alert thresholds and fourthly, it aims to maintain air quality where it is good and improve it in other cases.

As part of these measures to improve air quality, the European Commission has adopted proposals for daughter legislation under Directive 96/62/EC. The first of these directives to be enacted, Council Directive 1999/30/EC, has been passed into Irish Law as S.I. No 271 of 2002 (Air Quality Standards Regulations 2002), and has set limit values which came into operation on 17th June 2002. The Air Quality Standards Regulations 2002 detail margins of tolerance, which are trigger levels for certain types of action in the period leading to the attainment date. The margin of tolerance varies from 60% for lead, to 30% for 24-hour limit value for PM_{10}, 40% for the hourly and annual limit value for NO_2 and 26% for hourly SO_2 limit values. The margin of tolerance commenced from June 2002, and started to reduce from 1 January 2003 and every 12 months thereafter by equal annual percentages to reach 0% by the attainment date. A second daughter directive, EU Council Directive 2000/69/EC, has published limit values for both carbon monoxide and benzene in ambient air. This has also been passed into Irish Law under the Air Quality Standards Regulations 2002.

The most recent EU Council Directive on ambient air quality was published on the 11/06/08 which has been transposed into Irish Law as S.I. 180 of 2011. Council Directive 2008/50/EC combines the previous Air Quality Framework Directive and its subsequent daughter directives. Provisions were also made for the inclusion of new ambient limit values relating to $PM_{2.5}$. The margins of tolerance specific to each pollutant were also slightly adjusted from previous directives. In regards to existing ambient air quality standards, it is not proposed to modify the standards but to strengthen existing provisions to ensure that non-compliances are removed. In addition, new ambient standards for $PM_{2.5}$ are included in Directive 2008/50/EC. The approach for $PM_{2.5}$ was to establish a target value of 25 µg/m^3, as an annual average (to be attained everywhere by 2010) and a limit value of 25 µg/m^3, as an annual average (to be attained everywhere by 2015), coupled with a target to reduce human exposure generally to $PM_{2.5}$ between 2010 and 2020. This exposure reduction target will range from 0% (for $PM_{2.5}$ concentrations of less than 8.5 µg/m^3 to 20% of the average exposure indicator (AEI) for concentrations of between 18 - 22 µg/m^3). Where the AEI is currently greater than 22 µg/m^3 all appropriate measures should be employed to reduce this level to 18 µg/m^3 by 2020. The AEI is based on

measurements taken in urban background locations averaged over a three year period from 2008 - 2010 and again from 2018-2020. Additionally, an exposure concentration obligation of 20 µg/m^3 was set to be complied with by 2015 again based on the AEI.

Although the EU Air Quality Limit Values are the basis of legislation, other thresholds outlined by the EU Directives are used which are triggers for particular actions. The Alert Threshold is defined in Council Directive 96/62/EC as "a level beyond which there is a risk to human health from brief exposure and at which immediate steps shall be taken as laid down in Directive 96/62/EC". These steps include undertaking to ensure that the necessary steps are taken to inform the public (e.g. by means of radio, television and the press).

The Margin of Tolerance is defined in Council Directive 96/62/EC as a concentration which is higher than the limit value when legislation comes into force. It decreases to meet the limit value by the attainment date. The Upper Assessment Threshold is defined in Council Directive 96/62/EC as a concentration above which high quality measurement is mandatory. Data from measurement may be supplemented by information from other sources, including air quality modelling.

An annual average limit for both NO_X (NO and NO_2) is applicable for the protection of vegetation in highly rural areas away from major sources of NO_X such as large conurbations, factories and high road vehicle activity such as a dual carriageway or motorway. Annex VI of EU Directive 1999/30/EC identifies that monitoring to demonstrate compliance with the NO_X limit for the protection of vegetation should be carried out distances greater than:

- 5 km from the nearest motorway or dual carriageway
- 5 km from the nearest major industrial installation
- 20 km from a major urban conurbation

As a guideline, a monitoring station should be indicative of approximately 1000 km^2 of surrounding area.

Under the terms of EU Framework Directive on Ambient Air Quality (96/62/EC), geographical areas within member states have been classified in terms of zones. The zones have been defined in order to meet the criteria for air quality monitoring, assessment and management as described in the Framework Directive and Daughter Directives. Zone A is defined as Dublin and its environs, Zone B is defined as Cork City, Zone C is defined as 23 urban areas with a population greater than 15,000 and Zone D is defined as the remainder of the country. The Zones were defined based on among other things, population and existing ambient air quality.

EU Council Directive 96/62/EC on ambient air quality and assessment has been adopted into Irish Legislation (S.I. No. 33 of 1999). The act has designated the Environmental Protection Agency (EPA) as the competent authority responsible for the implementation of the Directive and for assessing ambient air quality in the State. Other commonly referenced ambient air quality standards include the World Health Organisation. The WHO guidelines differ from air quality standards in that they are primarily set to protect public health from the effects of air pollution. Air quality standards, however, are air quality guidelines recommended by governments, for which additional factors, such as socio-economic factors, may be considered.

Appendix 9.2

Transport Infrastructure Ireland Significance Criteria

Transport Infrastructure Ireland Significance Criteria

Table A9.2.1 *Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations*

Magnitude of Change	Annual Mean NO_2 / PM_{10}	No. days with PM_{10} concentration > 50 µg/m^3	Annual Mean $PM_{2.5}$
Large	Increase / decrease ≥4 µg/m^3	Increase / decrease >4 days	Increase / decrease ≥2.5 µg/m^3
Medium	Increase / decrease 2 - <4 µg/m^3	Increase / decrease 3 or 4 days	Increase / decrease 1.25 - <2.5 µg/m^3
Small	Increase / decrease 0.4 - <2 µg/m^3	Increase / decrease 1 or 2 days	Increase / decrease 0.25 - <1.25 µg/m^3
Imperceptible	Increase / decrease <0.4 µg/m^3	Increase / decrease <1 day	Increase / decrease <0.25 µg/m^3

Table A9.2.2 *Air Quality Impact Significance Criteria For Annual Mean Nitrogen Dioxide and PM10 and PM2.5 Concentrations at a Receptor*

Absolute Concentration in Relation to Objective/Limit Value	**Change in Concentration** [Note 1]		
	Small	**Medium**	**Large**
Increase with Scheme			
Above Objective/Limit Value With Scheme (≥40 µg/m^3 of NO_2 or PM_{10}) (≥25 µg/m^3 of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With Scheme (36 - <40 µg/m^3 of NO_2 or PM_{10}) (22.5 - <25 µg/m^3 of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With Scheme (30 - <36 µg/m^3 of NO_2 or PM_{10}) (18.75 - <22.5 µg/m^3 of $PM_{2.5}$)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With Scheme (<30 µg/m^3 of NO_2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value With Scheme (≥40 µg/m^3 of NO_2 or PM_{10}) (≥25 µg/m^3 of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value With Scheme (36 - <40 µg/m^3 of NO_2 or PM_{10}) (22.5 - <25 µg/m^3 of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value With Scheme (30 - <36 µg/m^3 of NO_2 or PM_{10}) (18.75 - <22.5 µg/m^3 of $PM_{2.5}$)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value With Scheme (<30 µg/m^3 of NO_2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight Beneficial

Note 1 Well Below Standard = <75% of limit value.

Appendix 9.3

Dust Management Plan

Dust Management Plan

The objective of dust control at the site is to ensure that no significant nuisance occurs at nearby sensitive receptors. In order to develop a workable and transparent dust control strategy, the following management plan has been formulated by drawing on best practice guidance from Ireland, the UK (IAQM (2014), BRE (2003), The Scottish Office (1996), UK ODPM (2002)) and the USA (USEPA, 1997).

Site Management

The aim is to ensure good site management by avoiding dust becoming airborne at source. This will be done through good design and effective control strategies.

At the construction planning stage, the siting of activities and storage piles will take note of the location of sensitive receptors and prevailing wind directions in order to minimise the potential for significant dust nuisance (see Figure 9.2 for the windrose for Dublin Airport). As the prevailing wind is predominantly westerly to south-westerly, locating construction compounds and storage piles downwind of sensitive receptors will minimise the potential for dust nuisance to occur at sensitive receptors.

Good site management will include the ability to respond to adverse weather conditions by either restricting operations on-site or quickly implementing effective control measures before the potential for nuisance occurs. When rainfall is greater than 0.2mm/day, dust generation is generally suppressed (IAQM, 2014; UK ODPM, 2002). The potential for significant dust generation is also reliant on threshold wind speeds of greater than 10 m/s (19.4 knots) (at 7m above ground) to release loose material from storage piles and other exposed materials (USEPA, 1986). Particular care should be taken during periods of high winds (gales) as these are periods where the potential for significant dust emissions are highest. The prevailing meteorological conditions in the vicinity of the site are favourable in general for the suppression of dust for a significant period of the year. Nevertheless, there will be infrequent periods where care will be needed to ensure that dust nuisance does not occur. The following measures shall be taken in order to avoid dust nuisance occurring under unfavourable meteorological conditions:

- The Principal Contractor or equivalent must monitor the contractors' performance to ensure that the proposed mitigation measures are implemented and that dust impacts and nuisance are minimised;
- During working hours, dust control methods will be monitored as appropriate, depending on the prevailing meteorological conditions;
- The name and contact details of a person to contact regarding air quality and dust issues shall be displayed on the site boundary, this notice board should also include head/regional office contact details;
- It is recommended that community engagement be undertaken before works commence on site explaining the nature and duration of the works to local residents and businesses;
- A complaints register will be kept on site detailing all telephone calls and letters of complaint received in connection with dust nuisance or air quality concerns, together with details of any remedial actions carried out;
- It is the responsibility of the contractor at all times to demonstrate full compliance with the dust control conditions herein;
- At all times, the procedures put in place will be strictly monitored and assessed.

The dust minimisation measures shall be reviewed at regular intervals during the works to ensure the effectiveness of the procedures in place and to maintain the goal of minimisation of dust through the use of best practice and procedures. In the event of dust nuisance occurring outside the site boundary, site activities will be reviewed and satisfactory procedures implemented to rectify the problem. Specific dust control measures to be employed are described below.

Site Roads / Haulage Routes

Movement of construction trucks along site roads (particularly unpaved roads) can be a significant source of fugitive dust if control measures are not in place. The most effective means of suppressing dust emissions from unpaved roads is to apply speed restrictions. Studies show that these measures can have a control efficiency ranging from 25 to 80% (UK ODPM, 2002).

- A speed restriction of 20 km/hr will be applied as an effective control measure for dust for on-site vehicles using unpaved site roads;
- Access gates to the site shall be located at least 10m from sensitive receptors where possible;
- Bowsers or suitable watering equipment will be available during periods of dry weather throughout the construction period. Research has found that watering can reduce dust emissions by 50% (USEPA, 1997). Watering shall be conducted during sustained dry periods to ensure that unpaved areas are kept moist. The required application frequency will vary according to soil type, weather conditions and vehicular use;
- Any hard surface roads will be swept to remove mud and aggregate materials from their surface while any unsurfaced roads shall be restricted to essential site traffic only.

Land Clearing / Earth Moving

Land clearing / earth-moving works during periods of high winds and dry weather conditions can be a significant source of dust.

- During dry and windy periods, and when there is a likelihood of dust nuisance, watering shall be conducted to ensure moisture content of materials being moved is high enough to increase the stability of the soil and thus suppress dust;
- During periods of very high winds (gales), activities likely to generate significant dust emissions should be postponed until the gale has subsided.

Storage Piles

The location and moisture content of storage piles are important factors which determine their potential for dust emissions.

- Overburden material will be protected from exposure to wind by storing the material in sheltered regions of the site. Where possible storage piles should be located downwind of sensitive receptors;
- Regular watering will take place to ensure the moisture content is high enough to increase the stability of the soil and thus suppress dust. The regular watering of stockpiles has been found to have an 80% control efficiency (UK ODPM, 2002).

- Where feasible, hoarding will be erected around site boundaries to reduce visual impact. This will also have an added benefit of preventing larger particles from impacting on nearby sensitive receptors.

Site Traffic on Public Roads

Spillage and blow-off of debris, aggregates and fine material onto public roads should be reduced to a minimum by employing the following measures:

- Vehicles delivering or collecting material with potential for dust emissions shall be enclosed or covered with tarpaulin at all times to restrict the escape of dust;
- At the main site traffic exits, a wheel wash facility shall be installed if feasible. All trucks leaving the site must pass through the wheel wash. In addition, public roads outside the site shall be regularly inspected for cleanliness, as a minimum on a daily basis, and cleaned as necessary.

Summary of Dust Mitigation Measures

The pro-active control of fugitive dust will ensure that the prevention of significant emissions, rather than an inefficient attempt to control them once they have been released, will contribute towards the satisfactory performance of the contractor. The key features with respect to control of dust will be:

- The specification of a site policy on dust and the identification of the site management responsibilities for dust issues;
- The development of a documented system for managing site practices with regard to dust control;
- The development of a means by which the performance of the dust minimisation plan can be regularly monitored and assessed; and
- The specification of effective measures to deal with any complaints received.

Appendix 10.1

Wind Microclimate Study GA2 Application, Baldoyle, Dublin

BRE Group

www.bre.co.uk

BRE Client Report

Wind Microclimate Study – GA2 Application, Baldoyle, Dublin

Prepared for: Lismore Homes Ltd
Date: 11th January 2022
Report Number: P121579 -1003 Issue 3

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Position Associate Director

Date 11th January 2022

Signature 

Authorised by

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Position Head of Wind Engineering

Date 11th January 2022

Signature 

Executive Summary

BRE have been commissioned by Raymond O'Malley, Agent acting for Lismore Homes Ltd, 4 Westmoreland Street, Dublin 2, Ireland to undertake a desk study to consider potential pedestrian level wind effects around the proposed Baldoyle Growth Area 2 development in Dublin.

This study has been undertaken by BRE as project number P121579-1003 and is based upon BRE proposal number P121579.

This report is based upon information provided to BRE via email, which included images and drawings of the proposed development. Selected examples of these images have been incorporated as figures into this report for ease of reference. It contains professional opinions regarding the wind effects likely to be generated by the buildings and by their context.

The main conclusions are:

- The proposed Growth Area 2 development is generally well sheltered from the prevailing southwesterly winds and the graduated increase in building heights from south to north will further help to minimise adverse wind effects. Some parts of the development are exposed to northerly winds and to a lesser extent by south easterly winds, but these are infrequent and of low intensity at this site so exposure to northerly winds and south easterly winds is not expected to have a significant adverse impact on the pedestrian level wind microclimate.
- The ground level wind conditions around the proposed Growth Area 2 development are expected to be generally suitable for the intended pedestrian activities at all footpaths, walkways and public realm areas.
- The pedestrian entrances to the buildings of the proposed Growth Area 2 development generally face the courtyard areas and are expected to be sheltered and suitable for entrance usage.
- The wind conditions on nearby roads and existing surrounding areas are not expected to be adversely impacted by the proposed Growth Area 2 development.

Table of Contents

1 Introduction

Planning permission was previously granted (Reg. Ref. F11A/0290 and ABP PL 06F.239732 refer) for a residential scheme called Phase 5 at Baldoyle-Stapolin, which is part of the overall Coast Residential Development at Baldoyle, Dublin. A new Strategic Housing Development application on the former Phase 5 lands, now known as GA2, Baldoyle-Stapolin is being prepared for 1,007 no. residential units.

BRE have been commissioned by Raymond O'Malley, Agent acting for Lismore Homes Ltd, 4 Westmoreland Street, Dublin 2, Ireland to undertake a desk study to consider potential pedestrian level wind effects around the proposed Baldoyle Growth Area 2 development of this scheme..

This study has been undertaken by BRE as project number P121579 - 1003 and is based upon BRE proposal number P121579.

This study is based on the professional experience and opinion of BRE.

2 Methodology

This assessment is based upon the professional opinion of an experienced BRE wind engineering expert who is a Chartered Civil and Structural Engineer with over 35 years of experience in this field. It is recognised that this opinion is qualitative in nature although the assessment of wind speed conditions for the Site is based on measured meteorological data and is therefore quantitative. This approach is widely accepted by planners and developers as being an appropriate methodology to support planning applications.

The professional opinion is based upon the wind effects generated by the buildings themselves, and by their context (i.e. the surrounding buildings and the macro-scale wind environment). This assessment enables potential pedestrian level wind environment issues around the site to be identified.

The purpose of undertaking a desk study is to identify areas of potentially unpleasant winds. However, people perceive the wind differently depending upon what they are doing. For example, people sitting will tolerate less windy conditions than people walking with purpose between locations. This means that an area having unpleasant winds for sitting purposes can be completely suitable for walking.

It is not practical to evaluate every location around a scheme in terms of every pedestrian activity, and a typical activity must therefore be chosen as the basis for making an assessment. For this purpose, the activities of Sitting (in the residential amenity areas) and Strolling (leisure-walking) and Entrances at the main entrances to the buildings have been chosen as being the most appropriate benchmarks. This is discussed further in Section 6.

It is important to recognise that a location having the potential to have unpleasant wind is not the same as that location being unpleasantly windy. A desk study offers a professional opinion about the likely wind conditions and draws attention to any areas of concern; hence it is qualitative by nature. The behaviour of the wind and its interaction with buildings means that it is not possible to be certain about the actual wind conditions - conditions which could be measured by a quantitative wind tunnel study.

3 The Proposed Development and Surroundings

Planning permission was previously granted (Reg. Ref. F11A/0290 and ABP PL 06F.239732 refer) for a residential scheme called Phase 5 at Baldoyle-Stapolin, which is part of the overall Coast Residential Development at Baldoyle, Dublin. A new Strategic Housing Development application on the former Phase 5 lands, now known as GA2, Baldoyle-Stapolin is being prepared for 1,007 no. residential units.

The proposed development is divided into three sectors (Sectors 6, 7 and 8) comprising 16 buildings with heights varying from four to 12 storeys, including basement and surface level car parking, secure bicycle parking, landscaping, water supply connection at Red Arches Road, and all ancillary site development works.

Figure 1 shows an aerial view of the development site and Figure 2 shows a plan view of the proposed development with the buildings colour coded by building height.

Figure 1 Aerial view of the area showing the site boundary (shown by the red line)

Figure 2 Plan view of the proposed development

The site is currently undeveloped and is located on the southern fringes of Fingal County Council administrative area, approximately 8km north-east of Dublin city centre. The site is located northwest of Baldoyle village, and approximately 7km from Dublin airport. The site is located approximately 500 metres from the Baldoyle Estuary area, the River Mayne lies approximately 300 metre to the north.

To the southeast of the proposed development is the Red Arches Park residential development with buildings of between three and five storeys tall. To the southwest is the proposed Growth Area 1 residential development and to the west is the proposed Growth Area 3 residential development. To the north, northeast and east of the proposed development is the Proposed Racecourse Regional Park that is before An Bord Pleanála for a decision in March 2022 (see JP06F.311315).

To the south of the site (outside of the site boundary) is a large rectangular area of open grassland and woodland; in the centre of the area's north perimeter is an existing pumping station. This area is known as the "Haggard".

The proposed buildings are arranged in courtyard blocks. The lowest height blocks, of four and five storeys are generally along the southern edge of the development with the tallest blocks, of between 10 and 12 storeys along the northern boundary. This height gradient is also reflected in the individual courtyard blocks. Figures 3 to 6 show aerial schematic views of the proposed development and local surroundings.

Figure 3 Aerial view of the proposed development from the southwest

Figure 4 Aerial view of the proposed development from the northwest

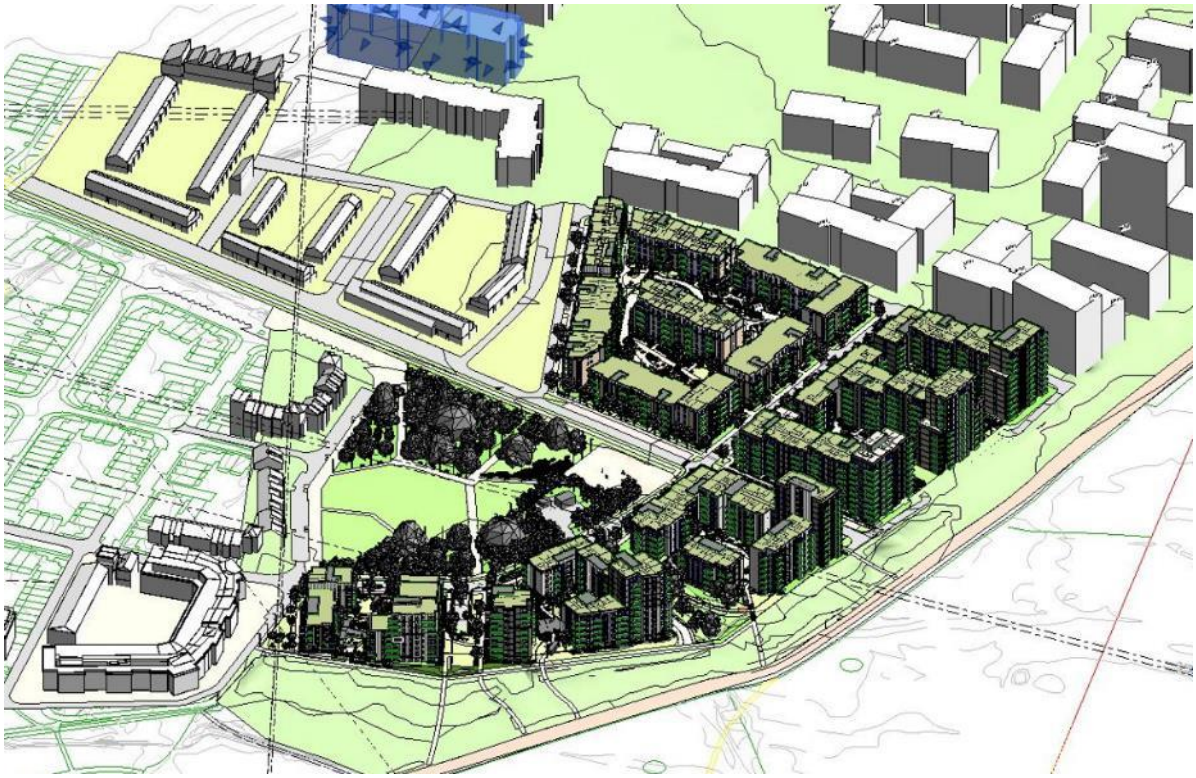

Figure 5 Aerial view of the proposed development from the northeast

Figure 6 Aerial view of the proposed development from the southeast

4 Meteorological Data

Meteorological data were purchased by BRE from the Irish Met Office for the meteorological station at Dublin Airport. This met station, which is approximately 7km from the to the northwest of the site, has been identified as being the most appropriate for the Baldoyle development and the wind conditions measured at this met site will be representative of those at the Baldoyle site.

The wind rose from the Dublin Airport met site for the year as a whole is shown in Figure 7. This wind rose shows that the prevailing wind direction is south westerly with little wind from the north, south or easterly sectors.

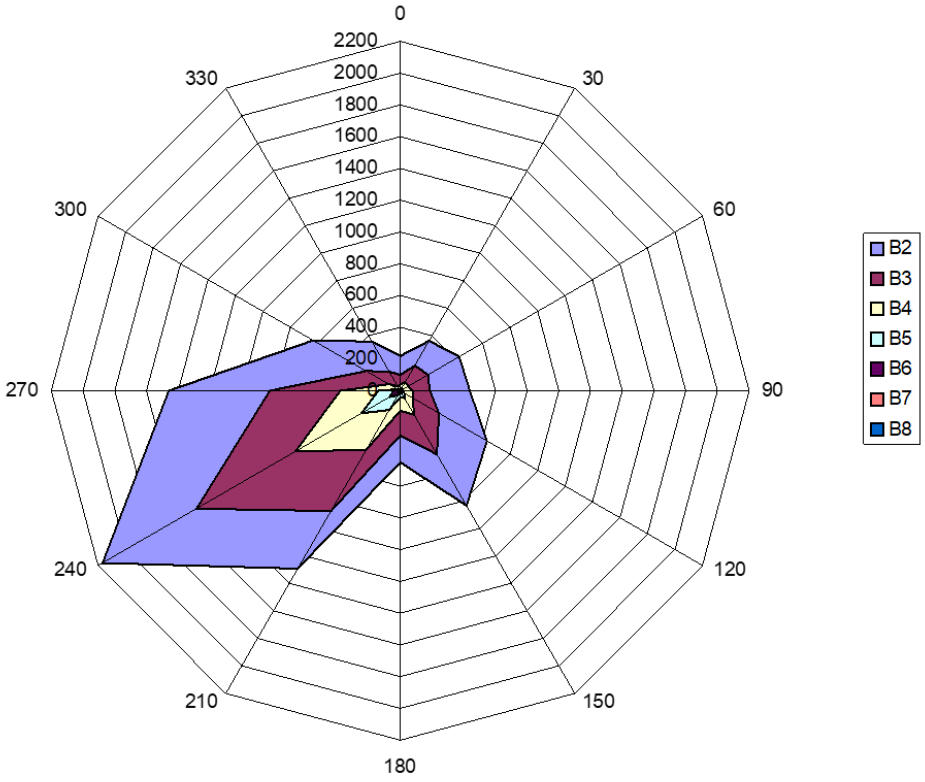

Figure 7 Wind rose for the Dublin Airport meteorological station
(this plot show the number of hours per year exceeding the given Beaufort range thresholds)

5 Comfort Criteria

Wind conditions for pedestrian comfort are generally based on the Beaufort wind scale which describes wind effects on land for a range of mean wind speeds. Table 1 shows the Beaufort wind scale and describes the effects attributable to each wind speed range[1].

Beaufort scale	Description	Mean wind speed range		Effects
		(m/s)	(mph)	
B0	Calm	0–0.2	0–0.5	No noticeable wind, smoke rises vertically
B1	Light air	0.3–1.5	0.7–3.4	Direction of wind shown by smoke drift but not wind vanes
B2	Light breeze	1.6–3.3	3.6–7.4	Wind felt on face, leaves rustle
B3	Gentle breeze	3.4–5.4	7.6–12.1	Wind extends light flag, leaves in constant motion
B4	Moderate breeze	5.5–7.9	12.3–17.7	Raises dust and loose paper; hair disarranged, clothing flaps
B5	Fresh breeze	8.0–10.7	17.9–24.0	Small trees in leaf begin to sway; limit of agreeable wind on land
B6	Strong breeze	10.8–13.8	24.2–30.9	Umbrellas used with difficulty; force of the wind felt on the body; wind noisy, frequent blinking
B7	Near gale	13.9–17.1	31.1–38.3	Inconvenience felt when walking; difficult to walk steadily; hair blown straight
B8	Gale	17.2–20.7	38.5–46.4	Generally impedes progress; walking difficult to control; great difficulty with balance in gusts
B9	Strong gale	20.8–24.4	46.6–54.7	People blown over by gusts; slight structural damage
B10	Storm	24.5–28.4	54.9–63.6	Seldom experienced inland; trees uprooted, significant structural damage
B11	Violent storm	28.5–32.2	63.8–72.1	Very rarely experienced; accompanied by widespread structural damage
B12	Hurricane	> 32.3	> 72.4	Countryside devastated; winds of this force only occur in hurricanes and tornadoes

Table 1 The Beaufort scale of wind effects on land

The wind microclimate assessment in this study is based upon a set of comfort criteria developed by Lawson with respect to people's perception of the suitability of the wind conditions for a range of activities from 'long-term sitting' (for example at open-air cafés), through 'standing' and 'strolling' and finally to 'business walking'. The more sedentary the activity, the lower the acceptable comfort threshold will be. Table 2[1] gives a description of the Lawson comfort criteria and the threshold wind speeds. The use of the Lawson comfort criteria has been shown to represent good standards of Irish environmental practice and is widely accepted by Local Planning Departments. The conditions have also been assessed for safety using the Lawson 'distress criteria' which have been developed for use in assessing the onset of wind-induced 'distress'. These are based on a probability of exceedance of 0.025% of a given threshold windspeed per year, or 0.040% exceedance per month and equate to approximately one exceedance per year or per month. The threshold mean windspeeds used are Beaufort 7 (15m/s) for frail people and cyclists and Beaufort 8 (20m/s) for the general public in areas where frail people or cyclist would not normally be expected.

[1] P Blackmore, BRE Digest 520, Wind Microclimate Around Buildings, May 2011

It should be recognised that the full Lawson comfort assessment can only be carried out with quantitative measurements of pedestrian level mean and gust wind speeds obtained from a wind tunnel study. The wind microclimate assessment carried out in this study uses expert judgement and experience to qualitatively apply the Lawson comfort criteria to the pedestrian microclimate around the development.

Activity	Lawson comfort criteria	
	Unacceptable	Tolerable
Roads and car parks, business walking, fast walking from A to B	10.7 m/s (B5) > 6%	10.7 m/s (B5) > 2%
People at work, workers around buildings	10.7 m/s (B5) > 2%	7.9 m/s (B4) > 2%
Pedestrian strolling, slow walking with occasional stops, shopping, short-term standing eg at bus stops	7.9 m/s (B4) > 4%	5.4 m/s (B3) > 6%
Long-term sitting – in open-air cafes, parks, etc. for periods of more than about 10 min	5.4 m/s (B3) > 6%	3.3 m/s (B2) > 6%
Entrances and exits of buildings or areas where there is a risk of sudden exposure to wind	5.4 m/s (B3) > 6%	3.3 m/s (B2) > 4%
Covered areas – pedestrian seating areas under cover, places of high cultural significance	5.4 m/s (B3) > 1%	3.3 m/s (B2) > 4%

Table 2 The Lawson comfort criteria and threshold mean wind speeds

6 Expected Wind Conditions Around the Proposed Development

6.1 Behaviour of the Wind

Wind fundamentally consists of the motion of air. It is the amount of air motion and how this motion is perceived that affects how windy a place is judged to be. A property of air is that it has inertia. This means that air does not move unless a force acts upon it. In layman's terms, air can be thought of as being 'lazy' and, given the choice, will always take the easiest path around a building. Understanding this issue is important when desk studies such as this are undertaken. This is because comments about wind conditions around a site can only be based upon a judgement about the likely routes that air will take. These judgements are tempered by experience of similar projects, and by knowledge of potential wind problems that might be encountered.

High-speed winds are usually produced by the passage of large-scale weather systems. These weather systems are created by the convective circulation pattern that results from differential heating of the earth's surface at the poles and the equator. This convective pattern combines with the effects of the earth's rotation to produce prevailing south-westerly winds across Ireland and the UK. Such winds not only come from this direction more often than any other, but they also tend to be the strongest winds that can occur. It is however important to consult wind records from a meteorological station close to the site of any proposed development in order to confirm the local prevailing wind direction before undertaking a desk study such as this. A site's proximity to the coast or topological features, such as mountains or lakes, can mean that winds may blow from alternative directions to the typical south-westerly.

Nearer to the ground, effects of surface roughness associated with buildings, trees and other obstructions influence certain aspects of the behaviour and properties of the wind. The ground level winds experienced by the public are influenced strongly by the geometry of nearby buildings. In general, the nearer the building is to a given location; the more strongly its influence is felt. Thus, although the local pedestrian level wind conditions (both the relative strength and gustiness of the wind and its direction) are influenced by nearby buildings, the frequency of occurrences of such winds, and the mean wind strength itself, are determined by wind conditions far above the earth's surface.

6.2 Overview of wind effects and their impact on pedestrian activities

Windward vortices are a phenomenon common to many tall buildings, especially those which rise above their surroundings and provide a significant frontage to the prevailing wind. High-speed winds from higher levels above the ground may be deflected downwards by the windward building façade, which can cause significant nuisance and/or distress to pedestrians in the vicinity. Entrances to buildings are particular areas of concern.

Another potentially problematic pedestrian level wind phenomenon occurs when winds (including perhaps those deflected to ground level by a windward vortex) accelerate around the windward corners of buildings. Such conditions can be particularly uncomfortable for pedestrians passing from a sheltered area with calm wind conditions immediately into a windy location as they step past the corner of an affected building.

Entrance doors can be wind-sensitive locations because people walking out from a windless conditioned indoor environment to outdoors are immediately confronted with the effects of the wind and can perceive the wind to be stronger than it actually is. For this reason, particular attention should be paid to the wind conditions around doorway locations. Entrances located at unprotected corners of buildings where winds tend to 'whip' around from one façade to the next can be particularly problematic.

The target Lawson pedestrian comfort criterion for this development, as defined in Table 2, are considered to be:

i) 'Long-term Sitting' in the residential amenity areas,
ii) 'Strolling' (often referred to as leisure-walking) on the pedestrian routes through and around the development, and
iii) 'Entrances' at the main entrances to the buildings.

These criteria have been chosen as being the most appropriate benchmarks for the High Street development.

The following assessments consider the wind effects around Sectors 6, 7 and 8 (shown respectively in Figures 8, 9 and 11) of the proposed GA2 development. It is our understanding that planning consent has been granted for the adjacent Growth Area 1 (GA1) and Growth Area 3 (GA3) developments so the assessment of the wind microclimate around the GA2 development assumes that the buildings of the GA1 and GA3 developments will be in place.

6.3 Sector 6

Sector 6 is at the southwest corner of the proposed GA2 development. This Sector comprises of six blocks arranged around a courtyard with the seventh block in the centre of the courtyard, as shown in Figure 7. The blocks around the periphery of the courtyard are all five storeys tall, with the exception of Blocks 3 and 7 on the eastern edge of the Sector which both include a six storey element. The central block, Block 6, is also six storeys high.

Sector 6 is surrounded on all sides by existing or proposed surrounding buildings and existing or proposed trees. To the south and west are the buildings of the GA1 and GA3 developments respectively, see Figures 3 and 4. The buildings of the GA1 development are two storeys (www.shoreline1shd.ie) and those of the GA3 development which are between five and 11 storeys (www.shoreline2shd.ie). To the north are the buildings of Sector 7 and to the northeast the Sector 8C buildings which are all of similar height or taller than the Sector 6 buildings, and to the east is the Haggard beyond which are the buildings of Sectors 8A and Sectors 8B see Figure 5. To the southeast are the buildings of the existing buildings of the Red Arches Park buildings, see Figure 6.

6.3.1 Potential Impact on Pedestrian-level Winds

The buildings surrounding Sector 6 are all generally of similar height or taller than the Sector 6 buildings and will provide good shelter from the prevailing south westerly wind. To the east there is less local shelter which is provided by the rows of existing and proposed trees on the Haggard and further afield by the proposed Sector 8A and 8B buildings. There are relatively narrow gaps between the Sector 6 buildings but accelerated wind flow through these gaps is not expected to occur because of the ground level shelter provided by surrounding buildings.

The main pedestrian activities throughout the year around this Sector are likely to be Strolling on the footpaths and walkways and Entrances at the main entrances to the buildings and Long-term sitting during the summer in the courtyard amenity areas. Sector 6 is well sheltered from the prevailing south westerly winds. There is less shelter from easterly winds, but these are expected to be relatively infrequent. It is therefore expected that the wind conditions at all locations around the Sector 6 buildings will be suitable for the intended pedestrian activities and there are not expected to be any adverse impacts on pedestrian comfort around the Sector 6 buildings.

There are not expected to be any locations around Sector 6 where the distress threshold wind speeds will be exceeded.

Figure 8 Plan view of the Sector 6 blocks

6.4 Sector 7

This Sector comprises of three 'I' shaped finger blocks (Blocks 1 to 3) the spines of which are orientated approximately north-south. The blocks create two courtyards open at the west and east ends, see Figure 8. Each block increases in height from the southern to northern end. At the southern end the blocks are five or six storeys high stepping up in height to a maximum height of 11 storeys (Block 1), 12 storeys (Block 2) and ten storeys (Block 3).

For southerly winds the orientation of the finger blocks and the increasing height from south to north minimises large, exposed faces and will tend to cause the wind to blow up and over the blocks thereby minimising downwash and adverse impacts from the prevailing wind direction. However, with regards to the ground level winds around the bases of these Sector buildings, these beneficial geometrical features are not present for northerly winds.

To the south of Sector 7 is Sector 6 and to the west are the proposed GA3 buildings which are between five and eleven storeys, see Figure 3. The northern ends of the three Sector 7 buildings are exposed and will have no shelter from northerly winds. To the east, Sector 7 will be largely sheltered by the buildings of Sector 8A, see Figure 6.

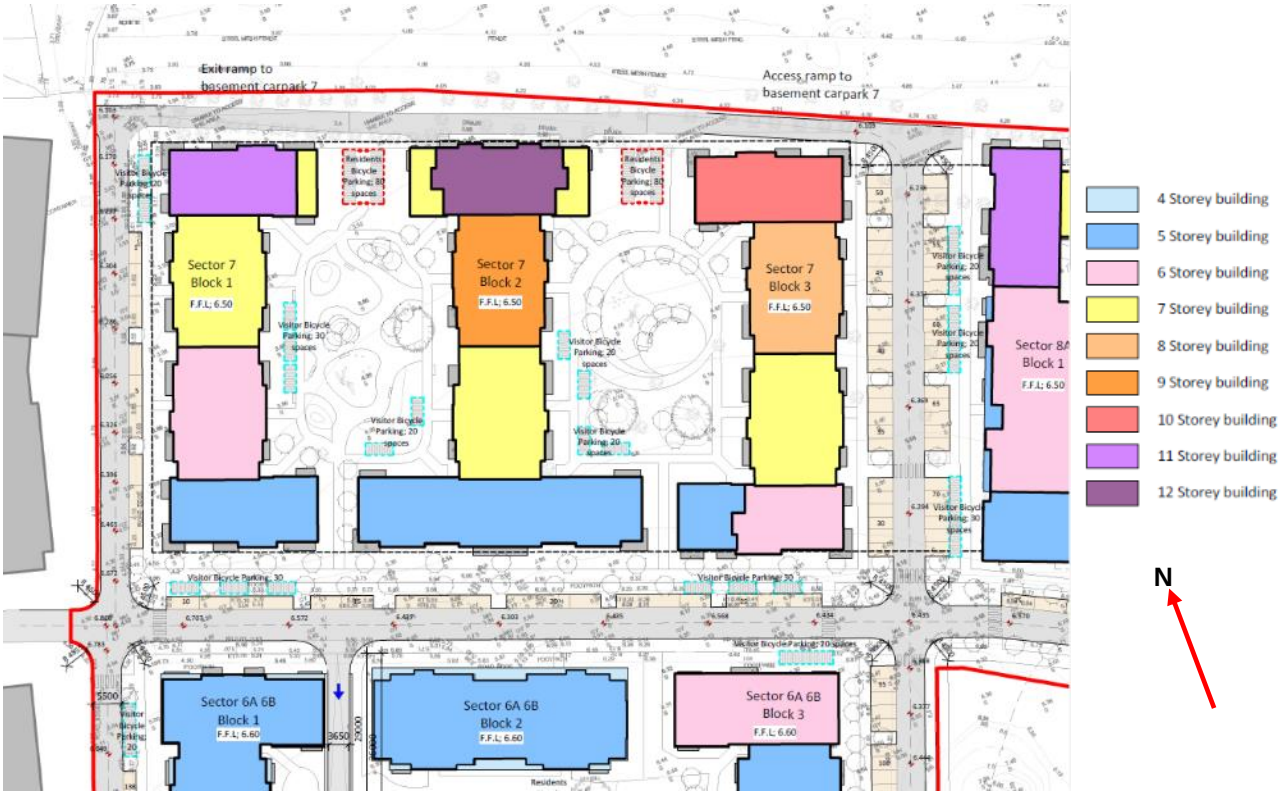

Figure 9 Plan view of the Sector 7 buildings

6.4.1 Potential Impact on Pedestrian-level Winds

Sector 7 is well sheltered from the prevailing southwesterly winds by Sector 6 and the proposed GA3 buildings. The tallest elements of the Sector 7 building will protrude above the average height of the surrounding buildings however there is unlikely to be significant downwash from the prevailing southwesterly winds. This is because of the north/south and east/west building orientations which mean that these winds do not blow directly towards the building facades. The Sector 7 buildings are also reasonably well sheltered from south easterly winds, which are relatively infrequent and light, by the Sector 8 buildings and the wooded areas of the Haggard. The Haggard includes several existing tall mature retained and protected trees, and many more new trees will be planted, see Figure 9. This wooded area will disperse the south easterly wind and create shelter at ground level. There are also rows of trees proposed along the south elevations of the Sector 7 buildings which will provide additional local shelter from south easterly winds. So no adverse wind effects are expected in or around Sector 7 from south westerly or south easterly wind directions.

However, there will be little shelter from northerly winds. It is therefore likely that northerly winds will create windward vortices on the exposed northern ends of the three Sector 7 blocks buildings. This will cause increased wind flow down the northern elevations of Blocks 1, 2 and 3 and will increase the ground level wind speeds. This effect will be worse close to the corners of the windward elevations and entrance

doors or footpaths should not be sited close to these corners. The drawings of the Sector 7 buildings show that there are no entrance doors or exits on the northern elevations of Blocks 1, 2 or 3 and there are no designated pedestrian walkways close to the corners.

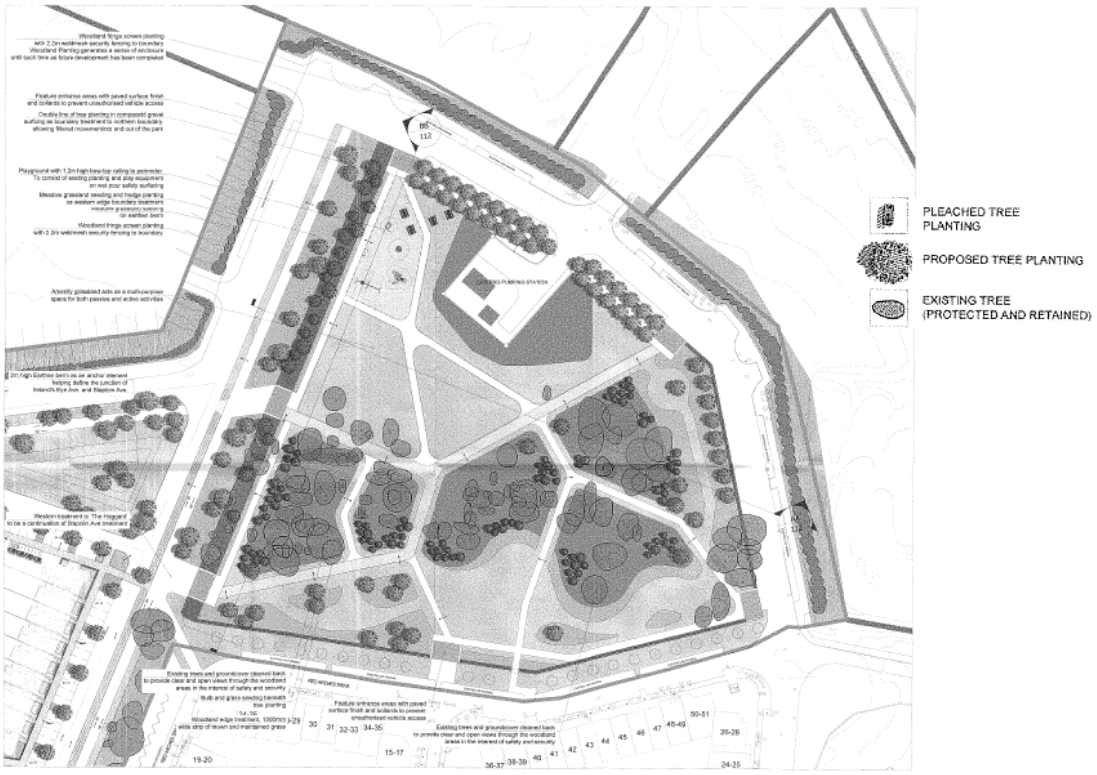

Figure 10 The Haggard showing the proposed and existing trees

Northerly winds are likely to blow through the gaps between Blocks 1 and 2 and between Blocks 2 and 3 potentially causing accelerated wind flow and increasing ground level wind speeds. The areas in the gaps between the north end of these blocks will be used for resident's bicycle storage. Further to the south in the courtyards the areas will be used for more sedentary activities such as strolling and sitting during the summer months.

Northerly winds are relatively infrequent, see the wind rose in Figure 7, and will generally have a lower strength than the prevailing south westerly winds. Given the low frequency of occurrence of northerly winds it is expected that the areas around the bicycle stores and in and around the courtyards will be suitable for Pedestrian strolling throughout the year and suitable for more sedentary activities during the summer months.

For the year as a whole it is expected that the wind conditions at all locations around the Sector 7 buildings will be suitable for the intended pedestrian activities and there are not expected to be any adverse impacts on pedestrian comfort around the Sector 7 buildings.

There are not expected to be any locations around Sector 7 where the distress threshold wind speeds will be exceeded.

6.5 Sector 8

This Sector comprises of three elements. Sector 8A has two buildings, one with heights of between five and 11 storeys and the other of five storeys. Sector 8B comprises of two buildings, one with heights between five and 11 storeys and the other with heights of six and seven storeys. Sector 8C comprises of two buildings, one with heights of four, five and eight stories and the other with heights of four and five storeys. Figure 11 shows the Sector 8 buildings.

The heights of the buildings in all three elements of this Sector increase from south to north thereby minimising large faces exposed to the prevailing southwesterly wind. Southwesterly winds approaching the Sector 8A, 8B and 8C buildings will therefore tend to blow up and over the blocks minimising downwash effects.

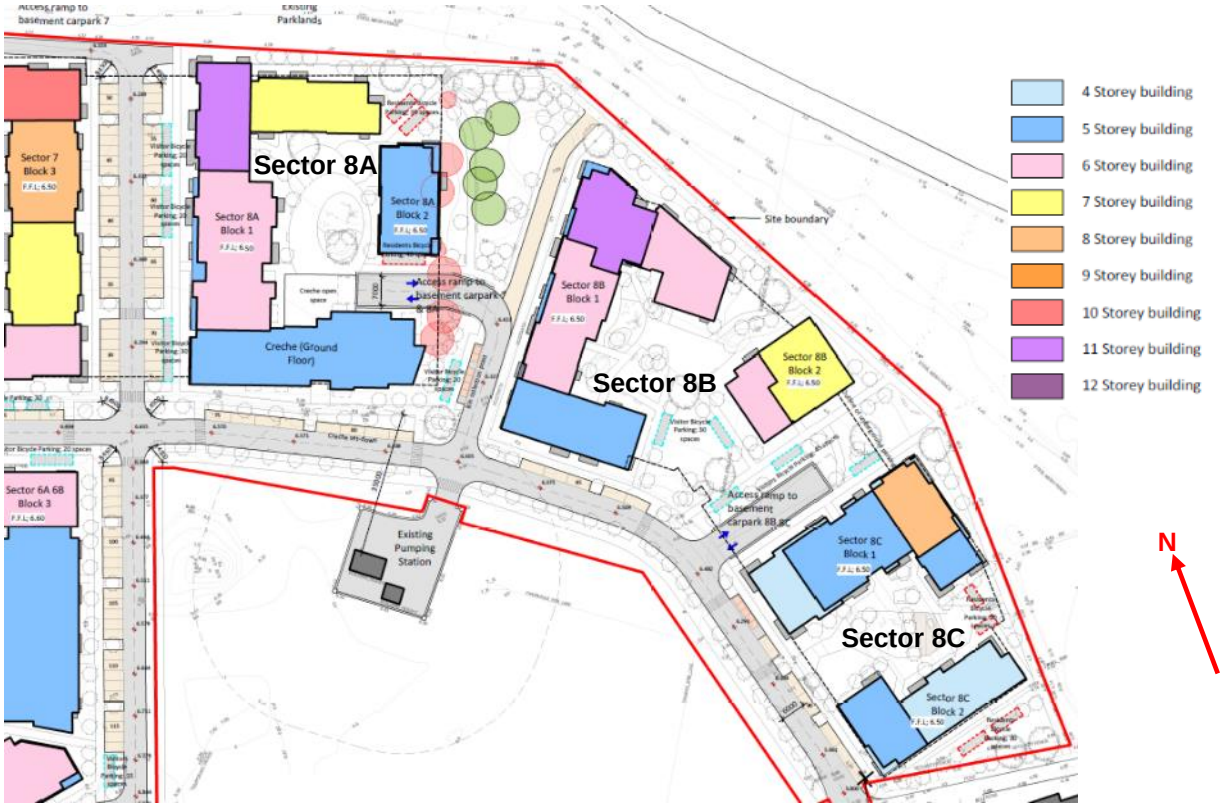

Figure 11 Plan view of the Sector 8 buildings

Immediately adjacent to the south or southwest of the Sector 8 buildings is the wooded area of the Haggard. This area includes a row of trees along the southwest side of Sector 8, see Figures 3 and 11. Beyond the Haggard (to the south) are the buildings of the Red Arches Park development which range between three and five storeys To the west are the Sector 6 and 7 buildings which will provide shelter to the west and southern ends of Sector 8, but the northern facades of the Sector 8 buildings will be exposed, see Figure 4. The northeast-facing facades of the Sector 8 buildings are exposed to northeast winds, with no shelter from existing or proposed buildings. The southeast corner of Sector 8 will be partially sheltered by the buildings of Red Arches Park, and the wooded areas of the Haggard, see Figures 6 and 10.

6.5.1 Potential Impact on Pedestrian-level Winds

Local shelter to all three elements of the Sector 8 buildings is provided from the prevailing south westerly winds by the wooded areas of the Haggard and the proposed rows of new trees along the adjacent roads. Beyond the Haggard are the buildings of the proposed GA1 buildings. Sector 8A will also be partly sheltered by the Sector 6 buildings. The graduated increase in height from south to north will also help to minimise the wind impact. However, the maximum height of the Sector 8A and 8B buildings is 11 storeys. In both cases there will be a five storey step height from the adjoining six storey block. This is the largest step height between buildings in the whole development and it is possible that windward vortices could develop and create downwash on the protruding five storey part of the building. This is likely to increase the wind speeds on the roof of the adjoining six storey buildings. However, there are no roof terraces or public amenity areas on these roofs. The downwash around these building will be convected downstream and dissipated and is not expected to reach down to ground level.

The courtyard of Sector 8A is mainly enclosed and protected from southwesterly winds so is expected to have wind conditions suitable for strolling throughout the year and for long-term sitting during the summer. The courtyard areas of Sectors 8B and 8C are more exposed to southwesterly winds. In Sector 8B there are some scattered trees in the entrance and inside of the courtyard and a row of trees along the access road which will provide local shelter. The wind conditions within the courtyard are likely to be suitable for strolling but it is recommended that seating areas are not located close to Block 2 because the wind conditions here could be unsuitable for long-term sitting. The entrance to the Sector 8C courtyard is sheltered by the proposed row of trees along the access road. There are also trees within the courtyard and especially in front of the seating area which will provide local shelter to the seating area. Based on the tree layout indicated on the drawing it is expected that the wind conditions within the Sector 8C courtyard will be suitable for strolling throughout the year and for long-term sitting during the summer.

For south easterly winds, Sector 8C will be sheltered by the nearby five storey buildings along Red Arches Road. Sector 8B will be sheltered by the Sector 8C buildings and the Sector 8A buildings will be partly sheltered by the Sector 8B and 8C buildings and by the wooded areas of the Haggard. There are no entrances on the exposed southern facades of the Sector 8 buildings. South easterly winds are relatively infrequent so it is expected that for this wind direction the ground level wind microclimate will be suitable for the intended pedestrian activities throughout the year.

The northern and north-east elevations of the Sector 8 buildings will be fully exposed to northerly winds. The tallest elements of Sector 8 are all on the northern edge and range in height from eight to 11 stories. Because there is no shelter from northerly winds it is likely that windward vortices will be developed on the northern elevations of the Sector 8B and Sector 8C buildings. This will cause increased wind speeds at ground level, which will be mitigated to a minor extent by the trees close to the northern facades. Northerly winds will create increased wind speeds close to windward corners along the north side of the Sector 8 buildings. The drawings of the Sector 8A, 8B and 8C buildings show that there are no entrance doors or exits on the northern elevations of any of the Blocks and there are trees/shrubs close to the potentially windy corners to prevent pedestrian access to these areas.

The courtyards of Sectors 8B and 8C have gaps in the northern facades which will be exposed to northerly winds. North easterly winds are likely to blow through the gaps between Sector 8B Blocks 1 and 2 and between Sector 8C Blocks 1 and 2 and into the courtyard areas.

North easterly winds are infrequent, see the wind rose in Figure 7, and have a lower intensity than the prevailing southwesterly winds. Therefore given the low frequency of northerly winds it is expected that the area in and around the courtyards will meet the Lawson criteria for Pedestrian strolling for northerly winds.

For the year as a whole it is expected that the wind conditions at all locations around the Sector 8 buildings will be suitable for the intended pedestrian activities and there are not expected to be any adverse impacts on pedestrian comfort around the Sector 8 buildings.

There are not expected to be any locations around Sector 8 where the distress threshold wind speeds will be exceeded.

7 Pedestrian Microclimate Amelioration Measures

It is important to recognise that a location having a potential to have unpleasant wind is not the same as that location being unpleasantly windy. A desk study offers a professional opinion about the likely wind conditions and draws attention to any areas of concern; hence it is qualitative by nature. The behaviour of the wind and its interaction with buildings means that it is not possible to be certain about the actual wind conditions. Hence in this situation, all of the areas of concern around a site need to be identified. This approach tends by its nature to be conservative. Wind tunnel testing gives a qualitative approach and will provide details of the actual extent and magnitude of windy areas and may possibly show that an area of concern identified in a desk study is either too large, or that this area is actually suitable for its intended activity. Nevertheless, experience has shown that the findings of a desk study are usually borne out by the results obtained by subsequent wind tunnel testing.

In summary, the wind conditions around the proposed GA2 development are expected to be suitable for the intended pedestrian activities. Therefore no wind mitigation is expected to be required.

8 Conclusion and Recommendations

This wind microclimate desk study has shown that the proposed Growth Area 2 development is generally well sheltered from the prevailing southwesterly winds and the graduated increase in building heights from south to north will further help to minimise adverse wind effects. Some parts of the development are exposed to northerly winds and to a lesser extent to south easterly winds, but winds from these directions are infrequent and of low intensity at this site so the exposure to northerly and south easterly winds is not expected to have a significant adverse impact on the pedestrian level wind microclimate.

The specific conclusions from this assessment are:

- The proposed Growth Area 2 development is generally well sheltered from the prevailing southwesterly winds and the graduated increase in building heights from south to north will further help to minimise adverse wind effects. Some parts of the development are exposed to northerly winds and to a lesser extent by south easterly winds, but these are infrequent and of low intensity at this site so exposure to northerly winds and south easterly winds is not expected to have a significant adverse impact on the pedestrian level wind microclimate.
- The ground level wind conditions around the proposed Growth Area 2 development are expected to be generally suitable for the intended pedestrian activities at all footpaths, walkways and public realm areas.
- The pedestrian entrances to the buildings of the proposed Growth Area 2 development generally face the courtyard areas and are expected to be sheltered and suitable for entrance usage.
- The wind conditions on nearby roads and existing surrounding areas are not expected to be adversely impacted by the proposed Growth Area 2 development.

9 References

Blackmore P, BRE Digest 520. Wind Microclimate around Buildings. May 2011

Report Ends

Appendix 11.1

Sunlight Daylight Assessment GA2 Application, Baldoyle, Dublin

BRE Group

www.bre.co.uk

BRE Client Report

Daylight and sunlight assessment for proposed development at GA2 Baldoyle

Prepared for: Lismore Homes Ltd

Date: 21 March 2022

Report Number: P117995-1002 Issue: 5

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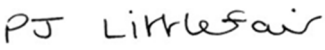
Signature 

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Introduction

It is proposed to develop the GA2 site at Baldoyle. The development includes construction of 1,007 residential apartments. The site is bounded to the south by dwellings on Red Arches Drive. The recently consented GA1 and GA3 developments are to the west. To the north and east of the site is open space.

This report assesses the impact on daylight and sunlight to surrounding areas and provision to rooms at the development itself. The results are compared to the guidelines in the BRE Report “Site layout planning for daylight and sunlight: a guide to good practice” and the standard EN17037:2018 “Daylight in buildings”. The older standard BS8206 Part 2 “Code of practice for daylighting” is also considered.

The calculations in this report are based on 3D models and floor plans of the site and each sector provided by CCH Architects. These included 3D models of each sector with associated floor plans and elevations dated 22/10/21 with minor revisions dated 03/11/2022. These are used in conjunction with site model and site plan and available details of surrounding buildings at Red Arches Park and Red Arches Drive and consented proposals at GA1 and GA3, where available from the respective planning application websites. No site visit was necessary.

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Methodology

Loss of daylight to existing dwellings

Guidance on the loss of light to existing buildings following construction of new development nearby is given in the BRE Report 'Site layout planning for daylight and sunlight: a guide to good practice'. This report is widely used by local authorities to help assess planning applications. This assessment has been carried out with reference to the second edition of the report, which was published in October 2011.

The advice in the BRE Report is widely used throughout Ireland and the United Kingdom to help assess planning applications. The Fingal Development Plan 2017-2023 Development Management Standards recommends the use of the BRE Report.

The guidance in the BRE Report is advisory in nature and is intended to assist with good design. There is no formal requirement to comply with the advice it contains.

The guidelines in the BRE Report usually apply to habitable rooms including living rooms, kitchens and bedrooms.

In the BRE Report loss of daylight (light from the sky, calculated on an overcast day) and sunlight (direct light from the sun) are assessed separately.

Loss of daylight – vertical sky component

The BRE Report recommends the calculation of the vertical sky component to assess loss of daylight. This is the ratio of the direct sky illuminance falling on the outside of a window, to the simultaneous horizontal illuminance under an unobstructed sky. The standard CIE Overcast Sky is used and the ratio is usually expressed as a percentage. The maximum value is almost 40% for a completely unobstructed vertical wall. The vertical sky component on a window is a good measure of the amount of daylight entering it.

A BRE computer program was used to calculate the vertical sky component, which has the same basis as the skylight indicators in the BRE Report.

The BRE Report sets out the following two guidelines for vertical sky component:

a) Where the vertical sky component at the centre of the existing window exceeds 27% with the new development in place, then enough sky light should still be reaching the existing window.

b) Where the vertical sky component with the new development is both less than 27% **and** less than 0.8 times its former value, then the area lit by the window is likely to appear more gloomy, and electric lighting will be needed for more of the time.

Loss of daylight - daylight distribution

The BRE report also gives guidance on the distribution of light in the existing buildings, based on the areas of the working plane (0.85m above floor level) which can and cannot receive direct skylight before and after.

These calculations require knowledge of room geometry. Since access was not available to collect the data for existing buildings, this calculation could not be carried out.

Loss of sunlight - existing dwellings

The BRE Report recommends that loss of sunlight should be checked for main living rooms of dwellings, and conservatories, if they have a window facing within 90° of due south.

If the centre of the window can receive more than one quarter of annual probable sunlight hours, including at least 5% of annual probable sunlight hours in the winter months between 21 September and 21 March, then the room should still receive enough sunlight. If the window already receives less than this, a reduction to less than 0.8 times its current value and a reduction of more than 4% of annual probable sunlight hours over the year may lead to the room it serves appearing colder and less cheerful and pleasant.

Existing buildings on Red Arches Drive and the GA1 development would be to the south of the development site and therefore loss of sunlight would not be an issue.

The nearest relevant windows at GA3 have been assessed for sunlight provision.

Loss of sunlight - existing gardens and open spaces

For outdoor amenity areas, the 2011 edition of the BRE Report 'Site layout planning for daylight and sunlight: a guide to good practice' recommends that at least half of the space should receive at least two hours of sunlight on 21st March.

There are large areas of open space to the north and east of the site. Only spaces close to proposed buildings may lose some sun. There are no existing garden areas with the potential to be impacted.

Impact Assessment

Appendix I of the BRE Report gives advice when assessing a loss of daylight and sunlight for an Environmental Impact Assessment.

Where the loss of skylight or sunlight fully meets the guidelines, the impact is assessed as negligible or minor adverse. Where the loss of light is well within the guidelines, or only a small number of windows or limited area of open space lose light (within the guidelines), a classification of negligible impact is more appropriate. Where the loss of light is only just within the guidelines, and a large number of windows or open space area are affected, a minor adverse impact would be more appropriate, especially if there is a particularly strong requirement for daylight in the affected building or open space.

Where the loss of skylight or sunlight does not meet the guidelines in the BRE Report, the impact is assessed as minor, moderate or major adverse. Factors tending towards a minor adverse impact would be:

- only a small number of windows or limited area of open space are affected
- the loss of light is only marginally outside the guidelines
- an affected room has other sources of skylight or sunlight
- the affected building or open space only has a low level requirement for skylight or sunlight.

Factors tending towards a major adverse impact include:

- a large number of windows or large area of open space are affected
- the loss of light is substantially outside the guidelines
- all the windows in a particular property are affected

- the affected indoor or outdoor spaces have a particularly strong requirement for skylight or sunlight.

Shadow Plotting

The BRE Report states that where a large building or development is proposed which may affect a number of open spaces it is often illustrative to plot a shadow plan showing the location of shadows at different times of day and year.

Shadow plots have been created for 21st March (spring equinox), 21st June (summer solstice) and 21st December (winter solstice) at clock times 8am, 10am, 12pm, 2pm and 4pm (plus 6pm for June only). They are shown in Appendix B.

In an An Bord Pleanála pre-application consultation opinion it was requested that "A month-by-month assessment of average daylight (sic) [sunlight] hours within the public open space should be provided within the daylight and sunlight analysis document to allow for a full understanding of the year round level of overshadowing of the primary outdoor recreation areas for the development should be submitted."

In order to satisfy this, plots are also shown for January, February, April and May. This gives a month-by-month assessment of sunlight provision at and around the site to allow for a full understanding of the year round level of overshadowing.

The shadows for 21st September (autumn equinox) are the same as those for 21st March (spring equinox). The shadows for 21st January, 21st February, 21st April and 21st May are the same as those at or around the 21st of November, October, August and July respectively.

In the plots, the times given are clock times. Between the end of March and the end of October, Irish Standard Time (IST) applies. The plots for September and October therefore correspond to the shadows produced one hour later in summer time; thus at 1pm IST in September/October, the shadows are as plotted on the 12pm GMT diagram for March/February. The March and February plots therefore correspond to 9am, 11am, 1pm, 3pm and 5pm IST in September and October.

The only numerical guidelines for overshadowing of open spaces are those described in the BRE Report for two hours of sunlight on 21st March. The shadow plots are therefore shown for illustrative purposes.

Daylight and sunlight provision to proposed habitable rooms

Guidance on daylight and sunlight to new dwellings, including numerical target values, is given in EN17037:2018 "Daylight in buildings". In the UK, this standard supersedes BS8206 Part 2:2008 Lighting for Buildings, Code of Practice for Daylighting. The Fingal Development Plan 2017-2023 recommends the use of BS8206 or any update on the document.

The Department of Housing, Local Government and Heritage document Sustainable Urban Housing: Design Standards for New Apartments December 2020 states "Where an applicant cannot fully meet all of the requirements of the daylight provisions above, this must be clearly identified and a rationale for any alternative, compensatory design solutions must be set out, which planning authorities should apply their discretion in accepting taking account of its assessment of specific. This may arise due to a design constraint associated with the site or location and the balancing of that assessment against the desirability of achieving wider planning objectives. Such objectives might include securing comprehensive urban regeneration and or an effective urban design and streetscape solution."

Daylight provision

EN17037 recommends minimum, medium and high target illuminances over at least 50% of a reference plane (0.85m from the floor) in a room, with further targets for 95% of the reference plane. Equivalent values of daylight factor for locations in Europe are also given. The daylight factor is the ratio of the illuminance at a point in on the working plane in a room divided by the illuminance of an unobstructed

surface outside. It is measured using the CIE standard overcast sky and takes into account factors such as surface reflectances and glazing transmittance.

The assessment has been undertaken using the daylight factor methodology. Table 1 gives the minimum, medium and high target illuminances and equivalent daylight factor values for Dublin to achieve over 50% of the reference plane (median values) and 95% of the reference plane.

Table 1: Daylighting targets in EN17037.

Level of recommendation	To achieve for at least 50% of a reference plane, for at least half of the daylight hours.		To achieve for at least 95% of a reference plane, for at least half of the daylight hours.	
	Target Illuminance (lx)	Equivalent Daylight Factor in Dublin (%)	Target Illuminance (lx)	Equivalent Daylight Factor in Dublin (%)
Minimum	300	2.0%	100	0.7%
Medium	500	3.4%	300	2.0%
High	750	5.0%	500	3.4%

The standard does not give recommendations for individual room types. Daylight would be required in habitable spaces such as living rooms, kitchens and bedrooms. Daylight provision to a living area would usually be considered more important than daylight to a bedroom.

In general, the recommendations are much more ambitious than those in BS8206 Part 2, which the standard supersedes, and were intended for internal areas of all types, not just a domestic setting. The target values would be very difficult to achieve for domestic rooms in an urban environment.

A UK National Annex recognises this and sets alternative targets for living rooms, kitchens and bedrooms. This is based on the equivalent daylight factor needed to achieve a certain illuminance on at least 50% of the reference plane. It is the opinion of the UK committee that the recommendation of a target illuminance level across 95% of the working plane need not be applied in dwellings.

The median illuminances recommended in the UK National Annex to be achieved over half the reference plane are 100 lux in bedrooms, 150 lux in living rooms and 200 lux in kitchens. For Dublin these would correspond to recommended equivalent median daylight factors, over at least 50% of the calculation plane, of 0.7% for a bedroom, 1.0% for a living room and 1.3% for a kitchen. For a room of combined use, the higher value should apply. However, for combined living/dining/kitchen rooms, local authorities may in practice accept the living room value in order to avoid small closed-off kitchen areas to force compliance with the standard.

The results are compared to UK National Annex equivalent targets as these recommendations have replaced those in BS8206 for the UK.

For this assessment the daylight factor was calculated at a series of points spaced at up to 0.3m apart on a reference plane (0.85m from the floor) in example worst-case rooms in each sector using software based on a Radiance ray tracing engine. The reference plane excluded main areas within 0.3m of a room's wall.

Results have also been assessed with reference to the older average daylight factor methodology in BS8206 Part 2. This standard recommended an average daylight factor of 1.0% in bedrooms, 1.5% in living rooms and 2.0% in kitchens. The daylight factor at a series of points in the room has been calculated in a same way as described above, but the entire room is used for the reference plane (areas 0.3m from the walls are not excluded).

The below table summarises the daylight recommendations used in the assessment.

Table 2: Daylight recommendations used for assessment of proposed rooms.

Room	EN17037 UK National Annex equivalent for Dublin. Median daylight factor value	BS8206-2:2008 recommendation. Average Daylight Factor value
Bedroom	0.7%	1.0%
Living Room	1.0%	1.5%
Kitchen	1.3%	2.0%

It would be impractical to analyse all rooms throughout a scheme of this size. In these cases it is usual to analyse a selection of rooms to assess the daylighting potential.

The assessment has been undertaken by analysing a selection of representative rooms on the lowest floor of each sector, including worst-case areas. Where rooms are below the recommendations on the lowest floors, equivalent rooms on higher floors have been analysed until the recommendations are met or the top floor reached. Combined living/dining/kitchen areas have been compared against the living room and kitchen recommendations.

The results have then been used to estimate an extrapolation of the results at other rooms in similar areas or that are similarly, or less, obstructed. For example, if the most obstructed bedrooms in a sector meet the recommendations it would be reasonable to assume that all bedrooms in that sector meet the recommendations. Or if a living/dining/kitchen area meets the recommendations then similar, less deep, or less obstructed rooms on the façade or in the sector would also be assumed to meet the recommendations.

The overall percentage of rooms that appear capable of meeting the recommendations has been estimated based on the above assumptions. These overall estimates carry uncertainty and should be seen as an indication of the overall results, rather than a definitive value.

The following values were used in the daylight factor calculations for internal and external surfaces. All clear glazing, window panels and curtain glazing have been assumed to be standard transparent double glazing.

Table 3: Factors used in daylight factor calculations.

Object / surface	Values used in calculations
Internal walls	Reflectance: 0.7
Internal floors	Reflectance: 0.2
Internal ceilings	Reflectance: 0.9
External walls, surrounding buildings and doors	Reflectance: 0.3
Ground	Reflectance: 0.2
Clear glazing (windows and balcony surrounds)	Transmittance based on a value of 0.68 from Pilkington data for low emissivity double glazing.
Maintenance factors (accounting for dirt on glazing)	Additional maintenance factors based on data in the UK National Annex of EN17037 (based on suburban setting): 0.96 vertical glazing
Window frames	Reflectance: 0.5

Sunlight to proposed dwellings

EN17037 gives minimum, medium and high recommended levels for sunlight exposure. This is measured via the duration received to a point on the inside of a window on a selected date (21st March). This assessment assumes a cloudless sky and therefore represents a maximum possible amount of sunlight. The assessment is undertaken using the calculation of sun position based on the geometrical equations in the standard.

Table 4 gives the recommended values of sunlight exposure. The standard states that at least one habitable room in a dwelling should receive at least the recommended exposure to sunlight.

Table 4: Sunlighting targets in EN17037.

Level of recommended exposure	Sunlight exposure
Minimum	1.5 Hours
Medium	3 Hours
High	4 Hours

The calculation point is 1.2m above the floor level (or 0.3m above sill level) at the middle of the aperture on the position of the inner wall. Frames are not included in the calculations. This point has been used assuming that sunlight would be able to penetrate any glazing or panelling in the aperture.

Using example calculation points, a diagram showing the areas able to receive the recommendations are shown for the worst-case ground floor. In areas where sunlight provision could increase, example points are also calculated on higher floors and a summary of the number of units in each sector with at least one room able to meet at least the minimum recommendation are shown for each sector.

Sunlight to proposed open spaces

The BRE Report 'Site layout planning for daylight and sunlight: a guide to good practice' recommends that at least half of a proposed space should receive at least two hours of sunlight on 21st March.

The courtyard areas at each proposed sector have been assessed using this methodology.

In an An Bord Pleanála pre-application consultation opinion it was requested that “A month-by-month assessment of average daylight (sic) [sunlight] hours within the public open space should be provided within the daylight and sunlight analysis document to allow for a full understanding of the year round level of overshadowing of the primary outdoor recreation areas for the development should be submitted.”

In order to satisfy this, the areas able to receive at least two hours of sunlight on have also been calculated for other months. There are guidelines only for 21st March and therefore the additional analysis is for information purposes only.

The areas of the proposed courtyards able to receive at least two hours of sunlight on 21st December (winter solstice), 21st January, 21st February, 21st April, 21st May and 21st June (summer solstice) have been calculated. The results for 21st September (autumn equinox) are the same as those for 21st March (spring equinox). The shadows for 21st January, 21st February, 21st April and 21st May are the same as those at or around the 21st of November, October, August and July respectively.

Loss of daylight and sunlight to surrounding areas

The below figure shows the site and surroundings. Existing dwellings and potential proposed and consented areas have been analysed. There are existing dwellings to the south east of the site on Red Arches Drive. Future development GA3 is located to the west. The nearest part of consented scheme GA1 is to the south of Sectors 6A/6B.

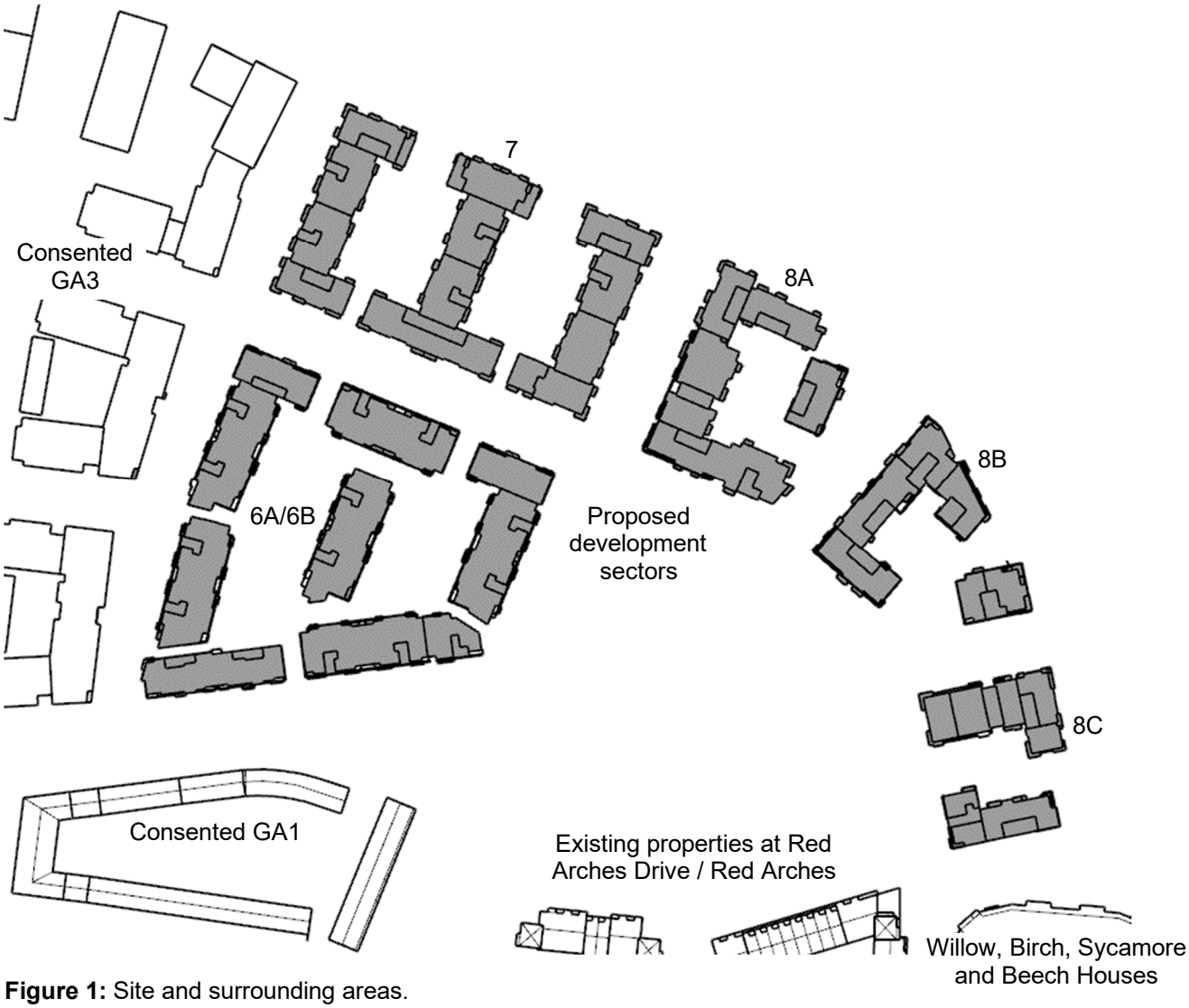


Figure 1: Site and surrounding areas.

To the south of Sector 8C are properties on the opposing side of Red Arches Drive. These are the closest existing dwellings to the site.

Based on available details and photography of the existing buildings, worst-case windows have been assessed for loss of daylight.

The full results are shown in Appendix A.

Willow, Birch, Sycamore and Beech Houses

Willow, Birch, Sycamore and Beech Houses are blocks of flats in the same building, directly to the south of Sector 8C. West and north facing windows have been analysed for loss of daylight. North east facing windows would have less view of the development site and therefore would be less impacted.

The windows analysed are shown in Figures A1 – A4 in Appendix A. The vertical sky component results before and after development are shown in Table A1 of Appendix A.

The results suggest that 46 windows would be below the BRE vertical sky component guidelines by having values less than 27% and less than 0.8 times those before. However, the design of the existing building has enclosed balconies and overhangs which restrict daylight provision. This can be seen in the existing low values of vertical sky component. Windows that are not part of enclosed balconies or do not have an overhang above them would meet the guidelines. The layout of the building façade, showing the enclosed balconies and overhangs is shown in Figure 2 and Figures A1 to A4 of Appendix A.

Figure 2: View of apartments on Red Arches Drive. The existing set back balconies limit skylight provision and could force a reliance on daylight from the area of Sector 8C.

The BRE Report “Site layout planning for daylight and sunlight: a guide to good practice” gives further advice in these situations and suggests that to assess the impact of existing balconies the calculations could be repeated without them in place.

Windows below the initial BRE guidelines have been recalculated without the balconies and overhangs in place. The results are shown in Table A2 of Appendix A.

Without the balcony overhangs, eight windows would be below the BRE vertical sky component guidelines. However, these windows would still be set back behind the main façade of the building as part of the enclosed area. The obstruction of projecting parts of the building still restricts daylight provision.

When these windows were also analysed on a flat façade, without set back enclosing or overhangs, (shown in Table A3 of Appendix A), all windows would meet the BRE guidelines.

There would be an impact to some existing windows, but these results show that the primary cause of this impact is due to the design of the existing buildings themselves. Windows set back into the building with balconies or overhangs above force a reliance on daylight from the area of the proposal site.

Planning permission exists for a scheme on this site that includes a 5-storey apartment building on Sector 8C (Reg. Ref. F11A/0290/E1 refers). The approved building height ranges from 18.9 metres to 22.1 metres compared with the proposed building height in the area closest to the surrounding properties of 17.2 metres.

Notwithstanding, the impact is assessed as minor adverse.

Loss of sunlight would not be an issue since the proposal site lies to the north.

Properties at Red Arches Drive / Red Arches Park

The closest windows to the proposal site at properties on the corner of Red Arches Drive / Red Arches Park have been analysed for loss of daylight. The windows analysed and vertical sky component results are shown in Figures A5-A6 and Table A4 of Appendix A.

All windows would meet the BRE vertical sky component guidelines since they would have values greater than 27% with the proposed development in place or more than 0.8 times those before. The impact is assessed as negligible.

Loss of sunlight would not be an issue since the proposal site lies to the north.

Future developments to west

GA1

The nearest part of the consented GA1 development is to the south of proposed Sectors 6A/6B. This area contains two storey houses. The worst-case ground floor windows facing Sectors 6A/6B have been analysed for daylight. Vertical sky components have been calculated with the development in place. The results are shown in Table A5 of Appendix A.

All windows would receive at least 27% vertical sky component with the proposed development in place.

The loss of daylight would be assessed as negligible.

Loss of sunlight would not be an issue since the windows face northerly.

GA3

The detailed scheme for GA3 has recently been consented. This is located to the west of the application site. East facing facades of Block F1, F2 and G5 would have a view of the proposed development Sectors 6A/6B and 7. A comparison between the empty site and the proposal is less appropriate here since the development has been designed knowing that a development would be on the site at GA2. The scheme architect issued our client's drawings to Shoreline Properties.

The vertical sky component at all east facing windows to habitable rooms on the ground and first floors have been calculated with the proposed development in place. The calculations have been carried out with any balconies in place, and repeated with them removed. The results are shown in Table A5 in Appendix A.

The BRE states that with a vertical sky component of at least 27% conventional window design will usually give reasonable results. Between 15% and 27% special measures such as changes to room layouts and larger windows may be needed for adequate daylight. Between 5% and 15% it is very difficult to adequate daylighting unless very large windows are used. With a vertical sky component of less than 5% it is often impossible to achieve reasonable daylight.

Of the windows at GA3 on the ground and first floors facing the proposal site, 3% would have values of vertical sky component greater than 27%, 60% would have values between 15% and 27%, 36% would have values between 5% and 15% and 1% would have values less than 5%. These results include balconies at GA3, which restrict daylight provision from higher angles and may force a reliance on an area directly opposite.

If these are theoretically removed, 33% of windows on the ground and first floor would have values of vertical sky component greater than 27%, with 66% of windows with values between 15% and 27%. This suggests that the balconies are responsible for some of the restriction in daylight.

The results suggest that special measures would be needed in the design of GA3. The recently consented development has recognised this, and large floor to ceiling windows are provided to rooms as part of the design.

The proposal for GA3 also contained a daylight and sunlight assessment. Of the worst-case rooms chosen facing GA2, the analysis suggested that daylight provision would be adequate. It is understood this analysis included an account for obstruction from GA2, but not in the exact form now proposed. However, the results and the above assessment does suggest that there is the potential for adequate daylight provision.

When compared to the existing empty site there would be a significant impact to daylight to the east facing façade of GA3. However, this would only be the case if future residents of GA3 experienced conditions with the empty GA2 site; the development has been designed knowing GA2 would be the site of future development. Special measures of larger windows are in place in the design of GA3 and any reduced values of vertical sky component may be at least partly due to existing balconies. The BRE Report suggest the guidelines should be interpreted flexibly. In special circumstances a higher degree of obstruction may be unavoidable if new developments are to match the height and proportions of existing buildings.

Since the east facades of Blocks F1, F2 and G5, looking towards the proposed development, face just south of due east, potential sunlight provision has been assessed. Windows on the ground and first floor have been assessed. The results have been calculated with and without balconies to GA3, and the results are shown in Table A5 of Appendix A.

With balconies to GA3 in place, 36% of windows on the ground and first floor would be able to receive at least 25% annual probable hours, including at least 5% in the winter months, meeting the BRE guidelines. When balconies are removed, 94% of the windows would be able to meet these targets. Adequate sunlight at GA3 is therefore achievable with the proposed development at GA2 in place; any restriction of sunlight appears predominately due to the provision of balconies at GA3, rather than the proposed development.

Daylight and sunlight provision to the proposed development

Daylight provision has been assessed to example rooms in each sector using the methodology in the UK National Annex of EN17037. A comparison to the older BS8206 is also included. Example rooms, including those in worst-case areas, have been analysed on the lowest floors. Where rooms would be below the recommendations, values have been calculated for equivalent rooms on higher floors until the recommendations are met or the top floor is reached.

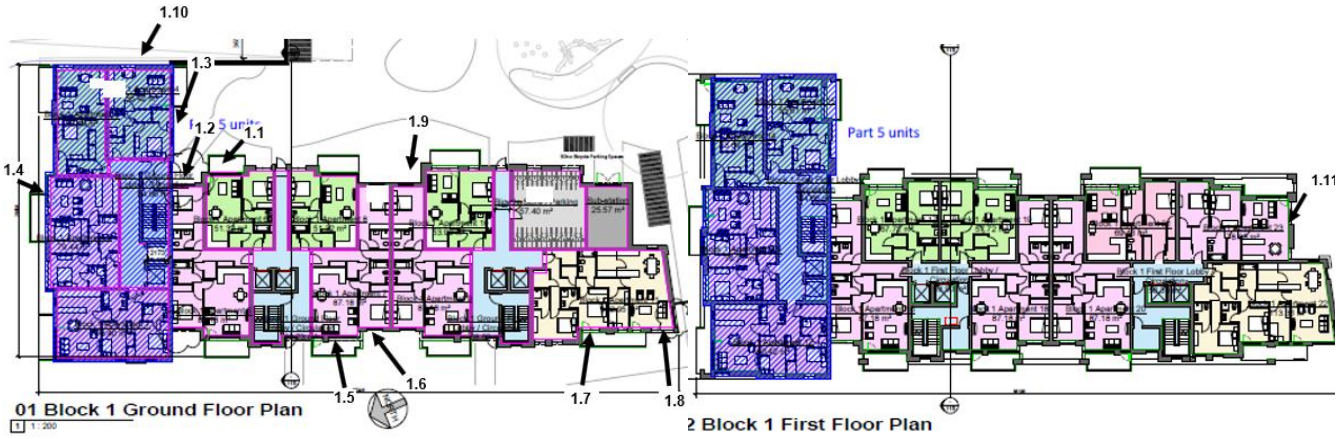
The results have been used to estimate the overall percentage of rooms that appear likely to be able to meet the recommendations. This gives an indication of the overall result across the scheme.

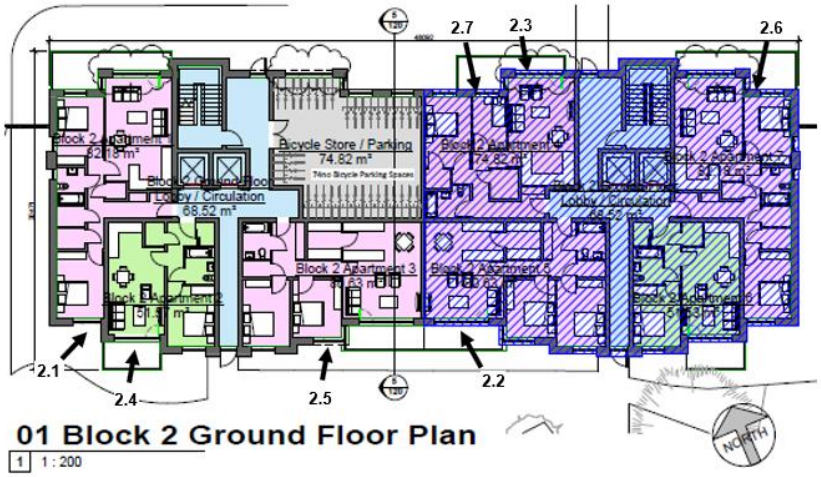
Ground floor windows have also been assessed for sunlight provision in each sector to get an indication of potential provision. Where there is the potential for sunlight to increase on upper floors, higher windows have also been assessed for a summary of the total number of units in each sector with at least one room able to receive at least the minimum 1.5 hours of sunlight recommended in EN17037. Windows facing northerly would be naturally limited for sunlight and therefore may be expected to be below the recommendations. Balconies have been included in the calculations. The calculations assume the whole window aperture is transparent with sunlight able to penetrate. A visual representation of the results is given for each sector.

Sectors 6A/6B

Daylight provision

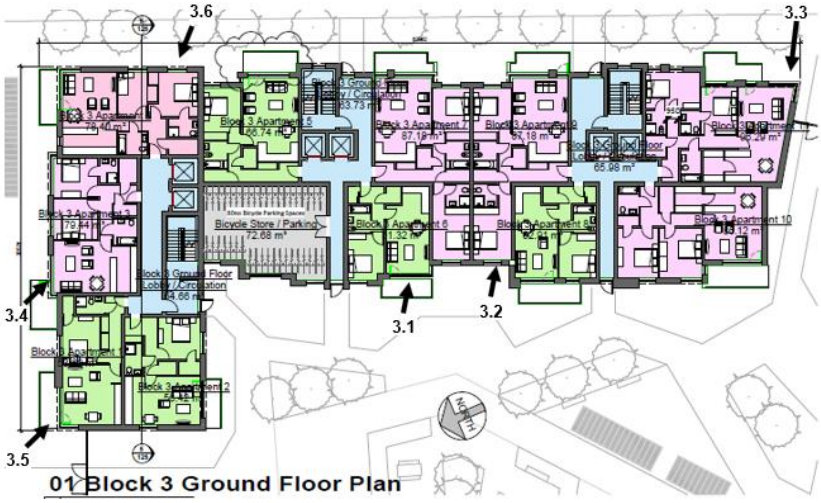
The representative example rooms analysed for each block at Sectors 6A/6B are shown in Figure 3. The results of the daylight analysis for the lowest floors are given in Table 5.



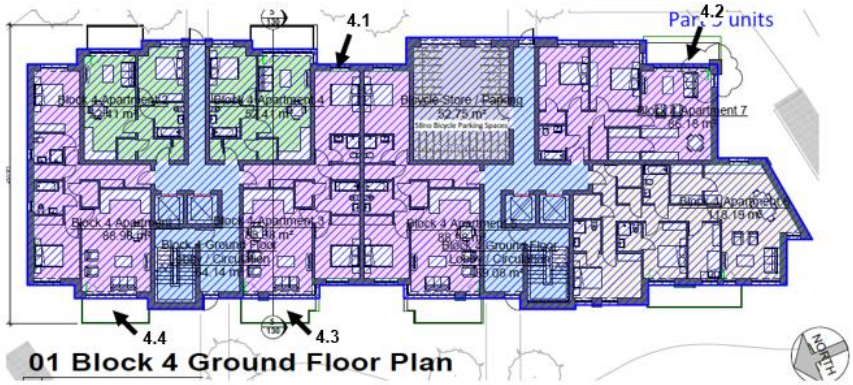


01 Block 2 Ground Floor Plan

1 1 : 200



01 Block 3 Ground Floor Plan



01 Block 4 Ground Floor Plan

Figure 3: Layouts of Blocks 1 to 7 of Sectors 6A/6B with example rooms on lowest floors analysed labelled.

Table 5: Daylight factor results for example rooms on lowest floors at Sectors 6A/6B.

Floor	Block / Room	Median Daylight Factor (%)	Recommendation(s) achieved (EN17037 UK National Annex equivalent for Dublin)	Average Daylight Factor (%)	BS8206-2:2008 recommendation achieved
Ground	1.1 Liv/Din/Kit	0.7	-	0.9	-
	1.2 Bed	0.9	UK NA Bed	1.6	Bed
	1.3 Bed	1.9	UK NA Bed	2.5	Bed
	1.4 Liv/Din/Kit	0.9	[Marginal UK NA Liv]	1.4	[Marginal Liv]
	1.5 Liv/Din/Kit	0.7	-	0.9	-
	1.6 Bed	0.8	UK NA Bed	1.4	Bed
	1.7 Bed	0.6	[Marginal UK NA Bed]	0.8	-
	1.8 Liv/Din/Kit	1.1	UK NA Liv	2.1	Liv & Kit
	1.9 Bed	0.7	UK NA Bed	1.0	Bed
	1.10 Liv/Din/Kit	1.6	UK NA Liv & Kit	2.1	Liv & Kit
First	1.11 Liv/Din/Kit	1.2	UK NA Liv	1.7	Liv
Ground	2.1 Bed	2.5	UK NA Bed	3.3	Bed
	2.2 Liv/Din/Kit	0.3	-	0.4	-
	2.3 Liv/Din/Kit	0.8	-	1.2	-
	2.4 Liv/Din/Kit	0.9	[Marginal UK NA Liv]	1.1	
	2.5 Bed	0.8	UK NA Bed	1.0	Bed
	2.6 Bed	0.9	UK NA Bed	0.9	-
	2.7 Bed	0.5	-	0.7	-
Ground	3.1 Liv/Din/Kit	1.0	UK NA Liv	1.5	Liv
	3.2 Bed	1.1	UK NA Bed	1.7	Bed
	3.3 Liv/Din/Kit	1.5	UK NA Liv & Kit	2.5	Liv & Kit
	3.4 Liv/Din/Kit	0.8	-	1.4	[Marginal Liv]
	3.5 Liv/Din/Kit	1.2	UK NA Liv	1.7	Liv
	3.6 Bed	1.5	UK NA Bed	1.8	UK NA Bed
Ground	4.1 Bed	1.2	UK NA Bed	1.5	Bed
	4.2 Liv/Din/Kit	0.6	-	0.8	-
	4.3 Liv/Din/Kit	0.9	[Marginal UK NA Liv]	1.4	[Marginal Liv]
	4.4 Liv/Din/Kit	0.6	-	1.0	-
Ground	5.1 Bed	0.9	UK NA Bed	1.4	Bed
	5.2 Liv/Din/Kit	0.5	-	0.4	-
	5.3 Bed	1.0	UK NA Bed	0.6	-
	5.4 Liv/Din/Kit	1.0	UK NA Liv	1.2	-
	5.5 Liv/Din/Kit	0.6	-	1.0	-
	5.6 Bed	1.0	UK NA Bed	1.5	Bed
Ground	6.1 Liv/Din/Kit	1.3	UK NA Liv & Kit	1.9	Liv [Marginal Kit]
	6.2 Bed	1.3	UK NA Bed	1.6	Bed
	6.3 Liv/Din/Kit	1.0	UK NA Liv	1.2	-
	6.4 Studio	2.5	UK NA Liv & Kit	3.0	Liv & Kit
	6.5 Liv/Din/Kit	1.2	UK NA Liv	1.6	Liv
Ground	7.1 Liv/Din/Kit	0.9	[Marginal UK NA Liv]	1.0	-
	7.2 Liv/Din/Kit	0.6	-	0.9	-
	7.3 Bed	0.7	UK NA Bed	0.9	[Marginal Bed]
	7.4 Liv/Din/Kit	3.1	UK NA Liv & Kit	3.8	Liv & Kit

Where rooms in the selection on the lowest floor are below the recommendations the results have been assessed on the floors above. The table below shows the floor where the recommendations would be met with value attained, or the value for the top floor.

Table 6: Daylight factor results for example rooms below the recommendations on lower floors.

Room	Floor recommendation(s) EN17037 UK National Annex equivalent for Dublin met, with Median Daylight Factor value (%)	Floor BS8206-2:2008 recommendation achieved with Average Daylight Factor value (%)
1.1 Liv/Din/Kit	3rd – UK NA Liv– 1.1 4th – UK NA Kit – 1.7	2nd – Liv– 1.5 4th – Kit – 3.0
1.4 Liv/Din/Kit	2nd – UK NA Liv – 1.0 3rd – UK NA Kit – 1.3	1st – Liv – 1.8 4th - Kit
1.5 Liv/Din/Kit	4th – UK NA Liv & Kit – 2.3	4th – Liv & Kit – 3.7
1.7 Bed	2nd – UK NA Bed – 0.7	2nd – Bed
1.8 Liv/Din/Kit	Meets liv on ground floor 1st – UK NA Kit – 1.3	Meets liv & kit on ground floor
1.11 Liv/Din/Kit	Meets liv on first floor 2nd – UK NA Kit – 1.3	Meets liv on first floor 2nd – Kit – 2.0
2.2 Liv/Din/Kit	4th – UK NA Liv & Kit – 1.7	4th – Kit – 2.9
2.3 Liv/Din/Kit	1st – UK NA Liv – 1.1 2nd – UK NA Kit – 1.4	1st – Liv & Kit – 2.4
2.4 Liv/Din/Kit	1st – UK NA Liv – 1.0 4th – UK NA Kit – 1.8	2nd – Liv – 1.5 4th – Kit – 3.0
2.6 Bed	Meets bed on ground floor	1st – Bed – 1.2
2.7 Bed	1st – UK NA Bed – 0.8	1st – Bed – 1.1
3.1 Liv/Din/Kit	Meets liv on ground floor 3rd – UK NA Kit – 1.4	Meets liv on ground floor 3rd – Kit 2.0
3.4 Liv/Din/Kit	1st – UK NA Liv – 1.1 5th – UK NA Kit – 1.3	1st – Liv – 1.6 5th – Kit – 2.2
3.5 Liv/Din/Kit	Meets liv on ground floor 2nd – UK NA Kit – 1.4	Meets liv on ground floor 2nd – Kit – 2.2
4.2 Liv/Din/Kit	2nd – UK NA Liv– 1.0 5th – UK NA Kit – 2.5	2nd – Liv – 1.5 5th – Kit – 3.8
4.3 Liv/Din/Kit	1st – UK NA Liv – 1.0 3rd – UK NA Kit – 1.3	1st – Liv – 1.5 5th - Kit
4.4 Liv/Din/Kit	2nd – UK NA Liv – 1.0 5th – UK NA Kit – 1.5	3rd – Liv – 1.5 5th – Kit – 2.5
5.2 Liv/Din/Kit	3rd – UK NA Liv	4th – Liv & Kit – 2.2
5.3 Bed	Meets bed on ground	1st – Bed - 1.2
5.4 Liv/Din/Kit	Meets liv on ground 4th – UK NA Kit – 2.0	3rd – Liv – 1.6 4th – Kit – 3.5
5.5 Liv/Din/Kit	4th – UK NA Liv & Kit – 1.5	3rd – Liv – 1.7 4th – Kit – 2.6
6.3 Liv/Din/Kit	4th – UK NA Liv & Kit – 1.8	2nd – Liv – 1.5 4th – Kit – 3.1
6.5 Liv/Din/Kit	Meets liv on ground floor 1st – UK NA Kit – 1.4	Meets liv on ground floor 2nd – Kit – 2.1
7.1 Liv/Din/Kit	1st – UK NA Liv – 1.0 3rd – UK NA Kit – 1.3	2nd – Liv – 1.6 4th – Kit – 2.4
7.2 Liv/Din/Kit	1st – UK NA Liv – 1.0 3rd – UK NA Kit – 1.3	2nd – Liv – 1.6 4th – Kit – 2.4
7.3 Bed	Meets bed on ground floor	1st – Bed – 1.1

The vast majority of bedrooms analysed would meet the recommendations. Using the above results, it is estimated that 99% of bedrooms across Sector 6A/6B would meet the recommendation in the UK National Annex of EN17037. A similar number may be expected to meet the older recommendations in BS8206.

Using the above results it has been estimated that 31% of the combined living areas over the whole of Sector 6A/6B would be able to meet the higher kitchen recommendation in the UK National Annex of EN17037. 83% of the living areas would be able to meet the living room recommendations. The overall

estimate would be similar when compared to the older BS8206 recommendations (28% meeting the higher kitchen recommendation; 78% meeting the living room recommendation).

The results suggest that dual aspect and less obstructed living areas would be able to meet the recommendations. Those rooms below the recommendations have access to a balcony, with the balcony above restricting daylight into the room. Daylight provision would increase with the removal of the balconies, however residents would lose a valuable private amenity space.

Sunlight provision

Figure 4: Visual representation of potential sunlight provision on 21st March – Ground floor at Sectors 6A/6B.

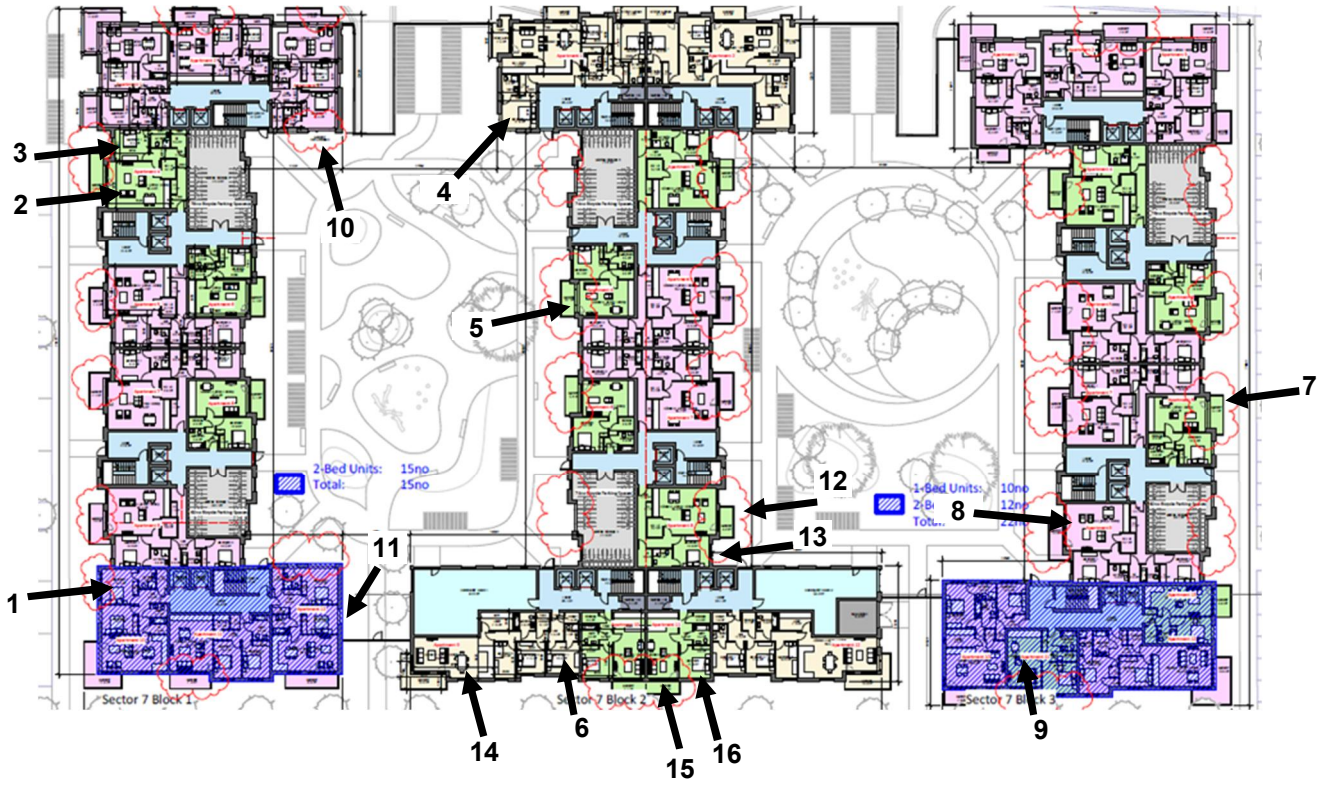
Northerly facing facades would be naturally limited in the sunlight they receive. Results suggest that in general southerly facing outer areas would be well sunlit. The results suggest that a large part of areas facing southerly into the courtyard space could receive at least the minimum 1.5 hours on 21st March. Any areas below the recommendations would be due to orientation or balcony/window position.

Of the 335 units in Sectors 6A/6B, the analysis suggests that 237 (71%) would be expected to have at least one room able to meet at least the minimum recommendation.

Sector 7

Daylight provision

The representative example rooms analysed for each block at Sector 7 are shown in Figure 5. The results of the daylight analysis are given in Table 7.



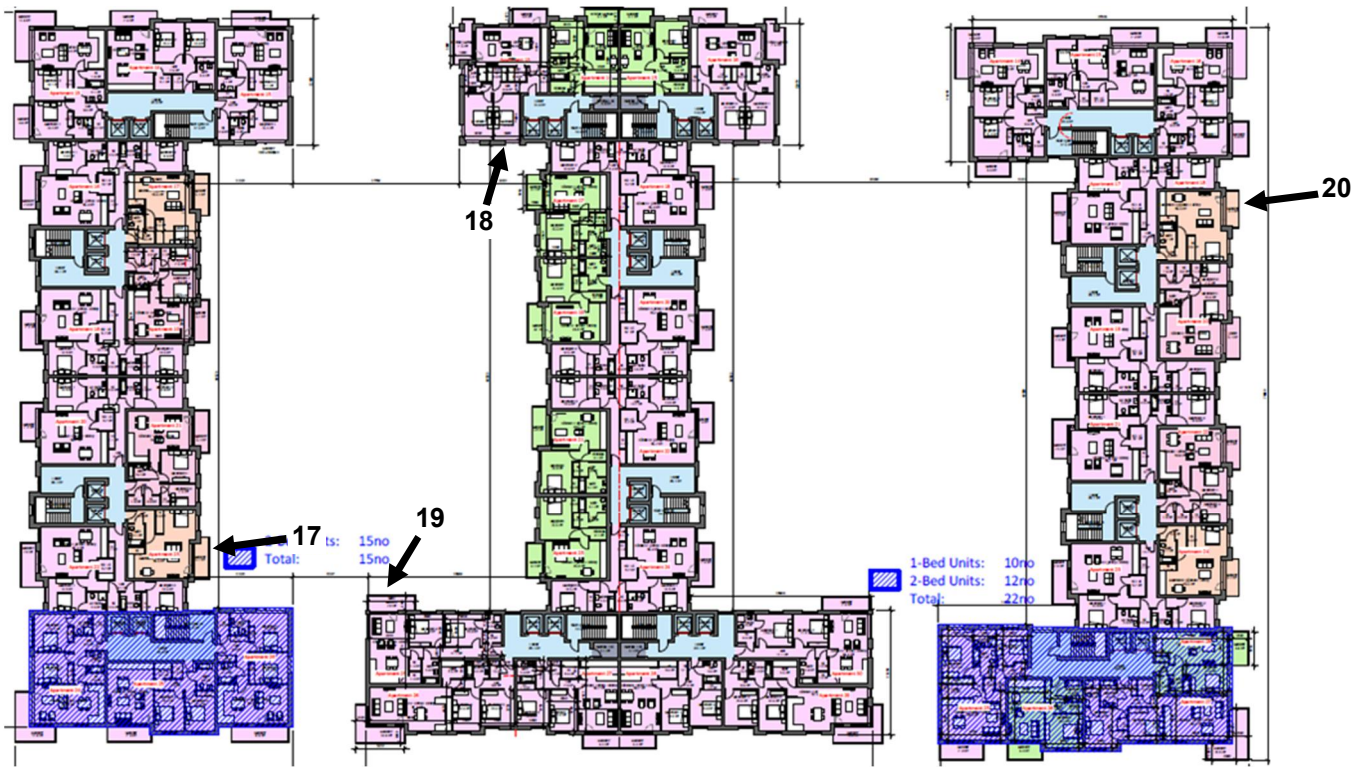


Figure 5: Ground floor (top) and first floor (bottom) layouts of Sector 7 with example rooms analysed labelled.

Table 7: Daylight factor results for example rooms at Sector 7.

Floor	Room	Median Daylight Factor (%)	Recommendation(s) achieved (EN17037 UK National Annex equivalent for Dublin)	Average Daylight Factor (%)	BS8206-2:2008 recommendation achieved
Ground	1 Bed	0.9	UK NA Bed	1.1	Bed
	2 Liv/Din/Kit	0.5	-	0.7	-
	3 Bed	1.1	UK NA Bed	1.5	Bed
	4 Bed	1.9	UK NA Bed	2.4	Bed
	5 Liv/Din/Kit	0.7	-	1.1	-
	6 Bed	1.0	UK NA Bed	1.9	Bed
	7 Liv/Din/Kit	0.7	-	1.3	-
	8 Liv/Din/Kit	0.6	-	1.2	-
	9 Liv/Din/Kit	0.8		1.4	-
	10 Bed	1.3	UK NA Bed	1.6	Bed
	11 Bed	0.8	UK NA Bed	1.0	Bed
	12 Liv/Din/Kit	0.4	-	0.9	-
	13 Bed	1.3	UK NA Bed	1.7	Bed
	14 Liv/Din/Kit	1.6	UK NA Liv & Kit	1.9	Liv
	15 Liv/Din/Kit	0.7	-	1.0	-
	16 Bed	1.8	UK NA Bed	2.3	Bed
First	17 Studio	1.1	UK NA Liv	1.5	Liv
	18 Bed	0.9	UK NA Bed	1.5	Bed
	19 Liv/Din/Kit	1.2	UK NA Liv	1.8	Liv
	20 Studio	1.4	UK NA Liv & Kit	1.7	Liv

Where rooms in the selection on the lowest floor are below the recommendations the results have been assessed on the floors above. The table below shows the floor where the recommendations would be met with value attained, or the value for the top floor.

Table 8: Daylight factor results for example rooms below the recommendations on lower floors.

Room	Floor recommendation(s) EN17037 UK National Annex equivalent for Dublin met, with Median Daylight Factor value (%)	Floor BS8206-2:2008 recommendation achieved with Average Daylight Factor value (%)
2 Liv/Din/Kit	6th – UK NA Liv – 1.0	6th – Liv & Kit – 2.2
5 Liv/Din/Kit	3rd – UK NA Liv – 1.1 5th – UK NA Kit – 1.3	3rd – Liv – 1.5 8th – Kit – 3.5
7 Liv/Din/Kit	3rd – UK NA Liv – 1.0 5th – UK NA Kit - 1.4	2nd – Liv – 1.6 6th – Kit – 3.3
8 Liv/Din/Kit	3rd – UK NA Liv – 1.0 4th – UK NA Kit – 1.3	2nd – Liv – 1.6 4th – Kit – 2.1
9 Liv/Din/Kit	3rd UK NA Liv – 1.0 4th – UK NA Kit – 1.4	2nd – Liv 1.7 3rd –Kit – 2.1
12 Liv/Din/Kit	4th – UK NA Liv – 1.0 6th – UK NA Kit – 2.1	4th – Liv – 1.5 6th – Kit – 3.2
14 Liv/Din/Kit	Meets liv & kit on ground floor	Meets liv on ground floor 1st – Kit - 2.1
15 Liv/Din/Kit	3rd – UK NA Liv - 1.0 4th – UK NA Liv & Kit – 1.9	2nd - Liv – 1.5 4th – Kit – 3.6
17 Studio	Meets liv on 1st floor 2nd – UK NA Kit – 1.3	Meets liv on first floor 3rd – Kit – 2.0
19 Liv/Din/Kit	Meets liv on 1st floor 3rd – UK NA Kit – 1.3	Meets liv on first floor 2nd – Kit – 2.0
20 Studio	Meets liv & kit on 1st floor	Meets liv on 1st floor 4th – Kit – 2.0

All bedrooms in the selection analysed would meet the UK National Annex bedroom recommendation and the older recommendation from BS8206. It is therefore estimated that 100% of the bedrooms in Sector 7 would be able to meet the recommendation.

The north facade of the building has an unobstructed view of the park to the north. Rooms would be likely to meet the recommendations here. The results suggest that some living areas on lower floors may be below the recommendations when the windows look out onto a balcony and face neighbouring buildings or blocks. Obstruction from neighbouring areas in an urban scheme like this would be unavoidable. The provision of balconies restricts daylight into rooms, but does provide a valuable amenity for future residents. Daylight could be improved by removing balconies, but the private amenity would be lost.

Based on the above results it is estimated that 56% of living areas over the whole of Sector 7 would be able to meet the kitchen target in the UK National Annex of EN17037, with 74% able to meet the living room target. Using the older BS8206 standard, 47% of living areas would be predicted to meet the kitchen target, with 78% meeting the living room target.

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Sunlight provision

Figure 6: Visual representation of potential sunlight provision on 21st March – Ground floor at Sector 7.

The ground floor south west facing facades (outer and courtyards) would mostly meet the recommendations with a mix of minimum, medium and high levels of sunlight provision. This is due to the position and size of the windows and balconies. The ground floor south east façade is limited for sunlight due partly to balcony provision and partly to the presence of the neighbouring block. Some ground floor spaces facing south east into courtyard areas may have limited sunlight. Provision would increase on upper floors.

Of the 333 units in Sector 7, the analysis suggests that 243 (73%) would be expected to have at least one room able to meet at least the minimum recommendation.

Sector 8A

Daylight provision

The worst-case example rooms analysed for each block at Sector 8A are shown in Figure 7. The results of the daylight analysis are given in Table 9.

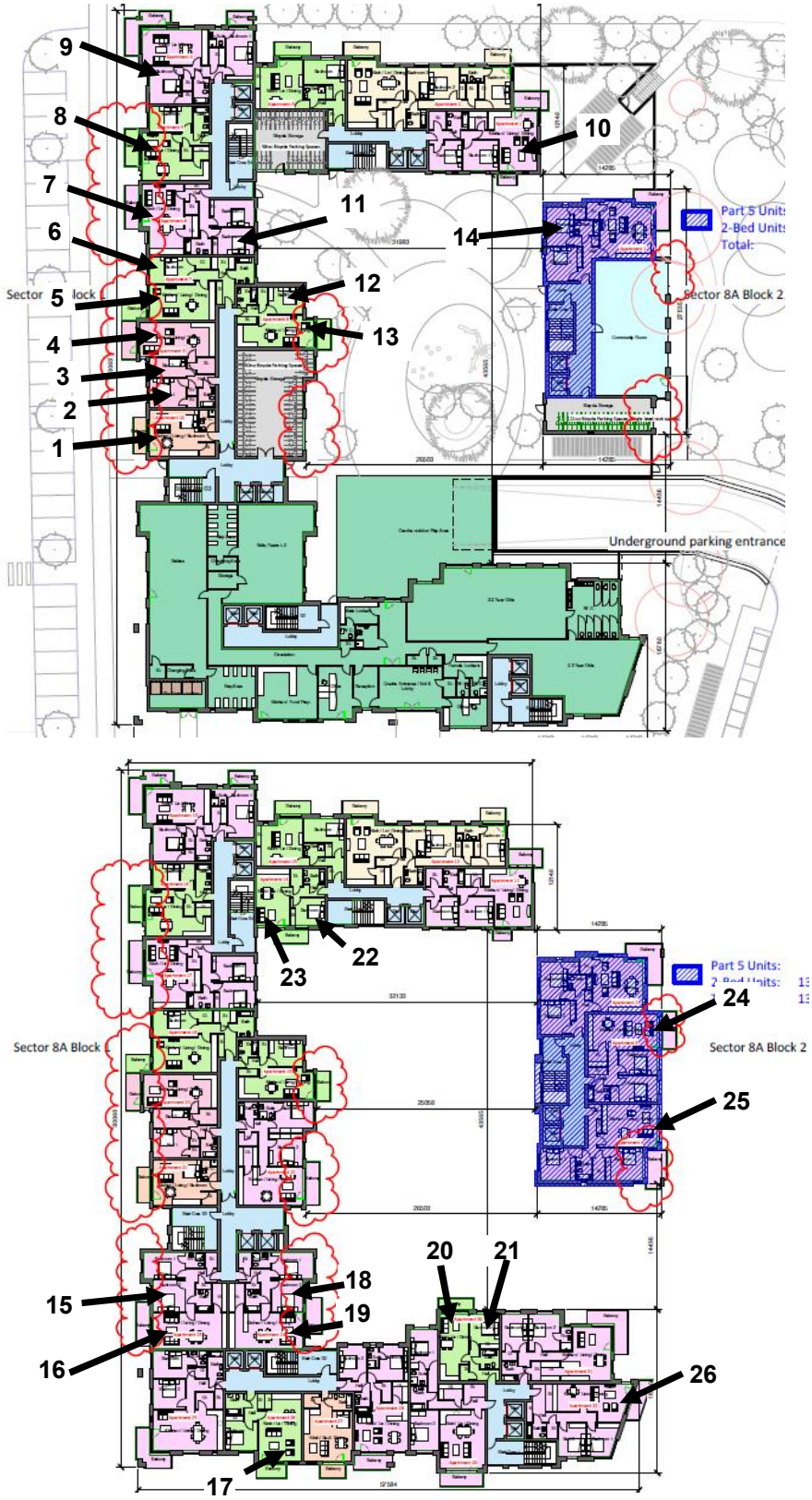


Figure 7: Ground floor (top) and first floor (bottom) layouts of Sector 8A with worst-case example rooms analysed labelled.

Table 9: Daylight factor results for example rooms at Sector 8A.

Floor	Room	Median Daylight Factor (%)	Recommendation(s) achieved (EN17037 UK National Annex equivalent for Dublin)	Average Daylight Factor (%)	BS8206-2:2008 recommendation achieved
Ground	1 Studio	0.9	-	1.0	-
	2 Bed	1.0	UK NA Bed	1.6	Bed
	3 Bed	1.0	UK NA Bed	1.3	Bed
	4 Liv/Din/Kit	0.6	-	0.7	-
	5 Liv/Din/Kit	0.7	-	0.9	-
	6 Bed	1.4	UK NA Bed	2.2	Bed
	7 Liv/Din/Kit	1.2	UK NA Liv	1.3	-
	8 Liv/Din/Kit	1.1	UK NA Liv	1.1	-
	9 Bed	1.4	UK NA Bed	2.1	Bed
	10 Liv/Din/Kit	2.0	UK NA Liv & Kit	2.7	Liv & Kit
	11 Bed	1.1	UK NA Bed	1.6	Bed
	12 Bed	1.1	UK NA Bed	1.9	Bed
	13 Liv/Din/Kit	0.6	-	0.7	-
	14 Bed	2.1	UK NA Bed	2.5	Bed
First	15 Bed	1.1	UK NA Bed	1.7	Bed
	16 Liv/Din/Kit	0.7	-	0.8	-
	17 Liv/Din/Kit	1.4	UK NA Liv & Kit	2.0	Liv & Kit
	18 Bed	1.2	UK NA Bed	1.5	-
	19 Liv/Din/Kit	0.4	-	0.6	-
	20 Liv/Din/Kit	0.9	[Marginal UK NA Liv]	1.4	[Marginal Liv]
	21 Bed	1.6	UK NA Bed	2.3	Bed
	22 Bed	1.0	UK NA Bed	1.2	Bed
	23 Liv/Din/Kit	0.5	-	0.7	-
	24 Liv/Din/Kit	1.1	UK NA Liv	1.6	Liv
	25 Liv/Din/Kit	1.3	UK NA Liv & Kit	2.0	Liv & Kit
	26 Liv/Din/Kit	1.0	UK NA Liv	1.5	Liv

Where rooms in the selection on the lowest floor are below the recommendations the results have been assessed on the floors above. The table below shows the floor where the recommendations would be met with value attained, or the value for the top floor.

Table 10: Daylight factor results for worst-case rooms below the recommendations on lower floors.

Room	Floor recommendation(s) EN17037 UK National Annex equivalent for Dublin met, with Median Daylight Factor value (%)	Floor BS8206-2:2008 recommendation achieved with Average Daylight Factor value (%)
1 Studio	1st – UK NA Liv – 1.1 3rd – UK NA Kit – 1.4	2nd – Liv – 1.6 4th – Kit – 2.2
4 Liv/Din/Kit	5th – UK NA Liv – 1.2	5th – Liv & Kit – 1.3
5 Liv/Din/Kit	4th – UK NA Liv – 1.1 5th – UK NA Kit - 1.6	4th – Liv - 1.5 5th – Kit – 2.2
7 Liv/Din/Kit	Meets UK NA Liv on Ground 2nd – UK NA Kit - 1.4	2nd – Liv– 1.5 5th – Kit – 2.0
8 Liv/Din/Kit	Meets UK NA Liv on Ground 3rd – UK NA Kit – 1.3	3rd – Liv – 1.6 6th – Kit - 2.1
13 Liv/Din/Kit	4th – UK NA Liv – 1.0 5th – UK NA Kit – 1.5	5th – Liv & Kit – 2.5
16 Liv/Din/Kit	5th – UK NA Liv & Kit - 1.5	5th – Liv & Kit – 2.5
19 Liv/Din/Kit	5th – UK NA Liv & Kit – 3.2	5th – Liv & Kit – 3.9
20 Liv/Din/Kit	2nd – UK NA Liv - 1.1 3rd - UK NA Kit – 1.3	2nd – Liv – 1.5 4th – Kit – 3.7
23 Liv/Din/Kit	5th – UK NA Liv - 1.0 6th – UK NA Kit – 1.4	6th – Liv & Kit - 2.0
24 Liv/Din/Kit	Meets UK NA Liv on First 4th - UK NA Kit – 1.5	Meets Liv on First 4th – Kit – 2.9
26 Liv/Din/Kit	Meets UK NA Liv on First 4th – UK NA Kit – 2.0	Meets Liv on First 4th – Kit – 3.1

The results suggest that all bedrooms analysed would meet the 0.7% bedroom median daylight factor recommendations in the UK National Annex of EN17037. It is therefore estimated that 100% of the bedrooms in Sector 8A would meet the UK National Annex of EN17037. All bedrooms are also estimated as able to meet the older average daylight factor target in BS8206.

The results for living areas suggest that those facing southerly towards the open space (and by extension also northerly open space facing) would be able to meet the living room and kitchen recommendations in the UK National Annex of EN17037. Dual aspect rooms and those without direct access to a balcony would also be expected to meet these recommendations. In more obstructed areas there would be rooms below the recommendations on lower floors. Areas of higher obstruction may be unavoidable in urban schemes. The provision of balconies also restricts daylight into rooms. Daylight could be improved by the removal of the balconies, but residents would lose a valuable private amenity space.

Using the above results it is estimated that 66% of combined living areas over the whole of Sector 8A would be able to meet the kitchen recommendation in the UK National Annex of EN17037, with 80% able to meet the living room recommendation. The overall estimate if the older average daylight factor recommendations are used from BS8206, is 61% to meet the kitchen target, and 73% to meet the living room target.

Sunlight provision

Figure 8: Visual representation of potential sunlight provision on 21st March – Ground floor at Sector 8A.

The main south west facing facade would meet at least the minimum recommendation. North facing facades are naturally limited. South east areas are obstructed on the ground floor, but provision increases on higher floors.

Of the 144 units in Sector 8A, the analysis suggests that 96 (66%) would be expected to have at least one room able to meet at least the minimum recommendation.

Sector 8B

Daylight provision

The worst-case example rooms analysed for each block at Sector 8B are shown in Figure 9. The results of the daylight analysis are given in Table 11.

Figure 9: Ground floor and first floor layouts of Sector 8B with worst-case example rooms analysed labelled.

Table 11: Daylight factor results for example rooms at Sector 8B.

Floor	Room	Median Daylight Factor (%)	Recommendation(s) achieved (EN17037 UK National Annex equivalent for Dublin)	Average Daylight Factor (%)	BS8206-2:2008 recommendation achieved
Ground	1 Liv/Din/Kit	1.0	UK NA Liv	1.6	Liv
	2 Bed	1.1	UK NA Bed	1.4	Bed
	3 Bed	1.7	UK NA Bed	1.8	Bed
	4 Liv/Din/Kit	1.6	UK NA Liv & Kit	1.9	Liv [Marginal Kit]
	5 Liv/Din/Kit	1.5	UK NA Liv & Kit	2.8	Liv & Kit
	6 Liv/Din/Kit	0.7	-	1.2	-
	7 Liv/Din/Kit	1.1	UK NA Liv	2.0	Liv & Kit
	8 Liv/Din/Kit	1.7	UK NA LIV & Kit	2.3	Liv & Kit
	9 Studio	1.3	UK NA LIV & Kit	1.8	Liv
	10 Liv/Din/Kit	1.5	UK NA LIV & Kit	2.1	Liv & Kit
First	11 Liv/Din/Kit	0.7	-	1.3	-
	12 Liv/Din/Kit	0.9	-	1.3	-

Where rooms in the selection on the lowest floor are below the recommendations the results have been assessed on the floors above. The table below shows the floor where the recommendations would be met with value attained, or the value for the top floor.

Table 12: Daylight factor results for worst-case rooms below the recommendations on lower floors.

Room	Floor recommendation(s) EN17037 UK National Annex equivalent for Dublin met, with Median Daylight Factor value (%)	Floor BS8206-2:2008 recommendation achieved with Average Daylight Factor value (%)
1 Liv/Din/Kit	1st - UK NA Liv - 1.0 3rd - UK NA Kit - 1.3	1st - Liv - 1.5 4th – Kit - 2.3
6 Liv/Din/Kit	4th - UK NA Liv - 1.0 5th - UK NA Kit - 1.3	1st – Liv - 1.5 5th – Kit – 2.8
7 Liv/Din/Kit	Meets UK NA Liv on Ground 1st – UK NA Kit – 1.4	Meets Liv and Kit on ground floor
9 Studio	Meets UK NA Liv & Kit on Ground	Meets Liv on ground floor 1st – Kit - 2.1
11 Liv/Din/Kit	4th - UK NA Liv - 1.2 5th – UK NA Kit - 1.3	2nd – Liv - 1.5 5th – Kit - 2.4
12 Liv/Din/Kit	2nd - UK NA Liv - 1.0 5th - UK NA Kit - 1.6	3rd – Liv - 1.6 5th – Kit - 2.9

Both of the worst-case bedrooms assessed would meet the UK National Annex recommendation for a bedroom. Other bedrooms appear to be similarly, or less, obstructed. It is therefore estimated that 100% of the bedrooms in Sector 8B seem likely to be able to meet the recommendations in the UK National Annex of EN17037 and the older BS8206.

The results suggest that the vast majority of outward facing living areas would be able to meet the living room recommendation in the UK National Annex of EN17037 and generally also be able to meet the kitchen recommendation too. The results suggest that analysed room 6 and the neighbouring living room would be below the recommendations on lower floors, but other living rooms on the façade would meet at least the living room recommendation on all floors. Internally facing living areas (as analysed by room 11 and 12) would meet the recommendations on higher floors. Living areas below the recommendations have access to a balcony area. The balcony above restricts daylight into the room, but provides an amenity area for residents

An indication of the overall percentage of rooms able to meet the recommendations has been assessed using the above results and extrapolating to similar rooms. It is estimated that 82% of the living/dining/kitchen areas in Sector 8B would be able to meet the higher kitchen recommendation in the UK National Annex of EN17037, with 90% able to meet the living room recommendation. The overall percentage estimate when compared to the older BS8206 average daylight factor recommendations would be 81% meeting the kitchen average daylight factor recommendation and 96% meeting the living room recommendation.

Sunlight provision

Figure 10: Visual representation of potential sunlight provision on 21st March – Ground floor at Sector 8B.

Results suggest that the outer south east and south west facing facades would be well sunlit. Southerly facing areas looking into the central courtyard may receive the recommended hours on 21st March in some areas. Provision improves on higher floors to the south east facing courtyard section.

Of the 125 units in Sector 8B, the analysis suggests that 82 (66%) would be expected to have at least one room able to meet at least the minimum recommendation.

Sector 8C

Daylight provision

The worst-case example rooms analysed for each block at Sector 8C are shown in Figure 11. The results of the daylight analysis are given in Table 13.

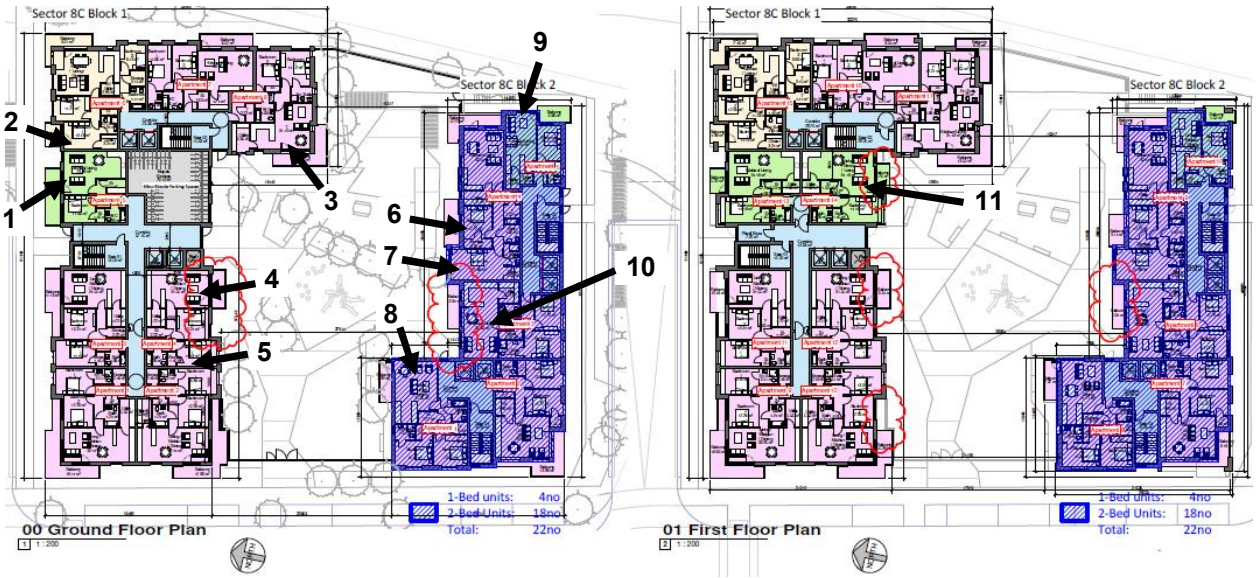


Figure 11: Ground floor and first floor layouts of Sector 8C with worst-case example rooms analysed labelled.

Table 13: Daylight factor results for example worst-case rooms at Sector 8C.

Floor	Room	Median Daylight Factor (%)	Recommendation(s) achieved (EN17037 or UK National Annex equivalent for Dublin)	Average Daylight Factor (%)	BS8206-2:2008 recommendation achieved
Ground	1 Liv/Din/Kit	1.1	UK NA Liv	1.3	-
	2 Bed	1.1	UK NA Bed	1.2	Bed
	3 Liv/Din/Kit	1.6	UK NA Liv & Kit	2.6	Liv & Kit
	4 Liv/Din/Kit	0.8	-	1.4	-
	5 Bed	1.2	UK NA Bed	2.1	Bed
	6 Bed	0.9	UK NA Bed	1.1	Bed
	7 Bed	1.0	UK NA Bed	2.1	Bed
	8 Liv/Din/Kit	1.2	UK NA Liv [Marginal UK NA Kit]	2.0	Liv & Kit
	9 Liv/Din/Kit	1.8	UK NA Liv & Kit	2.7	Liv & Kit
	10 Liv/Din/Kit	1.4	UK NA Liv & Kit	1.8	Liv
First	11 Liv/Din/Kit	0.7	-	0.8	-

Where rooms in the selection on the lowest floor are below the recommendations the results have been assessed on the floors above. The table below shows the floor where the recommendations would be met with value attained, or the value for the top floor.

Table 14: Daylight factor results for worst-case rooms below the recommendations on lower floors.

Room	Floor recommendation(s) in EN17037 UK National Annex equivalent for Dublin met, with Median Daylight Factor value (%)	Floor BS8206-2:2008 recommendation achieved with Average Daylight Factor value (%)
1 Liv/Din/Kit	Meets liv on ground floor 2nd - UK NA Kit - 1.4	2nd – Liv – 1.6 4th – Kit - 2.6
4 Liv/Din/Kit	1st - UK NA Liv - 1.1 2nd – UK NA Kit - 1.3	1st – Liv - 1.7 2nd – Kit - 2.0
8 Liv/Din/Kit	1st - UK NA Liv & Kit - 1.7	Meets on ground floor
10 Liv/Din/Kit	Meets liv and kit on ground floor	Meets liv on ground floor 1st - Kit - 2.2
11 Liv/Din/Kit	Third UK NA Liv - 1.1 Fourth UK NA Kit - 2.4	Fourth Liv & Kit - 2.9

All of the worst-case example bedrooms analysed would meet the daylight factor recommendations in the UK National Annex of EN17037 and the old BS8206. These results suggest that all 100% of the 132 bedrooms would be seem likely to be able to meet the recommendations in either standard.

Both of the two worst-case dual aspect living areas (rooms 3 and 8) would meet at least the UK National Annex living room recommendation. Room 3 also meets the kitchen recommendation from the ground floor upwards. Room 8 meets the kitchen recommendation from the first floor upwards. These results suggest that dual aspect rooms on the less obstructed outer edges of the sector are likely to meet the living room and kitchen recommendation.

The results for room 9 suggest that single aspect north east facing living areas would be able to meet the living room and kitchen recommendations.

The results for room 1 suggest that single aspect north west facing living areas appear likely to meet the living room UK National Annex recommendation from the ground floor, with the kitchen recommendation also met from the second floor.

Courtyard facing living areas have been analysed with rooms 4, 10 and 11. Room 4 would meet the living room UK National Annex recommendation on the first floor. Room 10 would meet the living room and kitchen recommendations from the ground floor. Room 11 would meet the living and kitchen recommendations on the third and fourth floors respectively.

Using the above worst-case analysis it is estimated that around 86% of the living/dining/kitchen areas over the whole of Sector 8C would meet the UK National Annex kitchen recommendation. 94% of these living areas have been estimated to meet the living room recommendations.

It is estimated that 81% of the living/dining/kitchen areas would meet the older BS8206 average daylight factor recommendations for a kitchen. 89% have been estimated to meet the recommendation for a living room.

Sunlight provision

Figure 12: Visual representation of potential sunlight provision on 21st March – Ground floor at Sector 8C.

North facing facades would be naturally limited and therefore would be expected to receive less than the minimum 1.5 hours of sunlight. The majority of the southern façade should be able to receive at least four hours of sunlight. The southern facing courtyard façade receives at least recommended levels to most portions. East and west facing facades should be able to receive at least the minimum recommendation for the most part.

Of the 70 Units in Sector 8C the analysis suggests 60 (86%) would be expected to have at least one room able to meet at least the minimum recommendation.

Daylight summary

Overall estimates for the percentages of rooms able to meet the recommendations in either the UK National Annex of EN17037 or the older BS8206 have been calculated based on example rooms analysed across the proposed sectors.

93% of rooms would meet the recommendations in the UK National Annex of EN17037 using the bedroom target and living room target for combined living/dining/kitchen areas. 83% of rooms meet these recommendations with the higher kitchen target used for combined spaces. Overall results are similar using the older BS8206 recommendations (92% using the bedroom target and living room target for combined rooms and 81% using the kitchen target for combined rooms).

The vast majority of bedrooms would appear likely to meet the bedroom recommendations.

Although a high proportion of living areas seem likely to be able to meet the living room or kitchen recommendation in either standard, there would be a number below the recommendation. However, these requirements would need to be balanced with other benefits of the scheme.

The Department of Housing, Local Government and Heritage document Sustainable Urban Housing: Design Standards for New Apartments December 2020 states “Where an applicant cannot fully meet all of the requirements of the daylight provisions above, this must be clearly identified and a rationale for any alternative, compensatory design solutions must be set out, which planning authorities should apply their discretion in accepting taking account of its assessment of specific. This may arise due to a design constraint associated with the site or location and the balancing of that assessment against the desirability of achieving wider planning objectives. Such objectives might include securing comprehensive urban regeneration and or an effective urban design and streetscape solution.”

The analysis suggests the majority of living areas below the recommendations would be on lower floors and have access to a balcony area. To improve daylight provision an alternative would involve removal of balconies. Although this would improve daylight provision future residents would lose a valuable private amenity space.

Sunlight summary

The sunlight analysis has calculated potential provision to the worst-case ground floor. In areas where sunlight may increase on upper floors further analysis has also been undertaken to get an understanding of sunlight provision across all units.

Northerly facing facades would be naturally limited in the sunlight they receive, but would have a view of the park to the north.

In general, southerly facing outer facades have the potential to meet the recommendations. Sunlight to these areas is impacted by balcony/façade design and proximity to other blocks. Areas facing into courtyards are more obstructed, but provision improves on upper floors.

Overall, the analysis suggests that around 70% of proposed units will have at least one habitable room able to receive at least the minimum 1.5 hours sunlight recommendation in EN 17037.

Sunlight to proposed courtyards

An assessment of sunlight provision to the proposed internal courtyards / amenity areas at each sector has been carried out. The areas able to receive at least two hours of sunlight on 21st March have been calculated. The BRE Report states that to be adequately sunlit, a space should be able to receive at least two hours of sunlight over at least half of its area.

A visual representation and numerical values are given in Figure 13 and Table 15 below.

Figure 13: Sunlight provision to proposed courtyards. Areas in orange would receive more than two hours of sunlight on 21st March. Areas in blue would receive less than two hours sunlight on 21st March.

Table 15: Sunlight provision results for proposed courtyards.

Sector Courtyard	Percentage of space able to receive at least two hours on 21st March (%)
6A/6B West side	74%
6A/6B East side	58%
7 West side	55%
7 East side	53%
8A	60%
8B	82%
Between 8B and 8C	83%
8C	64%

The results suggest that the courtyards at all Sectors would meet the BRE guidelines, as more than half of their areas would be able to receive more than two hours of sunlight on 21st March.

In order to respond to an An Bord Pleanála pre-application consultation opinion request “for a full understanding of the year round level of overshadowing of the primary outdoor recreation areas for the development” the areas able to receive at least two hours of sunlight have also been calculated for other months. There are guidelines only for 21st March and therefore the additional analysis is for information

purposes only. To further illustrate overshadowing, monthly shadow plotting has also been carried out (see next section and Appendix B).

The areas of the proposed courtyards able to receive at least two hours of sunlight on 21st December (winter solstice), 21st January, 21st February, 21st April, 21st May and 21st June (summer solstice) have been calculated. The results are shown in Figures 14 to 19 and Table 16. The results for 21st September (autumn equinox) are the same as those for 21st March (spring equinox). The shadows for 21st January, 21st February, 21st April and 21st May are the same as those at or around the 21st of November, October, August and July respectively.

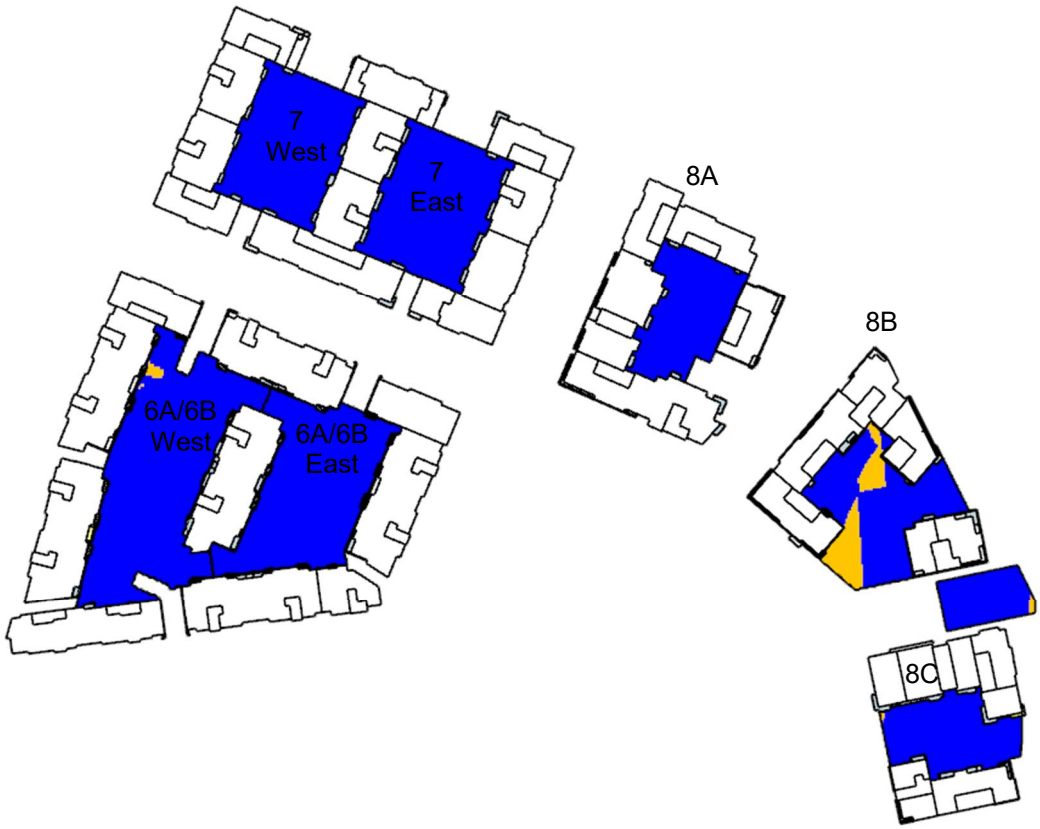


Figure 14: 21 December (winter solstice) – two hours of sunlight. Areas in orange would receive more than two hours of sunlight. Areas in blue would receive less than two hours sunlight.

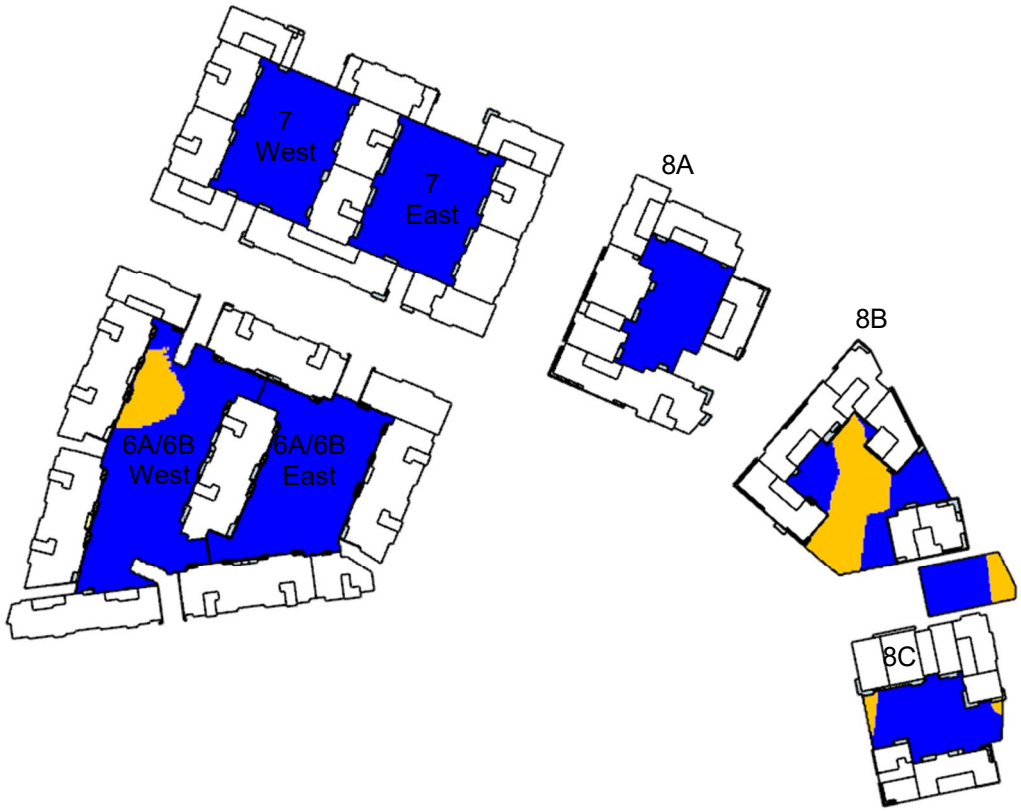


Figure 15: 21 January (and November) – two hours of sunlight. Areas in orange would receive more than two hours of sunlight. Areas in blue would receive less than two hours sunlight.

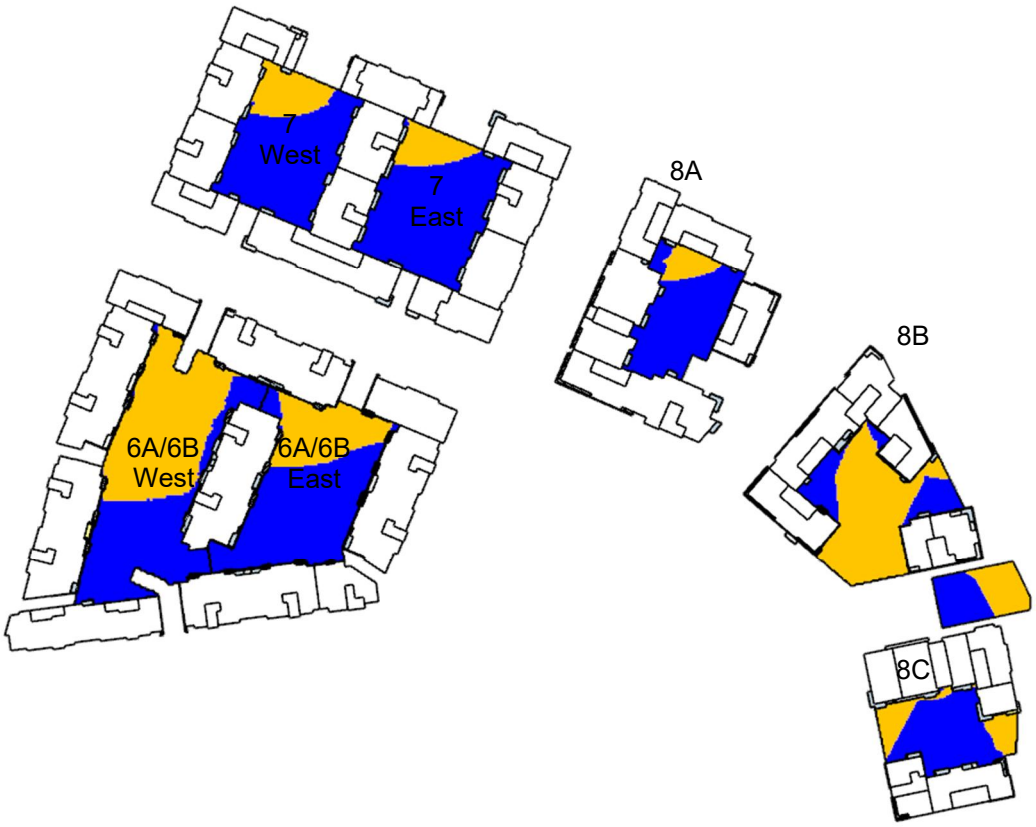


Figure 16: 21 February (and October) – two hours of sunlight. Areas in orange would receive more than two hours of sunlight. Areas in blue would receive less than two hours sunlight.

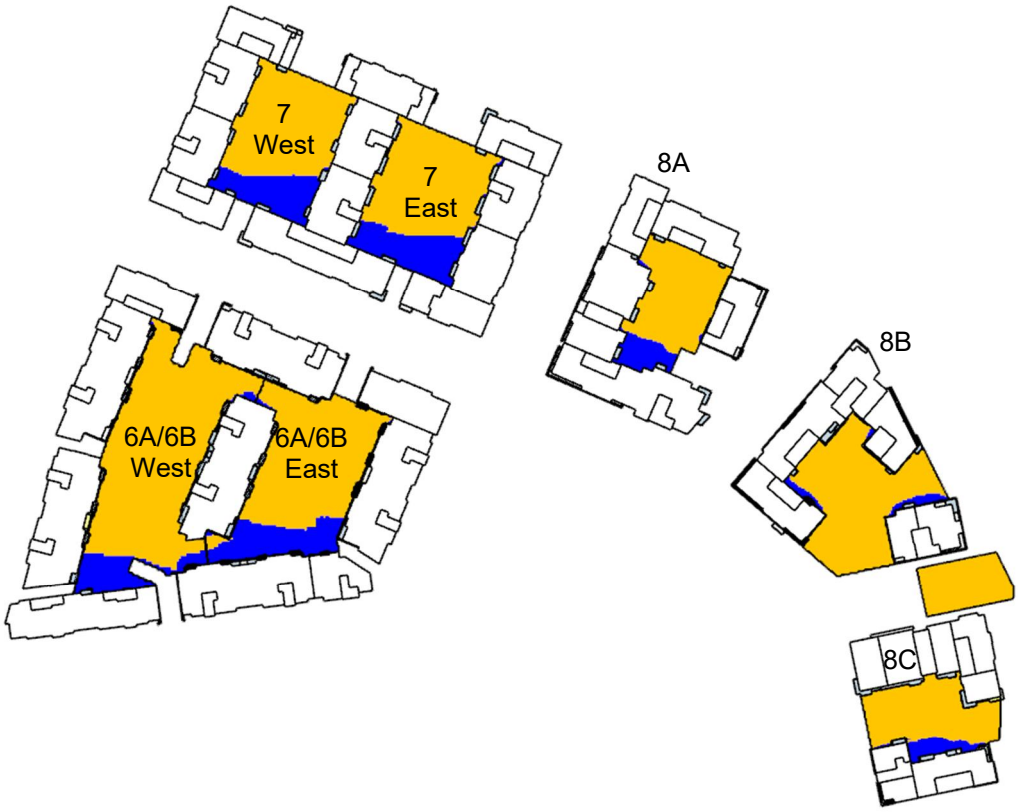


Figure 17: 21 April (and August) – two hours of sunlight. Areas in orange would receive more than two hours of sunlight. Areas in blue would receive less than two hours sunlight.

Figure 18: 21 May (and July) – two hours of sunlight. Areas in orange would receive more than two hours of sunlight. Areas in blue would receive less than two hours sunlight.

Figure 19: 21 June (summer solstice) – two hours of sunlight. Areas in orange would receive more than two hours of sunlight. Areas in blue would receive less than two hours sunlight.

Table 16: Areas able to receive at least two hours of sunlight in proposed courtyards throughout the year.

Sector Courtyard	Percentage of space able to receive at least two hours of sunlight						
	21 December	21 January / November	21 February / October	21 March / 21 September	21 April / August	21 May / July	21 June
6A/6B West side	1%	13%	54%	74%	88%	94%	96%
6A/6B East side	0%	0%	31%	58%	78%	92%	95%
7 West side	0%	0%	21%	55%	75%	85%	88%
7 East side	0%	0%	16%	53%	73%	84%	88%
8A	0%	0%	14%	60%	82%	91%	93%
8B	21%	52%	74%	82%	94%	99%	100%
Between 8B and 8C	2%	23%	48%	83%	100%	100%	100%
8C	0%	6%	29%	64%	87%	95%	98%

As expected, the courtyards would receive less sunlight in the winter due to the lower angle sun. The BRE guidelines would be met on 21 March and sunlight provision would increase throughout spring. In the summer months the vast majority of the courtyard spaces would be able to receive at least two hours of sunlight.

Shadow Plotting

Shadow plots have been created for 21st March (spring equinox), 21st June (summer solstice) and 21st December (winter solstice) at clock times 8am, 10am, 12pm, 2pm and 4pm (plus 6pm in summer).

Plots are also shown for January, February, April and May. This gives a month-by-month assessment of sunlight provision at and around the site to allow for a full understanding of the year round level of overshadowing.

The shadows for 21st September (autumn equinox) are the same as those for 21st March (spring equinox). The shadows for 21st January, 21st February, 21st April and 21st May are the same as those at or around the 21st of November, October, August and July respectively.

In the plots, the times given are clock times. Between the end of March and the end of October, Irish Standard Time (IST) applies. The plots for September and October therefore correspond to the shadows produced one hour later in summer time; thus at 1pm IST in September/October, the shadows are as plotted on the 12pm GMT diagram for March/February. The March and February plots therefore correspond to 9am, 11am, 1pm, 3pm and 5pm IST in September and October.

The plots are shown in Appendix B.

The below discussion focuses on the equinoxes and solstices, since they are the midpoint and extremes of shading conditions.

Spring / Autumn equinoxes

The shadow plots for 21st March suggest that around the equinoxes the proposed courtyards would be mostly shaded in the early morning, but large areas would receive sun as the day progresses, as can be seen in the above results for areas able to receive at least two hours of sunlight on this date. Only areas directly to the north of blocks would be prevented from receiving any sun at this time.

Although the shadow of the proposed buildings would reach neighbouring areas, it would mostly be confined to roadways and areas close to the buildings.

Summer solstice

The shadow plots for 21st June show that there would only be significant shading of the courtyard areas in the early morning and evening. For the majority of the day, large areas of the courtyards would be able to receive sun.

Shading of surrounding areas would mostly be confined to roadways and areas close to the proposed buildings.

Winter solstice

The shadow plots for 21st December show that the low angle winter sun would mean that all buildings, either proposed, existing or potential future developments, would cast longer shadows. Some courtyard areas would be able to receive at least some sun in this worst-case condition.

Conclusions

This report has assessed daylight and sunlight for GA2, Baldoyle. The results have been compared to the guidelines in the BRE Report “Site layout planning for daylight and sunlight: a guide to good practice” and the UK National Annex of EN17037 “Daylight in Buildings”.

The calculations have used the 3D models and plans of the scheme as provided to BRE.

There would be a minor adverse loss of daylight impact to some existing properties at Willow, Birch, Sycamore and Beech Houses. The primary cause of the loss of daylight is due to the design of the existing buildings themselves. Windows set back into the building with balconies or overhangs above force a reliance on daylight from the area of the proposal site. At other existing properties on Red Arches Park and Red Arches Drive there would be a negligible impact. Loss of sunlight would not be an issue to existing buildings, as the development site is to the north.

There would be a negligible impact on daylight to the consented GA1 scheme. Loss of sunlight would not be an issue since the proposed development site is to the north.

When compared to the existing empty site there would be a significant impact to daylight to the east facing façade of GA3. However, this would only be the case if future residents of GA3 experienced conditions with the empty GA2 site. Special measures of larger windows are in place in the design of GA3 and any reduced values of vertical sky component may be at least partly due to its balconies. The BRE Report also suggest the guidelines should be interpreted flexibly. In special circumstances a higher degree of obstruction may be unavoidable if new developments are to match the height and proportions of existing buildings.

An assessment of daylight provision to example worst-case and example rooms in the proposed development has been used to estimate the overall percentages of rooms able to meet the recommendations for domestic rooms types in the UK National Annex of EN17037 and the older BS8206.

93% of rooms are estimated to meet the recommendations in the UK National Annex of EN17037 using the bedroom target and living room target for combined living/dining/kitchen or studio areas. 83% of rooms meet these recommendations with the higher kitchen target used for combined spaces. Overall results are similar using the older BS8206 recommendations (92% using the bedroom target and living room target for combined rooms and 81% using the kitchen target for combined rooms). For combined living/dining/kitchen rooms, local authorities may in practice accept the living room value in order to avoid small closed-off kitchen areas to force compliance with the standard.

The vast majority of bedrooms would appear likely to meet the bedroom recommendations in either standard.

The analysis suggests the majority of living areas below the recommendations would have access to a balcony area. The requirements may need to be balanced with other benefits of the scheme. For example, the removal of balconies would mean occupants would not have private amenity and increased glazing could create privacy concerns.

Overall, analysis of sunlight provision to rooms suggests that around 70% of proposed units will have at least one habitable room able to receive at least the minimum 1.5 hours sunlight recommendation in EN 17037.

Sunlight provision to courtyards has also been assessed. All courtyards would meet the BRE guidelines as more than half of their areas would be able to receive more than two hours of sunlight on 21st March.

Appendix A Loss of daylight results

Willow, Birch, Sycamore and Beech Houses

Analysed section A

Figure A1: Analysed section A. West facing to Red Arches Park. Windows analysed labelled. Via Google 2021.

Analysed section B

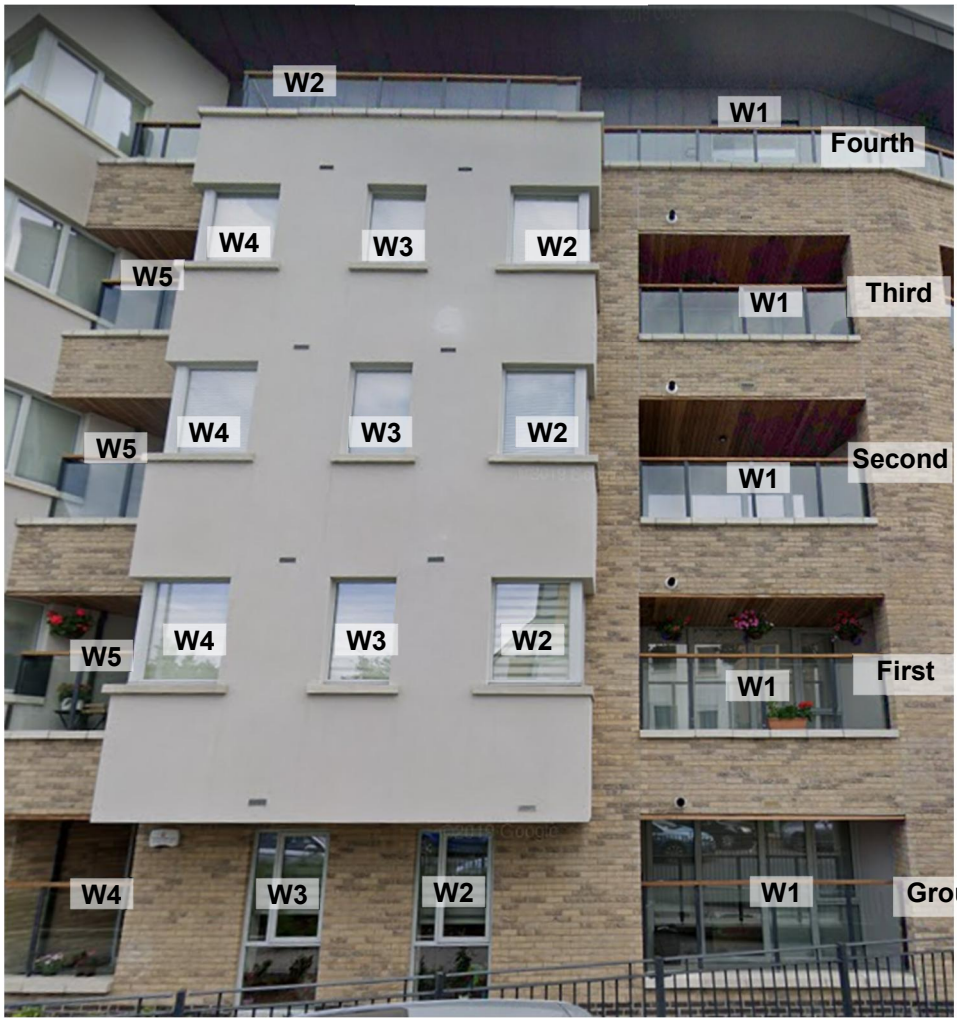


Figure A2: Analysed section B. North west facing to Red Arches Park / Red Arches Drive. Windows analysed labelled. Via Google 2021.

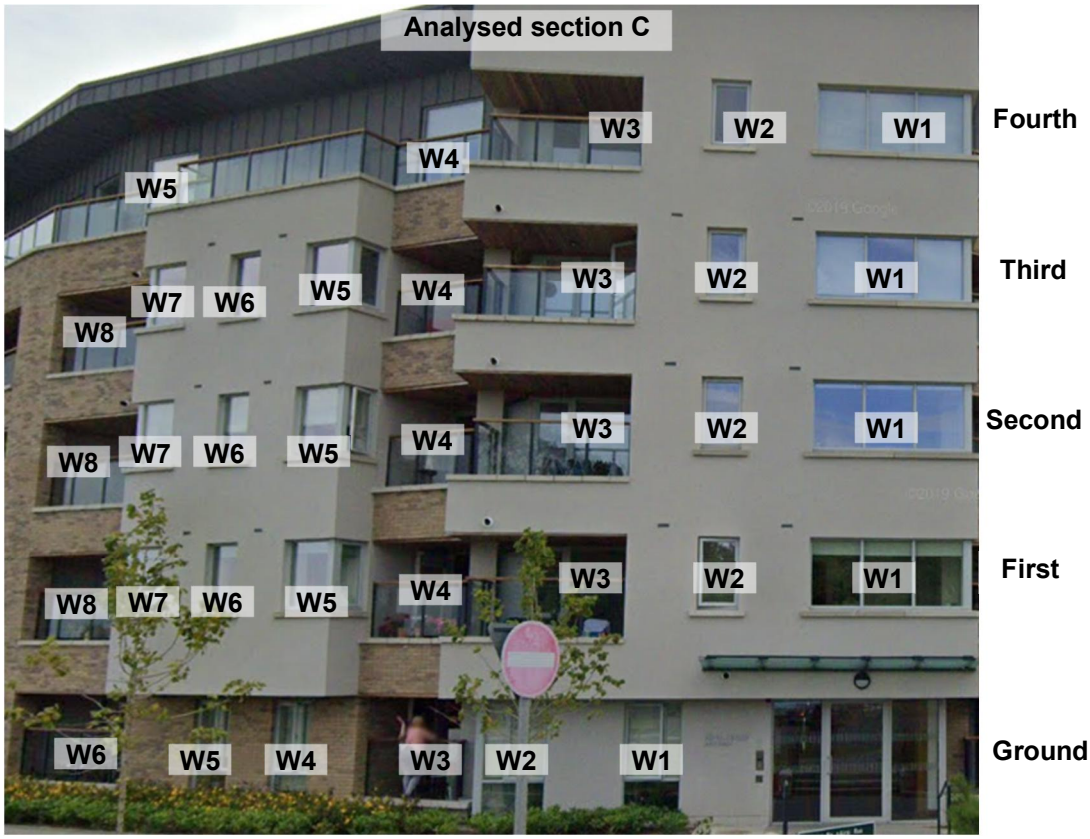


Figure A3: Analysed section C. North west facing to Red Arches Park / Red Arches Drive. Windows analysed labelled. Via Google 2021.

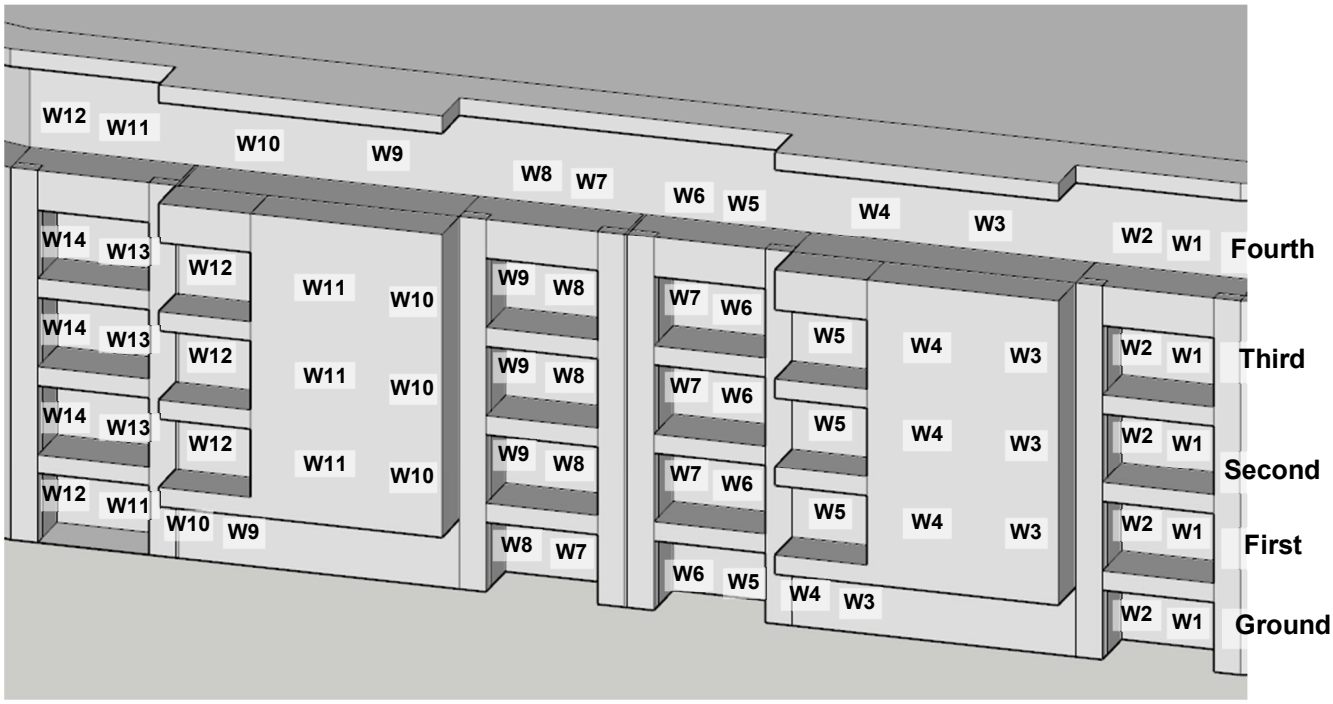


Figure A4: Analysed section D. North facing to Red Arches Drive and Sector 8C. Window positions analysed labelled. Via calculation model.

Table A1: Vertical sky component results Willow, Birch, Sycamore and Beech Houses – including overhangs.

Section	Floor	Window	Vertical sky component, % BEFORE	Vertical sky component, % AFTER	Ratio AFTER/BEFORE
Section A	Ground	W1	0.2	0.2	1.00
		W2	0.1	0.1	1.00
		W3	0.7	0.4	0.58
		W4	2.5	2.1	0.87
		W5	0.6	0.6	0.90
		W6	0.0	0.0	-
	First	W1	0.9	0.9	1.00
		W2	0.6	0.6	1.00
		W3	28.2	28.0	0.99
		W4	28.4	28.1	0.99
		W5	2.3	2.0	0.84
		W6	1.2	1.1	0.92
		W7	0.6	0.6	1.00
	Second	W1	3.4	3.4	1.00
		W2	2.9	2.9	1.00
		W3	32.3	32.1	0.99
		W4	32.4	32.1	0.99
		W5	5.4	5.0	0.94
		W6	3.4	3.3	0.98
		W7	3.0	3.0	1.00
	Third	W1	5.8	5.8	1.00
		W2	5.5	5.5	1.00
		W3	36.2	36.0	0.99
		W4	36.3	36.1	0.99
		W5	8.3	8.0	0.97

Section	Floor	Window	Vertical sky component, % BEFORE	Vertical sky component, % AFTER	Ratio AFTER/BEFORE
		W6	5.6	5.5	0.99
		W7	5.3	5.3	1.00
	Fourth	W1	27.4	27.2	0.99
		W2	24.8	24.5	0.99
		W3	19.4	19.1	0.99
		W4	18.9	18.7	0.99
		W5	25.2	25.0	0.99
		W6	27.3	27.1	0.99
Section B	Ground	W1	2.2	2.0	0.89
		W2	12.4	11.2	0.91
		W3	12.9	11.6	0.90
		W4	3.5	3.3	0.94
	First	W1	2.7	2.6	0.94
		W2	32.4	31.1	0.96
		W3	32.9	31.6	0.96
		W4	33.4	32.0	0.96
		W5	4.0	3.8	0.94
	Second	W1	4.7	4.5	0.97
		W2	34.9	33.9	0.97
		W3	35.2	34.1	0.97
		W4	35.5	34.4	0.97
		W5	4.5	4.3	0.96
	Third	W1	6.5	6.3	0.98
		W2	37.2	36.4	0.98
		W3	37.4	36.5	0.98
		W4	37.5	36.6	0.98
		W5	5.0	4.8	0.97
	Fourth	W1	28.1	27.5	0.98
		W2	16.5	16.3	0.98
Section C	Ground	W1	9.0	5.3	0.59
		W2	11.2	5.9	0.53
		W3	5.1	1.6	0.32
		W4	23.9	13.8	0.58
		W5	24.0	13.6	0.57
		W6	7.2	0.6	0.08
	First	W1	36.7	32.8	0.89
		W2	37.2	32.8	0.88
		W3	10.4	6.0	0.58
		W4	4.8	1.7	0.35
		W5	39.0	30.7	0.79
		W6	39.1	30.5	0.78
		W7	39.1	30.3	0.77
		W8	7.2	0.7	0.09
	Second	W1	37.6	34.6	0.92
		W2	38.0	34.6	0.91
		W3	10.5	6.7	0.64
		W4	4.8	1.9	0.40
		W5	39.1	33.0	0.84
		W6	39.2	32.9	0.84
		W7	39.2	32.8	0.84
		W8	7.2	1.9	0.26
	Third	W1	38.5	36.3	0.94
		W2	38.7	36.2	0.94
		W3	10.6	7.8	0.74
		W4	4.8	2.8	0.58

Section	Floor	Window	Vertical sky component, % BEFORE	Vertical sky component, % AFTER	Ratio AFTER/BEFORE
		W5	39.2	35.0	0.89
		W6	39.3	35.0	0.89
		W7	39.3	35.0	0.89
		W8	7.2	3.6	0.50
	Fourth	W1	39.2	37.7	0.96
		W2	39.2	37.6	0.96
		W3	12.9	11.1	0.86
		W4	25.6	23.2	0.91
		W5	28.3	25.9	0.91
Section D	Ground	W1	6.7	1.8	0.26
		W2	6.9	0.5	0.07
		W3	10.8	4.6	0.43
		W4	12.6	6.9	0.55
		W5	7.0	4.5	0.65
		W6	7.0	3.4	0.48
		W7	6.5	5.0	0.76
		W8	7.0	3.7	0.52
		W9	10.9	7.6	0.70
		W10	12.5	9.4	0.76
		W11	6.8	6.3	0.94
		W12	6.8	4.8	0.71
	First	W1	6.5	1.8	0.27
		W2	6.9	0.7	0.10
		W3	39.4	31.6	0.80
		W4	39.4	32.5	0.82
		W5	10.7	6.4	0.59
		W6	7.0	4.8	0.68
		W7	6.7	3.3	0.49
		W8	6.3	5.0	0.78
		W9	7.0	3.9	0.56
		W10	39.4	35.8	0.91
		W11	39.4	36.2	0.92
		W12	10.5	8.9	0.84
		W13	6.8	6.4	0.95
		W14	6.8	5.1	0.75
	Second	W1	6.5	3.1	0.47
		W2	6.9	2.0	0.29
		W3	39.4	33.8	0.86
		W4	39.4	34.4	0.87
		W5	10.7	7.5	0.70
		W6	7.0	5.3	0.76
		W7	6.7	4.1	0.61
		W8	6.3	5.2	0.83
		W9	7.0	4.7	0.66
		W10	39.5	36.8	0.93
		W11	39.5	37.0	0.94
		W12	10.5	9.2	0.88
		W13	6.8	6.4	0.95
		W14	6.8	5.4	0.80
	Third	W1	6.5	4.2	0.65
		W2	6.9	3.5	0.51
		W3	39.5	35.8	0.91
		W4	39.5	36.2	0.92
		W5	10.7	8.6	0.80
		W6	7.0	5.7	0.82

Section	Floor	Window	Vertical sky component, % BEFORE	Vertical sky component, % AFTER	Ratio AFTER/BEFORE
		W7	6.7	4.8	0.72
		W8	6.3	5.4	0.86
		W9	7.0	5.4	0.77
		W10	39.5	37.7	0.95
		W11	39.5	37.8	0.96
		W12	10.5	9.6	0.91
		W13	6.8	6.5	0.96
		W14	6.8	5.8	0.85
	Fourth	W1	26.6	24.4	0.92
		W2	24.4	22.3	0.91
		W3	18.6	16.7	0.90
		W4	19.5	17.8	0.91
		W5	24.5	23.0	0.94
		W6	26.1	24.6	0.94
		W7	26.1	24.8	0.95
		W8	24.3	23.1	0.95
		W9	18.6	17.5	0.94
		W10	19.5	18.5	0.95
		W11	24.7	23.8	0.96
		W12	26.6	25.8	0.97

Table A2: Vertical sky component results Willow, Birch, Sycamore and Beech Houses – Recalculation of windows below initial guidelines without overhangs (but still including any set back enclosure).

Section	Floor	Window	Vertical sky component, % BEFORE	Vertical sky component, % AFTER	Ratio AFTER/BEFORE
Section A	Ground	W3	25.9	25.6	0.99
		W6	15.6	15.6	1.00
Section C	Ground	W1	36.5	30.9	0.84
		W2	36.9	30.5	0.83
		W3	17.3	12.2	0.70
		W4	38.6	28.4	0.74
		W5	38.8	28.4	0.73
		W6	24.2	15.1	0.62
	First	W3	37.6	32.5	0.86
		W4	17.4	13.1	0.76
		W8	24.4	17.2	0.70
	Second	W3	38.2	34.3	0.90
		W4	17.5	14.2	0.81
		W8	25.0	19.7	0.79
	Third	W3	38.8	36.0	0.93
		W4	18.5	16.2	0.88
		W8	39.3	35.0	0.89
Section D	Ground	W1	24.6	18.3	0.74
		W2	24.5	15.6	0.63
		W3	39.4	31.5	0.80
		W4	39.4	32.3	0.82
		W5	24.6	21.7	0.88
		W6	25.6	20.7	0.81
		W7	23.9	22.2	0.93
		W8	24.9	20.9	0.84
		W9	39.4	35.6	0.90
		W10	39.4	35.9	0.91
		W12	24.9	22.5	0.90

Section	Floor	Window	Vertical sky component, % BEFORE	Vertical sky component, % AFTER	Ratio AFTER/BEFORE
	First	W1	24.8	19.9	0.80
		W2	24.7	17.7	0.72
		W5	39.4	33.8	0.86
		W6	24.8	22.5	0.91
		W7	24.7	20.9	0.84
		W8	24.1	22.7	0.94
		W9	25.1	21.9	0.87
		W14	25.1	23.2	0.92
	Second	W1	25.4	21.9	0.86
		W2	25.3	20.2	0.80
		W5	39.4	35.3	0.89
		W6	25.4	23.7	0.93
		W7	25.3	22.5	0.89
		W9	25.7	23.4	0.91
	Third	W1	29.1	26.8	0.92
		W2	29.1	25.7	0.88
		W7	29.1	27.1	0.93
		W9	29.5	27.9	0.94

Table A3: Vertical sky component results Willow, Birch, Sycamore and Beech Houses – Recalculation of windows below guidelines without overhangs to also exclude any set back enclosure.

Section	Floor	Window	Vertical sky component, % BEFORE	Vertical sky component, % AFTER	Ratio AFTER/BEFORE
Section C	Ground	W3	37.3	27.6	0.74
		W6	39.0	28.1	0.72
	First	W4	37.4	29.6	0.79
		W8	39.1	30.4	0.78
	Second	W8	39.2	32.9	0.84
Section D	Ground	W1	39.4	29.0	0.74
		W2	39.4	29.4	0.75
	First	W2	39.4	31.6	0.80

Properties at Red Arches Drive / Red Arches Park

Figure A5: Analysed section E. East facing on corner of Red Arches Drive and Red Arches Park. Windows analysed labelled. Ground W1 is obscured by a wall. Via Google 2021.

Figure A6: Analysed section F. North facing on corner of Red Arches Drive and Red Arches Park. Windows analysed labelled. Ground windows W1-W4 are obscured by a wall. Via Google 2021.

Table A4: Vertical sky component results for closest windows on the corner of Red Arches Drive and Red Arches Park.

Section	Floor	Window	Vertical sky component, % BEFORE	Vertical sky component, % AFTER	Ratio AFTER/ BEFORE
Section E	Ground	W1	7.5	7.5	1.00
		W2	28.0	25.5	0.91
		W3	19.8	17.8	0.90
		W4	24.3	22.5	0.93
		W5	20.8	19.3	0.93
	First	W1	23.9	21.8	0.91
		W2	30.4	28.4	0.94
		W3	28.0	26.2	0.94
		W4	21.2	19.6	0.93
		W5	27.2	25.8	0.95
		W6	23.8	22.6	0.95
	Second	W1	33.5	32.0	0.95
		W2	30.6	29.2	0.95
		W3	31.8	30.5	0.96
		W4	24.3	23.1	0.95
		W5	30.6	29.7	0.97
		W6	28.9	28.1	0.97
	Third	W1	36.1	35.1	0.97
		W2	34.0	33.1	0.97
		W3	35.5	34.6	0.98
		W4	35.2	34.4	0.98
Section F	Ground	W1	9.7	9.7	1.00

Section	Floor	Window	Vertical sky component, % BEFORE	Vertical sky component, % AFTER	Ratio AFTER/ BEFORE
		W2	27.4	26.1	0.95
		W3	24.3	22.6	0.93
		W4	19.9	18.2	0.92
		W5	38.6	34.3	0.89
		W6	37.7	33.6	0.89
		W7	27.7	25.4	0.92
	First	W1	29.3	27.1	0.92
		W2	12.8	10.4	0.81
		W3	29.4	25.6	0.87
		W4	23.5	20.1	0.86
		W5	38.8	35.2	0.91
		W6	38.0	34.6	0.91
		W7	28.3	26.2	0.93
	Second	W1	34.0	32.3	0.95
		W2	34.6	32.8	0.95
		W3	35.3	33.2	0.94
		W4	39.1	36.2	0.93
		W5	38.9	36.1	0.93
		W6	33.5	31.8	0.95
	Third	W1	36.3	35.3	0.97
		W2	36.7	35.5	0.97
		W3	37.0	35.6	0.96

GA1

The closest part of the GA1 site is to the south of Sectors 6A/6B. Ground floor windows and rooms are assessed for daylight via the vertical sky component with the proposed development in place.

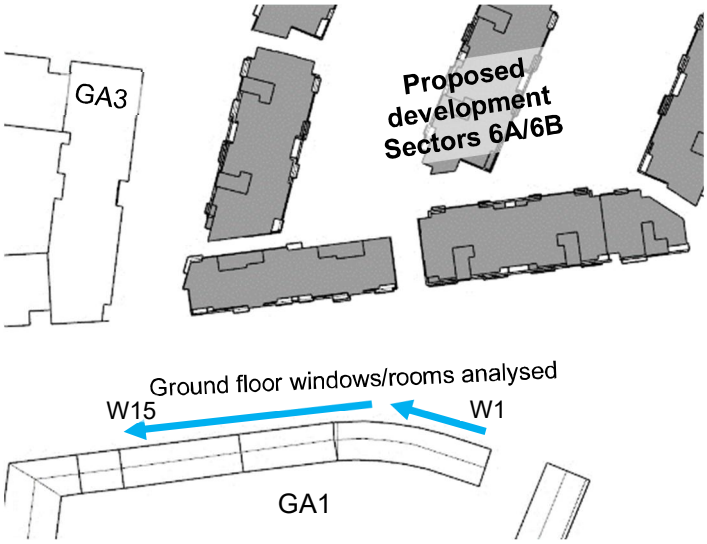


Figure A7: Areas analysed to the nearest consented parts of GA1.

Table A5: Vertical sky component and daylight distribution results for nearest parts of GA1.

Section	Floor	Window	Vertical sky component, %
			AFTER
GA1	Ground	W1	32.0
		W2	31.6
		W3	31.0
		W4	30.1
		W5	29.1
		W6	28.5
		W7	28.4
		W8	28.5
		W9	28.7
		W10	29.0
		W11	29.4
		W12	29.9
		W13	30.4
		W14	30.8
		W15	31.2

GA3

GA3 is to the west of the proposed development site. Vertical sky components have been calculated with the proposed development in place. The results are shown with and without balconies.

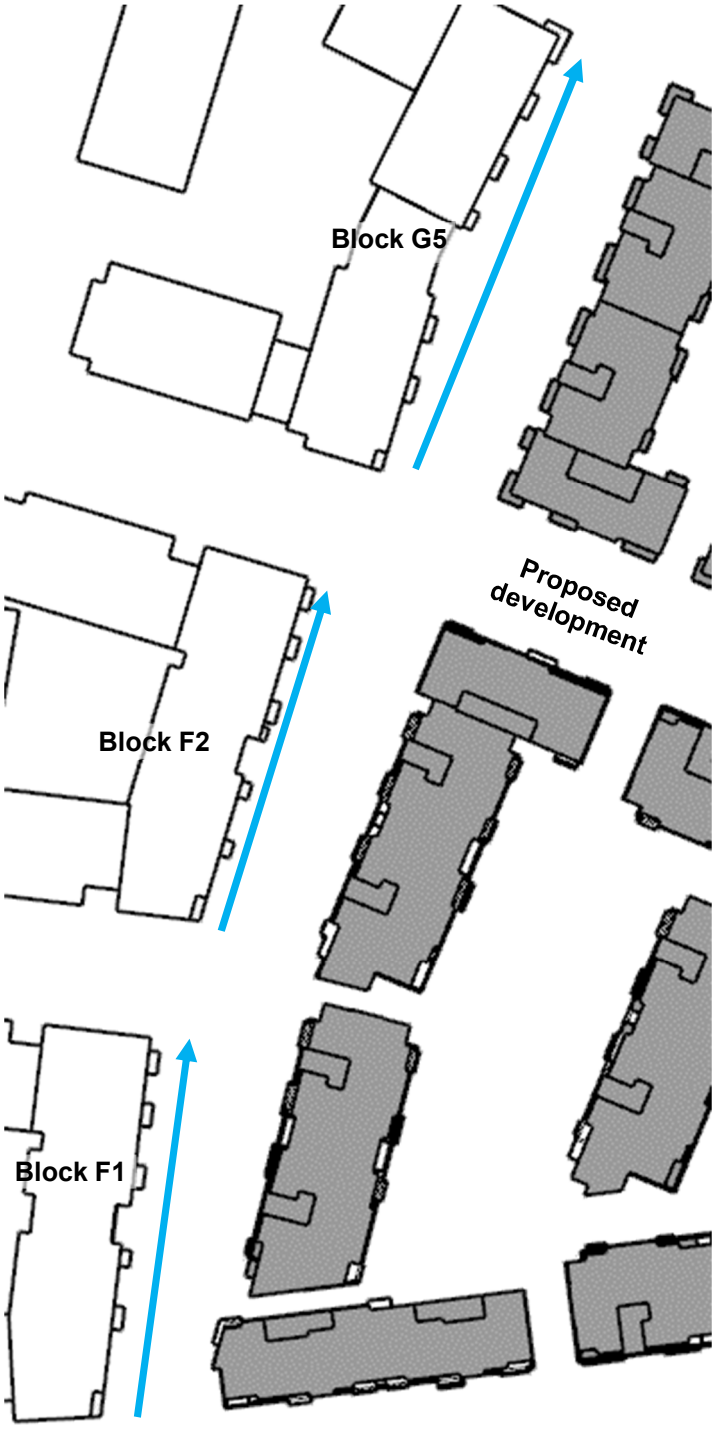


Figure A7: Analysed sections at windows facing the development at GA3 to the west. Blue arrows show order of windows analysed at each block.

Table A5: Vertical sky component results at example points on worst-case facades at the potential development to the west. Where the façade would face within 90° of due south, sunlight provision is also assessed.

Block / Floor	Window	Daylight - Vertical sky component, % AFTER		Sunlight – probable sunlight hours, % AFTER			
		With balconies	Without balconies	ANNUAL with balconies	WINTER with balconies	ANNUAL without balconies	WINTER without balconies
Block F1 Ground	W1	12.7	25.3	26	16	39	16
	W2	17.1	24.8	18	12	39	15
	W3	20.9	24.3	23	9	38	15
	W4	12.6	23.8	19	9	36	13
	W5	11.9	24.3	19	6	34	10
	W6	16.4	24.4	12	5	35	10
	W7	18.1	24.7	24	4	35	10
	W8	18.0	24.9	12	3	35	10
Block F1 First	W1	12.5	28.3	24	15	49	19
	W2	30.8	31.0	46	19	46	19
	W3	29.0	30.0	44	18	44	18
	W4	23.9	29.5	44	17	44	17
	W5	8.2	29.0	19	15	44	17
	W6	23.2	28.4	21	6	43	15
	W7	22.7	28.0	34	9	42	14
	W8	8.6	27.9	14	9	41	14
	W9	22.8	22.8	20	2	20	2
	W10	22.2	22.2	32	8	32	8
	W11	22.7	27.6	40	12	40	12
	W12	7.0	27.8	12	7	40	12
	W13	22.5	27.9	18	2	40	12
	W14	22.5	28.1	32	6	40	12
	W15	7.2	28.2	10	4	41	12
	W16	22.6	28.4	20	3	41	12
	W17	7.6	28.6	12	6	41	12
Block F2 Ground	W1	12.8	23.2	31	11	37	11
	W2	18.0	23.3	18	7	37	11
	W3	20.7	23.3	25	6	37	11
	W4	12.5	23.5	20	8	38	11
	W5	12.0	19.4	14	0	14	0
	W6	12.9	23.6	15	6	35	8
	W7	13.1	24.8	24	7	39	11
	W8	15.3	25.0	17	6	40	11
	W9	20.9	25.5	27	4	42	11
	W10	15.6	26.5	20	6	44	11
Block F2 First	W1	6.0	23.4	14	8	45	14
	W2	26.4	27.2	44	14	44	14
	W3	22.8	27.2	44	14	44	14
	W4	8.3	27.3	18	13	45	14
	W5	23.8	27.3	27	5	44	14
	W6	23.0	27.4	35	8	45	14
	W7	8.5	27.5	15	9	44	13
	W8	22.9	22.9	25	3	25	3
	W9	21.9	21.9	37	9	37	9
	W10	22.9	27.5	45	14	45	14
	W11	7.2	27.7	14	8	45	14
	W12	23.8	27.9	25	4	45	14
	W13	23.6	28.1	36	8	46	14
	W14	7.9	28.3	17	9	47	14

Block / Floor	Window	Daylight - Vertical sky component, % AFTER		Sunlight – probable sunlight hours, % AFTER			
		With balconies	Without balconies	ANNUAL with balconies	WINTER with balconies	ANNUAL without balconies	WINTER without balconies
	W15	21.3	28.7	21	3	48	14
	W16	9.0	29.5	18	9	49	14
Block G5 Ground	W1	25.6	25.8	41	14	41	14
	W2	9.8	21.0	16	8	35	12
	W3	18.5	20.8	20	5	36	12
	W4	16.5	16.5	14	0	14	0
	W5	20.1	20.1	30	8	30	8
	W6	20.0	20.0	31	9	31	9
	W7	16.7	16.7	33	10	33	10
	W8	9.4	19.6	21	11	34	11
	W9	16.1	19.2	22	7	35	11
	W10	14.9	19.0	28	8	35	10
	W11	8.1	18.7	14	8	34	10
	W12	14.7	18.8	17	6	34	10
	W13	15.6	19.2	28	7	36	10
	W14	9.2	19.7	19	8	36	10
	W15	15.9	20.7	18	5	37	10
	W16	18.5	21.9	28	6	37	10
	W17	13.2	24.0	23	8	39	10
Block G5 First	W1	28.7	28.9	46	16	46	16
	W2	21.7	26.4	44	16	44	16
	W3	6.4	25.8	15	10	44	15
	W4	19.5	25.3	19	5	43	15
	W5	18.8	24.8	33	10	43	15
	W6	5.3	24.4	12	8	42	15
	W7	21.2	24.0	24	5	42	14
	W8	19.1	19.1	17	1	17	1
	W9	23.1	23.1	35	10	35	10
	W10	23.0	23.0	36	11	36	11
	W11	19.5	19.5	39	12	39	12
	W12	5.3	22.5	13	11	40	13
	W13	18.2	22.0	24	6	40	13
	W14	16.7	21.7	32	9	40	12
	W15	4.3	21.3	7	6	40	12
	W16	15.7	21.3	17	3	39	12
	W17	16.9	21.4	32	9	40	13
	W18	5.1	21.8	11	7	40	12
	W19	16.0	22.5	15	2	39	12
	W20	19.4	23.5	28	6	39	11
	W21	8.6	25.3	17	6	42	12

bre

Appendix B Shadow Plotting

Shadow plots have been created for 21st March (spring equinox), 21st June (summer solstice) and 21st December (winter solstice) at clock times 8am, 10am, 12pm, 2pm and 4pm (plus 6pm in summer).

Plots are also shown for January, February, April and May. This gives a month-by-month assessment of sunlight provision at and around the site to allow for a full understanding of the year round level of overshadowing.

The shadows for 21st September (autumn equinox) are the same as those for 21st March (spring equinox). The shadows for 21st January, 21st February, 21st April and 21st May are the same as those at or around the 21st of November, October, August and July respectively.

In the plots, the times given are clock times. Between the end of March and the end of October, Irish Standard Time (IST) applies. The plots for September and October therefore correspond to the shadows produced one hour later in summer time; thus at 1pm IST in September/October, the shadows are as plotted on the 12pm GMT diagram for March/February. The March and February plots therefore correspond to 9am, 11am, 1pm, 3pm and 5pm IST in September and October.

The shadow diagrams in this appendix are shown in order from December to June.


North
21st Dec
08:00GMT
Proposed development site


North
21st Dec
10:00GMT
Proposed development site

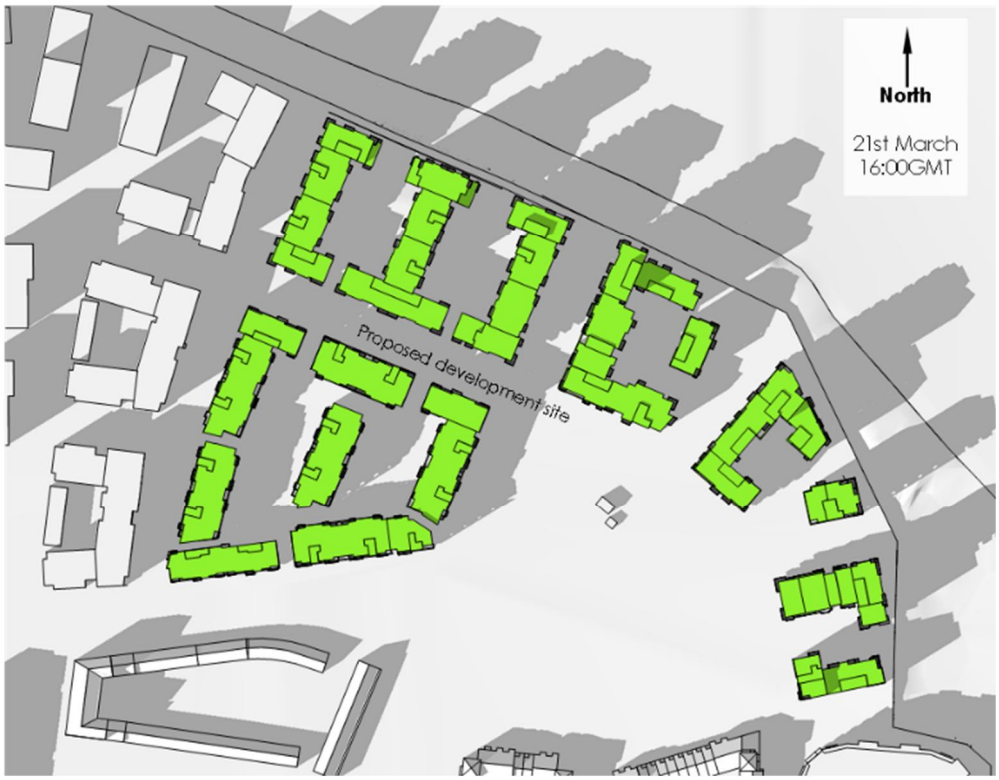

North
21st Jan
14:00GMT
Proposed development site

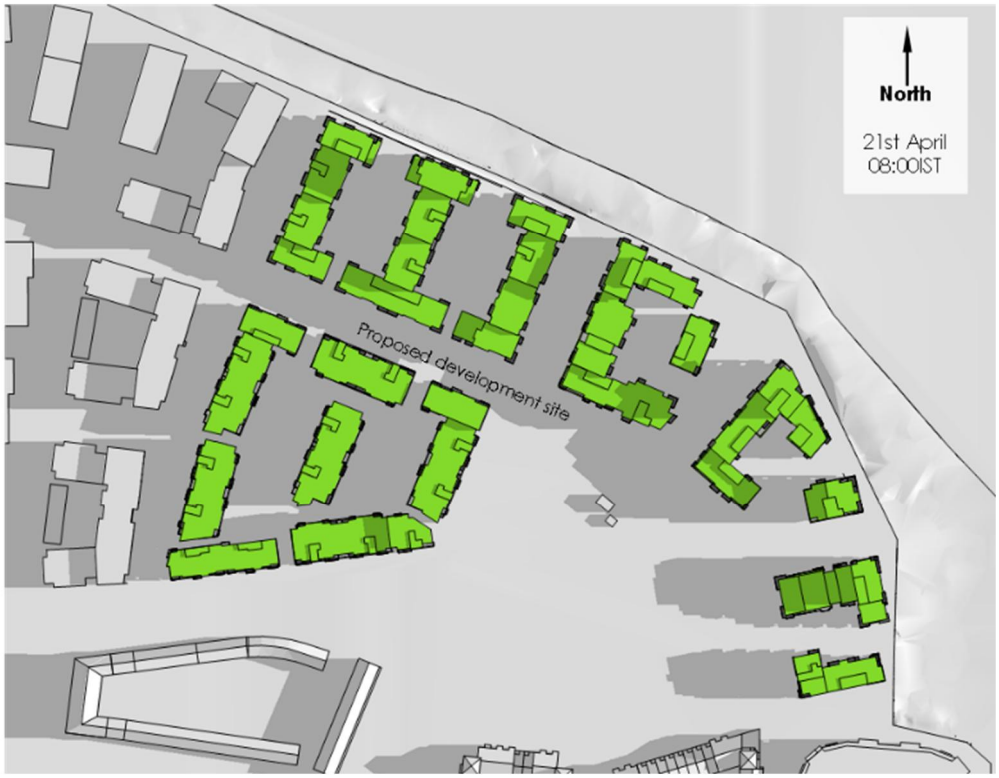

North
21st Jan
16:00GMT
Proposed development site


North
21st March
10:00GMT
Proposed development site


North
21st March
12:00GMT
Proposed development site


North
21st March
14:00GMT
Proposed development site

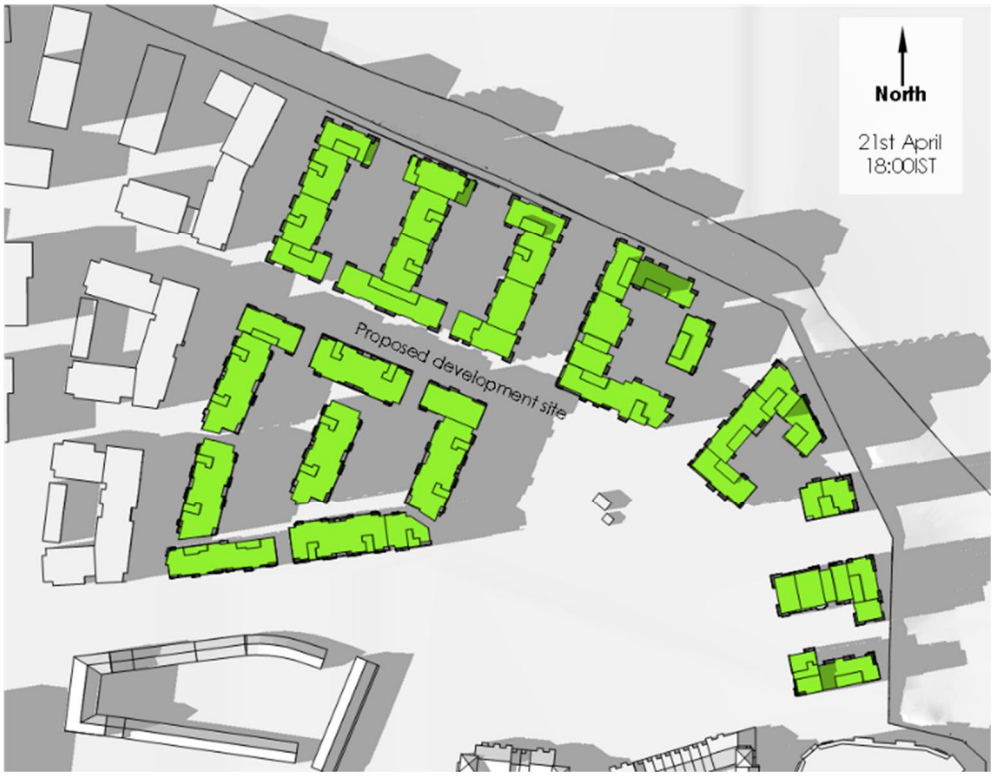

North
21st March
16:00GMT
Proposed development site




North
21st April
12:00IST
Proposed development site


North
21st April
14:00IST
Proposed development site


North
21st April
16:00IST
Proposed development site

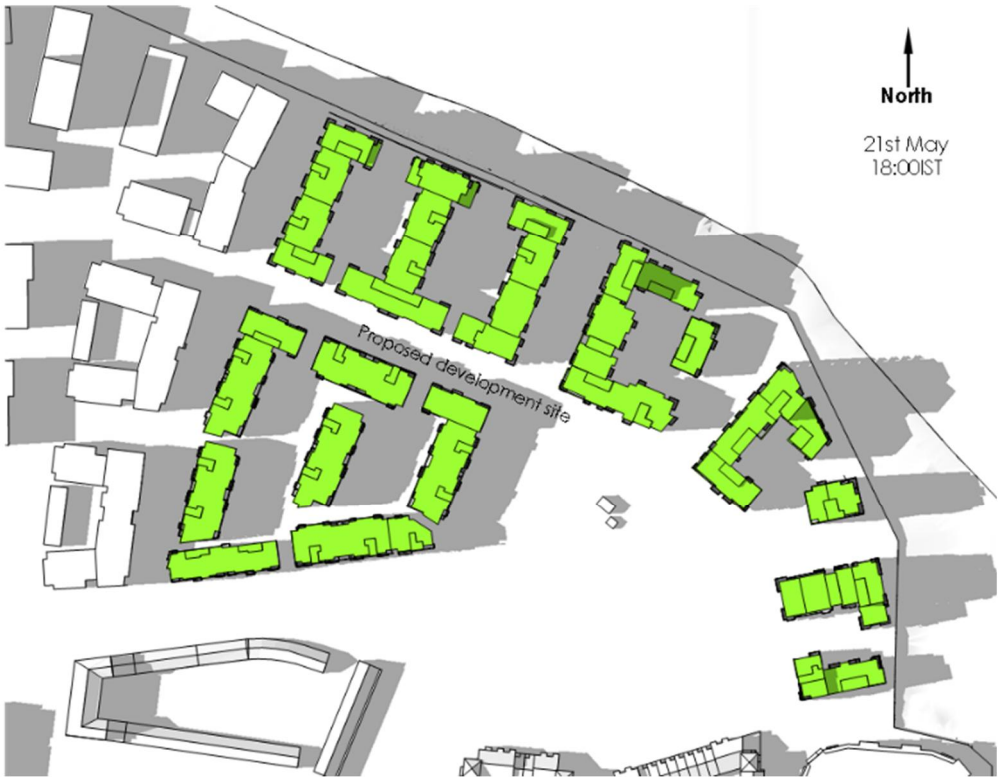

North
21st April
18:00IST
Proposed development site


North
21st May
08:00IST
Proposed development site


North
21st May
10:00IST
Proposed development site


North
21st May
12:00IST
Proposed development site


North
21st May
14:00IST
Proposed development site




North
21st June
08:00IST
Proposed development site


North
21st June
10:00IST
Proposed development site


North
21st June
12:00IST
Proposed development site


North
21st June
14:00IST
Proposed development site

Appendix 13.1

Photomontage Images

Model Works

Verified Photomontages

To be read in conjunction with

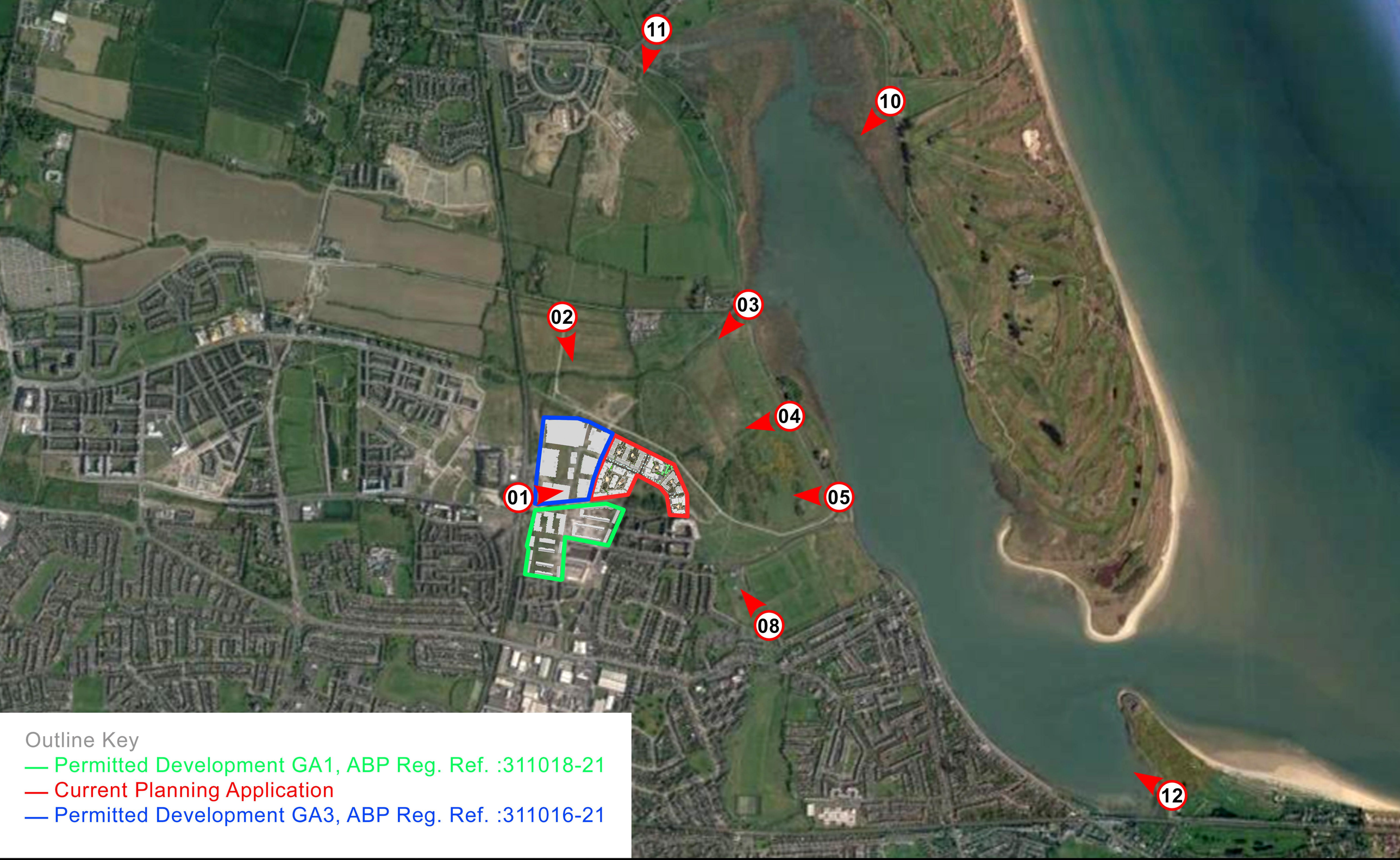
EIAR Chapter 13: Landscape & Visual

Proposed

Baldoyle GA2

Prepared by Model Works Ltd
for Lismore Homes Ltd

March 2022



Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

viewpoint: **View Map**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 09-11-2021 16:03
Canon 5D Mark II
24 mm Lens

location:
E 723086.335 N 740732.209

viewpoint: **View 01 Baseline**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS	*project:*	Baldoyle GA2	*photography:*	09-11-2021 16:03 Canon 5D Mark II 24 mm Lens	*location:*	E 723086.335 N 740732.209	*viewpoint:* **View 01 Proposed** *issued:* 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 09-11-2021 16:03
Canon 5D Mark II
24 mm Lens

location: E 723086.335 N 740732.209

viewpoint: **View 01 Cumulative**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 12-11-2021 14:31
Canon 5D Mark II
24 mm Lens

location: E 723225.926 N 741512.661

viewpoint: **View 02 Baseline**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 12-11-2021 14:31
Canon 5D Mark II
24 mm Lens

location: E 723225.926 N 741512.661

viewpoint: **View 02 Proposed**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 12-11-2021 14:31
Canon 5D Mark II
24 mm Lens

location: E 723225.926 N 741512.661

viewpoint: **View 02 Cumulative**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 25-06-2020 10:35
Canon 5D Mark II
24 mm Lens

location: E 323968.971 N 241502.744

viewpoint: **View 03 Baseline**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 25-06-2020 10:35
Canon 5D Mark II
24 mm Lens

location: E 323968.971 N 241502.744

viewpoint: **View 03 Proposed**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 25-06-2020 10:35
Canon 5D Mark II
24 mm Lens

location:
E 323968.971 N 241502.744

viewpoint: **View 03 Cumulative**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 12-11-2021 12:41
Canon 5D Mark II
24 mm Lens

location: E 724061.494 N 741123.706

viewpoint: **View 04 Baseline**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 12-11-2021 12:41
Canon 5D Mark II
24 mm Lens

location:
E 724061.494 N 741123.706

viewpoint: **View 04 Proposed**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 12-11-2021 12:41
Canon 5D Mark II
24 mm Lens

location:
E 724061.494 N 741123.706

viewpoint: **View 04 Cumulative**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 12-11-2021 13:14
Canon 5D Mark II
24 mm Lens

location: E 724221.875 N 740731.461

viewpoint: **View 05 Baseline**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 12-11-2021 13:14
Canon 5D Mark II
24 mm Lens

location: E 724221.875 N 740731.461

viewpoint: **View 05 Proposed**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 12-11-2021 13:14
Canon 5D Mark II
24 mm Lens

location: E 724221.875 N 740731.461

viewpoint: **View 05 Cumulative**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 12-11-2021 13:43
Canon 5D Mark II
24 mm Lens

location:
E 723993.865 N 740341.748

viewpoint: **View 08 Baseline**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 12-11-2021 13:43
Canon 5D Mark II
24 mm Lens

location:
E 723993.865 N 740341.748

viewpoint: **View 08 Proposed**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 12-11-2021 13:43
Canon 5D Mark II
24 mm Lens

location: E 723993.865 N 740341.748

viewpoint: **View 08 Cumulative**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 25-06-2020 09:41
Canon 5D Mark II
24 mm Lens

location: E 324485.38 N 242288.864

viewpoint: **View 10 Baseline**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 25-06-2020 09:41
Canon 5D Mark II
24 mm Lens

location: E 324485.38 N 242288.864

viewpoint: **View 10 Proposed**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 25-06-2020 09:41
Canon 5D Mark II
24 mm Lens

location: E 324485.38 N 242288.864

viewpoint: **View 10 Cumulative**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 25-06-2020 10:01
Canon 5D Mark II
24 mm Lens

location: E 323618.787 N 242525.451

viewpoint: **View 11 Baseline**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 25-06-2020 10:01
Canon 5D Mark II
24 mm Lens

location: E 323618.787 N 242525.451

viewpoint: **View 11 Proposed**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 25-06-2020 10:01
Canon 5D Mark II
24 mm Lens

location: E 323618.787 N 242525.451

viewpoint: **View 11 Cumulative**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 25-06-2020 11:22
Canon 5D Mark II
24 mm Lens

location: E 325597.285 N 239717.313

viewpoint: **View 12 Baseline**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

Outline Key

— Permitted Development GA1, ABP Reg. Ref. :311018-21

— Current Planning Application

— Permitted Development GA3, ABP Reg. Ref. :311016-21

MODEL WORKS

project: Baldoyle GA2

photography: 25-06-2020 11:22
Canon 5D Mark II
24 mm Lens

location: E 325597.285 N 239717.313

viewpoint: **View 12 Proposed**

issued: 23-03-2022

Angle of View 73° Horizontal (24 mm Lens)

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project: Baldoyle GA2

photography: 25-06-2020 11:22
Canon 5D Mark II
24 mm Lens

location: E 325597.285 N 239717.313

viewpoint: **View 12 Cumulative**

issued: 23-03-2022

Appendix 13.2

Arboricultural Report Arboricultural Inventory And Impact Assessment

Murray & Associates Landscape Architecture

murray & associates
landscape architecture

ARBORICULTURAL REPORT
ARBORICULTURAL INVENTORY
AND IMPACT ASSESSMENT

Incorporating a

TREE PROTECTION STRATEGY

At

GA2; RESIDENTIAL DEVELOPMENT, BALDOYLE, CO. DUBLIN

FOR

LISMORE HOMES LTD.

Murray & Associates
Landscape Architecture

16 The Seapoint Building
44-45 Clontarf Road, Dublin 3
Tel: +353 (0)1 8540090
Fax: +353 (0)1 8540095
mail@murray-associates.com
www.murray-associates.com

Member of the Irish Landscape Institute

Contents

Issue Sheet

Rev. No.	Issue Status	Date	Prepared By	Checked By
1	For Issue	17/12/21	HM/JW	JW

Introduction & Terms of reference

The trees and hedgerows were originally surveyed on the 15th October 2020 by the undersigned, the trees were resurveyed for this report on 15th December 2021. The findings of this survey and assessment have been summarised and recorded in the following report.
A number of mature trees on the development site area were surveyed and assessed. Some of the trees on the site will have to be removed to accommodate the development, but the number of trees to be removed is very low, of 19 trees 7no. are to be removed.

Scope

The site is the subject of a current planning application. This development comprises of the construction of 1,007 residential apartments (GFA: 92,280 sq.m.) in 16 no. 4 to 9 storey buildings comprising 56 no. studio apts., 281 no. one bed apts., 605 no. two bed apts., and 65 no. three beds with a ground floor creche (c. 820 sq.m.), 723 no. car parking spaces (604 no. spaces at basement level and 119 no. surface level spaces for visitors), 1,740 no. bicycles spaces at basement and ground floor levels, and 724 no. storage rooms; along with the landscape proposals described herein, and ancillary site development works.

The site is located in the townland of Stapolin, 1 km northwest of the town of Baldoyle, situated in the south eastern part of Fingal County. The development is part of the proposed Coast Development within the Baldoyle Stapolin area, located on major bus line and adjacent to the Clongriffin Dart Station. The area is zoned R1 for new residential developments, as are the sites to the south of this application. To the north is a large area of greenbelt, and east is Baldoyle Bay, which is an SAC and SPA

The site contains a large number of mature trees, this report assesses the 20 trees on site as of 16[5d] December 2021 This report has been commissioned to provide an arboricultural assessment of the site to assist the design team as they prepare detailed plans for the new development. The purpose of this assessment is to provide an analysis of any potential impact of the planning applications proposed development on the existing trees and hedgerows. The report will provide recommendations for preservation and or removal of trees and hedgerows. It will present a written report on the inspection of the trees. The report will provide a tree protection plan highlighting which trees are to be removed and/or retained.

This report should be read in conjunction with the following drawings:

Landscape Plan (REF: **1819_PL_P_01)**;

Tree Survey: (REF. **1819_TS_P_01**);

Arboricultural Impact Plan: (REF. **1819_TS_P_02**);

Proposed Development

This development comprises of the construction of 1,007 residential apartments (GFA: 92,280 sq.m.) in 16 no. 4 to 9 storey buildings comprising 56 no. studio apts., 281 no. one bed apts., 605 no. two bed apts., and 65 no. three beds with a ground floor creche (c. 820 sq.m.), 723 no. car parking spaces (604 no. spaces at basement level and 119 no. surface level spaces for visitors), 1,740 no. bicycles spaces at basement and ground floor levels, and 724 no. storage rooms; along with the landscape proposals described herein, and ancillary site development works.

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Figure 1 – Site location and context plan

Methodology Employed

An initial tree survey and visual condition assessment was on the 15th October 2020 and the 15th December 2021. Using the information gathered on site the data was input into GIS software Tree Plotter where they can accurately be located in ITM coordinates. The Trees were then re-surveyed on 15th December 2021 for this report.

For the purpose of this report the trees were assessed in accordance with BS 5837: 2012 "Trees in relation to design, demolition and construction". Only trees with diameters of 75mm or greater were surveyed, and those smaller than this were noted in the survey. In accordance with section 4.4.2.3 of the British standard document where trees formed obvious groups these were assessed and recorded as groups.

Section 4.4.2.3 of BS 5837: 2012 states:

Trees growing as groups or woodland should be identified and assessed as such where the arboriculturist determines that this is appropriate. However, an assessment of individuals within any group should still be undertaken if there is a need to differentiate between them, e.g. in order to highlight significant variation in attributes (including physiological or structural condition).

NOTE: The term "group" is intended to identify trees that form cohesive arboricultural features either aerodynamically (e.g. trees that provide companion shelter), visually (e.g. avenues or screens) or culturally, including for biodiversity (e.g. parkland or wood pasture), in respect of each of the three subcategories.

Tree Survey Methodology

Tree Species

Common and botanical names of the tree species were recorded.

Tree Crown Dimensions

Tree height (Ht), crown clearance (Cl) and crown-spread (NESW cardinal points) measurements are in metres and are estimated.

Stem Diameter (Dbh)

Measurements are in millimetres and taken at 1.5m from ground level, multiple stems (St) are recorded as a function of the BS:5837 RPA formulae described below.

Tree age classes were recorded as:

Y	Young	Recently planted (with 5 years or so)
SM	Semi-Mature	Well established young tree
EM	Early Mature	Established tree not yet fully grown
M	Mature	Full or near full grown tree
LM	Late Mature	Older specimen in full maturity
OM	Over Mature	Reached full maturity now declining through natural causes
Vet	Veteran	Notable due to large size, old age, ecological importance

Tree Physiological and Structural condition was graded as:

Good:	No obvious defects visible, vigour and form of tree good.
Fair:	Tree in average condition for its age and the environment.
Poor:	Tree shows signs of ill health/structural defect
Bad:	Tree in seriously bad health/major structural problem

Work Recommendations

Preliminary management recommendations are made where necessary and pertain to current site conditions unless otherwise stated.

Estimated Remaining Contribution (ERC)

The approximate number of years that a tree should continue to live and contribute amenity, conservation or landscape value to the site under current site condition.

Tree Retention Categories

The tree retention category system grades a tree's suitability for retention within a development:

- ***A*** Indicates a tree of high quality and value. These are trees that are particularly good examples of their species, which also provide landscape value. These trees are in such a condition as to be able to make a substantial contribution. (A minimum of 40 years is suggested)
- ***B*** Indicates a tree of moderate quality and value. Trees that might be included in the high category but are downgraded because of impaired condition. These trees are in such a condition as to make a significant contribution. (A minimum of 20 years is suggested)
- ***C*** Indicates a tree of low quality and value - trees with an estimated remaining life expectancy of at least 10 years, or trees with a stem diameter of below 150mm and/or <10m in height.
- **U** Trees that are in such a condition that they cannot realistically be retained as living trees in the context of the current land use for longer than 10 years.

Subcategories

Tree categories may be further categorised using the following sub-categories (e.g.C1, C2 or C3)

1. Mainly Arboricultural qualities,
2. Mainly landscape qualities,
3. Mainly cultural values.

Root Protection Area

The Root Protection Area (RPA) is the minimum area around individual trees to be protected from disturbance during construction works; RPA is recorded as a radius in metres measured from the tree stem and is shown on the tree survey/constraints drawing as a circle with the tree stem in the centre.
For single stem trees, the root protection area (RPA) should be calculated as an area equivalent to a circle with a radius 12 times the stem diameter.

For trees with more than one stem, one of the two calculation methods below should be used. The calculated RPA for each tree should be capped to 707 m2.

For trees with two to five stems, the combined stem diameter should be calculated as follows:

√ ((stem diameter 1)2 + (stem diameter 2)2 ... + (stem diameter 5)2)

For trees with more than five stems, the combined stem diameter should be calculated as follows:

√ ((mean stem diameter)2 × number of stems)

The survey concentrated primarily on the significant trees located within the development area. The objective of this survey was to gather information regarding the tree's location on the proposed development site and the impact the proposed development may have on the trees. Please refer to appendix 1 for the tree inventory. Significant trees can be equated as those trees whose visual importance to the surrounding area is enough to justify special efforts to protect/preserve and whose loss would have an irremediable adverse impact on the local environment. Significance can also be placed depending on the trees age, another variable to imply significance can be the aesthetic merit of the tree based on its unusual size, intrinsic physical features or outstanding appearance or occurring in a unique location or context, and thus provides a special contribution as a landmark or landscape feature.

Tree diameters (DBH) were estimated at 1.5 meter above grade as per standard arboricultural practice. Tree height was measured with the use of a digital clinometer. The trees were categorized in accordance with BS5837:2012.

Tree Survey Results

Category	Number of trees	Trees to be removed
A	0	-
B	9	5
C	10	2
U	1	-

Table 1. Category of the Trees surveyed (BS 5837:2012, Item 4.5 Tree categorisation method)

The trees within the site area are in predominantly fair condition. There are no category A trees on site.

Trees to be removed are: five category B and two C, consisting of all Sycamore species. The application includes the planting of additional trees in the areas where these trees are set to be removed and across the site, there will be an overall net increase in tree cover in this area,

The remainder of the trees on the site are Sycamore (Acer Pseudoplatanus), as well as a single failing Italian Alder. It is recommended that these remaining trees be maintained for maturity of the planting scheme on site, however due to their condition be monitored and replaced where necessary as the proposed planting establishes.

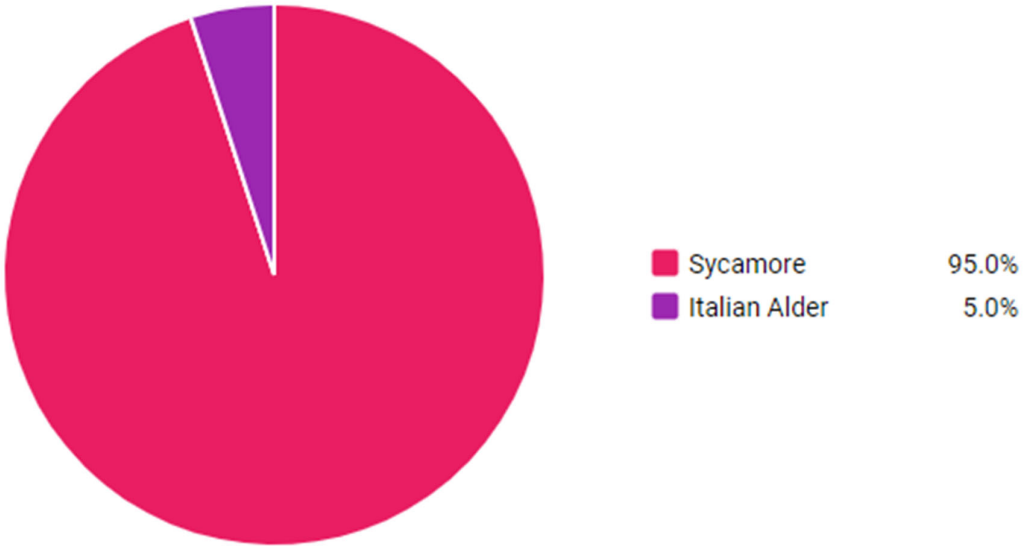

Fig.2 Species composition of the tree cover on site as a %

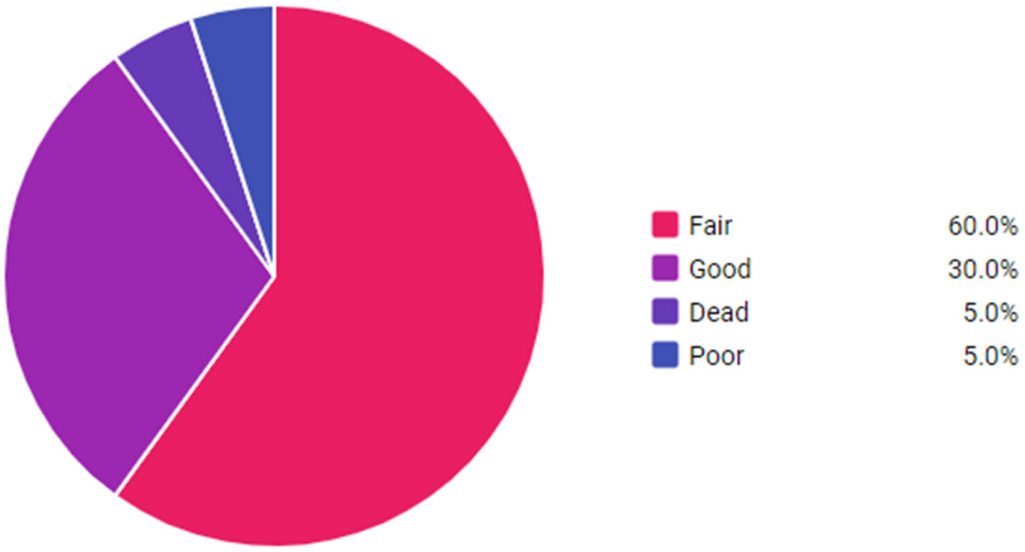

Figure 3. Tree Quality Breakdown

Tree Protection Details

Protected Tree Zone/Construction Exclusion Zone

Trees that are destined to be retained must be protected by barriers, signage and/or ground protection prior to any materials or machinery being brought on site and prior to any development, demolition or soil stripping takes place. Areas that are designated for new plantings should be similarly protected. Barriers should be fit for the purpose of excluding construction activity. The tree protection zone shall be set out as (figure 4)

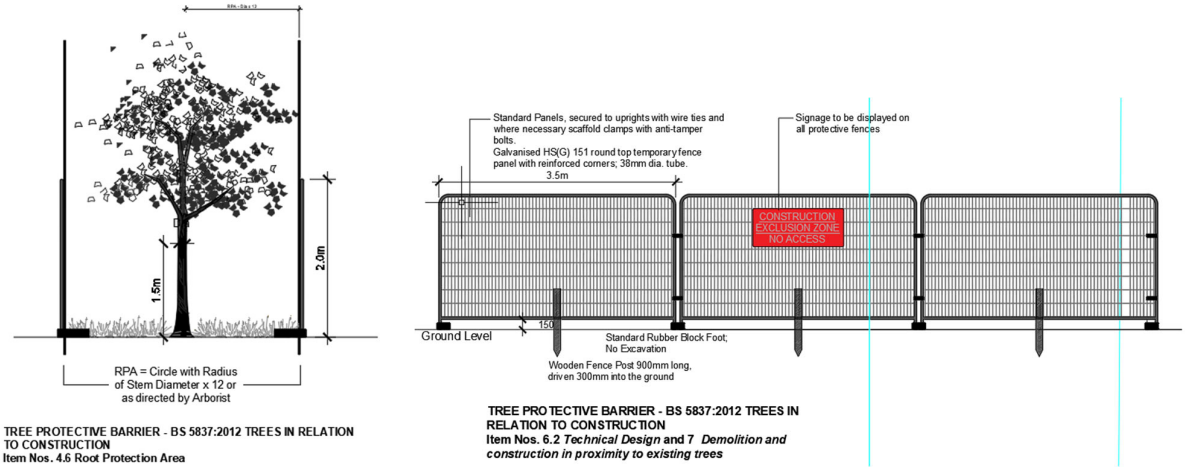

Figure 4: Construction Fencing Detail

A notice 'Construction Exclusion Zone' shall be placed on tree protection fencing at regular intervals along the protective fencing. This notice shall include contact details for the Site Arborist. The noticed should say 'Strictly no access should be permitted to the R.P.A. unless instructed by the Site Arborist.', 'No materials of any kind are to be stored within the R.P.A.', 'No "Spilling out" of materials shall take place within the R.P.A.' and, 'No fires are to be lit within the R.P.A.'.

The Contractor is to maintain the protective fencing in good condition to the satisfaction of the Site Arborist for the duration of the contract. Any damage to fencing is to be reported to the Site Arborist immediately. Damaged fencing is to be repaired within 2 hours of the damage occurring. All works within the vicinity of the damaged fencing are to be suspended until the fencing is repaired.

Ground Protection

Although works within the RPA are not recommended should essential works be required within the RPA. The installation of ground protection in the form of a single thickness of scaffold boards on top of a compressible layer laid onto a geotextile may be acceptable (see figure.5) For wheeled or tracked movements within the R.P.A. the ground protection should be designed by an engineer to accommodate the likely loading. Any works within the RPA must be undertaken with prior consultation with the arborist.

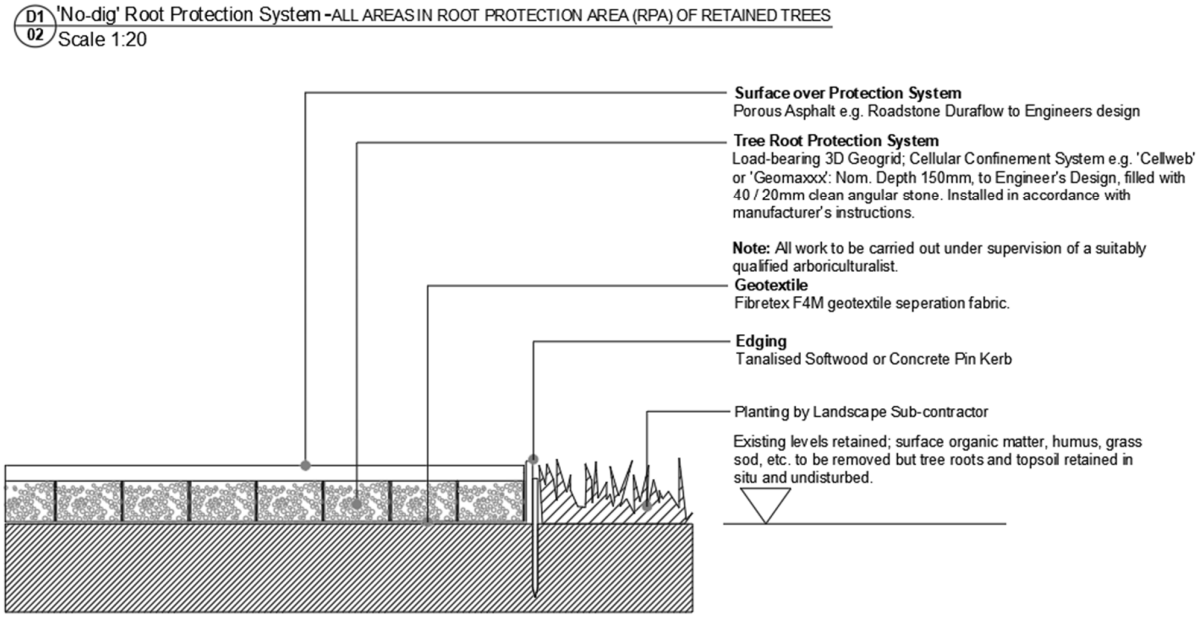

Figure 5 : Construction Fencing Detail

Arboricultural Method Statement/Tree Protection Strategy

The object of this arboricultural method statement/tree protection plan is to provide information for the building contractor/site manager on how the trees or hedgerows on the site need to be protected pre, during and post development works so that they can prepare their own site specific detailed method statement for their works

It is necessary for the protective fencing to be erected and all other mitigation measures required to be put in place prior to any development works commencing on site to ensure all retained trees and their critical rooting zone are protected for the duration of the works. Refer to tree protection details for the position of protective fencing and additional mitigation measures

The protection for trees and hedgerows shown for retention will occur in three stages known as pre, during and post development.

Arboricultural Method Statement/Tree Protection Strategy – Management Stages		
Stage 1 – Pre development works	**Stage 2 - The construction works stage**	**Stage 3-Post Development Works**
1. Consultation with Arborist and developer	1. Protective Fencing – management and maintenance	1. Site inspection by arborist to ensure plan adhered to and trees protected
2. Site meeting - consultation with Arborist, developer, main contractor and sub-contractor	2. Excavations – works only commence when protective fencing in place	
3. Tree works – Appointment of professional tree surgeon	3. Working within the RPA – All works within the RPA to be discussed and agreed with the arborist	
4. Erection of protective fencing/Mitigation measures	4. Finished ground levels/Landscaping – All works to ensure the integrity of tree/s Protected.	

Table 2. Arboricultural Method Statement/Tree Protection Strategy – Management Stages

Stage 1 - Pre-Development Work

Prior to works commencing on site the following needs to be agreed and implemented

Appointment of an arborist (Site Arborist) to oversee all works relevant to trees;
Establishment of tree protection (refer to Drawing 1819_TS_P_02);
Monitoring of tree protection (adherence to the Tree Protection Code of Practice);
Supervision of works in the vicinity of trees;
Post construction re-assessment of retained trees

Site meeting

Prior to any works on site, it is necessary that a meeting be arranged between the project manager, site foreman, the project landscape architect, the project arborist and the local authority to identify and finalize the trees for removal and the line of protective fencing and any other mitigation measures.

Tree works

The Contractor shall take all precautions to ensure that any trees which are not required to be taken down under the contract shall remain undisturbed and undamaged. The Contractor must appoint a qualified arboricultural contractor to undertake all tree works subject to approval by the Consulting Arborist. The Contractor shall undertake no works to trees unless instructed by the Contract Administrator. Five working days' notice of intention to undertake works to be given.

The works are to be undertaken in accordance with BS 3998 2010.

Erection of protective fencing/Mitigation measures

The erection of protective fencing is to be erected to the fence line shown in tree protection plan. The fencing must adhere with BS 5837: 2012 (Figure 4 above). Signage must be placed on the fence to highlight its importance. Once the fencing is erected works can commence on-site.

Stage 2 - The Construction Works Stage

Protective Fencing

During the course of the construction works the integrity of the fencing must be respected and remain in place at all times. No building materials or soil heaps are to be stored within this area. Should essential works need to take place with the root protection area the project arborist must be informed in advance and any mitigation measures are to be put in place. The protective fencing must remain in situ for the duration of the project and must only be removed upon completion of all works.

Excavations

Excavation works are only to commence once the protective fence line is in place. The excavations need to be viewed on site once marked out with the project manager, site foreman and the project arborist in advanced of excavation to determine the extent of the impact and the works space required to allow the construction works proceed and to assess any additional mitigation measures that may be required to protect the retained trees. In certain areas it may be necessary to use alternative methods of excavation to prevent encroachment into the RPA of the trees to be retained and this may include such methods as retaining walls, no dig technique etc.

Working within the RPA

The Site Arborist should be given 5 days' notice of any works within, or access required to this zone.

All works must be carried out manually root pruning is to be undertaken by an arborist using handheld equipment such as a handsaw. For pedestrian movements within the R.P.A. the installation of ground protection in the form of a single thickness of scaffold boards on top of a compressible layer laid onto a geotextile may be acceptable. For wheeled or tracked movements within the R.P.A. the ground protection should be designed by an engineer to accommodate the likely loading.

Finished ground levels/Landscaping

Trees that are to be retained should be protected so that soil disturbance and changes in soil levels do not occur. The construction exclusion zone surrounding a tree should contain sufficient rooting volume to ensure the survival of the tree. The location and erection of protective fences is as specified in accordance with BS 5837:2012 ''Trees in relation to Construction'' and on the drawings (see drawing no.**1819_TS_P_02**). Where changes in level occurs, these are to be either

graded into the finished levels starting outside the RPA or alternatively, retaining wall structures are to be used differentiating between the different levels. All finished surfaces are to be porous to allow the free movement of water and gaseous exchange to the roots.
Where hard surfaces are proposed within the Root Protection Area (RPA) a strict no dig design excavation must be adhered to, avoiding unnecessary root loss. In the event where excavation is essential a hand dig system must be undertaken under arborist supervision. The hard surface must be permeable to allow the roots moisture infiltration and gaseous diffusion. Structurally, the hard surface should be designed to avoid localised compaction, by evenly distributing the carried weight. The sub-base will consist of a three-dimensional cellular confinement system with the build up to the engineer's detail and approved by the arborist.

All operations to be in accordance with BS 5837:2012 Trees in relation to design, demolition and construction -Recommendations.

Stage 3 - Post Development Works

The project is not to be considered complete until the arborist has inspected the site and is satisfied that all retained trees have been protected in accordance with the site-specific Tree Protection Plan and there has been no negative impact on the retained trees on site as a result of the development.

Conclusions

The proposed development will have some impact on the existing tree cover on the site, where 7 trees are marked for removal, however additional replanting will works will mitigate any loss of trees as a result of the development, and will be a net positive to the tree cover in this particular location. Final numbers of trees to be removed will be subject to detailed landscape design. Due to the condition of the trees to be retained it is recommended that they are monitored as the scheme develops and are replaced where appropriate after the proposed planting establishes.

Cascade chart for tree quality assessment- BS5837:2012

Category and definition	Criteria (including subcategories where appropriate)			Identification on plan
Trees unsuitable for retention (See Note)				
Category U Those in such a condition that they cannot realistically be retained as living trees in the context of the current land use for longer than 10 years	• Trees that have a serious, irremediable, structural defect, such that their early loss is expected due to collapse, including those that will become unviable after removal of other category U trees (e.g. where, for whatever reason, the loss of companion shelter cannot be mitigated by pruning) • Trees that are dead or are showing signs of significant, immediate, and irreversible overall decline • Trees infected with pathogens of significance to the health and/or safety of other trees nearby, or very low quality trees suppressing adjacent trees of better quality *NOTE Category U trees can have existing or potential conservation value which it might be desirable to preserve; see [BS5837:2012]* ***4.5.7****.*			
Trees to be considered for retention				
	1 Mainly arboricultural qualities	**2 Mainly landscape qualities**	**3 Mainly cultural values, including conservation**	
Category A Trees of high quality with an estimated remaining life expectancy of at least 40 years	Trees that are particularly good examples of their species, especially if rare or unusual; or those that are essential components of groups or formal or semi-formal arboricultural features (e.g. the dominant and/or principal trees within an avenue	Trees, groups or woodlands of particular visual importance as arboricultural and/or landscape features	Trees, groups or woodlands of significant conservation, historical, commemorative or other value (e.g. veteran trees or wood-pasture)	
Category B Trees of moderate quality with an estimated remaining life expectancy of at least 20 years	Trees that might be included in category A, but are downgraded because of impaired condition (e.g. presence of significant though remediable defects, including unsympathetic past management and storm damage), such that they are unlikely to be suitable for retention for beyond 40 years; or trees lacking the special quality necessary to merit the category A designation	Trees present in numbers, usually growing as groups or woodlands, such that they attract a higher collective rating than they might as individuals; or trees occurring as collectives but situated so as to make little visual contribution to the wider locality	Trees with material conservation or other cultural value	
Category C Trees of low quality with an estimated remaining life expectancy of at least 10 years, or young trees with a stem diameter below 150 mm	Unremarkable trees of very limited merit or such impaired condition that they do not qualify in higher categories	Trees present in groups or woodlands, but without this conferring on them significantly greater collective landscape value; and/or trees offering low or only temporary/transient landscape benefit	Trees with no material conservation or other cultural value	

Tree Survey Tables

ID	Latin Name	Common Name	Stem Dia. [mm]	Tree Height [m]	Branch Spread [m]				Life Stage	Structural Condition	Physiological Condition	Quality Category	RPA [m]	Comments	Recommendations
					N	E	S	W							
T104	Acer pseudoplatanus	Sycamore	280	10	4	4	5	5	Early-mature	Fair	Fair	C2	3.36	Competition - Adjacent trees. Deadwood - Minor. Epicormic growth - Base. Ivy or climbing plant. Multi-stemmed.	Overhaul crown and remove all deadwood. Reduce crown by 20%. Remove all Ivy
T105	Acer pseudoplatanus	Sycamore	280	10	4	4	5	5	Early-mature	Fair	Fair	C2	3.36	Competition - Adjacent trees. Deadwood - Minor. Epicormic growth - Base. Ivy or climbing plant. Multi-stemmed.	Overhaul crown and remove all deadwood. Reduce crown by 20%. Remove all Ivy
T106	Acer pseudoplatanus	Sycamore	510	12	4	5	5	6	Mature	Fair	Fair	C2	6.12	Deadwood - Minor. Epicormic growth - Base. Ivy or climbing plant. Pruning wounds - Decayed. Suppressed crown - Minor. Unbalanced crown - Minor.	Overhaul crown and remove all deadwood. Reduce crown by 20%. Remove all Ivy

T107	Acer pseudoplatanus	Sycamore	280	10	4	4	5	5	Early-mature	Fair	Fair	C2	3.36	Competition - Adjacent trees. Deadwood - Minor. Epicormic growth - Base. Ivy or climbing plant. Multi-stemmed.	Overhaul crown and remove all deadwood. Reduce crown by 20%. Remove all Ivy
T108	Acer pseudoplatanus	Sycamore	280	10	4	4	5	5	Early-mature	Fair	Fair	C2	3.36	Competition - Adjacent trees. Deadwood - Minor. Epicormic growth - Base. Ivy or climbing plant. Multi-stemmed.	Overhaul crown and remove all deadwood. Reduce crown by 20%. Remove all Ivy
T110	Acer pseudoplatanus	Sycamore	490	11	5	5	5	4	Mature	Fair	Fair	C2	5.88	Branch - Broken. Competition - Adjacent trees. Deadwood - Minor. Excavation within root zone - Suspected. Ivy or climbing plant. Root damage - Suspected.	Overhaul crown and remove all deadwood. Reduce crown by 20%. Remove all Ivy
T696	Acer pseudoplatanus	Sycamore	730	14	4	3.5	4.1	4.1	Mature	Good	Good	B1	8.76	Heavily suppressed by ivy	
T697	Acer pseudoplatanus	Sycamore	730	14	4	3.5	4.1	4.1	Mature	Good	Good	B1	8.76	Heavily suppressed by ivy	

T698	Acer pseudoplatanus	Sycamore	730	14	4	3.5	4.1	4.1	Mature	Poor	Dead	B1	8.76	Heavily suppressed by ivy
T699	Acer pseudoplatanus	Sycamore	620	14	4	2.5	2.1	3.2	Mature	Good	Good	B1	7.44	Heavily suppressed by ivy
T700	Acer pseudoplatanus	Sycamore	820	14	4.5	3.2	4	4	Mature	Fair	Fair	B2	9.84	Heavily suppressed by ivy
T701	Acer pseudoplatanus	Sycamore	820	14	4.5	3.2	4	4	Mature	Fair	Fair	B2	9.84	Heavily suppressed by ivy
T702	Acer pseudoplatanus	Sycamore	440.91	9	4	4	4	4	Mature	Good	Good	B1	5.29	Heavily suppressed by ivy
T703	Acer pseudoplatanus	Sycamore	710	11	2.8	3.8	3.7	3.8	Mature	Fair	Fair	C1	8.52	Heavily suppressed by ivy
T705	Acer pseudoplatanus	Sycamore	680	14	3.7	3.2	3.7	3.2	Mature	Good	Good	B2	8.16	Heavily suppressed by ivy
T704	Acer pseudoplatanus	Sycamore	710	11	2.8	3.8	3.7	3.8	Mature	Fair	Fair	C1	8.52	Heavily suppressed by ivy
T706	Acer pseudoplatanus	Sycamore	393.7	7	4	3.5	4	3.5	Mature	Fair	Fair	C2	4.72	Heavily suppressed by ivy
T707	Acer pseudoplatanus	Sycamore	960	11	3.5	3.5	3.5	3.5	Mature	Good	Good	B1	11.52	Heavily suppressed by ivy
T708	Alnus cordata	Italian Alder	500	14	3.5	3.5	3.5	3.5	Mature	Poor	Poor	U	6	Heavily suppressed by ivy; in decline

Tree Survey Plans

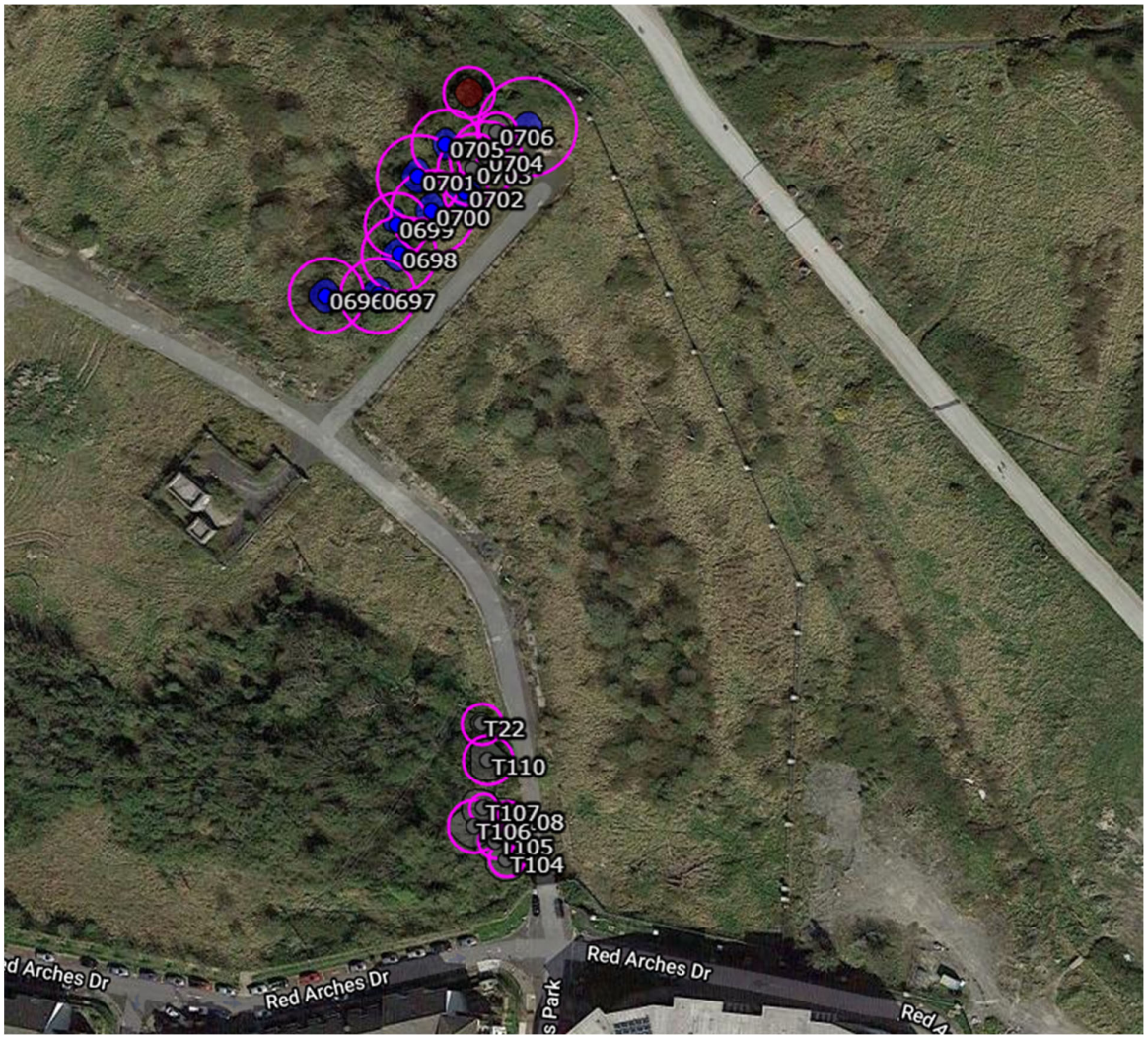

Figure 2 – Tree inventory on TreePlotter

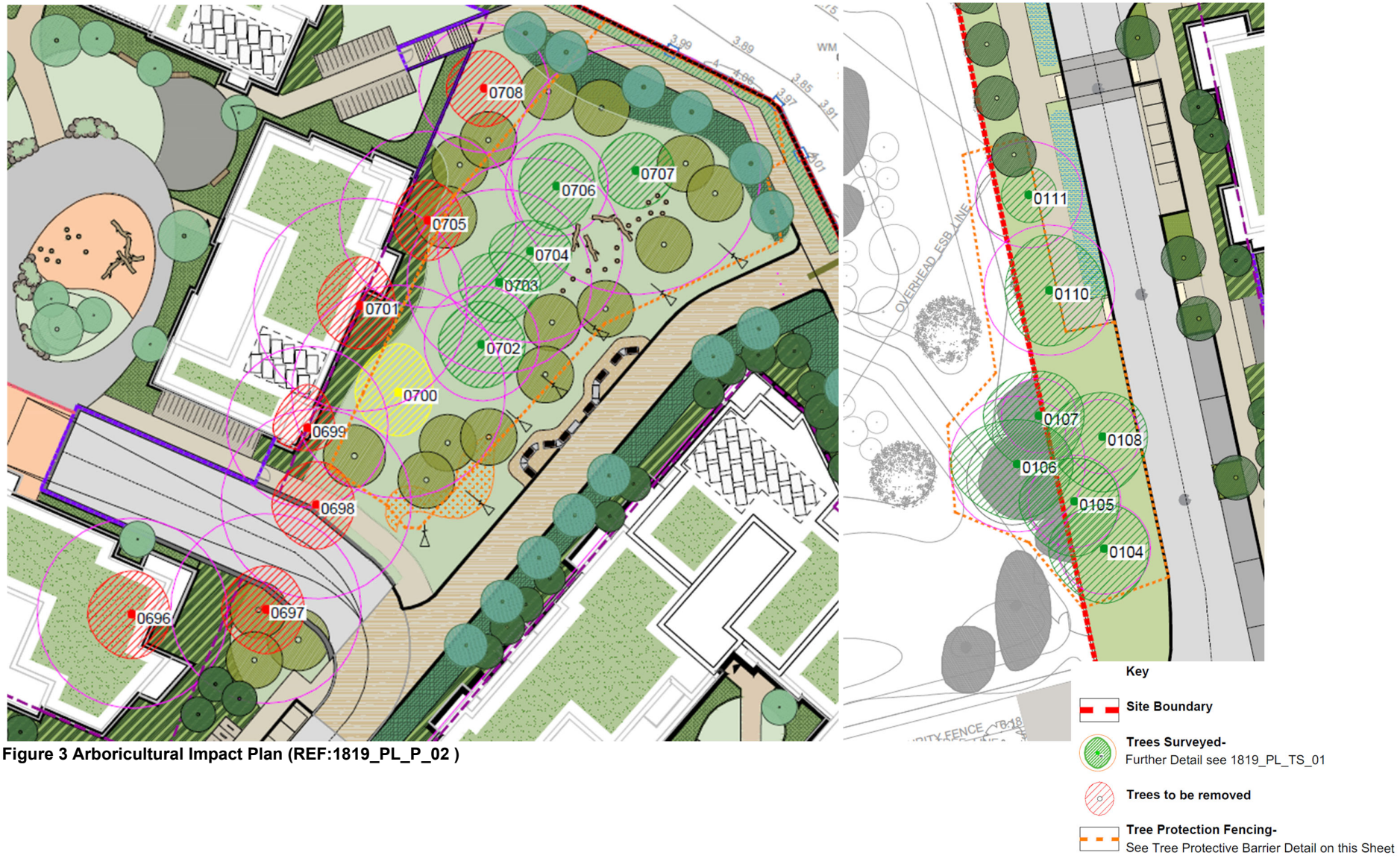

Figure 3 Arboricultural Impact Plan (REF:1819_PL_P_02)

Disclaimers

This report is intended solely for the benefit of the parties to whom it is addressed, and no responsibility is extended to any third party for the whole or any part of its contents. The conclusions and recommendations in this report are only valid for a period of one year. This period of validity may be reduced in the case of any change in conditions to or in proximity to the tree. In the event of adverse weather conditions, there is the possibility of any tree despite good report surveys, falling over.

In the event of a falling tree causing damage to residential or non-residential buildings in their proximity, no liability will attach to this firm, in the event of damage by such trees, to any person, any building public or private, or any mechanical vehicle or otherwise. Recommendations made in this report are subject to the knowledge and expertise of the qualified Arborist that carried out the above inspections.

Signed John J Ward

Dated: 23rd March 2022
John Ward

ISA Certified Arborist

APPENDIX 14.1

RECORDED ARCHAEOLOGICAL MONUMENTS

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Recorded Archaeological Monuments located within c. 1 km of the proposed development are listed below (source Record of Monuments and Places for Co. Dublin, www.archaeology.ie).

RMP No.	**DU015-055----**
Class:	Enclosure
Townland:	MAYNETOWN
Description:	Located towards the western end of an east-west ridge with extensive views of the coast and Ireland's Eye. An aerial photograph (OS 8, 7654) shows cropmark evidence for a roughly circular univallate enclosure. Geophysical survey and two test excavations were undertaken at the site in advance of proposed development. The geophysical revealed the presence of a large circular enclosure, (c. 70m in diam.) that abutted an unusual 'avenue' feature, defined by two parallel ditches leading away from an east-facing entrance. Initial archaeological testing (Licence no. 00E0732) consisted of a single trench situated diagonally across the site, that confirmed the presence of a ditch, entrance and archaeological material both internally and external to the main enclosure ditch. A decorated bone bead was recovered (Wallace, A. 2002, 115). Further test excavation (Licence no. 07E0547) consisted of opening sections across the enclosure ditch and 'avenue'. The enclosure ditch (c. 7m wide x 2m deep) was filled by a number of silty clay deposits that contained much charcoal, butchered animal bone and sea shell (oyster, mussel, razor shell, periwinkle, cockles etc.). The lower fills were waterlogged in nature and contained lenses of organic material including decayed wood and grass. A charcoal sample from the primary fill was dated to AD 687–887 (2 Sigma). A section was also excavated through the southern avenue ditch and this revealed a cut measuring c. 5m wide by 1.2m deep. It had a concave profile and was filled by silty/sandy clay deposits that contained occasional seashell, butchered animal bone and charcoal (Moriarty, C. 2008:477 www.excavations.ie) According to the Portmarnock South LAP, the buffer zone for the monument will form part the open space within the green infrastructure network. The site is currently fenced within overgrown wasteland. Scheduled for inclusion in the next revision of the RMP
Compiled by:	Geraldine Stout
Updated by:	Christine Baker
Date of upload:	27 January 2015
References:	Wallace, A. 2002 Maynetown. In I. Bennett (ed.), Excavations 2000: summary accounts of archaeological excavations in Ireland, 115. Bray. Wordwell. Moriarty, C. 2008 Rathlogan: pit In I. Bennett (ed.), Excavations 2005: summary accounts of archaeological excavations in Ireland, 193, no. 790. Dublin. Wordwell. Moriarty, C. 2009c Final report, archaeological Excavations at Portmarnock Mound (DU015:014) and the Maynetown enclosure (DU015:055) Co. Dublin (Licence no. 07E0574). Unpublished report submitted to the National Monuments Service, Department of Arts, Heritage and the Gaeltacht.

RMP No.	**DU015-063----**
Class:	Enclosure
Townland:	GRANGE (Coolock By., Coolock ED)
Description:	An aerial photograph (OS 7 9517, 9519) showed cropmark evidence for a univallate enclosure which is roughly circular in plan. Test excavation (Licence no. 03E1496) was undertaken in advance of housing development. Nine trenches were opened on the site of the monument but no traces of any features were identified (O'Carroll, E. 2003:485 www.excavations.ie). Now built over. Not scheduled for inclusion in the next revision of the RMP
Compiled by:	Geraldine Stout
Updated by:	Christine Baker
Date of upload:	28 January 2015
References:	O'Carroll, E. 2006 Carrowmurragh: medieval. In I. Bennett (ed.), Excavations 2003: summary accounts of archaeological excavations in Ireland, 419, No.1554. Bray. Wordwell.

RMP No.	**DU015-064001-**
Class:	Enclosure
Townland:	GRANGE (Coolock By., Malahide ED)
Description:	An aerial photograph (OS 7, 9517, 9519) showed cropmark evidence for a univallate enclosure (diam. c. 20m) with an annex on the E. Test excavation (Licence no. 03E1496) in advance of housing development did not identify the site (O'Carroll, E. 2003: 485 www.excavations.ie). Now built over. Not scheduled for inclusion in the next revision of the RMP
Compiled by:	Geraldine Stout
Updated by:	Christine Baker
Date of upload:	28 January 2015
References:	O'Carroll, E. 2006 Carrowmurragh: medieval. In I. Bennett (ed.), Excavations 2003: summary accounts of archaeological excavations in Ireland, 419, No.1554. Bray. Wordwell. O'Carroll, E. 2006 Carrowmurragh: medieval. in I. Bennett Excavations 2003. Summary accounts of archaeological excavations in Ireland, 419, No.1554. Bray.

RMP No.	**DU015-096----**
Class:	Burnt mound
Townland:	GRANGE (Coolock By., Malahide ED)
Description:	Pre-development testing in 1993 revealed the remains of a prehistoric burnt mound (L 0.68m, Wth 0.82m). It comprised a deposit of heat shattered stone (O'Carroll 2006, 117). Not scheduled for inclusion in the next revision of the RMP
Compiled by:	Geraldine Stout
Date of upload:	26 August 2011
References:	O'Carroll, E. 2009 Ballynagran landfill, Coolbeg. In I. Bennett (ed.), Excavations 2006: summary accounts of archaeological excavations in Ireland, 571 (No. 2170). Dublin. Wordwell.

RMP No.	**DU015-097----**
Class:	Burnt mound
Townland:	GRANGE (Coolock By., Coolock ED)

Description: Archaeological testing in 2003 revealed the remains of a small prehistoric burnt-mound (L 0.82m, Wth 0.68m). It consisted of a deposit of heat shattered stone (O Carroll, E 2006, 117).
Not scheduled for inclusion in the next revision of the RMP
Compiled by: Geraldine Stout
Date of upload: 26 August 2011

RMP No. **DU015-118----**

Class: Enclosure
Townland: DRUMNIGH
Description: A circular enclosure visible as a crop mark on an aerial photograph (SMR file; pers. comm. T. Condit). This site was subject to three geophysical surveys. Geophysical survey (Licence no. 07R0230) was undertaken in advance of proposed realignment. It identified a pennanular ditch (c.30m diam.) with an entrance to the east (Nicholls 2008). Another geophyscial survey (Licence no. 07R0230EXT), also in advance of a proposed road realignment immediately north, identified another circular feature (c.25m diam.) which may be associated (Harrison 2008). A third geophysical survey (14R0045) in advance of the Greater Dublin Drainage Scheme identified the southern limit of the same enclosure, the ditch of which may contain burnt remains (Bonsall 2014, 9).
Scheduled for inclusion in the next revision of the RMP
Compiled by: David O'Connor
Updated by: Christine Baker
Date of upload: 28 January 2015
References: Nicholls, J. 2008a Geophysical Survey Report: R123 Mayne Road Upgrade, Drumnigh, Snugborough & Maynetown Townlands, North County Dublin (Licence no. 07R0230). Unpublished report submitted to the National Monuments Service, Department of Arts, Heritage and the Gaeltacht.
Harrison, D. 2008a Geophysical Survey Report: R123 Mayne Road, Portmarnock, North County Dublin (Licence no. 07R0230EXT). Unpublished report submitted to the National Monuments Service, Department of Arts, Heritage and the Gaeltacht.
Bonsall, J. 2014 Archaeological Geophysical Survey, Great Dublin Drainage Scheme, Blanchardstown to Swords (Licence no. 14E0045). Unpublished report submitted to the National

Monuments Service, Department of Arts, Heritage and the Gaeltacht.

RMP No. **DU015-130----**

Class: Enclosure
Townland: MAYNETOWN
Description: The site was subject to geophysical survey (Licence no. 07R0230) in advance of a proposed road realignment. It confirmed the presence of a sub circular enclosure (34m in diam.) that contains internal responses suggestive of pits and postholes (Harrison 2008, 8).
Scheduled for inclusion in the next revision of the RMP
Compiled by: Paul Walsh
Updated by: Christine Baker
Date of upload: 28 January 2015
References: Harrison, D. 2008a Geophysical Survey Report: R123 Mayne Road, Portmarnock, North County Dublin (Licence no. 07R0230EXT). Unpublished report submitted to the National Monuments Service, Department of Arts, Heritage and the Gaeltacht.

RMP No. **DU015-135----**
Class: Enclosure
Townland: DRUMNIGH
Description: An enclosure was identified by geophysical survey (Licence no. 07R0230 ext.) undertaken in advance of a road realignment scheme. The circular enclosure (25m diam.) is located 27m N of another enclosure DU015-118--- on the S-facing slope of a low E – W ridge. Internal responses indicative of pits and postholes have been identified suggesting an area of occupation or settlement (Harrison 2008, 8).
Scheduled for inclusion in the next revision of the RMP
Compiled by: Christine Baker
Date of upload: 6 February 2015
References: Harrison, D. 2008a Geophysical Survey Report: R123 Mayne Road, Portmarnock, North County Dublin (Licence no. 07R0230EXT). Unpublished report submitted to the National Monuments Service, Department of Arts, Heritage and the Gaeltacht.

APPENDIX 14.2

ARCHAEOLOGICAL FINDS

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The recorded archaeological finds in the vicinity of the proposed development, are listed below, all noted in the National Museum of Ireland files, Kildare Street, Dublin 2, or in other published catalogues of prehistoric material: Raftery (1983 - iron age antiquities), Eogan (1965; 1993; 1994 - bronze swords, Bronze Age hoards and goldwork), Harbison (1968; 1969a; 1969b - bronze axes, halberds and daggers) and the Irish Stone Axe Project Database.

NMI Reg.	**1958:50**
Location	Snugborough
Object Type	Fragment of Decorated Slab

NMI Reg.	**IA/L/1985:1**
Location	Baldoyle
Object Type	Strike-a-Light

NMI Reg.	**IA/33/85**
Location	Donaghmede
Object Type	Silver Vessel

NMI Reg.	**IA/189/86**
Location	Saintdoolaghs
Object Type	Bronze (?) Ring Brooch; Bronze Buckle; 2 Pieces of Lead

APPENDIX 14.3

EXCAVATIONS

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The excavation bulletin website (www.excavations.ie) was consulted to identify previous excavations that have been carried out within the study area. This database contains summary accounts of excavations carried out in Ireland from 1970 to 2020.

Excavation No.: 2003:485
Site name: The Grange, Donaghmede
SMR No.: N/A
Licence No.: 03E1496
Author: Ellen O'Carroll, The Archaeology Company, Office 1, 17 Castle Street, Dalkey, Co. Dublin.
Site type: Burnt mound
ITM: E 722525m, N 740725m
Description: Testing took place at Grange Road, Donaghmede, Co. Dublin. The client was developing an area of 133 acres for a large mixed-use and residential development. The site contains two recorded monuments, cropmarks SMR 15:63 and 15:64, and the site of a lodge house, Grange Lodge (see No. 486 below, 03E1345). This licence relates to the testing at the site of the cropmarks.
Nine trenches were excavated on the site of the monument. No trace of any features relating to the enclosure indicated by a cropmark on aerial photographs was found. The remains of a small prehistoric burnt-mound feature were uncovered in Trenches 5 and 6. It measured 0.68m north–south by 0.82m and consisted of a deposit of heat-shattered stone in a very dark grey clay, with small stones and fine pebbles (mostly sandstone). This deposit sat in dark greyish-brown clay with charcoal. This site was to be directly impacted upon by the development and further mitigation in the form of excavation was recommended.

Excavation No.: 2003:486
Site name: Grange Lodge, Donaghmede
SMR No.: N/A
Licence No.: 03E1495
Author: Ellen OCarroll, The Archaeology Company, Office 1, 17 Castle Street, Dalkey, Co. Dublin.
Site type: Post-medieval
ITM: E 722625m, N 740525m
Description: Testing took place at Grange Road, Donaghmede, Co. Dublin, on an area of 133 acres proposed for a large mixed-use and residential development. The site contains two recorded monuments, cropmarks SMR 15:63 and 15:64 (see No. 485 above, 03E1496), and the site of a lodge house, Grange Lodge.
The site of the former Grange Lodge was firstly cleared of all scrub. Three test-trenches were excavated north–south along the site, which uncovered the foundation remains of the 18th–19th-century gate lodge, on the grounds of a larger estate, and associated outhouses. The lodge was a substantial two-storey house with a rounded front elevation. It had two side wings, also rounded at either end. It appears to have had a cobbled yard in the centre and a series of outhouses located to the north of this.

Excavation No.: 2004:444
Site name: BALDOYLE/STAPOLIN
SMR No.: SMR 15:63 and 15:64
Licence No.: 04E1294

Author: Sinéad Phelan, Margaret Gowen & Co. Ltd, 27 Merrion Square, Dublin 2.
Site type: 19th-century garden
ITM: E 723317m, N 740861m
Description: This assessment was carried out in the townlands of Stapolin and Baldoyle. The proposed development will involve the construction of a large-scale residential development. Nine test-trenches were mechanically excavated across the proposed development area. Garden features and outhouses relating to the 19th-century Stapolin House were exposed. No other archaeological deposits were identified during this assessment.

Excavation No.: 2004:453
Site name: SITE 4:4, GRANGE, BALDOYLE
SMR No.: N/A
Licence No.: 04E0342
Author: Stuart D. Elder, The Archaeology Company, Birr Technology Centre, Mill Island, Birr, Co. Offaly.
Site type: Enclosure
ITM: E 723557m, N 740191m
Description: Test-trenching at a new town development at Grange, Baldoyle, revealed several charcoal-rich features (No. 446 above, 03E1535) and the trenches were subsequently widened into an area measuring some 250m2. A subcircular ditch feature of c. 100m in circumference was noted and a number of sections excavated through it. These sections showed up to seven fills – alternate episodes of silting and slumping – as well as a narrow recut towards the end-of-use phase, and the eventual deliberate backfilling. Rounded ditch terminals and a metalled pathway through the entrance were located on the north side of the site, and a series of three, possibly four, substantial post-holes 2m or so inside the ditch at the entrance represented a probable square-plan gate-tower feature. The enclosure ditch measured c. 30m in diameter by 3m wide by up to 2.3m deep.
Surviving internal features were represented by rubbish pits and linear features, with a single posthole evident towards the centre of the site. The dearth of directly attributable structural features was frustrating, but wide furrows cutting the backfilled ditch and the features within it attested to the intensity of tillage farming since the site went out of use. Artefacts included a fragment of lignite bracelet and a copper-alloy stick pin from pit deposits towards the centre of the site and a socketed iron object from the western terminal of the ditch.
Post-excavation analysis is ongoing, but the site has provisionally been interpreted as a levelled ringfort.

Excavation No.: 2004:464
Site name: SITE 11:1, GRANGE, BALDOYLE
SMR No.: N/A
Licence No.: 04E0347
Author: Stuart D. Elder, The Archaeology Company, Birr Technology Centre, Mill Island, Birr, Co. Offaly.
Site type: Post-medieval
ITM: E 724541m, N 740359m
Description: This site was found during testing close to the site of the former Grange Lodge at the highest point of land within a new town development at Grange, Baldoyle (No. 446 above, 03E1535), and was

characterised by sixteen linear features. The features were filled with seashells and animal bone fragments in a dark silty clay matrix. The few finds noted indicate an 18th/19th-century date and the site has been interpreted as drainage activity.

Excavation No.: 2005:382
Site name: FATHER COLLINS PARK, GRANGE ROAD, BALDOYLE
SMR No.: N/A
Licence No.: 05E1372
Author: Colm Moriarty, Margaret Gowen & Co. Ltd, 27 Merrion Square, Dublin 2.
Site type: Post-medieval
ITM: E 722965m, N 740244m
Description: An assessment was carried out at Father Collins Park, Baldoyle, to establish the nature and extent of a number of anomalies identified in a geophysical survey (Licence 05R166). Seven test-trenches were mechanically excavated at the proposed development site. These revealed that most of the anomalies were related to 19th-century land division and drainage. However, at the very northern end of the park one area of archaeological potential was identified. Four shallow cuts were identified, two of which had evidence for in situ burning. It is possible that these features are the remains of crude kilns. A fragment of Westerwald pottery was recovered from one of the cuts, suggesting that this feature, at least, dates to the 17th or early 18th centuries. The remainder of the finds (slag, burnt stone, burnt brick) recovered from these features are suggestive of some form of industrial activity being carried out at this site. Though the full extent of the archaeological features could not be defined in the test-trenches excavated, the geophysical survey results suggest that subsurface activity stretches over an area measuring 45m north–south by 10m.

Excavation No.: 2017:94
Site name: Saint Mary's, Baldoyle
SMR No.: none
Licence No.: 17E0169
Author: Donald Murphy and Will O'Siorain
Site type: Non Archaeological
ITM: E 724482m, N 740051m
Description: Three test trenches were excavated within the footprint of the proposed development. Rubble, cables and pipes were exposed within Trench 1 and this section of the site had been significantly disturbed in the past. Sandy material was exposed within Trench 2 and Trench 3. This represented redeposited material and it is likely that this section of the site was reclaimed land and also disturbed. Modern features including a pit and linear feature were identified in Trench 2 and a slightly curved feature and pit filled with animal bone in Trench 3. All features were filled with loose garden soil and are modern.
A section of this site located west of Trench 2 and Trench 3 was also monitored. The same sandy redeposited material was exposed within this area. No archaeological features or deposits were recorded and no finds were recovered.
Archaeological Consultancy Services Unit, Unit 21 Boyne Business Park, Greenhills, Drogheda, Co Louth

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APPENDIX 14.4

NATIONAL INVENTORY OF ARCHITECTURAL HERITAGE

PREPARED BY CRDS LTD.

The recorded archaeological sites within c. 1km of the development are listed below, all noted in the National Inventory of Architectural Heritage (NIAH) for Co. Dublin (https://www.buildingsofireland.ie/).

Reg No **11358037**
Strand Road, STAPOLIN, Baldoyle,

Rating	Regional
Cat of Special Interest	Architectural, Social, Technical
Original Use	House
In Use As	House
Date	1860 - 1900
Coordinates	324523, 240457
Date Recorded	28/06/2005
Date Updated	--/--/--
Description	Detached three-bay single-storey thatched house, c.1880. Single-bay single-storey flat-roofed extension to rear, c.1950. ROOF: Double-pitched; straw thatched; decorative hazel rod pinning; concrete coping; red brick chimney stacks; flat-roof to return; nap rendered chimney stack. WALLS: Roughcast; unpainted; nap dressings, side and rear return elevations; unpainted. OPENINGS: Square-headed openings. Granite sills; fixed pane timber windows; replacement timber panelled door.

Reg No **11358049**
Baldoyle National School, Brookstone Road, BALDOYLE

Rating	Regional
Cat of Special Interest	Architectural, Social
Original Use	School
In Use As	School
Date	1930 - 1950
Coordinates	324211, 240101
Date Recorded	28/06/2005
Date Updated	--/--/--
Description	Detached multiple-bay single-storey school, c.1940. Comprising nine-bay central block with hipped roof. Multiple-

bay single-storey flat-roofed block attached to front elevation. ROOF: Double pitched hipped roof with slates and concrete ridge tiles; cast-iron rainwater goods; two red brick and rendered chimney stacks to rear pitch of roof. WALLS: Pebble dashed on a brick plinth. OPENINGS: Square headed patent reveals, stone cills; timber sash windows: projecting brick door surround; timber panelled door.

Reg No	**50130223**
	Main Street, Clongriffen, Dublin 13, DUBLIN

Rating	Regional
Cat of Special Interest	Artistic, Historical, Social, Technical
Original Use	Post box
In Use As	Post box
Date	1930 - 1940
Coordinates	322797, 240721
Date Recorded	06/06/2018
Date Updated	--/--/--
Description	Freestanding round-plan cast-iron pillar postbox, installed c. 1930, having shallow domed cap, moulded corona, neck moulding, cylindrical shaft and moulded plinth base. Curved hinged door incorporating letter slot with raised frame below and raised 'P&T' motif. Raised lettering to each side of slot reads 'An chéad bailiú eile/Next collection'. Raised lettering to plinth base reads 'St. Johns Ironworks, Enniscorthy'. Later overflow collection box to rear face.
Appraisal	An example of a postbox from the early years of the Irish Republic, manufactured by St. Johns Ironworks, Enniscorthy, firm that supplied cast-iron postboxes from 1922-46. The design is based on earlier pillar boxes, but is distinguished by the 'P&T' logo of the Irish postal service in Gaelic and English lettering.

APPENDIX 14.5

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Appendix 15.1

Turning Movement Survey

JB Barry Consulting Engineers

IDASO

Survey Name: HDR 20 128 Grange Rd
Site: Site 1
Location: —
Date: Wed 31-Jan-2018

	A => A							A => B							A => C							A => D						
TIME	CAR	LGV	OGV1	OGV2	5V (BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	5V (BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	5V (BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	5V (BUS	TOT	PCU
07:00	0	1	0	0	0	1	1	8	2	0	0	0	10	10	38	3	0	0	0	41	41	43	8	0	0	1	52	53
07:15	1	0	0	0	0	1	1	17	1	0	0	0	18	18	55	4	0	0	2	61	63	33	9	0	0	2	44	46
07:30	0	0	0	0	0	0	0	29	3	0	0	0	32	32	50	6	1	0	0	57	57.5	60	5	0	0	3	68	71
07:45	0	0	0	0	0	0	0	38	2	0	0	0	40	40	92	7	1	0	0	100	100.5	48	8	0	1	5	62	68.3
07:00 H/TOT	1	1	0	0	0	2	2	92	8	0	0	0	100	100	235	20	2	0	2	259	262	184	30	0	1	11	226	238.3
08:00	0	0	0	0	0	0	0	35	3	1	0	1	40	41.5	108	6	1	1	0	116	117.8	51	3	1	0	3	58	61.5
08:15	0	0	0	0	0	0	0	34	1	0	0	0	35	35	60	3	0	0	0	63	63	29	2	0	0	2	33	35
08:30	0	0	0	0	0	0	0	25	2	0	0	0	27	27	74	3	0	0	0	77	77	18	3	0	0	2	23	25
08:45	0	0	0	0	0	0	0	44	1	0	0	0	45	45	60	1	0	0	0	61	61	10	2	0	1	0	13	14.3
08:00 H/TOT	0	0	0	0	0	0	0	138	7	1	0	1	147	148.5	302	13	1	1	0	317	318.8	108	10	1	1	7	127	135.8
09:00	0	0	0	0	0	0	0	40	2	1	0	0	43	43.5	57	3	0	0	0	60	60	20	4	0	1	3	28	32.3
09:15	1	0	0	0	0	1	1	41	7	0	0	0	48	48	98	2	0	0	0	100	100	38	2	1	0	2	43	45.5
09:30	0	0	0	0	0	0	0	24	2	0	0	0	26	26	44	5	0	0	0	49	49	40	6	1	0	4	51	55.5
09:45	0	0	0	0	0	0	0	24	2	0	0	0	26	26	41	3	1	0	0	45	45.5	25	3	2	0	1	31	33
09:00 H/TOT	1	0	0	0	0	1	1	129	13	1	0	0	143	143.5	240	13	1	0	0	254	254.5	123	15	4	1	10	153	166.3
10:00	0	0	0	0	0	0	0	16	4	0	0	0	20	20	44	5	0	0	0	49	49	30	0	0	0	2	32	34
10:15	0	0	0	0	0	0	0	4	1	1	0	0	6	6.5	40	7	0	0	0	47	47	25	5	0	0	3	33	36
10:30	1	0	0	0	0	1	1	18	1	0	0	0	19	19	47	6	0	0	1	54	55	33	3	0	0	1	37	38
10:45	1	0	0	0	0	1	1	18	1	0	1	0	20	21.3	32	5	0	0	0	37	37	28	5	0	1	2	36	39.3
10:00 H/TOT	2	0	0	0	0	2	2	56	7	1	1	0	65	66.8	163	23	0	0	1	187	188	116	13	0	1	8	138	147.3
11:00	0	0	0	0	0	0	0	17	3	1	0	0	21	21.5	38	2	2	0	0	42	43	21	2	2	0	3	28	32
11:15	1	0	0	0	0	1	1	23	1	0	0	0	24	24	47	6	0	0	0	53	53	18	4	2	0	2	26	29
11:30	1	1	0	0	0	2	2	9	3	0	0	0	12	12	39	2	0	0	0	41	41	30	5	0	0	1	36	37
11:45	0	0	0	0	0	0	0	23	2	0	0	0	25	25	50	3	1	0	0	54	54.5	27	5	0	0	2	34	36
11:00 H/TOT	2	1	0	0	0	3	3	72	9	1	0	0	82	82.5	174	13	3	0	0	190	191.5	96	16	4	0	8	124	134
12:00	0	0	0	0	0	0	0	18	4	0	0	0	22	22	46	1	1	0	0	48	48.5	29	6	1	0	1	37	38.5
12:15	0	0	0	0	0	0	0	25	2	1	0	0	28	28.5	43	4	3	0	0	50	51.5	23	4	2	0	2	31	34
12:30	0	0	0	0	0	0	0	21	5	0	0	0	26	26	53	4	0	0	0	57	57	16	2	1	0	1	20	21.5
12:45	0	0	0	0	0	0	0	27	1	0	0	0	28	28	73	6	0	0	1	80	81	26	4	1	0	2	33	35.5
12:00 H/TOT	0	0	0	0	0	0	0	91	12	1	0	0	104	104.5	215	15	4	0	1	235	238	94	16	5	0	6	121	129.5
13:00	0	0	0	0	0	0	0	16	0	0	0	0	16	16	57	4	0	0	0	61	61	31	6	1	0	1	39	40.5
13:15	0	0	0	0	0	0	0	30	2	1	0	0	33	33.5	77	3	0	0	0	80	80	32	1	1	1	3	38	42.8
13:30	1	0	0	0	0	1	1	46	1	1	0	0	48	48.5	56	2	0	1	0	59	60.3	37	4	2	0	2	45	48
13:45	0	0	0	0	0	0	0	27	1	0	0	0	28	28	52	4	0	0	0	56	56	28	0	0	0	2	30	32
13:00 H/TOT	1	0	0	0	0	1	1	119	4	2	0	0	125	126	242	13	0	1	0	256	257.3	128	11	4	1	8	152	163.3
14:00	0	0	0	0	0	0	0	23	4	1	0	0	28	28.5	74	4	0	0	1	79	80	20	0	0	3	2	25	30.9
14:15	0	0	0	0	0	0	0	34	1	0	0	0	35	35	56	3	0	0	0	59	59	11	4	1	1	1	18	20.8
14:30	1	0	0	0	0	1	1	28	0	0	0	0	28	28	60	2	1	0	0	63	63.5	24	3	0	0	2	29	31
14:45	0	0	0	0	0	0	0	24	3	1	0	0	28	28.5	63	0	0	0	0	63	63	33	1	0	0	2	36	38
14:00 H/TOT	1	0	0	0	0	1	1	109	8	2	0	0	119	120	253	9	1	0	1	264	265.5	88	8	1	4	7	108	120.7
15:00	1	0	0	0	0	1	1	12	2	0	0	0	14	14	65	6	1	0	0	72	72.5	22	4	1	0	1	28	29.5
15:15	1	0	0	0	0	1	1	17	2	0	0	0	19	19	36	2	0	0	1	39	40	24	1	0	0	2	27	29
15:30	6	0	0	0	1	7	8	26	2	0	0	0	28	28	67	3	2	0	0	72	73	45	3	0	0	1	49	50
15:45	6	0	0	0	0	6	6	22	0	0	0	0	22	22	55	3	0	0	0	58	58	36	5	1	0	0	42	42.5
15:00 H/TOT	14	0	0	0	1	15	16	77	6	0	0	0	83	83	223	14	3	0	1	241	243.5	127	13	2	0	4	146	151
16:00	4	1	0	0	0	5	5	30	3	0	0	0	33	33	75	7	0	0	0	82	82	33	11	1	0	3	48	51.5
16:15	3	0	0	0	0	3	3	31	4	0	0	0	35	35	57	8	1	0	0	66	66.5	31	2	0	0	3	36	39
16:30	3	1	0	0	0	4	4	26	3	0	0	0	29	29	87	8	1	0	0	96	96.5	33	11	0	0	1	45	46
16:45	1	0	0	0	0	1	1	44	3	0	0	0	47	47	56	4	2	0	0	62	63	32	6	0	0	2	40	42
16:00 H/TOT	11	2	0	0	0	13	13	131	13	0	0	0	144	144	275	27	4	0	0	306	308	129	30	1	0	9	169	178.5
17:00	1	0	0	0	0	1	1	29	0	0	0	0	29	29	83	4	0	0	0	87	87	32	4	2	1	1	40	43.3
17:15	5	0	0	0	0	5	5	20	0	0	0	0	20	20	67	5	0	0	0	72	72	29	4	0	0	2	35	37
17:30	3	0	0	0	0	3	3	36	0	0	0	0	36	36	63	2	0	0	0	65	65	35	5	0	0	1	41	42
17:45	2	0	0	0	0	2	2	45	2	0	0	0	47	47	76	4	0	0	0	80	80	25	2	0	0	2	29	31
17:00 H/TOT	11	0	0	0	0	11	11	130	2	0	0	0	132	132	289	15	0	0	0	304	304	121	15	2	1	6	145	153.3
18:00	4	0	0	0	0	4	4	68	2	0	0	0	70	70	89	2	0	0	0	91	91	41	2	0	1	1	45	47.3
18:15	2	0	0	0	0	2	2	57	2	0	0	0	59	59	90	4	1	0	0	95	95.5	35	1	0	0	2	38	40
18:30	1	0	0	0	0	1	1	30	1	0	0	0	31	31	60	3	0	0	0	63	63	32	2	0	0	1	35	36
18:45	2	0	0	0	0	2	2	40	2	0	0	0	42	42	86	7	0	0	0	93	93	38	2	0	0	3	43	46
18:00 H/TOT	9	0	0	0	0	9	9	195	7	0	0	0	202	202	325	16	1	0	0	342	342.5	146	7	0	1	7	161	169.3
12 TOT	53	4	0	0	1	58	59	1339	96	9	1	1	1446	1453	2936	191	20	2	6	3155	3174	1460	184	24	11	91	1770	1887

B => A							B => B							B => C							B => D							C => A							C => B							C => C							C => D					
CAR	LGV	OGV1	OGV2	5V (BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	5V (BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	5V (BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	5V (BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	5V (BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	5V (BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	5V (BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	5V (BUS	TOT
1	0	0	0	0	1	1	0	0	0	0	0	0	0	12	6	0	1	1	20	22.3	67	14	2	0	0	83	84	15	4	1	0	1	21	22.5	10	2	0	0	0	12	12	0	0	0	0	0	0	0	67	8	0	0	2	77
5	1	0	0	0	6	6	0	0	0	0	0	0	0	22	4	0	0	1	27	28	76	3	1	1	0	81	82.8	16	5	0	0	0	21	21	12	1	0	0	1	14	15	0	0	0	0	0	0	0	62	11	3	3	2	81
6	1	0	0	0	7	7	0	1	0	0	0	1	1	30	2	2	0	1	35	37	88	7	1	2	0	98	101.1	28	5	1	1	3	38	42.8	17	3	0	0	0	20	20	0	0	0	0	0	0	0	70	10	2	0	1	83
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15	2	0	0	0	17	17	0	0	0	0	0	0	0	48	7	1	0	2	58	60.5	96	10	3	1	1	111	114.8	51	2	0	0	0	53	53	26	8	0	0	1	35	36	0	0	0	0	0	0	0	74	12	1	0	1	88
14	5	0	0	0	19	19	0	0	0	0	0	0	0	56	6	1	0	0	63	63.5	66	8	0	0	2	76	78	49	1	0	0	0	50	50	31	7	1	0	1	40	41.5	0	0	0	0	0	0	0	79	8	2	1	1	91
11	2	0	0	0	13	13	0	0	0	0	0	0	0	53	1	3	0	1	58	60.5	91	12	3	4	3	113	122.7	60	2	0	0	1	63	64	57	3	0	0	0	60	60	0	0	0	0	0	0	0	70	7	0	0	0	77
48	10	0	0	0	58	58	0	0	0	0	0	0	0	181	18	5	0	4	208	214.5	320	42	7	6	6	381	398.3	223	11	1	1	1	237	239.8	141	24	1	0	3	169	172.5	0	0	0	0	0	0	0	297	32	4	2	3	338
20	1	0	0	0	21	21	1	0	0	0	0	1	1	40	9	1	1	2	53	56.8	76	7	1	4	0	88	93.7	46	2	1	0	0	49	49.5	60	6	0	0	1	67	68	0	0	0	0	0	0	0	116	2	3	0	0	121
10	4	0	0	0	14	14	0	0	0	0	0	0	0	65	7	1	0	0	73	73.5	80	14	3	4	1	102	109.7	58	1	1	0	0	60	60.5	42	5	1	0	1	49	50.5	0	0	0	0	0	0	0	100	8	2	1	0	111
18	7	1	0	0	26	26.5	0	0	0	0	0	0	0	37	4	1	0	1	43	44.5	77	10	2	2	2	93	98.6	43	3	0	0	0	46	46	50	12	1	0	1	64	65.5	0	0	0	0	0	0	0	62	9	3	2	0	76
5	1	1	0	0	7	7.5	0	0	0	0	0	0	0	50	4	0	0	1	55	56	81	17	6	3	0	107	113.9	45	1	0	0	0	46	46	28	3	1	2	1	35	39.1	0	0	0	0	0	0	0	57	9	1	1	0	68
53	13	2	0	0	68	69	1	0	0	0	0	1	1	192	24	3	1	4	224	230.8	314	48	12	13	3	390	415.9	192	7	2	0	0	201	202	180	26	3	2	4	215	223.1	0	0	0	0	0	0	0	335	28	9	4	0	376
10	3	0	0	0	13	13	0	0	0	0	0	0	0	35	3	3	0	1	42	44.5	64	14	5	0	0	83	85.5	38	3	1	1	0	43	44.8	36	5	3	0	1	45	47.5	0	0	0	0	0	0	0	70	6	1	2	0	79
10	4	1	0	0	15	15.5	0	0	0	0	0	0	0	27	5	1	1	1	35	37.8	56	28	4	2	0	90	94.6	39	4	1	1	0	45	46.8	37	5	1	1	0	44	45.8	0	0	0	0	0	0	0	47	6	0	0	0	53
5	0	0	0	0	5	5	1	0	0	0	0	1	1	49	5	0	0	0	54	54	60	20	4	3	0	87	92.9	40	2	1	0	0	43	43.5	38	11	1	0	1	51	52.5	0	0	0	0	0	0	0	67	6	2	1	0	76
5	4	0	0	0	9	9	0	0	0	0	0	0	0	38	7	1	0	1	47	48.5	61	16	2	5	0	84	91.5	35	4	0	0	0	39	39	30	1	1	0	1	33	34.5	0	0	0	0	0	0	0	67	9	2	0	1	79
30	11	1	0	0	42	42.5	1	0	0	0	0	1	1	149	20	5	1	3	178	184.8	241	78	15	10	0	344	364.5	152	13	3	2	0	170	174.1	141	22	6	1	3	173	180.3	0	0	0	0	0	0	0	251	27	5	3	1	287
21	3	1	0	0	25	25.5	0	0	0	0	0	0	0	42	1	2	0	1	46	48	78	16	4	2	0	100	104.6	45	7	0	0	0	52	52	35	8	1	0	2	46	48.5	0	0	0	0	0	0	0	51	8	2	0	2	63
12	3	0	0	0	15	15	0	0	0	0	0	0	0	44	7	3	0	2	56	59.5	65	15	6	3	0	89	95.9	49	7	0	0	2	58	60	31	4	1	0	0	36	36.5	0	0	0	0	0	0	0	54	6	2	0	1	63
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47	16	1	0	0	64	64.5	0	0	0	0	0	0	0	171	19	6	0	4	200	207	280	75	22	12	1	390	417.6	183	22	0	0	2	207	209	130	23	3	1	4	161	167.8	0	0	0	0	0	0	0	239	31	9	2	4	285
19	4	0	0	0	23	23	0	0	0	0	0	0	0	34	2	1	0	1	38	39.5	69	15	5	5	0	94	103	66	6	0	0	0	72	72	45	8	3	0	1	57	59.5	0	0	0	0	0	0	0	64	5	1	1	0	71
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82	7	0	0	0	89	89	0	0	0	0	0	0	0	158	14	0	0	3	175	178	347	34	0	0	1	382	383	353	10	0	0	1	364	365	173	8	0	0	3	184	187	0	0	0	0	0	0	0	327	26	1	0	1	355
686	121	9	0	1	817	822.5	3	2	0	0	0	5	5	2075	215	38	3	43	2374	2440	4014	778	139	85	16	5032	5228	2864	193	14	5	13	3089	3116	1948	223	36	4	38	2249	2310	0	0	0	0	0	0	0	3518	369	75	28	30	4020

	D => A							D => B							D => C							D => D						
PCU	CAR	LGV	OGV1	OGV2	5V (BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	5V (BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	5V (BUS	TOT	PCU	CAR	LGV	OGV1	OGV2	5V (BUS	TOT	PCU
79	19	1	1	1	6	28	35.8	42	11	1	0	1	55	56.5	25	5	0	0	1	31	32	0	0	0	0	0	0	0
88.4	26	6	1	0	3	36	39.5	103	10	1	3	2	119	125.4	29	5	1	0	2	37	39.5	0	0	0	0	0	0	0
85	18	4	1	0	1	24	25.5	117	31	1	4	0	153	158.7	47	11	0	0	0	58	58	0	0	0	0	0	0	0
96	41	4	0	1	1	47	49.3	114	13	1	1	0	129	130.8	56	8	0	1	1	66	68.3	0	0	0	0	0	0	0
348.4	104	15	3	2	11	135	150.1	376	65	4	8	3	456	471.4	157	29	1	1	4	192	197.8	0	0	0	0	0	0	0
84.8	35	2	0	0	2	39	41	127	17	1	0	0	145	145.5	111	10	2	0	2	125	128	0	0	0	0	0	0	0
89.5	19	0	0	0	0	19	19	99	4	0	2	1	106	109.6	85	6	2	2	2	97	102.6	0	0	0	0	0	0	0
94.3	13	1	0	0	1	15	16	65	10	3	0	0	78	79.5	78	9	1	0	0	88	88.5	0	0	0	0	0	0	0
77	17	0	0	1	1	19	21.3	68	14	1	4	0	87	92.7	80	1	0	1	0	82	83.3	0	0	0	0	0	0	0
345.6	84	3	0	1	4	92	97.3	359	45	5	6	1	416	427.3	354	26	5	3	4	392	402.4	0	0	0	0	0	0	0
122.5	32	0	0	0	2	34	36	72	19	4	3	0	98	103.9	45	6	4	1	0	56	59.3	0	0	0	0	0	0	0
113.3	22	1	1	0	5	29	34.5	71	16	2	4	0	93	99.2	70	8	3	1	0	82	84.8	0	0	0	0	0	0	0
80.1	16	6	2	0	2	26	29	73	8	5	2	0	88	93.1	60	1	0	2	1	64	67.6	0	0	0	0	0	0	0
69.8	24	3	0	0	2	29	31	65	7	7	0	0	79	82.5	50	3	1	0	1	55	56.5	0	0	0	0	0	0	0
385.7	94	10	3	0	11	118	130.5	281	50	18	9	0	358	378.7	225	18	8	4	2	257	268.2	0	0	0	0	0	0	0
82.1	26	1	0	0	3	30	33	76	17	2	2	1	98	102.6	48	5	2	0	0	55	56	0	0	0	0	0	0	0
53	19	1	0	0	2	22	24	68	17	2	4	0	91	97.2	44	7	2	0	1	54	56	0	0	0	0	0	0	0
78.3	18	5	2	0	1	26	28	84	14	4	1	0	103	106.3	40	8	2	2	0	52	55.6	0	0	0	0	0	0	0
81	20	2	0	0	3	25	28	60	13	8	2	0	83	89.6	39	5	1	0	0	45	45.5	0	0	0	0	0	0	0
294.4	83	9	2	0	9	103	113	288	61	16	9	1	375	395.7	171	25	7	2	1	206	213.1	0	0	0	0	0	0	0
66	28	1	2	0	1	32	34	69	15	4	0	1	89	92	45	10	3	1	1	60	63.8	0	0	0	0	0	0	0
65	30	1	2	0	1	34	36	62	14	2	3	1	82	87.9	56	6	1	0	1	64	65.5	0	0	0	0	0	0	0
77.1	25	2	1	0	1	29	30.5	67	13	6	5	1	92	102.5	75	2	3	2	0	82	86.1	0	0	0	0	0	0	0
88	25	4	0	0	3	32	35	47	19	3	1	1	71	74.8	63	6	1	0	1	71	72.5	0	0	0	0	0	0	0
296.1	108	8	5	0	6	127	135.5	245	61	15	9	4	334	357.2	239	24	8	3	3	277	287.9	0	0	0	0	0	0	0
72.8	26	5	1	0	2	34	36.5	71	31	2	3	0	107	111.9	54	5	1	1	0	61	62.8	0	0	0	0	0	0	0
83.3	15	3	2	0	0	20	21	66	25	6	4	1	102	111.2	54	10	0	1	1	66	68.3	0	0	0	0	0	0	0
68	27	5	1	0	3	36	39.5	72	15	6	3	1	97	104.9	61	7	2	0	0	70	71	0	0	0	0	0	0	0
63.5	23	2	0	0	0	25	25	72	18	3	3	1	97	103.4	61	9	0	0	0	70	70	0	0	0	0	0	0	0
287.6	91	15	4	0	5	115	122	281	89	17	13	3	403	431.4	230	31	3	2	1	267	272.1	0	0	0	0	0	0	0
86.1	40	6	1	0	2	49	51.5	74	11	3	2	0	90	94.1	66	6	4	0	0	76	78	1	0	0	0	0	1	1
96	32	0	0	3	1	36	40.9	81	8	2	2	1	94	98.6	95	5	1	1	1	103	105.8	0	0	0	0	0	0	0
96	26	1	0	2	3	32	37.6	81	24	6	0	0	111	114	63	8	2	1	1	75	78.3	0	0	0	0	0	0	0
102.3	23	4	0	0	1	28	29	80	22	2	1	0	105	107.3	75	6	2	1	2	86	90.3	0	0	0	0	0	0	0
380.4	121	11	1	5	7	145	159	316	65	13	5	1	400	414	299	25	9	3	4	340	352.4	1	0	0	0	0	1	1
81.8	22	0	0	0	3	25	28	88	19	4	1	1	113	117.3	87	7	1	0	0	95	95.5	0	0	0	0	0	0	0
79.6	21	1	0	0	2	24	26	111	11	4	1	1	128	132.3	70	14	2	2	1	89	93.6	0	0	0	0	0	0	0
81.3	26	7	0	0	1	34	35	123	7	3	2	0	135	139.1	75	9	2	1	2	89	93.3	0	0	0	0	0	0	0
110	31	4	0	0	3	38	41	85	12	5	1	0	103	106.8	58	2	2	0	0	62	63	0	0	0	0	0	0	0
352.7	100	12	0	0	9	121	130	407	49	16	5	2	479	495.5	290	32	7	3	3	335	345.4	0	0	0	0	0	0	0
115.8	36	2	1	0	1	40	41.5	68	16	3	3	0	90	95.4	79	4	4	1	0	88	91.3	0	0	0	0	0	0	0
73	40	4	0	0	0	44	44	82	21	3	1	0	107	109.8	64	16	0	0	1	81	82	0	0	0	0	0	0	0
72.3	38	8	0	0	0	46	46	57	12	1	1	0	71	72.8	60	3	1	2	0	66	69.1	0	0	0	0	0	0	0
101.5	40	4	0	0	4	48	52	79	11	0	0	0	90	90	69	5	0	0	0	74	74	0	0	0	0	0	0	0
362.6	154	18	1	0	5	178	183.5	286	60	7	5	0	358	368	272	28	5	3	1	309	316.4	0	0	0	0	0	0	0
97.1	35	6	1	0	3	45	48.5	74	12	2	1	0	89	91.3	70	6	0	0	1	77	78	0	0	0	0	0	0	0
103.5	33	6	0	0	3	42	45	58	7	7	0	0	72	75.5	75	11	2	0	1	89	91	0	0	0	0	0	0	0
88	42	1	0	1	1	45	47.3	73	12	0	1	0	86	87.3	102	11	0	0	0	113	113	0	0	0	0	0	0	0
87.5	40	4	0	0	1	45	46	79	9	4	0	0	92	94	74	11	2	0	1	88	90	0	0	0	0	0	0	0
376.1	150	17	1	1	8	177	186.8	284	40	13	2	0	339	348.1	321	39	4	0	3	367	372	0	0	0	0	0	0	0
67.8	41	3	2	0	0	46	47	87	6	0	0	0	93	93	95	13	0	0	0	108	108	0	0	0	0	0	0	0
83.5	51	6	0	0	3	60	63	86	6	1	0	0	93	93.5	83	4	0	0	1	88	89	0	0	0	0	0	0	0
92	51	1	0	0	0	52	52	87	6	0	0	0	93	93	93	5	0	0	0	98	98	0	0	0	0	0	0	0
94.5	47	3	0	0	2	52	54	92	8	0	1	0	101	102.3	84	8	0	1	0	93	94.3	0	0	0	0	0	0	0
337.8	190	13	2	0	5	210	216	352	26	1	1	0	380	381.8	355	30	0	1	1	387	389.3	0	0	0	0	0	0	0
105.5	56	3	0	0	0	59	59	91	8	1	0	0	100	100.5	94	4	0	0	1	99	100	0	0	0	0	0	0	0
96	60	10	0	0	1	71	72	103	5	0	0	0	108	108	87	4	0	0	0	91	91	0	0	0	0	0	0	0
76	62	5	0	0	2	69	71	93	9	1	0	0	103	103.5	75	4	0	0	3	82	85	0	0	0	0	0	0	0
79	62	7	0	0	2	71	73	75	3	0	0	0	78	78	72	7	0	1	3	83	87.3	0	0	0	0	0	0	0
356.5	240	25	0	0	5	270	275	362	25	2	0	0	389	390	328	19	0	1	7	355	363.3	0	0	0	0	0	0	0
4124	1519	156	22	9	85	1791	1899	3837	636	127	72	15	4687	4859	3241	326	57	26	34	3684	3780	1	0	0	0	0	1	1

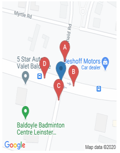
IDASO

Survey Name: HDR 20 128 Grange Rd

Site: Site 2

Location: —

Date: Tue 21-May-2019



	A => A									A => B								
TIME	P/C	M/C	CAR	LGV	)GV1	)GV2	V (B	TOT	PCU	P/C	M/C	CAR	LGV	)GV1	)GV2	'SV (BUS	TOT	PCU
07:00	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	4
07:15	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3	3
07:30	0	0	0	0	0	0	0	0	0	0	0	9	1	0	0	0	10	10
07:45	0	0	0	0	0	0	0	0	0	1	0	5	0	0	0	0	6	5.2
H/TOT	0	0	0	0	0	0	0	0	0	1	0	21	1	0	0	0	23	22.
08:00	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	11	11
08:15	0	0	0	0	0	0	0	0	0	1	0	10	0	0	0	0	11	10.
08:30	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	13	13
08:45	0	0	0	0	0	0	0	0	0	1	0	6	2	0	0	0	9	8.2
H/TOT	0	0	0	0	0	0	0	0	0	2	0	40	2	0	0	0	44	42.
09:00	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	9	9
09:15	0	0	0	0	0	0	0	0	0	1	0	5	0	0	0	0	6	5.2
09:30	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	5	5
09:45	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	4
H/TOT	0	0	0	0	0	0	0	0	0	1	0	23	0	0	0	0	24	23.
10:00	0	0	0	0	0	0	0	0	0	2	0	2	2	0	0	0	6	4.4
10:15	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
10:30	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2
10:45	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3	3
H/TOT	0	0	0	0	0	0	0	0	0	2	0	8	2	0	0	0	12	10.
11:00	0	0	0	0	0	0	0	0	0	0	0	3	2	0	0	0	5	5
11:15	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	4
11:30	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
11:45	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	4	4.5
H/TOT	0	0	0	0	0	0	0	0	0	0	0	10	3	1	0	0	14	14.
12:00	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	8	8
12:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:30	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2
12:45	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3	3
H/TOT	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	13	13
13:00	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	4
13:15	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	5	5
13:30	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2
13:45	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	7	7
H/TOT	0	0	0	0	0	0	0	0	0	0	0	18	0	0	0	0	18	18
14:00	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	8	8
14:15	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	7	7
14:30	0	0	0	0	0	0	0	0	0	0	0	11	1	0	0	0	12	12
14:45	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	4	4
H/TOT	0	0	0	0	0	0	0	0	0	0	0	29	2	0	0	0	31	31
15:00	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	4
15:15	0	0	0	0	0	0	0	0	0	0	0	7	1	0	0	0	8	8
15:30	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	4
15:45	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	4
H/TOT	0	0	0	0	0	0	0	0	0	0	0	19	1	0	0	0	20	20
16:00	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0	5	5
16:15	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	9	9
16:30	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2
16:45	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	9	9
H/TOT	0	0	0	0	0	0	0	0	0	0	0	24	1	0	0	0	25	25
17:00	0	0	0	0	0	0	0	0	0	1	0	3	0	0	0	0	4	3.2
17:15	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	7	7
17:30	0	0	0	0	0	0	0	0	0	0	0	6	1	0	0	0	7	7
17:45	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	13	13
H/TOT	0	0	0	0	0	0	0	0	0	1	0	29	1	0	0	0	31	30.
18:00	0	0	0	0	0	0	0	0	0	0	1	7	2	0	0	0	10	9.4
18:15	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	6	6
18:30	0	0	0	0	0	0	0	0	0	0	0	6	1	0	0	0	7	7
18:45	0	0	0	0	0	0	0	0	0	0	0	6	1	0	0	0	7	7
H/TOT	0	0	0	0	0	0	0	0	0	0	1	25	4	0	0	0	30	29.
12 TOT	0	0	0	0	0	0	0	0	0	7	1	259	17	1	0	0	285	279

	A => C									A => D								
TIME	P/C	M/C	CAR	LGV	)GV1	)GV2	'SV (BUS	TOT	PCU	P/C	M/C	CAR	LGV	)GV1	)GV2	V (B	TOT	PCU
07:00	0	0	0	0	0	0	0	0	0	1	0	13	4	0	0	0	18	17.
07:15	3	0	1	0	0	0	0	4	1.6	0	0	15	0	0	0	0	15	15
07:30	0	0	0	0	0	0	0	0	0	0	0	19	0	0	0	0	19	19
07:45	0	0	1	0	0	0	0	1	1	0	0	12	2	0	0	0	14	14
H/TOT	3	0	2	0	0	0	0	5	2.6	1	0	59	6	0	0	0	66	65.
08:00	0	0	1	2	0	0	0	3	3	0	2	20	1	0	0	0	23	21.8
08:15	0	0	0	0	0	0	0	0	0	2	2	21	0	0	0	0	25	22.
08:30	1	0	0	0	0	0	0	1	0.2	1	0	18	1	0	0	0	20	19.
08:45	1	0	4	0	0	0	0	5	4.2	0	0	11	1	0	0	0	12	12
H/TOT	2	0	5	2	0	0	0	9	7.4	3	4	70	3	0	0	0	80	75.
09:00	0	0	4	2	0	0	0	6	6	0	0	13	1	0	0	0	14	14
09:15	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0	5	5
09:30	0	0	2	0	0	0	0	2	2	0	0	8	3	0	0	0	11	11
09:45	0	0	1	0	0	0	0	1	1	1	0	10	0	0	0	0	11	10.
H/TOT	0	0	7	2	0	0	0	9	9	1	0	35	5	0	0	0	41	40.
10:00	0	0	1	0	0	0	0	1	1	0	0	8	0	0	0	0	8	8
10:15	0	0	1	1	0	0	0	2	2	0	0	3	0	0	0	0	3	3
10:30	0	0	3	0	0	0	0	3	3	0	0	6	1	1	0	0	8	8.5
10:45	0	0	1	0	0	0	0	1	1	0	0	5	1	0	0	0	6	6
H/TOT	0	0	6	1	0	0	0	7	7	0	0	22	2	1	0	0	25	25.5
11:00	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	5	5
11:15	0	0	1	0	0	0	0	1	1	0	0	8	0	0	0	0	8	8
11:30	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	4
11:45	0	0	2	0	0	0	0	2	2	0	0	7	0	0	0	0	7	7
H/TOT	0	0	3	0	0	0	0	3	3	0	0	24	0	0	0	0	24	24
12:00	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	6	6
12:15	0	0	1	0	0	0	0	1	1	0	0	13	0	1	1	0	15	16.8
12:30	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	4
12:45	0	0	0	0	0	0	0	0	0	0	0	5	2	1	1	0	9	10.8
H/TOT	0	0	1	0	0	0	0	1	1	0	0	28	2	2	2	0	34	37.6
13:00	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	6	6
13:15	0	0	1	0	0	0	0	1	1	0	0	6	2	0	0	0	8	8
13:30	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	3	3
13:45	0	0	1	0	0	0	0	1	1	1	0	9	1	0	0	0	11	10.
H/TOT	0	0	2	0	0	0	0	2	2	1	0	23	4	0	0	0	28	27.
14:00	1	0	0	0	0	0	0	1	0.2	0	0	12	1	0	0	0	13	13
14:15	0	0	1	0	0	0	0	1	1	1	0	2	0	0	0	0	3	2.2
14:30	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	7	7
14:45	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	5	5
H/TOT	1	0	1	0	0	0	0	2	1.2	1	0	26	1	0	0	0	28	27.
15:00	0	0	3	0	0	0	0	3	3	0	0	8	1	0	0	0	9	9
15:15	0	0	1	0	0	0	0	1	1	0	0	6	2	0	0	0	8	8
15:30	0	0	1	0	0	0	0	1	1	1	0	7	2	0	0	0	10	9.2
15:45	0	0	0	0	0	0	0	0	0	1	0	6	0	0	0	0	7	6.2
H/TOT	0	0	5	0	0	0	0	5	5	2	0	27	5	0	0	0	34	32.4
16:00	0	0	1	0	0	0	0	1	1	0	0	7	0	0	0	0	7	7
16:15	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	12	12
16:30	0	0	2	0	0	0	0	2	2	1	0	10	0	0	0	0	11	10.
16:45	0	0	0	0	0	0	0	0	0	0	2	7	0	1	0	0	10	9.3
H/TOT	0	0	3	0	0	0	0	3	3	1	2	36	0	1	0	0	40	38.5
17:00	0	0	1	0	0	0	0	1	1	0	0	8	1	0	0	0	9	9
17:15	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	7	7
17:30	0	0	1	0	0	0	0	1	1	0	0	12	1	0	0	0	13	13
17:45	0	0	0	0	0	0	0	0	0	0	0	9	2	0	0	0	11	11
H/TOT	0	0	2	0	0	0	0	2	2	0	0	36	4	0	0	0	40	40
18:00	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	7	7
18:15	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	6	6
18:30	0	0	1	0	0	0	0	1	1	0	0	6	0	0	0	0	6	6
18:45	0	0	0	0	0	0	0	0	0	1	0	10	1	0	0	0	12	11.
H/TOT	0	0	1	0	0	0	0	1	1	1	0	29	1	0	0	0	31	30.
12 TOT	6	0	38	5	0	0	0	49	44.	11	6	415	33	4	2	0	471	463

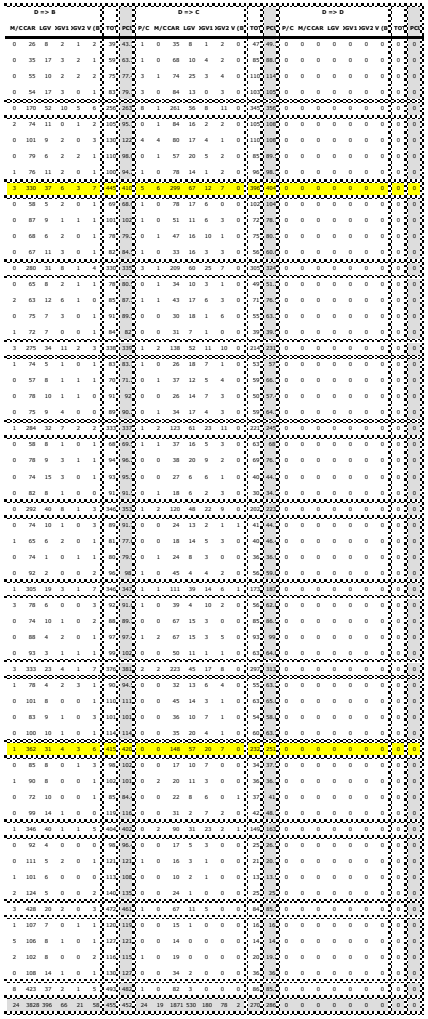
	B => A									B => B								
TIME	P/C	M/C	CAR	LGV	)GV1	)GV2	V (B	TOT	PCU	P/C	M/C	CAR	LGV	)GV1	)GV2	V (B	TOT	PCU
07:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15	0	0	3	1	0	0	0	4	4	0	0	0	0	0	0	0	0	0
07:30	0	0	5	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0
07:45	0	0	6	2	0	0	0	8	8	0	0	0	0	0	0	0	0	0
H/TOT	0	0	14	3	0	0	0	17	17	0	0	0	0	0	0	0	0	0
08:00	0	0	5	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0
08:15	0	0	3	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0
08:30	0	0	4	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0
08:45	0	0	7	0	0	0	0	7	7	0	0	0	0	0	0	0	0	0
H/TOT	0	0	19	0	0	0	0	19	19	0	0	0	0	0	0	0	0	0
09:00	0	0	5	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0
09:15	1	0	5	1	0	0	0	7	6.2	0	0	0	0	0	0	0	0	0
09:30	0	0	2	1	0	0	0	3	3	0	0	0	0	0	0	0	0	0
09:45	0	0	2	1	0	0	0	3	3	0	0	0	0	0	0	0	0	0
H/TOT	1	0	14	3	0	0	0	18	17.	0	0	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:15	0	0	2	0	1	0	0	3	3.5	0	0	0	0	0	0	0	0	0
10:30	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
10:45	0	0	1	1	0	0	0	2	2	0	0	0	0	0	0	0	0	0
H/TOT	0	0	4	1	1	0	0	6	6.5	0	0	0	0	0	0	0	0	0
11:00	0	0	2	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0
11:15	0	0	3	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0
11:30	0	0	5	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0
11:45	0	0	2	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0
H/TOT	0	0	12	0	0	0	0	12	12	0	0	0	0	0	0	0	0	0
12:00	0	0	4	0	1	0	0	5	5.5	0	0	0	0	0	0	0	0	0
12:15	1	0	2	2	0	0	0	5	4.2	0	0	0	0	0	0	0	0	0
12:30	0	0	2	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0
12:45	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
H/TOT	1	0	9	2	1	0	0	13	12.	0	0	0	0	0	0	0	0	0
13:00	0	0	4	1	0	0	0	5	5	0	0	0	0	0	0	0	0	0
13:15	0	0	4	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0
13:30	0	0	4	1	0	0	0	5	5	0	0	0	0	0	0	0	0	0
13:45	0	0	7	0	0	0	0	7	7	0	0	0	0	0	0	0	0	0
H/TOT	0	0	19	2	0	0	0	21	21	0	0	0	0	0	0	0	0	0
14:00	0	0	5	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0
14:15	0	0	7	0	0	0	0	7	7	0	0	0	0	0	0	0	0	0
14:30	0	0	5	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0
14:45	1	0	10	0	0	0	0	11	10.	0	0	0	0	0	0	0	0	0
H/TOT	1	0	27	0	0	0	0	28	27.	0	0	0	0	0	0	0	0	0
15:00	2	0	6	1	0	0	0	9	7.4	0	0	0	0	0	0	0	0	0
15:15	0	0	6	2	0	0	0	8	8	0	0	0	0	0	0	0	0	0
15:30	0	0	6	0	0	0	0	6	6	0	0	0	0	0	0	0	0	0
15:45	0	0	3	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0
H/TOT	2	0	21	3	0	0	0	26	24.	0	0	0	0	0	0	0	0	0
16:00	0	0	10	0	0	0	0	10	10	0	0	0	0	0	0	0	0	0
16:15	1	0	3	0	0	0	0	4	3.2	0	0	0	0	0	0	0	0	0
16:30	0	0	9	0	0	0	0	9	9	0	0	0	0	0	0	0	0	0
16:45	0	0	5	1	1	0	0	7	7.5	0	0	0	0	0	0	0	0	0
H/TOT	1	0	27	1	1	0	0	30	29.	0	0	0	0	0	0	0	0	0
17:00	0	0	6	0	0	0	0	6	6	0	0	0	0	0	0	0	0	0
17:15	0	0	5	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0
17:30	0	0	11	0	0	0	0	11	11	0	0	0	0	0	0	0	0	0
17:45	0	0	3	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0
H/TOT	0	0	25	0	0	0	0	25	25	0	0	0	0	0	0	0	0	0
18:00	0	0	9	0	0	0	0	9	9	0	0	0	0	0	0	0	0	0
18:15	0	0	8	2	0	0	0	10	10	0	0	0	0	0	0	0	0	0
18:30	0	0	11	0	0	0	0	11	11	0	0	0	0	0	0	0	0	0
18:45	0	0	2	1	0	0	0	3	3	0	0	0	0	0	0	0	0	0
H/TOT	0	0	30	3	0	0	0	33	33	0	0	0	0	0	0	0	0	0
12 TOT	6	0	221	18	3	0	0	248	245	0	0	0	0	0	0	0	0	0

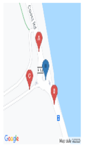
	B => C									B => D								
TIME	P/C	M/C	CAR	LGV	)GV1	)GV2	V (B	TOT	PCU	P/C	M/C	CAR	LGV	)GV1	)GV2	V (B	TOT	PCU
07:00	0	0	4	2	0	0	0	6	6	3	0	52	11	2	0	0	68	66.
07:15	0	0	17	2	3	0	0	22	23.5	2	1	72	6	0	0	2	83	82.
07:30	0	0	17	3	0	0	0	20	20	4	0	70	9	0	1	1	85	84.
07:45	1	0	30	5	1	0	0	37	36.	1	0	77	13	0	0	1	92	92.
H/TOT	1	0	68	12	4	0	0	85	86.	10	1	271	39	2	1	4	328	326
08:00	0	0	34	5	0	0	0	39	39	1	1	75	7	0	0	2	86	86.
08:15	1	0	39	8	0	0	0	48	47.	3	1	93	9	0	0	1	107	105
08:30	0	0	31	5	0	0	0	36	36	2	0	116	10	2	0	2	132	133
08:45	0	0	41	7	0	0	0	48	48	0	1	80	4	3	2	3	93	99.
H/TOT	1	0	145	25	0	0	0	171	170	6	3	364	30	5	2	8	418	425
09:00	1	0	26	4	1	0	0	32	31.	2	0	74	4	0	0	4	84	86.
09:15	0	0	29	7	2	0	0	38	39	1	1	86	12	1	0	4	105	108
09:30	0	1	18	6	2	1	0	28	29.	1	0	89	9	1	0	0	100	99.
09:45	0	0	14	3	1	0	0	18	18.5	1	0	64	8	1	0	1	75	75.
H/TOT	1	1	87	20	6	1	0	116	119	5	1	313	33	3	0	9	364	370
10:00	0	0	28	7	1	0	0	36	36.5	1	0	71	9	2	0	1	84	85.
10:15	0	0	21	7	0	0	0	28	28	0	0	64	10	0	1	1	76	78.
10:30	0	0	26	5	2	0	0	33	34	0	0	89	5	3	1	0	98	101
10:45	0	0	24	7	1	0	0	32	32.5	1	1	65	10	4	0	1	82	83.
H/TOT	0	0	99	26	4	0	0	129	131	2	1	289	34	9	2	3	340	348
11:00	0	0	15	4	0	0	0	19	19	0	1	64	5	6	0	1	77	80.
11:15	0	0	24	7	3	0	0	34	35.5	1	0	74	9	2	1	1	88	90.
11:30	0	0	17	4	2	0	0	23	24	0	0	78	7	3	2	2	92	98.
11:45	0	0	13	7	2	0	0	22	23	3	1	70	10	4	0	0	88	87
H/TOT	0	0	69	22	7	0	0	98	102	4	2	286	31	15	3	4	345	356
12:00	0	0	21	4	0	0	0	25	25	0	1	69	10	5	0	1	86	88.
12:15	1	0	23	10	2	0	0	36	36.	1	0	77	6	1	0	1	86	86.
12:30	2	0	26	6	0	0	0	34	32.4	4	0	81	10	2	0	0	97	94.
12:45	0	0	16	5	2	0	0	23	24	0	1	70	10	4	0	1	86	88.
H/TOT	3	0	86	25	4	0	0	118	118	5	2	297	36	12	0	3	355	359
13:00	0	0	10	3	0	0	0	13	13	2	2	87	6	4	1	1	103	105
13:15	0	1	25	5	1	0	0	32	31.	4	1	104	8	5	1	1	124	125
13:30	0	0	33	2	1	1	0	37	38.	2	0	84	12	3	1	1	103	105
13:45	0	0	34	5	1	0	0	40	40.5	1	1	65	8	1	0	0	76	75.
H/TOT	0	1	102	15	3	1	0	122	124	9	4	340	34	13	3	3	406	410
14:00	0	0	22	7	0	0	0	29	29	1	0	67	14	5	0	1	88	90.
14:15	0	0	32	3	0	1	0	36	37.	3	0	65	8	1	0	1	78	77.
14:30	0	0	33	5	0	0	0	38	38	3	0	62	11	0	0	0	76	73.
14:45	0	0	21	5	0	0	0	26	26	6	2	75	7	2	0	3	95	93
H/TOT	0	0	108	20	0	1	0	129	130	13	2	269	40	8	0	5	337	334
15:00	0	0	26	4	1	0	0	31	31.5	4	0	82	12	1	0	1	100	98.
15:15	0	0	20	6	1	0	0	27	27.5	4	0	93	13	1	0	2	113	112
15:30	1	0	28	5	1	0	0	35	34.	4	0	73	6	2	2	0	87	87.
15:45	0	0	12	6	0	0	0	18	18	7	0	60	5	0	2	1	75	73
H/TOT	1	0	86	21	3	0	0	111	112	19	0	308	36	4	4	4	375	371
16:00	0	0	13	7	0	0	0	20	20	31	0	90	8	0	0	2	131	108
16:15	0	0	19	5	0	0	0	24	24	4	0	70	19	0	0	1	94	91.
16:30	0	1	22	3	1	0	0	27	26.	5	0	80	12	0	0	0	97	93
16:45	0	0	23	1	0	0	0	24	24	6	0	57	8	1	1	1	74	72
H/TOT	0	1	77	16	1	0	0	95	94.	46	0	297	47	1	1	4	396	365
17:00	0	0	17	2	1	0	0	20	20.5	4	0	80	6	1	1	1	93	92.
17:15	0	0	10	2	1	0	0	13	13.5	1	1	55	14	2	1	1	75	76.
17:30	0	0	7	1	0	0	0	8	8	5	0	79	6	1	0	0	91	87.
17:45	0	0	12	2	0	0	0	14	14	2	0	62	8	1	0	2	75	75.
H/TOT	0	0	46	7	2	0	0	55	56	12	1	276	34	5	2	4	334	333
18:00	0	0	5	4	0	0	0	9	9	2	1	79	9	0	0	2	93	92.
18:15	0	0	5	1	0	0	0	6	6	4	0	79	11	1	0	2	97	96.
18:30	0	0	9	0	0	0	0	9	9	3	1	99	5	0	0	0	108	105
18:45	0	0	13	1	0	0	0	14	14	3	0	89	7	0	0	2	101	101
H/TOT	0	0	32	6	0	0	0	38	38	12	2	346	32	1	0	6	399	395
12 TOT	7	3	1005	215	34	3	0	126	128	143	19	3656	426	78	18	57	439	439

	C => A									C => B								
TIME	P/C	M/C	CAR	LGV	)GV1	)GV2	V (B	TOT	PCU	P/C	M/C	CAR	LGV	)GV1	)GV2	V (B	TOT	PCU
07:00	0	0	1	0	0	0	0	1	1	0	0	3	1	0	0	0	4	4
07:15	0	0	0	0	0	0	0	0	0	1	0	4	0	0	0	0	5	4.2
07:30	0	0	0	0	0	0	0	0	0	0	0	5	5	0	0	0	10	10
07:45	0	0	0	0	0	0	0	0	0	0	0	6	4	3	0	0	13	14.
H/TOT	0	0	1	0	0	0	0	1	1	1	0	18	10	3	0	0	32	32.
08:00	0	0	0	1	0	0	0	1	1	0	0	5	5	0	0	0	10	10
08:15	0	0	2	0	0	0	0	2	2	0	0	6	3	0	0	0	9	9
08:30	0	0	0	0	0	0	0	0	0	1	0	5	5	0	0	0	11	10.
08:45	0	0	0	1	0	0	0	1	1	0	0	6	4	1	1	0	12	13.
H/TOT	0	0	2	2	0	0	0	4	4	1	0	22	17	1	1	0	42	43
09:00	0	0	0	0	0	0	0	0	0	0	0	10	7	1	0	0	18	18.
09:15	0	0	0	0	0	0	0	0	0	0	0	7	7	0	0	0	14	14
09:30	0	0	0	1	0	0	0	1	1	1	0	11	7	1	0	0	20	19.
09:45	0	0	1	0	0	0	0	1	1	0	1	13	5	0	0	0	19	18.
H/TOT	0	0	1	1	0	0	0	2	2	1	1	41	26	2	0	0	71	70.
10:00	0	0	0	1	0	0	0	1	1	0	0	18	7	2	0	0	27	28
10:15	0	0	0	0	0	0	0	0	0	0	0	17	4	1	0	0	22	22.
10:30	0	0	0	0	0	0	0	0	0	0	0	24	7	1	0	0	32	32.
10:45	0	0	1	0	0	0	0	1	1	1	0	18	8	0	0	0	27	26.
H/TOT	0	0	1	1	0	0	0	2	2	1	0	77	26	4	0	0	108	109
11:00	0	0	1	1	1	0	0	3	3.5	0	0	16	7	2	0	0	25	26
11:15	0	0	2	0	0	0	0	2	2	0	0	20	6	0	0	0	26	26
11:30	0	0	0	0	0	0	0	0	0	0	1	18	5	2	0	0	26	26.
11:45	0	0	0	0	0	0	0	0	0	0	0	12	5	5	0	0	22	24.
H/TOT	0	0	3	1	1	0	0	5	5.5	0	1	66	23	9	0	0	99	103
12:00	0	0	0	0	0	0	0	0	0	0	0	18	3	0	0	0	21	21
12:15	0	0	1	0	0	0	0	1	1	0	0	18	8	2	0	0	28	29
12:30	0	0	0	0	0	0	0	0	0	0	0	31	9	0	0	0	40	40
12:45	0	0	0	0	0	0	0	0	0	0	0	22	5	3	0	0	30	31.
H/TOT	0	0	1	0	0	0	0	1	1	0	0	89	25	5	0	0	119	122
13:00	0	0	0	0	0	0	0	0	0	1	1	42	4	1	0	0	49	48.
13:15	0	0	1	0	0	0	0	1	1	0	1	19	4	2	0	0	26	26.
13:30	0	0	0	0	0	0	0	0	0	0	0	15	2	0	0	0	17	17
13:45	0	0	0	0	0	0	0	0	0	0	0	5	3	0	0	0	8	8
H/TOT	0	0	1	0	0	0	0	1	1	1	2	81	13	3	0	0	100	99.
14:00	0	0	1	0	0	0	0	1	1	0	0	16	6	1	0	0	23	23.5
14:15	0	0	1	0	0	0	0	1	1	0	0	25	4	1	0	0	30	30.5
14:30	0	0	2	0	0	0	0	2	2	0	0	26	1	1	1	0	29	30.
14:45	0	0	1	0	0	0	0	1	1	0	0	33	6	0	0	0	39	39
H/TOT	0	0	5	0	0	0	0	5	5	0	0	100	17	3	1	0	121	124
15:00	0	0	2	0	0	0	0	2	2	0	0	26	4	0	0	0	30	30
15:15	0	0	2	0	0	0	0	2	2	0	0	27	2	0	0	0	29	29
15:30	0	0	2	0	0	0	0	2	2	1	0	34	4	2	0	0	41	41.2
15:45	0	0	0	0	0	0	0	0	0	0	0	39	6	1	0	0	46	46.5
H/TOT	0	0	6	0	0	0	0	6	6	1	0	126	16	3	0	0	146	147
16:00	0	0	1	0	0	0	0	1	1	0	0	28	7	0	0	0	35	35
16:15	0	0	0	0	0	0	0	0	0	0	0	16	5	0	0	0	21	21
16:30	0	0	0	0	0	0	0	0	0	0	0	38	3	2	0	0	43	44
16:45	0	1	2	0	0	0	0	3	2.4	0	0	50	4	3	0	0	57	58.5
H/TOT	0	1	3	0	0	0	0	4	3.4	0	0	132	19	5	0	0	156	159
17:00	2	0	2	0	0	0	0	4	2.4	0	0	50	3	1	0	0	54	54.5
17:15	1	0	2	0	0	0	0	3	2.2	0	0	31	6	0	0	0	37	37
17:30	0	0	2	1	0	0	0	3	3	1	0	32	2	0	0	0	35	34.
17:45	0	1	0	0	0	0	0	1	0.4	0	0	30	3	0	0	0	33	33
H/TOT	3	1	6	1	0	0	0	11	8	1	0	143	14	1	0	0	159	159
18:00	0	0	1	0	0	0	0	1	1	0	0	27	0	0	0	0	27	27
18:15	0	0	0	0	0	0	0	0	0	0	0	13	1	0	0	0	14	14
18:30	0	0	0	1	0	0	0	1	1	0	0	9	0	0	0	1	10	11
18:45	0	0	0	0	0	0	0	0	0	0	0	18	1	0	0	0	19	19
H/TOT	0	0	1	1	0	0	0	2	2	0	0	67	2	0	0	1	70	71
12 TOT	3	2	31	7	1	0	0	44	40.	7	4	962	208	39	2	1	122	123

	C => C									C => D								
TIME	P/C	M/C	CAR	LGV	)GV1	)GV2	V (B	TOT	PCU	P/C	M/C	CAR	LGV	)GV1	)GV2	V (B	TOT	PCU
07:00	0	0	0	0	0	0	0	0	0	1	0	46	4	1	1	1	54	56
07:15	0	0	0	0	0	0	0	0	0	0	0	11	4	1	0	0	16	16.
07:30	0	0	0	0	0	0	0	0	0	1	0	14	6	4	0	0	25	26.
07:45	0	0	0	0	0	0	0	0	0	0	1	10	8	5	0	0	24	25.
H/TOT	0	0	0	0	0	0	0	0	0	2	1	81	22	11	1	1	119	125
08:00	0	0	0	0	0	0	0	0	0	0	0	12	7	5	4	0	28	35.
08:15	0	0	0	0	0	0	0	0	0	0	0	12	8	6	1	0	27	31.
08:30	0	0	0	0	0	0	0	0	0	0	1	15	8	2	1	0	27	28.
08:45	0	0	0	0	0	0	0	0	0	1	0	15	9	8	2	0	35	40.
H/TOT	0	0	0	0	0	0	0	0	0	1	1	54	32	21	8	0	117	137
09:00	0	0	0	0	0	0	0	0	0	0	0	15	14	4	2	0	35	39.
09:15	0	0	0	0	0	0	0	0	0	0	0	21	13	7	3	0	44	51.
09:30	0	0	0	0	0	0	0	0	0	1	0	27	17	5	6	0	56	65.
09:45	0	0	0	0	0	0	0	0	0	0	0	31	14	7	1	0	53	57.
H/TOT	0	0	0	0	0	0	0	0	0	1	0	94	58	23	12	0	188	214
10:00	0	0	0	0	0	0	0	0	0	0	0	20	19	8	1	0	48	53.
10:15	0	0	0	0	0	0	0	0	0	0	0	29	17	4	3	0	53	58.
10:30	0	0	0	0	0	0	0	0	0	0	0	26	10	7	3	0	46	53.
10:45	0	0	0	0	0	0	0	0	0	0	0	38	16	4	3	0	61	66.
H/TOT	0	0	0	0	0	0	0	0	0	0	0	113	62	23	10	0	208	233
11:00	0	0	0	0	0	0	0	0	0	1	0	23	16	3	5	0	48	55.
11:15	0	0	0	0	0	0	0	0	0	0	0	37	17	6	1	0	61	65.
11:30	0	0	0	0	0	0	0	0	0	0	1	39	15	3	1	0	59	61.
11:45	0	0	0	0	0	0	0	0	0	1	0	43	16	10	3	0	73	81.
H/TOT	0	0	0	0	0	0	0	0	0	2	1	142	64	22	10	0	241	263
12:00	0	0	0	0	0	0	0	0	0	0	1	26	13	4	3	0	47	52.
12:15	0	0	0	0	0	0	0	0	0	3	1	41	18	2	3	0	68	69.
12:30	0	0	0	0	0	0	0	0	0	0	1	39	15	5	0	1	61	63.
12:45	0	0	0	0	0	0	0	0	0	1	0	48	12	4	3	0	68	73.
H/TOT	0	0	0	0	0	0	0	0	0	4	3	154	58	15	9	1	244	259
13:00	0	0	0	0	0	0	0	0	0	0	0	53	13	6	3	0	75	81.
13:15	0	0	0	0	0	0	0	0	0	1	0	37	4	3	3	0	48	52.
13:30	0	0	0	0	0	0	0	0	0	0	1	26	9	2	2	0	40	43
13:45	0	0	0	0	0	0	0	0	0	3	0	18	7	4	0	0	32	31.
H/TOT	0	0	0	0	0	0	0	0	0	4	1	134	33	15	8	0	195	209
14:00	0	0	0	0	0	0	0	0	0	1	0	47	11	6	2	0	67	71.
14:15	0	0	0	0	0	0	0	0	0	0	0	43	8	9	0	0	60	64.
14:30	0	0	0	0	0	0	0	0	0	1	0	49	10	6	3	0	69	75.
14:45	0	0	0	0	0	0	0	0	0	1	1	44	22	1	3	0	72	75
H/TOT	0	0	0	0	0	0	0	0	0	3	1	183	51	22	8	0	268	286
15:00	0	0	0	0	0	0	0	0	0	0	2	54	13	3	2	0	74	76.
15:15	0	0	0	0	0	0	0	0	0	0	0	89	7	4	2	0	102	107
15:30	0	0	0	0	0	0	0	0	0	1	1	88	20	5	4	0	119	125
15:45	0	0	0	0	0	0	0	0	0	0	1	94	14	4	1	0	114	117
H/TOT	0	0	0	0	0	0	0	0	0	1	4	325	54	16	9	0	409	426
16:00	0	0	0	0	0	0	0	0	0	0	0	70	10	2	2	0	84	87.
16:15	0	0	0	0	0	0	0	0	0	0	1	60	13	3	1	0	78	80.
16:30	0	0	0	0	0	0	0	0	0	0	1	81	16	3	1	0	102	104
16:45	0	0	0	0	0	0	0	0	0	0	1	86	10	0	2	0	99	101
H/TOT	0	0	0	0	0	0	0	0	0	0	3	297	49	8	6	0	363	373
17:00	0	0	0	0	0	0	0	0	0	0	1	130	15	3	0	0	149	150
17:15	0	0	0	0	0	0	0	0	0	0	0	70	3	0	0	0	73	73
17:30	0	0	0	0	0	0	0	0	0	2	0	91	10	0	0	0	103	101
17:45	0	0	0	0	0	0	0	0	0	1	0	46	4	2	0	0	53	53.
H/TOT	0	0	0	0	0	0	0	0	0	3	1	337	32	5	0	0	378	378
18:00	0	0	0	0	0	0	0	0	0	0	0	39	1	0	0	0	40	40
18:15	0	0	0	0	0	0	0	0	0	1	0	30	5	0	0	0	36	35.
18:30	0	0	0	0	0	0	0	0	0	0	0	18	4	0	0	0	22	22
18:45	0	0	0	0	0	0	0	0	0	0	0	30	4	0	0	0	34	34
H/TOT	0	0	0	0	0	0	0	0	0	1	0	117	14	0	0	0	132	131
12 TOT	0	0	0	0	0	0	0	0	0	22	16	2031	529	181	81	2	286	303

	D => A									
TIME	P/C	M/C	CAR	LGV	)GV1	)GV2	V (B	TOT	PCU	P/C
07:00	0	0	4	0	0	0	0	4	4	0
07:15	0	0	2	1	0	0	0	3	3	1
07:30	0	0	6	0	0	0	0	6	6	4
07:45	2	0	7	0	0	1	0	10	9.7	8
H/TOT	2	0	19	1	0	1	0	23	22.	13
08:00	0	0	5	1	0	0	0	6	6	15
08:15	1	0	7	0	1	0	0	9	8.7	15
08:30	0	0	8	2	0	0	0	10	10	20
08:45	0	0	13	1	0	0	0	14	14	9
H/TOT	1	0	33	4	1	0	0	39	38.	59
09:00	0	0	10	3	1	0	0	14	14.	3
09:15	0	0	10	1	0	0	0	11	11	2
09:30	0	0	4	0	0	0	0	4	4	1
09:45	0	0	7	0	0	0	0	7	7	0
H/TOT	0	0	31	4	1	0	0	36	36.	6
10:00	0	0	4	0	0	0	0	4	4	1
10:15	0	0	5	0	0	0	0	5	5	1
10:30	0	0	4	0	0	0	0	4	4	5
10:45	0	0	1	0	0	0	0	1	1	3
H/TOT	0	0	14	0	0	0	0	14	14	10
11:00	1	0	4	1	0	0	0	6	5.2	1
11:15	0	0	5	0	0	0	0	5	5	2
11:30	0	0	2	0	0	0	0	2	2	1
11:45	0	0	3	1	0	0	0	4	4	1
H/TOT	1	0	14	2	0	0	0	17	16.	5
12:00	0	0	4	0	0	0	0	4	4	0
12:15	0	0	6	0	0	0	0	6	6	2
12:30	0	0	4	0	0	0	0	4	4	0
12:45	0	0	7	0	0	0	0	7	7	0
H/TOT	0	0	21	0	0	0	0	21	21	2
13:00	0	0	5	2	0	0	0	7	7	1
13:15	0	0	9	0	0	0	0	9	9	6
13:30	0	0	5	0	0	0	0	5	5	3
13:45	0	0	10	1	0	0	0	11	11	0
H/TOT	0	0	29	3	0	0	0	32	32	10
14:00	0	0	2	1	0	0	0	3	3	2
14:15	0	0	8	0	0	0	0	8	8	1
14:30	0	0	11	0	0	0	0	11	11	2
14:45	0	0	6	1	0	0	0	7	7	0
H/TOT	0	0	27	2	0	0	0	29	29	5
15:00	0	0	9	2	0	0	0	11	11	1
15:15	1	0	7	1	0	0	0	9	8.2	0
15:30	0	0	11	0	0	0	0	11	11	5
15:45	0	0	12	0	0	0	0	12	12	2
H/TOT	1	0	39	3	0	0	0	43	42.	8
16:00	1	0	8	0	0	0	0	9	8.2	1
16:15	2	0	16	0	0	0	0	18	16.	2
16:30	0	1	8	1	0	0	0	10	9.4	2
16:45	0	1	13	0	0	0	0	14	13.	5
H/TOT	3	2	45	1	0	0	0	51	47.	10
17:00	0	0	15	2	0	0	0	17	17	2
17:15	0	0	11	0	0	0	0	11	11	2
17:30	2	0	10	2	0	0	0	14	12.	5
17:45	2	0	16	0	0	0	0	18	16.	7
H/TOT	4	0	52	4	0	0	0	60	56.	16
18:00	1	0	11	0	0	0	0	12	11.	3
18:15	1	1	12	1	0	0	0	15	13.	6
18:30	0	0	12	1	0	0	0	13	13	2
18:45	0	0	9	1	0	0	0	10	10	6
H/TOT	2	1	44	3	0	0	0	50	47.	17
12 TOT	14	3	368	27	2	1	0	415	404	161





IDASO

Survey Name: HDR 20 128 Grange Rd

Site: Site 3

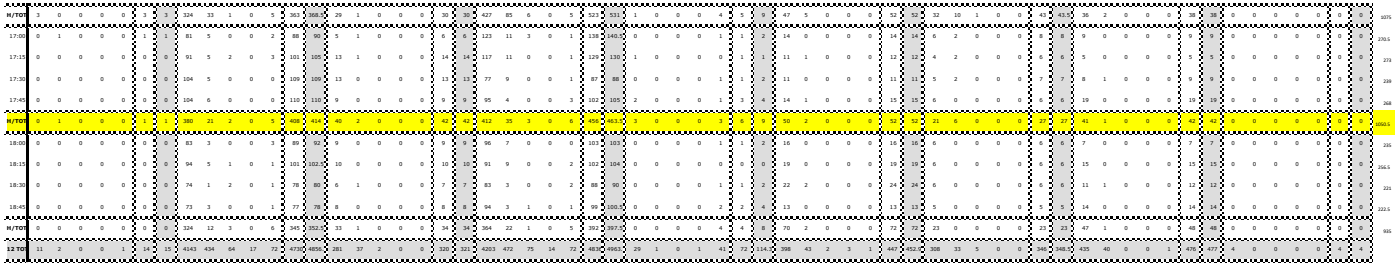
Location: —

Date: Wed 31-Jan-2018

	A => A							A => B							A => C						
TIME	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU
07:00	0	0	0	0	1	1	2	41	10	0	0	2	53	55	3	1	0	0	0	4	4
07:15	0	0	0	0	0	0	0	45	9	1	0	1	56	57.5	6	3	0	0	0	9	9
07:30	0	0	0	0	0	0	0	85	13	0	0	3	101	104	6	2	0	0	0	8	8
07:45	0	0	0	0	0	0	0	109	17	2	0	2	130	133	9	2	0	0	0	11	11
H/TOT	0	0	0	0	1	1	2	280	49	3	0	8	340	349.5	24	8	0	0	0	32	32
08:00	0	0	0	0	0	0	0	135	19	1	0	7	162	169.5	4	2	0	0	0	6	6
08:15	0	0	0	0	0	0	0	180	11	1	0	1	193	194.5	3	3	0	0	0	6	6
08:30	1	0	0	0	0	1	1	136	15	0	0	2	153	155	8	2	0	0	0	10	10
08:45	0	0	0	0	0	0	0	119	14	3	0	2	138	141.5	8	0	0	0	0	8	8
H/TOT	1	0	0	0	0	1	1	570	59	5	0	12	646	660.5	23	7	0	0	0	30	30
09:00	0	0	0	0	0	0	0	117	12	4	1	3	137	143.3	7	1	0	0	0	8	8
09:15	0	0	0	0	0	0	0	91	16	3	1	2	113	117.8	5	2	0	0	0	7	7
09:30	0	0	0	0	0	0	0	75	18	1	1	0	95	96.8	0	0	0	0	0	0	0
09:45	1	0	0	0	0	1	1	62	7	1	1	2	73	76.8	5	1	0	0	0	6	6
H/TOT	1	0	0	0	0	1	1	345	53	9	4	7	418	434.7	17	4	0	0	0	21	21
10:00	0	0	0	0	0	0	0	45	11	4	1	1	62	66.3	5	0	0	0	0	5	5
10:15	0	0	0	0	0	0	0	57	10	2	1	2	72	76.3	1	0	0	0	0	1	1
10:30	1	0	0	0	0	1	1	72	11	1	0	0	84	84.5	4	1	0	0	0	5	5
10:45	0	0	0	0	0	0	0	70	14	1	1	0	86	87.8	7	5	0	0	0	12	12
H/TOT	1	0	0	0	0	1	1	244	46	8	3	3	304	314.9	17	6	0	0	0	23	23
11:00	0	0	0	0	0	0	0	69	8	2	1	1	81	84.3	3	0	0	0	0	3	3
11:15	0	0	0	0	0	0	0	73	15	0	1	4	93	98.3	0	0	0	0	0	0	0
11:30	0	0	0	0	0	0	0	63	10	1	0	0	74	74.5	4	1	1	0	0	6	6.5
11:45	0	0	0	0	0	0	0	69	8	2	3	0	82	86.9	3	0	0	0	0	3	3
H/TOT	0	0	0	0	0	0	0	274	41	5	5	5	330	344	10	1	1	0	0	12	12.5
12:00	0	1	0	0	0	1	1	56	11	1	1	1	70	72.8	2	2	0	0	0	4	4
12:15	1	0	0	0	0	1	1	70	5	3	0	3	81	85.5	3	2	0	0	0	5	5
12:30	0	0	0	0	0	0	0	86	6	3	1	0	96	98.8	5	0	0	0	0	5	5
12:45	0	0	0	0	0	0	0	79	12	3	0	1	95	97.5	6	1	0	0	0	7	7
H/TOT	1	1	0	0	0	2	2	291	34	10	2	5	342	354.6	16	5	0	0	0	21	21
13:00	0	0	0	0	0	0	0	75	12	1	0	1	89	90.5	12	0	0	0	0	12	12
13:15	1	0	0	0	0	1	1	98	6	2	0	2	108	111	6	0	0	0	0	6	6
13:30	1	0	0	0	0	1	1	93	6	1	0	1	101	102.5	5	0	0	0	0	5	5
13:45	1	0	0	0	0	1	1	103	11	3	1	2	120	124.8	3	0	0	0	0	3	3
H/TOT	3	0	0	0	0	3	3	369	35	7	1	6	418	428.8	26	0	0	0	0	26	26
14:00	0	0	0	0	0	0	0	93	10	1	0	0	104	104.5	3	0	0	0	0	3	3
14:15	0	0	0	0	0	0	0	93	8	2	0	3	106	110	4	1	0	0	0	5	5
14:30	0	0	0	0	0	0	0	102	5	1	2	1	111	115.1	9	0	1	0	0	10	10.5
14:45	0	0	0	0	0	0	0	92	6	0	0	0	98	98	7	0	0	0	0	7	7
H/TOT	0	0	0	0	0	0	0	380	29	4	2	4	419	427.6	23	1	1	0	0	25	25.5
15:00	1	0	0	0	0	1	1	88	4	2	0	1	95	97	1	0	0	0	0	1	1
15:15	0	0	0	0	0	0	0	81	7	2	0	1	91	93	6	0	0	0	0	6	6
15:30	0	0	0	0	0	0	0	85	4	2	0	2	93	96	8	1	0	0	0	9	9
15:45	0	0	0	0	0	0	0	108	7	1	0	2	118	120.5	8	0	0	0	0	8	8
H/TOT	1	0	0	0	0	1	1	362	22	7	0	6	397	406.5	23	1	0	0	0	24	24
16:00	0	0	0	0	0	0	0	78	9	1	0	0	88	88.5	5	1	0	0	0	6	6
16:15	0	0	0	0	0	0	0	82	6	0	0	2	90	92	6	0	0	0	0	6	6
16:30	3	0	0	0	0	3	3	76	11	0	0	1	88	89	8	0	0	0	0	8	8
16:45	0	0	0	0	0	0	0	88	7	0	0	2	97	99	10	0	0	0	0	10	10

	B => A							B => B							B => C						
TIME	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU
07:00	25	1	1	0	4	31	35.5	0	0	0	0	0	0	0	2	2	0	0	0	4	4
07:15	30	2	0	0	2	34	36	0	0	0	0	3	3	6	2	2	0	0	0	4	4
07:30	56	8	0	0	1	65	66	0	0	0	0	1	1	2	5	1	0	0	0	6	6
07:45	65	3	0	0	5	73	78	0	0	0	0	1	1	2	10	2	0	0	0	12	12
H/TOT	176	14	1	0	12	203	215.5	0	0	0	0	5	5	10	19	7	0	0	0	26	26
08:00	91	6	1	0	0	98	98.5	0	0	0	0	2	2	4	3	0	0	0	0	3	3
08:15	113	8	3	0	1	125	127.5	0	0	0	0	0	0	0	7	0	0	0	0	7	7
08:30	116	8	1	0	3	128	131.5	1	0	0	0	1	2	3	5	1	0	0	0	6	6
08:45	107	12	1	0	0	120	120.5	1	0	0	0	1	2	3	10	0	0	0	0	10	10
H/TOT	427	34	6	0	4	471	478	2	0	0	0	4	6	10	25	1	0	0	0	26	26
09:00	100	10	1	0	2	113	115.5	1	0	0	0	1	2	3	11	0	0	0	0	11	11
09:15	85	10	0	1	2	98	101.3	1	0	0	0	0	1	1	9	1	0	0	0	10	10
09:30	74	12	1	0	1	88	89.5	1	0	0	0	2	3	5	7	0	0	0	0	7	7
09:45	73	6	3	1	1	84	87.8	0	0	0	0	1	1	2	7	3	0	0	0	10	10
H/TOT	332	38	5	2	6	383	394.1	3	0	0	0	4	7	11	34	4	0	0	0	38	38
10:00	66	6	2	0	0	74	75	0	0	0	0	0	0	0	4	1	1	0	0	6	6.5
10:15	59	6	2	2	1	70	74.6	0	0	0	0	1	1	2	3	2	0	0	0	5	5
10:30	66	4	0	0	1	71	72	2	0	0	0	1	3	4	6	2	0	0	0	8	8
10:45	57	12	3	1	1	74	77.8	1	0	0	0	1	2	3	6	1	0	0	0	7	7
H/TOT	248	28	7	3	3	289	299.4	3	0	0	0	3	6	9	19	6	1	0	0	26	26.5
11:00	57	17	2	3	0	79	83.9	1	0	0	1	0	2	3.3	4	0	0	0	0	4	4
11:15	67	16	2	0	1	86	88	1	0	0	0	1	2	3	1	1	0	0	0	2	2
11:30	93	7	2	1	2	105	109.3	0	0	0	0	1	1	2	4	2	0	0	0	6	6
11:45	63	7	4	0	0	74	76	1	1	0	0	0	2	2	4	1	0	0	1	6	7
H/TOT	280	47	10	4	3	344	357.2	3	1	0	1	2	7	10.3	13	4	0	0	1	18	19
12:00	83	9	1	1	2	96	99.8	0	0	0	0	0	0	0	8	0	0	0	0	8	8
12:15	89	7	1	1	0	98	99.8	1	0	0	0	1	2	3	8	1	0	0	0	9	9
12:30	85	14	3	0	3	105	109.5	2	0	0	0	1	3	4	7	1	0	0	0	8	8
12:45	88	12	0	0	0	100	100	0	0	0	0	0	0	0	5	0	0	0	0	5	5
H/TOT	345	42	5	2	5	399	409.1	3	0	0	0	2	5	7	28	2	0	0	0	30	30
13:00	121	12	0	0	1	134	135	1	0	0	0	1	2	3	9	1	0	0	0	10	10
13:15	105	8	0	0	2	115	117	0	0	0	0	1	1	2	9	1	0	3	0	13	16.9
13:30	102	11	2	0	1	116	118	1	0	0	0	0	1	1	7	2	0	0	0	9	9
13:45	96	9	4	0	2	111	115	5	0	0	0	1	6	7	18	1	0	0	0	19	19
H/TOT	424	40	6	0	6	476	485	7	0	0	0	3	10	13	43	5	0	3	0	51	54.9
14:00	90	5	2	1	0	98	100.3	1	0	0	0	2	3	5	3	0	0	0	0	3	3
14:15	79	9	5	0	1	94	97.5	0	0	0	0	1	1	2	6	0	0	0	0	6	6
14:30	81	8	2	0	1	92	94	1	0	0	0	1	2	3	4	1	0	0	0	5	5
14:45	99	10	2	0	5	116	122	0	0	0	0	0	0	0	10	1	0	0	0	11	11
H/TOT	349	32	11	1	7	400	413.8	2	0	0	0	4	6	10	23	2	0	0	0	25	25
15:00	120	10	7	2	4	143	153.1	0	0	0	0	1	1	2	7	0	0	0	0	7	7
15:15	99	15	3	0	2	119	122.5	0	0	0	0	1	1	2	5	0	1	0	0	6	6.5
15:30	99	21	3	0	1	124	126.5	1	0	0	0	1	2	3	3	2	0	0	0	5	5
15:45	101	9	1	0	3	114	117.5	1	0	0	0	0	1	1	12	1	0	0	0	13	13
H/TOT	419	55	14	2	10	500	519.6	2	0	0	0	3	5	8	27	3	1	0	0	31	31.5
16:00	108	28	2	0	2	140	143	1	0	0	0	1	2	3	13	1	0	0	0	14	14
16:15	113	23	1	0	2	139	141.5	0	0	0	0	1	1	2	13	2	0	0	0	15	15
16:30	106	17	2	0	0	125	126	0	0	0	0	0	0	0	8	0	0	0	0	8	8
16:45	100	17	1	0	1	119	120.5	0	0	0	0	2	2	4	13	2	0	0	0	15	15

	C => A							C => B							C => C							
TIME	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	CAR	LGV	OGV1	OGV2	SV (BU	TOT	PCU	
07:00	4	1	0	0	0	5	5	10	1	0	0	0	11	11	0	0	0	0	0	0	0	
07:15	10	1	0	0	0	11	11	9	0	0	0	0	9	9	0	0	0	0	0	0	0	
07:30	12	0	0	0	0	12	12	5	1	0	0	0	6	6	0	0	0	0	0	0	0	
07:45	10	1	0	0	0	11	11	15	2	0	0	0	17	17	0	0	0	0	0	0	0	
H/TOT	36	3	0	0	0	39	39	39	4	0	0	0	43	43	0	0	0	0	0	0	0	717
08:00	15	1	0	0	0	16	16	24	0	0	0	0	24	24	0	0	0	0	0	0	0	321
08:15	17	1	0	0	0	18	18	22	1	0	0	0	23	23	0	0	0	0	0	0	0	376
08:30	12	0	0	0	0	12	12	19	1	0	0	0	20	20	1	0	0	0	0	1	1	339.5
08:45	9	0	0	0	0	9	9	12	2	0	0	0	14	14	0	0	0	0	0	0	0	306
H/TOT	53	2	0	0	0	55	55	77	4	0	0	0	81	81	1	0	0	0	0	1	1	1342.5
09:00	9	0	0	0	0	9	9	18	1	0	0	0	19	19	0	0	0	0	0	0	0	308.8
09:15	7	0	0	0	0	7	7	11	0	0	0	0	11	11	0	0	0	0	0	0	0	255.1
09:30	6	1	0	0	0	7	7	6	0	0	0	0	6	6	0	0	0	0	0	0	0	211.3
09:45	6	3	0	0	0	9	9	6	2	0	0	0	8	8	1	0	0	0	0	1	1	201.6
H/TOT	28	4	0	0	0	32	32	41	3	0	0	0	44	44	1	0	0	0	0	1	1	976.8
10:00	1	1	0	0	0	2	2	8	2	0	0	0	10	10	0	0	0	0	0	0	0	164.8
10:15	8	0	0	0	0	8	8	3	1	0	0	0	4	4	0	0	0	0	0	0	0	170.9
10:30	7	0	0	0	0	7	7	8	1	0	0	0	9	9	0	0	0	0	0	0	0	190.5
10:45	2	0	1	0	0	3	3.5	7	4	0	0	0	11	11	0	0	0	0	0	0	0	202.1
H/TOT	18	1	1	0	0	20	20.5	26	8	0	0	0	34	34	0	0	0	0	0	0	0	728.3
11:00	3	0	0	0	0	3	3	3	1	0	0	0	4	4	0	0	0	0	0	0	0	185.5
11:15	3	0	0	0	0	3	3	5	2	0	0	0	7	7	0	0	0	0	0	0	0	201.3
11:30	4	0	0	0	0	4	4	4	2	0	0	0	6	6	0	0	0	0	0	0	0	208.3
11:45	4	0	0	0	0	4	4	4	1	0	0	0	5	5	1	0	0	0	0	1	1	184.9
H/TOT	14	0	0	0	0	14	14	16	6	0	0	0	22	22	1	0	0	0	0	1	1	780
12:00	8	0	1	0	0	9	9.5	6	0	0	0	1	7	8	0	0	0	0	0	0	0	203.1
12:15	5	0	0	0	0	5	5	6	1	0	0	0	7	7	0	0	0	0	0	0	0	215.3
12:30	1	0	0	0	0	1	1	9	0	0	0	0	9	9	1	0	0	0	0	1	1	236.3
12:45	3	0	0	0	0	3	3	6	0	0	0	0	6	6	0	0	0	0	0	0	0	218.5
H/TOT	17	0	1	0	0	18	18.5	27	1	0	0	1	29	30	1	0	0	0	0	1	1	873.2
13:00	8	0	0	0	0	8	8	7	2	0	0	0	9	9	0	0	0	0	0	0	0	267.5
13:15	8	0	0	0	0	8	8	7	1	0	0	0	8	8	0	0	0	0	0	0	0	269.9
13:30	3	0	0	0	0	3	3	8	2	0	0	0	10	10	0	0	0	0	0	0	0	249.5
13:45	8	0	0	0	0	8	8	5	0	0	0	0	5	5	0	0	0	0	0	0	0	282.8
H/TOT	27	0	0	0	0	27	27	27	5	0	0	0	32	32	0	0	0	0	0	0	0	1069.7
14:00	8	2	0	0	0	10	10	12	1	0	0	0	13	13	0	0	0	0	0	0	0	238.8
14:15	5	1	0	0	0	6	6	5	0	0	0	0	5	5	0	0	0	0	0	0	0	231.5
14:30	4	1	0	0	0	5	5	11	0	0	0	0	11	11	0	0	0	0	0	0	0	243.6
14:45	7	0	1	0	0	8	8.5	2	1	0	0	0	3	3	0	0	0	0	0	0	0	249.5
H/TOT	24	4	1	0	0	29	29.5	30	2	0	0	0	32	32	0	0	0	0	0	0	0	963.4
15:00	3	1	0	0	0	4	4	8	0	0	0	0	8	8	0	0	0	0	0	0	0	273.1
15:15	8	0	0	0	0	8	8	4	0	0	0	0	4	4	0	0	0	0	0	0	0	242
15:30	2	2	1	0	0	5	5.5	8	0	0	0	0	8	8	0	0	0	0	0	0	0	253
15:45	2	0	0	0	0	2	2	8	3	0	0	0	11	11	0	0	0	0	0	0	0	273
H/TOT	15	3	1	0	0	19	19.5	28	3	0	0	0	31	31	0	0	0	0	0	0	0	1041.1
16:00	9	4	0	0	0	13	13	7	1	0	0	0	8	8	0	0	0	0	0	0	0	275.5
16:15	5	5	1	0	0	11	11.5	10	0	0	0	0	10	10	0	0	0	0	0	0	0	278
16:30	8	1	0	0	0	9	9	10	1	0	0	0	11	11	0	0	0	0	0	0	0	254
16:45	10	0	0	0	0	10	10	9	0	0	0	0	9	9	0	0	0	0	0	0	0	267.5



Appendix 15.2

Sample Traffic Modelling Output File

JB Barry Consulting Engineers

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.0.6896

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

Filename: Junction 1 - Hole in the Wall 3.j9
Path: O:\20 Projects\20211 - Baldoyle Phase 5\00.WIP\Model\TRL
Report generation date: 07/03/2022 12:11:56

Summary of junction performance

	AM								PM							
	Queue (PCU)	95% Queue (PCU)	Delay (s)	RFC	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity	Queue (PCU)	95% Queue (PCU)	Delay (s)	RFC	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity
Baseline 2021 - 2021																
Arm 1	1.3	2.0	6.13	0.54	A	8.85	A	16 % [Arm 3]	1.3	2.1	6.19	0.54	A	21.22	C	-2 % [Arm 3]
Arm 2	2.1	3.0	8.68	0.66	A				4.7	24.0	16.77	0.82	C			
Arm 3	3.6	15.4	12.58	0.77	B				13.7	69.0	44.14	0.95	E			
Arm 4	1.2	2.5	6.43	0.53	A				1.7	2.0	7.59	0.61	A			

	DN AM								DN PM									
	Queue (PCU)	95% Queue (PCU)	Delay (s)	RFC	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity	Queue (PCU)	95% Queue (PCU)	Delay (s)	RFC	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity	Queue (PCU)	95 Que (PC
Opening Year 2026 - 20																		
Arm 1	1.8	2.1	7.88	0.63	A	13.00	B	6 % [Arm 3]	1.7	1.9	7.43	0.61	A	52.20	F	-10 % [Arm 3]	2.0	2.
Arm 2	3.0	11.6	11.82	0.74	B				9.9	54.4	33.50	0.92	D				3.2	12.
Arm 3	6.4	32.2	20.94	0.86	C				49.4	114.4	126.99	1.06	F				6.7	33.
Arm 4	1.7	2.7	8.22	0.61	A				2.3	4.5	9.40	0.68	A				1.7	2.

	DN AM								DN PM									
	Queue (PCU)	95% Queue (PCU)	Delay (s)	RFC	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity	Queue (PCU)	95% Queue (PCU)	Delay (s)	RFC	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity	Queue (PCU)	95 Que (PC
Future Year 2041 - 204																		
Arm 1	3.2	12.7	12.44	0.75	B	32.84	D	-6 % [Arm 3]	2.6	7.5	10.32	0.71	B	180.60	F	-20 % [Arm 3]	3.6	15.
Arm 2	6.7	34.5	23.84	0.87	C				60.1	123.9	153.04	1.08	F				7.2	38.
Arm 3	24.3	90.6	68.93	0.99	F				143.7	220.0	429.67	1.22	F				29.5	96.
Arm 4	2.9	10.6	12.82	0.74	B				3.5	15.0	12.74	0.77	B				3.0	11.

	AM								PM							
	Queue (PCU)	95% Queue (PCU)	Delay (s)	RFC	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity	Queue (PCU)	95% Queue (PCU)	Delay (s)	RFC	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity
Stress Test 2041 - Stress 2026																
Arm 1	3.1	11.5	11.41	0.75	B	17.27	C	2 % [Arm 3]	2.2	3.6	8.72	0.67	A	83.68	F	-15 % [Arm 3]
Arm 2	4.0	19.0	15.28	0.79	C				17.5	77.8	56.38	0.97	F			
Arm 3	9.0	49.7	29.10	0.91	D				86.4	150.9	208.06	1.13	F			
Arm 4	1.9	3.3	9.20	0.64	A				2.7	8.5	10.76	0.72	B			
Stress Test 2041 - Stress 2041																
Arm 1	6.5	32.7	22.17	0.87	C	52.44	F	-10 % [Arm 3]	3.6	15.9	13.15	0.77	B	245.88	F	-24 % [Arm 3]
Arm 2	10.9	58.5	38.74	0.93	E				92.1	155.5	228.71	1.14	F			
Arm 3	45.4	112.1	113.64	1.05	F				196.8	220.0	575.38	1.27	F			
Arm 4	3.3	14.0	14.35	0.76	B				4.2	20.8	15.14	0.80	C			

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle. Junction LOS and Junction Delay are demand-weighted averages. Network Residual Capacity indicates the amount by which network flow could be increased before a user-definable threshold (see Analysis Options) is met.

File summary

File Description

Title	
Location	
Site number	
Date	16/10/2020
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	JBBARRY\TransportPC
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	Residual capacity criteria type	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
5.75	✓		✓	Delay	0.85	36.00	20.00

Analysis Set Details

ID	Name	Include in report	Use specific Demand Set (s)	Specific Demand Set (s)	Network flow scaling factor (%)	Network capacity scaling factor (%)
A2	Opening Year 2026	✓	✓	D3,D4,D5,D6	100.000	100.000

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D12	Stress 2041	AM	ONE HOUR	07:45	09:15	15	✓

Opening Year 2026 - Stress 2041, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Pedestrian Crossing	Arm 1 - Pedestrian crossing	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Arm 2 - Pedestrian crossing	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Arm 3 - Pedestrian crossing	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Arm 4 - Pedestrian crossing	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3, 4	52.44	F

Junction Network Options

Driving side	Lighting	Network residual capacity (%)	First arm reaching threshold
Left	Normal/unknown	-10	Arm 3

Arms

Arms

Arm	Name	Description
1	Grange Rd East	
2	Hole in The Wall South	
3	Grange Rd West	
4	Hole In The Wall North	

Roundabout Geometry

Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
1	6.60	7.20	25.0	21.0	55.0	51.0	
2	6.00	6.10	7.0	18.4	55.0	52.0	
3	5.40	7.50	4.0	17.6	55.0	62.0	
4	7.00	7.00	0.0	17.2	55.0	41.0	

Pelican/Puffin Crossings

Arm	Space between crossing and junc. entry (Signalised) (PCU)	Amber time preceding red (s)	Amber time regarded as green (s)	Time from traffic red start to green man start (s)	Time period green man shown (s)	Clearance Period (s)	Traffic minimum green (s)
1	4.00	3.00	2.90	1.00	6.00	6.00	7.00
2	4.00	3.00	2.90	1.00	6.00	6.00	7.00
3	4.00	3.00	2.90	1.00	6.00	6.00	7.00
4	2.00	3.00	2.90	1.00	6.00	6.00	7.00

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
1	0.622	2016
2	0.562	1698
3	0.543	1653
4	0.630	2023

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Default vehicle mix	Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1		ONE HOUR	✓	1016	100.000
2		ONE HOUR	✓	986	100.000
3		ONE HOUR	✓	1213	100.000
4		ONE HOUR	✓	787	100.000

Demand overview (Pedestrians)

Arm	Profile type	Average pedestrian flow (Ped/hr)
1	[ONEHOUR]	0.00
2	[ONEHOUR]	0.00
3	[ONEHOUR]	0.00
4	[ONEHOUR]	0.00

Origin-Destination Data

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	332	595	89
	2	242	0	439	305
	3	582	509	0	122
	4	209	406	172	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	10	10	10	10
	2	10	10	10	10
	3	10	10	10	10
	4	10	10	10	10

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max 95th percentile Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
1	0.87	22.17	6.5	32.7	C	932	1398
2	0.93	38.74	10.9	58.5	E	905	1357
3	1.05	113.64	45.4	112.1	F	1113	1670
4	0.76	14.35	3.3	14.0	B	722	1083

Main Results for each time segment

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Pedestrian demand (Ped/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	765	191	813	0.00	1510	0.507	760	772	0.0	1.1	5.253	A
2	742	186	641	0.00	1338	0.555	737	932	0.0	1.3	6.531	A
3	913	228	475	0.00	1395	0.655	905	902	0.0	2.0	7.961	A
4	592	148	995	0.00	1396	0.424	589	386	0.0	0.8	4.889	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Pedestrian demand (Ped/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	913	228	972	0.00	1411	0.647	910	922	1.1	2.0	7.850	A
2	886	222	767	0.00	1267	0.699	882	1115	1.3	2.5	10.154	B
3	1090	273	569	0.00	1344	0.811	1081	1080	2.0	4.4	14.565	B
4	707	177	1189	0.00	1274	0.555	705	461	0.8	1.4	6.940	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Pedestrian demand (Ped/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1119	280	1153	0.00	1298	0.862	1103	1085	2.0	5.9	18.904	C
2	1086	271	930	0.00	1176	0.924	1059	1326	2.5	9.2	28.923	D
3	1336	334	684	0.00	1281	1.042	1244	1305	4.4	27.4	58.255	F
4	867	217	1378	0.00	1154	0.751	859	549	1.4	3.1	13.119	B

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Pedestrian demand (Ped/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1119	280	1166	0.00	1290	0.867	1116	1101	5.9	6.5	22.170	C
2	1086	271	941	0.00	1170	0.928	1079	1342	9.2	10.9	38.736	E
3	1336	334	696	0.00	1275	1.048	1264	1323	27.4	45.4	113.642	F
4	867	217	1401	0.00	1140	0.760	866	559	3.1	3.3	14.355	B

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Pedestrian demand (Ped/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	913	228	1048	0.00	1363	0.670	930	1014	6.5	2.3	9.480	A
2	886	222	782	0.00	1259	0.704	919	1196	10.9	2.7	12.710	B
3	1090	273	591	0.00	1332	0.819	1248	1110	45.4	6.0	64.734	F
4	707	177	1348	0.00	1173	0.603	714	491	3.3	1.7	8.738	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Pedestrian demand (Ped/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	765	191	827	0.00	1501	0.510	769	787	2.3	1.2	5.447	A
2	742	186	648	0.00	1334	0.556	748	949	2.7	1.4	6.812	A
3	913	228	482	0.00	1391	0.656	929	914	6.0	2.2	8.832	A
4	592	148	1019	0.00	1381	0.429	596	392	1.7	0.8	5.065	A

Queue Variation Results for each time segment

07:45 - 08:00

Arm	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1	1.12	0.61	1.11	1.55	1.61			N/A	N/A
2	1.35	0.61	1.25	1.72	1.97			N/A	N/A
3	2.03	0.29	1.19	3.40	4.27			N/A	N/A
4	0.80	0.61	1.10	1.54	1.60			N/A	N/A

08:00 - 08:15

Arm	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1	1.97	0.05	0.53	5.20	8.24			N/A	N/A
2	2.47	0.06	0.63	6.62	10.52			N/A	N/A
3	4.37	0.07	1.31	12.08	18.65			N/A	N/A
4	1.35	0.06	0.79	3.02	4.31			N/A	N/A

08:15 - 08:30

Arm	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1	5.95	0.04	0.42	15.07	32.25			N/A	N/A
2	9.21	0.07	1.60	26.70	43.16			N/A	N/A
3	27.36	2.72	21.11	56.31	70.48			N/A	N/A
4	3.13	0.03	0.33	3.13	14.01			N/A	N/A

08:30 - 08:45

Arm	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1	6.53	0.04	0.35	9.45	32.67			N/A	N/A
2	10.93	0.05	0.51	30.56	58.45			N/A	N/A
3	45.35	6.11	36.47	90.73	112.14			N/A	N/A
4	3.35	0.03	0.31	3.35	9.96			N/A	N/A

08:45 - 09:00

Arm	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1	2.30	0.05	0.53	6.21	9.99			N/A	N/A
2	2.73	0.04	0.45	7.41	13.66			N/A	N/A
3	5.99	0.05	0.53	17.16	30.15			N/A	N/A
4	1.71	0.09	1.18	3.65	5.03			N/A	N/A

09:00 - 09:15

Arm	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1	1.16	0.03	0.35	2.28	5.85			N/A	N/A
2	1.40	0.03	0.33	1.97	6.85			N/A	N/A
3	2.16	0.03	0.32	2.16	8.69			N/A	N/A
4	0.83	0.04	0.40	1.97	3.41			N/A	N/A

Junctions 9

OSCADY 9 - Signalised Intersection Module

Version: 9.5.0.6896

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

Filename: Junction 2 - Longfield Road 3.j9
Path: O:\20 Projects\20211 - Baldoyle Phase 5\00.WIP\Model\TRL
Report generation date: 09/03/2022 10:03:41

Summary of junction performance

	AM								PM							
	Queue (PCU)	95% Queue (PCU)	Delay (s)	DOS	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity	Queue (PCU)	95% Queue (PCU)	Delay (s)	DOS	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity
	Baseline 2021 - 2021															
Arm A	71.9	?	398.83	1.18	F	267.15	F	-100 % [Arm A - Traffic Stream 2]	23.8	?	103.86	0.98	F	86.72	F	-100 % [Arm A - Traffic Stream 2]
Arm B	5.5	?	42.19	0.38	D				25.4	?	95.45	0.92	F			
Arm C	70.6	?	253.54	1.21	F				26.0	?	71.06	0.88	E			
Arm D	3.9	?	44.17	0.26	D				1.8	?	41.93	0.11	D			

	AM								PM							
	Queue (PCU)	95% Queue (PCU)	Delay (s)	DOS	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity	Queue (PCU)	95% Queue (PCU)	Delay (s)	DOS	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity
	Opening Year 2026 - DN 2026															
Arm A	121.8	?	729.18	1.30	F	468.87	F	-100 % [Arm A - Traffic Stream 2]	43.5	?	196.71	1.08	F	142.97	F	-100 % [Arm A - Traffic Stream 2]
Arm B	6.3	?	43.84	0.44	D				41.8	?	152.06	1.02	F			
Arm C	110.1	?	454.05	1.34	F				38.3	?	106.63	0.98	F			
Arm D	5.6	?	46.31	0.38	D				2.2	?	42.32	0.14	D			
	Opening Year 2026 - DS 2026															
Arm A	122.0	?	723.32	1.30	F	456.48	F	-100 % [Arm A - Traffic Stream 2]	44.0	?	193.06	1.08	F	149.32	F	-100 % [Arm A - Traffic Stream 2]
Arm B	6.4	?	44.07	0.45	D				42.8	?	155.50	1.03	F			
Arm C	112.7	?	449.96	1.34	F				47.3	?	130.10	1.03	F			
Arm D	7.2	?	48.57	0.47	D				4.0	?	44.20	0.26	D			

	AM								PM							
	Queue (PCU)	95% Queue (PCU)	Delay (s)	DOS	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity	Queue (PCU)	95% Queue (PCU)	Delay (s)	DOS	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity
	Future 2041 - DN 2041															
Arm A	233.0	?	1365.12	1.51	F			-100 %	76.4	?	413.78	1.19	F			-100 %

Arm B	7.3	?	44.53	0.49	D	807.49	F	[Arm A - Traffic Stream 2]	102.5	?	508.21	1.25	F	347.55	F	[Arm A - Traffic Stream 2]
Arm C	187.6	?	717.63	1.46	F				72.3	?	198.17	1.08	F			
Arm D	6.2	?	47.13	0.41	D				2.4	?	42.54	0.16	D			
	Future 2041 - DS 2041															
Arm A	233.1	?	1355.11	1.51	F	803.79	F	-100 % [Arm A - Traffic Stream 2]	86.4	?	506.37	1.22	F	374.06	F	-100 % [Arm A - Traffic Stream 2]
Arm B	7.4	?	45.00	0.51	D				87.4	?	395.39	1.16	F			
Arm C	196.5	?	747.96	1.46	F				95.3	?	312.82	1.16	F			
Arm D	7.9	?	49.62	0.51	D				4.3	?	44.46	0.28	D			

	AM								**PM**							
	Queue (PCU)	**95% Queue (PCU)**	**Delay (s)**	**DOS**	**LOS**	**Junction Delay (s)**	**Junction LOS**	**Network Residual Capacity**	**Queue (PCU)**	**95% Queue (PCU)**	**Delay (s)**	**DOS**	**LOS**	**Junction Delay (s)**	**Junction LOS**	**Network Residual Capacity**
	Stress Test - Stress 2026															
Arm A	122.9	?	689.37	1.30	F	437.43	F	-100 % [Arm A - Traffic Stream 2]	39.1	?	139.65	1.05	F	234.01	F	-100 % [Arm A - Traffic Stream 2]
Arm B	6.8	?	46.05	0.51	D				60.2	?	265.24	1.20	F			
Arm C	142.9	?	487.08	1.34	F				91.6	?	320.15	1.19	F			
Arm D	16.2	?	75.05	0.87	E				6.9	?	47.90	0.45	D			
	Stress Test - Stress 2041															
Arm A	233.8	?	1295.12	1.51	F	846.63	F	-100 % [Arm A - Traffic Stream 2]	78.5	?	380.30	1.19	F	483.03	F	-100 % [Arm A - Traffic Stream 2]
Arm B	7.8	?	47.17	0.57	D				114.6	?	576.84	1.34	F			
Arm C	257.4	?	987.08	1.46	F				153.0	?	580.23	1.31	F			
Arm D	18.0	?	82.88	0.91	F				7.2	?	48.34	0.46	D			

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle. Junction LOS and Junction Delay are demand-weighted averages. Network Residual Capacity indicates the amount by which network flow could be increased before a user-definable threshold (see Analysis Options) is met.

File summary

File Description

Title	
Location	
Site number	
Date	30/09/2020
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	JBBARRY\TransportPC
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	Residual capacity criteria type	DOS Threshold	Average Delay threshold (s)	Queue threshold (PCU)
5.75	✓		✓	Delay	0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D1	2021	AM	ONE HOUR	07:45	09:15	15	✓
D2	2021	PM	ONE HOUR	14:45	16:15	15	✓
D3	DN 2026	AM	ONE HOUR	07:45	09:15	15	✓
D4	DN 2026	PM	ONE HOUR	14:45	16:15	15	✓
D5	DS 2026	AM	ONE HOUR	07:45	09:15	15	✓
D6	DS 2026	PM	ONE HOUR	14:45	16:15	15	✓
D7	DN 2041	AM	ONE HOUR	07:45	09:15	15	✓
D8	DN 2041	PM	ONE HOUR	14:45	16:15	15	✓
D9	DS 2041	AM	ONE HOUR	07:45	09:15	15	✓

D10	DS 2041	PM	ONE HOUR	14:45	16:15	15	✓
D11	Stress 2026	AM	ONE HOUR	07:45	09:15	15	✓
D12	Stress 2041	AM	ONE HOUR	07:45	09:15	15	✓
D13	Stress 2026	PM	ONE HOUR	14:45	16:15	15	✓
D14	Stress 2041	PM	ONE HOUR	14:45	16:15	15	✓

Baseline 2021 - 2021, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Queue percentiles	Analysis Options	Queue percentiles cannot be calculated for signalised junction unless in Lane Simulation mode.
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Analysis Set Details

ID	Name	Include in report	Use specific Demand Set (s)	Specific Demand Set (s)	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	Baseline 2021	✓	✓	D1,D2	100.000	100.000

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Junction Delay (s)	Junction LOS
1	untitled	Signalised		267.15	F

Junction Network Options

Driving side	Lighting	Network residual capacity (%)	First arm reaching threshold
Left	Normal/unknown	-100	Arm A - Traffic Stream 2

Arms

Arms

Arm	Name	Description
A	untitled	
B	untitled	
C	untitled	
D	untitled	

OSCADY Traffic Streams

Arm	Traffic Stream	Phase	Notional EEG (s)	Signals EEG (s)	Destination arms	Straight move
A	1	A	0.00	0.00	B, C	C
	2	B	0.00	0.00	D	C
B	1	D	0.00	0.00	C	D
	2	C	0.00	0.00	A, D	D
C	1	H	0.00	0.00	A, D	A
	2	I	0.00	0.00	B	A
D	1	F	0.00	0.00	A, B	B
	2	E	0.00	0.00	C	B

OSCADY Lanes

Arm	Traffic Stream	Destination arms	Gradient (%)	Width (m)	Turning radius (m)	Nearside lane	Has bay
A	1	B, C	0	3.50	15.80	✓	
	2	D	0	3.00	18.00		
B	1	C	0	3.00	12.40	✓	
	2	A, D	0	3.00	26.80		
C	1	A, D	0	4.50	15.40	✓	
	2	B	0	3.50	14.90		
D	1	A, B	0	3.75	19.60		
	2	C	0	3.00	19.70	✓	

Signal Timings

Junction 1

Junction	Sequence to use	Cycle time (s)	Maximum cycle time (s)	Start displacement (s)	End displacement (s)
1	1	120	120	1.40	2.90

Optimisation options

Junction	Optimise stage lengths	Optimise cycle time	Optimiser demand source	Optimiser message
1	✓	✓	Average	Timings provide capacity maximisation.

Phases

Junction	Phase	Name	Minimum green (s)
1	A		7
	B		7
	C		7
	D		7
	E		7
	F		7
	G		12
	H		7
	I		7

Library Stages

Junction	Library Stage	Phases in stage	User stage minimum (s)	Run every N cycles	Probability of running (%)
1	1	A, H	20		
	2	B, D, I	20		
	3	D, C	5		
	4	F, E	20		
	5	G	5		

Stage Sequences

Junction	Sequence	Name	Stage IDs	Stage ends
1	1		1, 2, 3, 4, 5	39, 66, 78, 103, 0
	2		1, 2, 3, 5, 4	10, 25, 40, 59, 73
	3		1, 2, 4, 3, 5	10, 25, 40, 54, 73
	4		1, 2, 4, 5, 3	10, 25, 40, 59, 73
	5		1, 2, 5, 3, 4	10, 25, 45, 59, 73
	6		1, 2, 5, 4, 3	10, 25, 45, 59, 73
	7		1, 3, 2, 4, 5	10, 25, 40, 54, 73
	8		1, 3, 2, 5, 4	10, 25, 40, 59, 73
	9		1, 3, 4, 2, 5	10, 25, 40, 54, 73
	10		1, 3, 4, 5, 2	10, 25, 40, 59, 73

Intergreen Matrix for Junction 1

		To								
		A	B	C	D	E	F	G	H	I
From	A			5	5	5	5	5		5
	B			5		5	5	5	5	
	C	5	5			5	5	5	5	5
	D	5				5		5		
	E	5	5	5	5			5	5	5
	F	5	5	5				5	5	5
	G	5	5	5	5	5	5		5	5
	H		5	5		5	5	5		
	I	5		5		5	5	5		

Interstage Matrix for Junction 1

		To				
		1	2	3	4	5
From	1	0	5	5	5	5
	2	5	0	5	5	5
	3	5	5	0	5	5
	4	5	5	5	0	5
	5	5	5	5	5	0

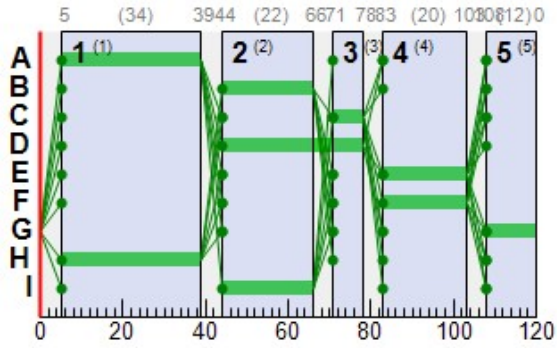
Resultant Stages

Junction	Resultant Stage	Library Stage ID	Phases in this stage	Stage start (s)	Stage end (s)	Stage duration (s)	User stage minimum (s)	Stage minimum (s)
1	1	1	A,H	5	39	34	20	20
	2	2	B,D,I	44	66	22	20	20
	3	3	D,C	71	78	7	5	7
	4	4	F,E	83	103	20	20	20
	5	5	G	108	0	12	5	12

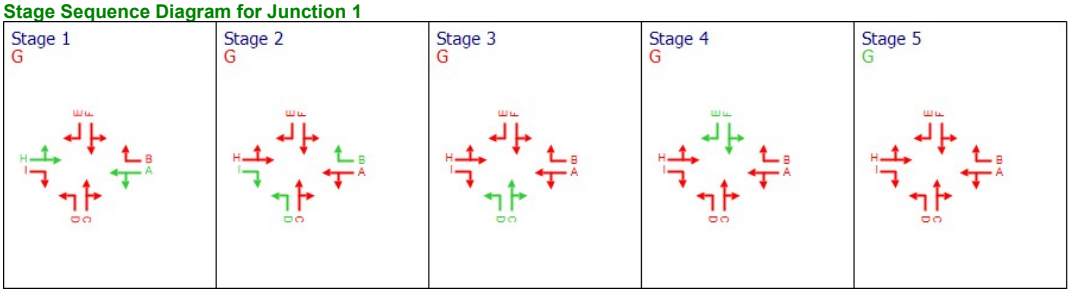
Resultant Phase Green Periods

Junction	Phase	Green period	Start time (s)	End time (s)	Duration (s)
1	A	1	5	39	34
	B	1	44	66	22
	C	1	71	78	7
	D	1	44	78	34
	E	1	83	103	20
	F	1	83	103	20
	G	1	108	0	12
	H	1	5	39	34
	I	1	44	66	22

Phase Timings Diagram for Junction 1



Stage Sequence Diagram for Junction 1



Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D1	2021	AM	ONE HOUR	07:45	09:15	15	✓

Default vehicle mix	Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		ONE HOUR	✓	624	100.000
B		ONE HOUR	✓	187	100.000
C		ONE HOUR	✓	866	100.000
D		ONE HOUR	✓	127	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A	B	C	D
From	A	0	173	432	19
	B	44	0	139	4
	C	417	410	0	39
	D	43	8	76	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A	B	C	D
From	A	10	10	10	10
	B	10	10	10	10
	C	10	10	10	10
	D	10	10	10	10

Results

Results Summary for whole modelled period

Arm	Max DOS	Max Delay (s)	Max Queue (PCU)	Max 95th percentile Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	1.18	398.83	71.9	?	F	573	859
B	0.38	42.19	5.5	?	D	172	257
C	1.21	253.54	70.6	?	F	795	1192
D	0.26	44.17	3.9	?	D	117	175

Main Results for each time segment

07:45 - 08:00

Arm	Traffic Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Calculated saturation flow (PCU/hr)	Effective green time (s)	NEEG (s)	Capacity (PCU/hr)	DOS	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Signalised level of service
A	1	455	114	1913	35.50	0.00	566	0.805	405	0.0	12.7	53.386	D
	2	14	4	1897	23.50	0.00	371	0.039	13	0.0	0.4	39.352	D
B	1	105	26	1708	35.50	0.00	505	0.207	95	0.0	2.5	32.913	C
	2	36	9	1955	8.50	0.00	138	0.261	31	0.0	1.2	58.653	E
C	1	343	86	2048	35.50	0.00	606	0.567	309	0.0	8.5	40.685	D
	2	309	77	1912	23.50	0.00	375	0.824	267	0.0	10.4	68.179	E
D	1	38	10	2001	21.50	0.00	359	0.107	34	0.0	1.1	42.009	D
	2	57	14	1780	21.50	0.00	319	0.179	51	0.0	1.6	43.386	D

08:00 - 08:15

Arm	Traffic Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Calculated saturation flow (PCU/hr)	Effective green time (s)	NEEG (s)	Capacity (PCU/hr)	DOS	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Signalised level of service
A	1	544	136	1913	35.50	0.00	566	0.961	517	12.7	19.5	76.980	E
	2	17	4	1897	23.50	0.00	371	0.046	17	0.4	0.5	39.462	D
B	1	125	31	1708	35.50	0.00	505	0.247	123	2.5	3.0	33.636	C
	2	43	11	1956	8.50	0.00	139	0.312	42	1.2	1.4	60.550	E
C	1	410	102	2048	35.50	0.00	606	0.677	402	8.5	10.5	44.994	D
	2	369	92	1912	23.50	0.00	375	0.984	343	10.4	16.8	99.695	F
D	1	46	11	2000	21.50	0.00	358	0.128	45	1.1	1.3	42.345	D
	2	68	17	1780	21.50	0.00	319	0.214	67	1.6	1.9	44.061	D

08:15 - 08:30

Arm	Traffic Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Calculated saturation flow (PCU/hr)	Effective green time (s)	NEEG (s)	Capacity (PCU/hr)	DOS	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Signalised level of service
A	1	666	167	1913	35.50	0.00	566	1.177	560	19.5	46.1	145.195	F
	2	21	5	1897	23.50	0.00	371	0.056	21	0.5	0.6	39.615	D
B	1	153	38	1708	35.50	0.00	505	0.303	150	3.0	3.7	34.707	C
	2	53	13	1954	8.50	0.00	138	0.382	51	1.4	1.8	63.455	E
C	1	502	126	2048	35.50	0.00	606	0.829	488	10.5	14.1	55.140	E
	2	451	113	1912	23.50	0.00	375	1.205	371	16.8	36.9	177.436	F
D	1	56	14	2001	21.50	0.00	359	0.157	55	1.3	1.6	42.819	D
	2	84	21	1780	21.50	0.00	319	0.262	82	1.9	2.4	45.050	D

08:30 - 08:45

Arm	Traffic Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Calculated saturation flow (PCU/hr)	Effective green time (s)	NEEG (s)	Capacity (PCU/hr)	DOS	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Signalised level of service
A	1	666	167	1913	35.50	0.00	566	1.177	565	46.1	71.4	282.745	F
	2	21	5	1897	23.50	0.00	371	0.056	21	0.6	0.6	39.615	D
B	1	153	38	1708	35.50	0.00	505	0.303	153	3.7	3.7	34.721	C
	2	53	13	1954	8.50	0.00	138	0.382	53	1.8	1.8	63.821	E
C	1	502	126	2048	35.50	0.00	606	0.829	502	14.1	14.3	57.744	E
	2	451	113	1912	23.50	0.00	375	1.205	374	36.9	56.3	333.486	F
D	1	56	14	2001	21.50	0.00	359	0.157	56	1.6	1.6	42.823	D
	2	84	21	1780	21.50	0.00	319	0.262	84	2.4	2.4	45.073	D

08:45 - 09:00

Arm	Traffic Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Calculated saturation flow (PCU/hr)	Effective green time (s)	NEEG (s)	Capacity (PCU/hr)	DOS	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Signalised level of service
A	1	544	136	1913	35.50	0.00	566	0.961	560	71.4	67.4	410.116	F
	2	17	4	1897	23.50	0.00	371	0.046	17	0.6	0.5	39.462	D
B	1	125	31	1708	35.50	0.00	505	0.247	128	3.7	3.0	33.653	C
	2	43	11	1956	8.50	0.00	139	0.312	45	1.8	1.4	60.992	E
C	1	410	102	2048	35.50	0.00	606	0.677	425	14.3	10.6	46.086	D
	2	369	92	1912	23.50	0.00	375	0.984	369	56.3	56.3	478.343	F
D	1	46	11	2000	21.50	0.00	358	0.128	47	1.6	1.3	42.350	D
	2	68	17	1780	21.50	0.00	319	0.214	70	2.4	1.9	44.089	D

09:00 - 09:15

Arm	Traffic Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Calculated saturation flow (PCU/hr)	Effective green time (s)	NEEG (s)	Capacity (PCU/hr)	DOS	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Signalised level of service
A	1	455	114	1913	35.50	0.00	566	0.805	570	67.4	38.9	357.785	F
	2	14	4	1897	23.50	0.00	371	0.039	15	0.5	0.4	39.352	D
B	1	105	26	1708	35.50	0.00	505	0.207	107	3.0	2.5	32.926	C
	2	36	9	1955	8.50	0.00	138	0.261	37	1.4	1.2	58.980	E
C	1	343	86	2048	35.50	0.00	606	0.567	351	10.6	8.6	41.051	D
	2	309	77	1912	23.50	0.00	375	0.824	376	56.3	39.4	489.871	F
D	1	38	10	2001	21.50	0.00	359	0.107	39	1.3	1.1	42.014	D
	2	57	14	1780	21.50	0.00	319	0.179	58	1.9	1.6	43.408	D

Queue Variation Results for each time segment

07:45 - 08:00

Arm	Traffic Stream	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
A	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
B	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
C	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
D	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A

08:00 - 08:15

Arm	Traffic Stream	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
A	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
B	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
C	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
D	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A

08:15 - 08:30

Arm	Traffic Stream	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
A	1	0.00	~1	~1	~1	~1			N/A	N/A

	2	0.00	~1	~1	~1	~1			N/A	N/A
B	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
C	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
D	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A

08:30 - 08:45

Arm	Traffic Stream	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
A	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
B	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
C	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
D	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A

08:45 - 09:00

Arm	Traffic Stream	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
A	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
B	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
C	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
D	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A

09:00 - 09:15

Arm	Traffic Stream	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
A	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
B	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
C	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
D	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A

Baseline 2021 - 2021, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Queue percentiles	Analysis Options	Queue percentiles cannot be calculated for signalised junction unless in Lane Simulation mode.
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Analysis Set Details

ID	Name	Include in report	Use specific Demand Set (s)	Specific Demand Set (s)	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	Baseline 2021	✓	✓	D1,D2	100.000	100.000

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Junction Delay (s)	Junction LOS
1	untitled	Signalised		86.72	F

Junction Network Options

Driving side	Lighting	Network residual capacity (%)	First arm reaching threshold
Left	Normal/unknown	-100	Arm A - Traffic Stream 2

Arms

Arms

Arm	Name	Description
A	untitled	
B	untitled	
C	untitled	
D	untitled	

OSCADY Traffic Streams

Arm	Traffic Stream	Phase	Notional EEG (s)	Signals EEG (s)	Destination arms	Straight move
A	1	A	0.00	0.00	B, C	C
	2	B	0.00	0.00	D	C
B	1	D	0.00	0.00	C	D
	2	C	0.00	0.00	A, D	D
C	1	H	0.00	0.00	A, D	A
	2	I	0.00	0.00	B	A
D	1	F	0.00	0.00	A, B	B
	2	E	0.00	0.00	C	B

OSCADY Lanes

Arm	Traffic Stream	Destination arms	Gradient (%)	Width (m)	Turning radius (m)	Nearside lane	Has bay
A	1	B, C	0	3.50	15.80	✓	
	2	D	0	3.00	18.00		
B	1	C	0	3.00	12.40	✓	
	2	A, D	0	3.00	26.80		
C	1	A, D	0	4.50	15.40	✓	
	2	B	0	3.50	14.90		
D	1	A, B	0	3.75	19.60		
	2	C	0	3.00	19.70	✓	

Signal Timings

Junction 1

Junction	Sequence to use	Cycle time (s)	Maximum cycle time (s)	Start displacement (s)	End displacement (s)
1	1	120	120	1.40	2.90

Optimisation options

Junction	Optimise stage lengths	Optimise cycle time	Optimiser demand source	Optimiser message
1	✓	✓	Average	Timings provide delay minimisation.

Phases

Junction	Phase	Name	Minimum green (s)
1	A		7
	B		7
	C		7
	D		7
	E		7
	F		7
	G		12
	H		7
	I		7

Library Stages

Junction	Library Stage	Phases in stage	User stage minimum (s)	Run every N cycles	Probability of running (%)
1	1	A, H	20		
	2	B, D, I	20		
	3	D, C	5		
	4	F, E	20		
	5	G	5		

Stage Sequences

Junction	Sequence	Name	Stage IDs	Stage ends
1	1		1, 2, 3, 4, 5	38, 63, 78, 103, 0
	2		1, 2, 3, 5, 4	10, 25, 40, 59, 73
	3		1, 2, 4, 3, 5	10, 25, 40, 54, 73
	4		1, 2, 4, 5, 3	10, 25, 40, 59, 73
	5		1, 2, 5, 3, 4	10, 25, 45, 59, 73
	6		1, 2, 5, 4, 3	10, 25, 45, 59, 73
	7		1, 3, 2, 4, 5	10, 25, 40, 54, 73
	8		1, 3, 2, 5, 4	10, 25, 40, 59, 73
	9		1, 3, 4, 2, 5	10, 25, 40, 54, 73
	10		1, 3, 4, 5, 2	10, 25, 40, 59, 73

Intergreen Matrix for Junction 1

		To								
		A	B	C	D	E	F	G	H	I
From	A			5	5	5	5	5		5
	B			5		5	5	5	5	
	C	5	5			5	5	5	5	5
	D	5				5		5		
	E	5	5	5	5			5	5	5
	F	5	5	5				5	5	5
	G	5	5	5	5	5	5		5	5
	H		5	5		5	5	5		
	I	5		5		5	5	5		

Interstage Matrix for Junction 1

		To				
		1	2	3	4	5
From	1	0	5	5	5	5
	2	5	0	5	5	5
	3	5	5	0	5	5
	4	5	5	5	0	5
	5	5	5	5	5	0

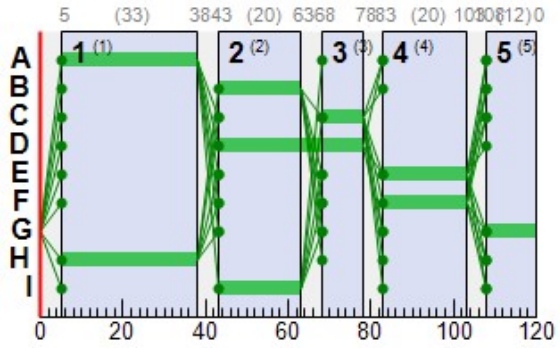
Resultant Stages

Junction	Resultant Stage	Library Stage ID	Phases in this stage	Stage start (s)	Stage end (s)	Stage duration (s)	User stage minimum (s)	Stage minimum (s)
1	1	1	A,H	5	38	33	20	20
	2	2	B,D,I	43	63	20	20	20
	3	3	D,C	68	78	10	5	7
	4	4	F,E	83	103	20	20	20
	5	5	G	108	0	12	5	12

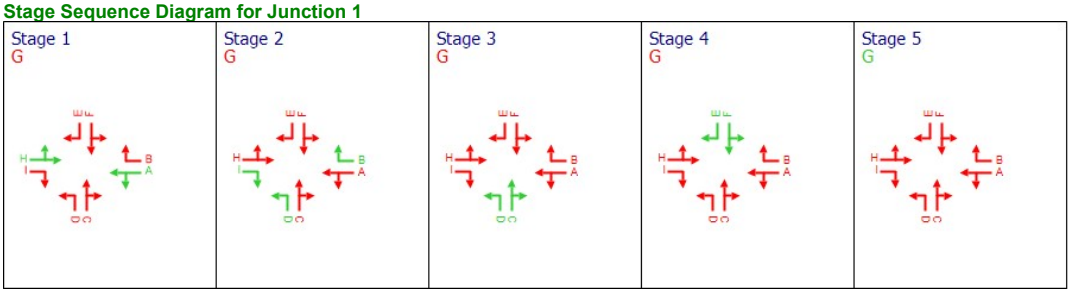
Resultant Phase Green Periods

Junction	Phase	Green period	Start time (s)	End time (s)	Duration (s)
1	A	1	5	38	33
	B	1	43	63	20
	C	1	68	78	10
	D	1	43	78	35
	E	1	83	103	20
	F	1	83	103	20
	G	1	108	0	12
	H	1	5	38	33
	I	1	43	63	20

Phase Timings Diagram for Junction 1



Stage Sequence Diagram for Junction 1



Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D2	2021	PM	ONE HOUR	14:45	16:15	15	✓

Default vehicle mix	Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		ONE HOUR	✓	516	100.000
B		ONE HOUR	✓	588	100.000
C		ONE HOUR	✓	726	100.000
D		ONE HOUR	✓	58	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A	B	C	D
From	A	0	114	377	25
	B	149	0	433	6
	C	427	256	0	43
	D	20	5	33	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A	B	C	D
From	A	10	10	10	10
	B	10	10	10	10
	C	10	10	10	10
	D	10	10	10	10

Results

Results Summary for whole modelled period

Arm	Max DOS	Max Delay (s)	Max Queue (PCU)	Max 95th percentile Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	0.98	103.86	23.8	?	F	473	710
B	0.92	95.45	25.4	?	F	540	809
C	0.88	71.06	26.0	?	E	666	999
D	0.11	41.93	1.8	?	D	53	80

Main Results for each time segment

14:45 - 15:00

Arm	Traffic Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Calculated saturation flow (PCU/hr)	Effective green time (s)	NEEG (s)	Capacity (PCU/hr)	DOS	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Signalised level of service
A	1	370	92	1923	34.50	0.00	553	0.669	331	0.0	9.6	45.787	D
	2	19	5	1897	21.50	0.00	340	0.055	17	0.0	0.5	41.240	D
B	1	326	81	1708	36.50	0.00	520	0.627	293	0.0	8.2	43.157	D
	2	117	29	1950	11.50	0.00	187	0.624	100	0.0	4.1	70.392	E
C	1	354	88	2047	34.50	0.00	588	0.601	318	0.0	9.0	42.644	D
	2	193	48	1912	21.50	0.00	343	0.562	170	0.0	5.7	53.341	D
D	1	19	5	2009	21.50	0.00	360	0.052	17	0.0	0.5	41.172	D
	2	25	6	1780	21.50	0.00	319	0.078	22	0.0	0.7	41.626	D

15:00 - 15:15

Arm	Traffic Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Calculated saturation flow (PCU/hr)	Effective green time (s)	NEEG (s)	Capacity (PCU/hr)	DOS	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Signalised level of service
A	1	441	110	1923	34.50	0.00	553	0.798	430	9.6	12.4	54.252	D
	2	22	6	1897	21.50	0.00	340	0.066	22	0.5	0.6	41.406	D
B	1	389	97	1708	36.50	0.00	520	0.749	381	8.2	10.4	49.970	D
	2	139	35	1950	11.50	0.00	187	0.746	134	4.1	5.4	82.874	F
C	1	423	106	2047	34.50	0.00	588	0.718	414	9.0	11.2	47.964	D
	2	230	58	1912	21.50	0.00	343	0.672	224	5.7	7.2	59.031	E
D	1	22	6	2004	21.50	0.00	359	0.063	22	0.5	0.6	41.326	D
	2	30	7	1780	21.50	0.00	319	0.093	29	0.7	0.8	41.875	D

15:15 - 15:30

Arm	Traffic Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Calculated saturation flow (PCU/hr)	Effective green time (s)	NEEG (s)	Capacity (PCU/hr)	DOS	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Signalised level of service
A	1	541	135	1922	34.50	0.00	553	0.978	508	12.4	20.5	81.389	F
	2	28	7	1897	21.50	0.00	340	0.081	27	0.6	0.8	41.636	D
B	1	477	119	1708	36.50	0.00	520	0.917	456	10.4	15.5	69.017	E
	2	171	43	1950	11.50	0.00	187	0.913	159	5.4	8.4	110.630	F
C	1	517	129	2047	34.50	0.00	588	0.879	499	11.2	15.7	61.911	E
	2	282	70	1912	21.50	0.00	343	0.823	271	7.2	9.8	72.047	E
D	1	28	7	2009	21.50	0.00	360	0.076	27	0.6	0.8	41.533	D
	2	36	9	1780	21.50	0.00	319	0.114	36	0.8	1.0	42.225	D

15:30 - 15:45

Arm	Traffic Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Calculated saturation flow (PCU/hr)	Effective green time (s)	NEEG (s)	Capacity (PCU/hr)	DOS	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Signalised level of service
A	1	541	135	1922	34.50	0.00	553	0.978	531	20.5	23.0	107.032	F
	2	28	7	1897	21.50	0.00	340	0.081	28	0.8	0.8	41.637	D
B	1	477	119	1708	36.50	0.00	520	0.917	474	15.5	16.3	80.437	F
	2	171	43	1950	11.50	0.00	187	0.913	168	8.4	9.1	137.387	F
C	1	517	129	2047	34.50	0.00	588	0.879	516	15.7	16.0	67.561	E
	2	282	70	1912	21.50	0.00	343	0.823	281	9.8	10.0	77.474	E
D	1	28	7	2009	21.50	0.00	360	0.076	28	0.8	0.8	41.534	D
	2	36	9	1780	21.50	0.00	319	0.114	36	1.0	1.0	42.227	D

15:45 - 16:00

Arm	Traffic Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Calculated saturation flow (PCU/hr)	Effective green time (s)	NEEG (s)	Capacity (PCU/hr)	DOS	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Signalised level of service
A	1	441	110	1923	34.50	0.00	553	0.798	482	23.0	12.8	68.193	E
	2	22	6	1897	21.50	0.00	340	0.066	23	0.8	0.6	41.407	D
B	1	389	97	1708	36.50	0.00	520	0.749	412	16.3	10.6	54.601	D
	2	139	35	1950	11.50	0.00	187	0.746	152	9.1	5.9	103.987	F
C	1	423	106	2047	34.50	0.00	588	0.718	441	16.0	11.3	50.089	D
	2	230	58	1912	21.50	0.00	343	0.672	241	10.0	7.3	61.944	E
D	1	22	6	2004	21.50	0.00	359	0.063	23	0.8	0.6	41.327	D
	2	30	7	1780	21.50	0.00	319	0.093	30	1.0	0.8	41.878	D

16:00 - 16:15

Arm	Traffic Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Calculated saturation flow (PCU/hr)	Effective green time (s)	NEEG (s)	Capacity (PCU/hr)	DOS	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Signalised level of service
A	1	370	92	1923	34.50	0.00	553	0.669	382	12.8	9.7	47.133	D
	2	19	5	1897	21.50	0.00	340	0.055	19	0.6	0.5	41.241	D
B	1	326	81	1708	36.50	0.00	520	0.627	335	10.6	8.3	44.078	D
	2	117	29	1950	11.50	0.00	187	0.624	123	5.9	4.3	76.685	E
C	1	354	88	2047	34.50	0.00	588	0.601	363	11.3	9.0	43.191	D
	2	193	48	1912	21.50	0.00	343	0.562	199	7.3	5.8	54.402	D
D	1	19	5	2009	21.50	0.00	360	0.052	19	0.6	0.5	41.173	D
	2	25	6	1780	21.50	0.00	319	0.078	25	0.8	0.7	41.629	D

Queue Variation Results for each time segment

14:45 - 15:00

Arm	Traffic Stream	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
A	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
B	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
C	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
D	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A

15:00 - 15:15

Arm	Traffic Stream	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
A	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
B	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
C	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
D	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A

15:15 - 15:30

Arm	Traffic Stream	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
A	1	0.00	~1	~1	~1	~1			N/A	N/A

	2	0.00	~1	~1	~1	~1			N/A	N/A
B	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
C	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
D	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A

15:30 - 15:45

Arm	Traffic Stream	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
A	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
B	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
C	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
D	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A

15:45 - 16:00

Arm	Traffic Stream	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
A	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
B	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
C	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
D	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A

16:00 - 16:15

Arm	Traffic Stream	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
A	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
B	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
C	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
D	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A

Opening Year 2026 - DN 2026, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Queue percentiles	Analysis Options	Queue percentiles cannot be calculated for signalised junction unless in Lane Simulation mode.
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Analysis Set Details

ID	Name	Include in report	Use specific Demand Set (s)	Specific Demand Set (s)	Network flow scaling factor (%)	Network capacity scaling factor (%)
A2	Opening Year 2026	✓	✓	D3,D4,D5,D6	100.000	100.000

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Junction Delay (s)	Junction LOS
1	untitled	Signalised		468.87	F

Junction Network Options

Driving side	Lighting	Network residual capacity (%)	First arm reaching threshold
Left	Normal/unknown	-100	Arm A - Traffic Stream 2

Arms

Arms

Arm	Name	Description
A	untitled	
B	untitled	
C	untitled	
D	untitled	

OSCADY Traffic Streams

Arm	Traffic Stream	Phase	Notional EEG (s)	Signals EEG (s)	Destination arms	Straight move
A	1	A	0.00	0.00	B, C	C
	2	B	0.00	0.00	D	C
B	1	D	0.00	0.00	C	D
	2	C	0.00	0.00	A, D	D
C	1	H	0.00	0.00	A, D	A
	2	I	0.00	0.00	B	A
D	1	F	0.00	0.00	A, B	B
	2	E	0.00	0.00	C	B

OSCADY Lanes

Arm	Traffic Stream	Destination arms	Gradient (%)	Width (m)	Turning radius (m)	Nearside lane	Has bay
A	1	B, C	0	3.50	15.80	✓	
	2	D	0	3.00	18.00		
B	1	C	0	3.00	12.40	✓	
	2	A, D	0	3.00	26.80		
C	1	A, D	0	4.50	15.40	✓	
	2	B	0	3.50	14.90		
D	1	A, B	0	3.75	19.60		
	2	C	0	3.00	19.70	✓	

Signal Timings

Junction 1

Junction	Sequence to use	Cycle time (s)	Maximum cycle time (s)	Start displacement (s)	End displacement (s)
1	1	120	120	1.40	2.90

Optimisation options

Junction	Optimise stage lengths	Optimise cycle time	Optimiser demand source	Optimiser message
1	✓	✓	Average	Timings provide capacity maximisation.

Phases

Junction	Phase	Name	Minimum green (s)
1	A		7
	B		7
	C		7
	D		7
	E		7
	F		7
	G		12
	H		7
	I		7

Library Stages

Junction	Library Stage	Phases in stage	User stage minimum (s)	Run every N cycles	Probability of running (%)
1	1	A, H	20		
	2	B, D, I	20		
	3	C, D	5		
	4	E, F	20		
	5	G	5		

Stage Sequences

Junction	Sequence	Name	Stage IDs	Stage ends
1	1		1, 2, 3, 4, 5	39, 66, 78, 103, 0
	2		1, 2, 3, 5, 4	18, 41, 64, 92, 115
	3		1, 2, 4, 3, 5	18, 41, 64, 87, 115
	4		1, 2, 4, 5, 3	18, 41, 64, 92, 115
	5		1, 2, 5, 3, 4	18, 41, 69, 92, 115
	6		1, 2, 5, 4, 3	18, 41, 69, 92, 115
	7		1, 3, 2, 4, 5	18, 41, 64, 87, 115
	8		1, 3, 2, 5, 4	18, 41, 64, 92, 115
	9		1, 3, 4, 2, 5	18, 41, 64, 87, 115
	10		1, 3, 4, 5, 2	18, 41, 64, 92, 115

Intergreen Matrix for Junction 1

		To								
		A	B	C	D	E	F	G	H	I
From	A			5	5	5	5	5		5
	B			5		5	5	5	5	
	C	5	5			5	5	5	5	5
	D	5				5		5		
	E	5	5	5	5			5	5	5
	F	5	5	5				5	5	5
	G	5	5	5	5	5	5		5	5
	H		5	5		5	5	5		
	I	5		5		5	5	5		

Interstage Matrix for Junction 1

		To				
		1	2	3	4	5
From	1	0	5	5	5	5
	2	5	0	5	5	5
	3	5	5	0	5	5
	4	5	5	5	0	5
	5	5	5	5	5	0

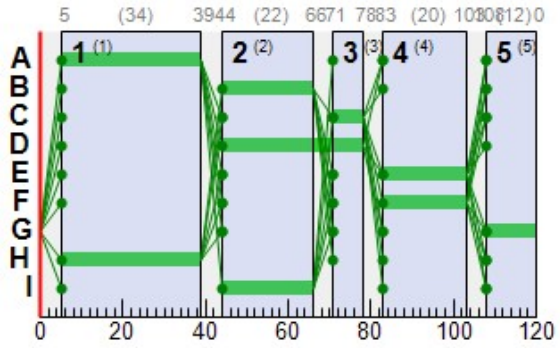
Resultant Stages

Junction	Resultant Stage	Library Stage ID	Phases in this stage	Stage start (s)	Stage end (s)	Stage duration (s)	User stage minimum (s)	Stage minimum (s)
1	1	1	A,H	5	39	34	20	20
	2	2	B,D,I	44	66	22	20	20
	3	3	C,D	71	78	7	5	7
	4	4	E,F	83	103	20	20	20
	5	5	G	108	0	12	5	12

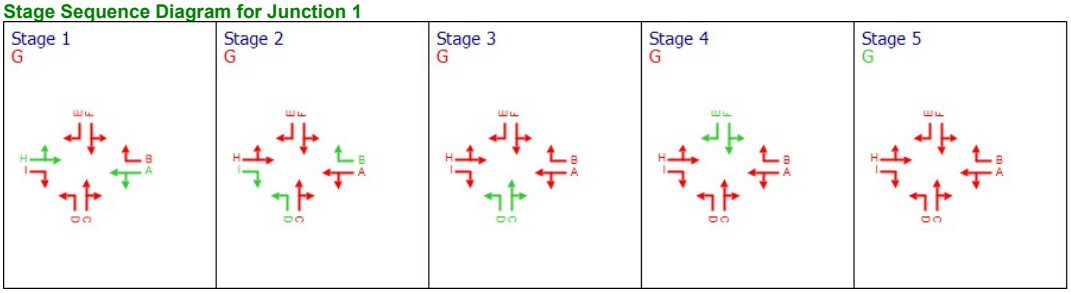
Resultant Phase Green Periods

Junction	Phase	Green period	Start time (s)	End time (s)	Duration (s)
1	A	1	5	39	34
	B	1	44	66	22
	C	1	71	78	7
	D	1	44	78	34
	E	1	83	103	20
	F	1	83	103	20
	G	1	108	0	12
	H	1	5	39	34
	I	1	44	66	22

Phase Timings Diagram for Junction 1



Stage Sequence Diagram for Junction 1



Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D3	DN 2026	AM	ONE HOUR	07:45	09:15	15	✓

Default vehicle mix	Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		ONE HOUR	✓	699	100.000
B		ONE HOUR	✓	214	100.000
C		ONE HOUR	✓	979	100.000
D		ONE HOUR	✓	181	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		A	B	C	D
From	A	0	190	476	33
	B	49	0	158	7
	C	460	455	0	64
	D	61	11	109	0

Vehicle Mix

Heavy Vehicle Percentages

		To			
		A	B	C	D
From	A	10	10	10	10
	B	10	10	10	10
	C	10	10	10	10
	D	10	10	10	10

Results

Results Summary for whole modelled period

Arm	Max DOS	Max Delay (s)	Max Queue (PCU)	Max 95th percentile Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
A	1.30	729.18	121.8	?	F	641	962
B	0.44	43.84	6.3	?	D	196	295
C	1.34	454.05	110.1	?	F	898	1348
D	0.38	46.31	5.6	?	D	166	249

Main Results for each time segment

07:45 - 08:00

Arm	Traffic Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Calculated saturation flow (PCU/hr)	Effective green time (s)	NEEG (s)	Capacity (PCU/hr)	DOS	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Signalised level of service
A	1	501	125	1913	35.50	0.00	566	0.886	440	0.0	15.3	61.860	E
	2	25	6	1897	23.50	0.00	371	0.067	22	0.0	0.7	39.773	D
B	1	119	30	1708	35.50	0.00	505	0.235	108	0.0	2.8	33.414	C
	2	42	11	1958	8.50	0.00	139	0.304	37	0.0	1.4	60.132	E
C	1	394	99	2041	35.50	0.00	604	0.653	354	0.0	10.0	43.867	D
	2	343	86	1912	23.50	0.00	375	0.915	290	0.0	13.1	80.068	F
D	1	54	14	2000	21.50	0.00	358	0.151	48	0.0	1.5	42.728	D
	2	82	21	1780	21.50	0.00	319	0.257	73	0.0	2.3	44.929	D

08:00 - 08:15

Arm	Traffic Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Calculated saturation flow (PCU/hr)	Effective green time (s)	NEEG (s)	Capacity (PCU/hr)	DOS	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Signalised level of service
A	1	599	150	1913	35.50	0.00	566	1.058	545	15.3	28.8	102.534	F
	2	30	7	1897	23.50	0.00	371	0.080	29	0.7	0.8	39.972	D
B	1	142	36	1708	35.50	0.00	505	0.281	140	2.8	3.4	34.277	C
	2	50	13	1959	8.50	0.00	139	0.363	49	1.4	1.7	62.621	E
C	1	471	118	2041	35.50	0.00	604	0.780	460	10.0	12.8	51.135	D
	2	409	102	1912	23.50	0.00	375	1.092	362	13.1	24.9	132.302	F
D	1	65	16	2000	21.50	0.00	358	0.181	64	1.5	1.8	43.233	D
	2	98	24	1780	21.50	0.00	319	0.307	96	2.3	2.8	46.054	D

08:15 - 08:30

Arm	Traffic Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Calculated saturation flow (PCU/hr)	Effective green time (s)	NEEG (s)	Capacity (PCU/hr)	DOS	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Signalised level of service
A	1	733	183	1913	35.50	0.00	566	1.296	565	28.8	70.9	212.857	F
	2	36	9	1897	23.50	0.00	371	0.098	36	0.8	1.0	40.251	D
B	1	174	43	1708	35.50	0.00	505	0.344	171	3.4	4.2	35.570	D
	2	62	15	1959	8.50	0.00	139	0.444	60	1.7	2.1	66.478	E
C	1	577	144	2041	35.50	0.00	604	0.956	548	12.8	20.0	73.844	E
	2	501	125	1912	23.50	0.00	375	1.338	374	24.9	56.7	258.166	F
D	1	79	20	2000	21.50	0.00	358	0.221	78	1.8	2.2	43.967	D
	2	120	30	1780	21.50	0.00	319	0.376	117	2.8	3.4	47.775	D

08:30 - 08:45

Arm	Traffic Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Calculated saturation flow (PCU/hr)	Effective green time (s)	NEEG (s)	Capacity (PCU/hr)	DOS	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Signalised level of service
A	1	733	183	1913	35.50	0.00	566	1.296	566	70.9	112.8	418.554	F
	2	36	9	1897	23.50	0.00	371	0.098	36	1.0	1.0	40.252	D
B	1	174	43	1708	35.50	0.00	505	0.344	174	4.2	4.2	35.592	D
	2	62	15	1959	8.50	0.00	139	0.444	62	2.1	2.1	67.113	E
C	1	577	144	2041	35.50	0.00	604	0.956	571	20.0	21.6	91.366	F
	2	501	125	1912	23.50	0.00	375	1.338	374	56.7	88.4	485.806	F
D	1	79	20	2000	21.50	0.00	358	0.221	79	2.2	2.2	43.978	D
	2	120	30	1780	21.50	0.00	319	0.376	120	3.4	3.4	47.846	D

08:45 - 09:00

Arm	Traffic Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Calculated saturation flow (PCU/hr)	Effective green time (s)	NEEG (s)	Capacity (PCU/hr)	DOS	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Signalised level of service
A	1	599	150	1913	35.50	0.00	566	1.058	566	112.8	121.0	666.628	F
	2	30	7	1897	23.50	0.00	371	0.080	30	1.0	0.8	39.974	D
B	1	142	36	1708	35.50	0.00	505	0.281	145	4.2	3.4	34.302	C
	2	50	13	1959	8.50	0.00	139	0.363	52	2.1	1.7	63.358	E
C	1	471	118	2041	35.50	0.00	604	0.780	505	21.6	13.1	58.639	E
	2	409	102	1912	23.50	0.00	375	1.092	374	88.4	97.1	775.113	F
D	1	65	16	2000	21.50	0.00	358	0.181	66	2.2	1.8	43.247	D
	2	98	24	1780	21.50	0.00	319	0.307	101	3.4	2.8	46.138	D

09:00 - 09:15

Arm	Traffic Stream	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Calculated saturation flow (PCU/hr)	Effective green time (s)	NEEG (s)	Capacity (PCU/hr)	DOS	Throughput (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Signalised level of service
A	1	501	125	1913	35.50	0.00	566	0.886	563	121.0	105.7	763.341	F
	2	25	6	1897	23.50	0.00	371	0.067	25	0.8	0.7	39.775	D
B	1	119	30	1708	35.50	0.00	505	0.235	121	3.4	2.8	33.433	C
	2	42	11	1958	8.50	0.00	139	0.304	43	1.7	1.4	60.650	E
C	1	394	99	2041	35.50	0.00	604	0.653	406	13.1	10.1	44.798	D
	2	343	86	1912	23.50	0.00	375	0.915	372	97.1	89.8	925.365	F
D	1	54	14	2000	21.50	0.00	358	0.151	55	1.8	1.5	42.739	D
	2	82	21	1780	21.50	0.00	319	0.257	84	2.8	2.3	44.989	D

Queue Variation Results for each time segment

07:45 - 08:00

Arm	Traffic Stream	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
A	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
B	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
C	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
D	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A

08:00 - 08:15

Arm	Traffic Stream	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
A	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
B	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
C	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
D	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A

08:15 - 08:30

Arm	Traffic Stream	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
A	1	0.00	~1	~1	~1	~1			N/A	N/A

	2	0.00	~1	~1	~1	~1			N/A	N/A
B	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
C	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
D	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A

08:30 - 08:45

Arm	Traffic Stream	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
A	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
B	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
C	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
D	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A

08:45 - 09:00

Arm	Traffic Stream	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
A	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
B	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
C	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
D	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A

09:00 - 09:15

Arm	Traffic Stream	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
A	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
B	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
C	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A
D	1	0.00	~1	~1	~1	~1			N/A	N/A
	2	0.00	~1	~1	~1	~1			N/A	N/A

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.0.6896

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

Filename: Junction 3 - Coast Rd_Red Arches 3.j9
Path: O:\20 Projects\20211 - Baldoyle Phase 5\00.WIP\Model\TRL
Report generation date: 08/03/2022 07:15:13

Summary of junction performance

	AM								PM							
	Queue (PCU)	95% Queue (PCU)	Delay (s)	RFC	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity	Queue (PCU)	95% Queue (PCU)	Delay (s)	RFC	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity
Baseline 2021 - 2021																
Arm 1	1.6	1.9	7.13	0.59	A	5.57	A	53 % [Arm 1]	0.7	2.9	4.58	0.38	A	4.26	A	137 % [Arm 2]
Arm 2	0.6	2.9	3.95	0.37	A				0.7	2.9	4.07	0.39	A			
Arm 3	0.2	0.5	3.79	0.13	A				0.1	0.5	3.49	0.06	A			

	DN AM								DN PM									
	Queue (PCU)	95% Queue (PCU)	Delay (s)	RFC	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity	Queue (PCU)	95% Queue (PCU)	Delay (s)	RFC	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity	Queue (PCU)	95 Que (PC
Opening Year 2026 - 202																		
Arm 1	2.2	4.3	9.12	0.67	A	6.70	A	34 % [Arm 1]	0.8	2.7	4.91	0.42	A	4.56	A	113 % [Arm 2]	2.5	6.6
Arm 2	0.8	2.5	4.40	0.43	A				0.8	2.5	4.39	0.43	A				0.9	2.3
Arm 3	0.3	1.2	4.25	0.21	A				0.1	0.5	3.64	0.07	A				0.4	1.2

	DN AM								DN PM									
	Queue (PCU)	95% Queue (PCU)	Delay (s)	RFC	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity	Queue (PCU)	95% Queue (PCU)	Delay (s)	RFC	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity	Queue (PCU)	95 Que (PC
Future Year 2041 - 204																		
Arm 1	3.4	14.6	12.58	0.76	B	8.64	A	19 % [Arm 1]	1.0	2.0	5.44	0.47	A	5.06	A	89 % [Arm 2]	3.9	18.
Arm 2	1.0	1.7	4.87	0.48	A				1.0	1.6	4.89	0.49	A				1.1	1.6
Arm 3	0.3	1.4	4.61	0.23	A				0.1	0.5	3.86	0.09	A				0.5	1.9

	AM								PM							
	Queue (PCU)	95% Queue (PCU)	Delay (s)	RFC	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity	Queue (PCU)	95% Queue (PCU)	Delay (s)	RFC	LOS	Junction Delay (s)	Junction LOS	Network Residual Capacity
Stress Test - Stress 2026																
Arm 1	4.8	24.7	18.32	0.82	C	11.16	B	9 % [Arm 1]	1.3	1.6	6.72	0.55	A	6.21	A	53 % [Arm 2]
Arm 2	1.2	1.6	5.47	0.52	A				1.5	1.9	6.35	0.59	A			
Arm 3	1.3	2.2	7.27	0.54	A				0.4	1.5	4.70	0.28	A			
Stress Test - Stress 2041																
Arm 1	10.4	56.5	36.66	0.92	E	19.40	C	-1 % [Arm 1]	1.7	2.0	7.72	0.61	A	7.15	A	40 % [Arm 2]
Arm 2	1.5	1.8	6.18	0.58	A				2.0	3.0	7.42	0.65	A			
Arm 3	1.5	2.3	8.35	0.58	A				0.5	1.9	5.05	0.30	A			

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle. Junction LOS and Junction Delay are demand-weighted averages. Network Residual Capacity indicates the amount by which network flow could be increased before a user-definable threshold (see Analysis Options) is met.

File summary

File Description

Title	
Location	
Site number	
Date	02/10/2020
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	JBBARRY\TransportPC
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	Residual capacity criteria type	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
5.75	✓		✓	Delay	0.85	36.00	20.00

Analysis Set Details

ID	Name	Include in report	Use specific Demand Set (s)	Specific Demand Set (s)	Network flow scaling factor (%)	Network capacity scaling factor (%)
A2	Opening Year 2026	✓	✓	D3,D4,D5,D6	100.000	100.000

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D14	Stress 2041	PM	ONE HOUR	12:45	14:15	15	✓

Opening Year 2026 - Stress 2041, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	7.15	A

Junction Network Options

Driving side	Lighting	Network residual capacity (%)	First arm reaching threshold
Left	Normal/unknown	40	Arm 2

Arms

Arms

Arm	Name	Description
1	untitled	
2	untitled	
3	untitled	

Roundabout Geometry

Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
1	4.30	6.10	2.9	18.6	16.5	42.0	
2	4.75	7.00	2.9	33.0	16.5	38.0	
3	4.00	6.25	7.8	36.0	16.5	37.0	

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
1	0.593	1416
2	0.646	1619
3	0.636	1563

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Default vehicle mix	Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1		ONE HOUR	✓	714	100.000
2		ONE HOUR	✓	882	100.000
3		ONE HOUR	✓	307	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		1	2	3
From	1	4	553	157
	2	624	0	258
	3	127	180	0

Vehicle Mix

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	10	10	10
	2	10	10	10
	3	10	10	10

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max 95th percentile Queue (PCU)	Max LOS	Average Demand (PCU/hr)	Total Junction Arrivals (PCU)
1	0.61	7.72	1.7	2.0	A	655	983
2	0.65	7.42	2.0	3.0	A	809	1214
3	0.30	5.05	0.5	1.9	A	282	423

Main Results for each time segment

12:45 - 13:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	538	134	135	1336	0.402	535	566	0.0	0.7	4.922	A
2	664	166	121	1541	0.431	661	549	0.0	0.8	4.484	A
3	231	58	470	1263	0.183	230	311	0.0	0.2	3.830	A

13:00 - 13:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	642	160	162	1320	0.486	641	678	0.7	1.0	5.814	A
2	793	198	144	1525	0.520	791	658	0.8	1.2	5.386	A
3	276	69	564	1204	0.229	276	372	0.2	0.3	4.265	A

13:15 - 13:30

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	786	197	198	1299	0.605	784	829	1.0	1.7	7.647	A
2	971	243	177	1505	0.645	968	805	1.2	2.0	7.338	A
3	338	85	689	1124	0.301	337	455	0.3	0.5	5.032	A

13:30 - 13:45

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	786	197	198	1299	0.605	786	831	1.7	1.7	7.721	A
2	971	243	177	1504	0.646	971	807	2.0	2.0	7.424	A
3	338	85	691	1123	0.301	338	457	0.5	0.5	5.047	A

13:45 - 14:00

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	642	160	162	1320	0.486	644	681	1.7	1.1	5.880	A
2	793	198	145	1525	0.520	796	661	2.0	1.2	5.455	A
3	276	69	567	1202	0.230	277	375	0.5	0.3	4.283	A

14:00 - 14:15

Arm	Total Demand (PCU/hr)	Junction Arrivals (PCU)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	Throughput (exit side) (PCU/hr)	Start queue (PCU)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	538	134	136	1336	0.402	539	570	1.1	0.7	4.977	A
2	664	166	121	1540	0.431	665	553	1.2	0.8	4.534	A
3	231	58	474	1261	0.183	231	313	0.3	0.2	3.848	A

Queue Variation Results for each time segment

12:45 - 13:00

Arm	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1	0.73	0.61	1.10	1.54	1.60			N/A	N/A
2	0.83	0.61	1.10	1.54	1.60			N/A	N/A
3	0.25	0.00	0.00	0.25	0.25			N/A	N/A

13:00 - 13:15

Arm	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1	1.03	0.10	0.99	1.63	2.02			N/A	N/A
2	1.18	0.08	0.96	2.13	2.96			N/A	N/A
3	0.33	0.00	0.00	0.33	0.33			N/A	N/A

13:15 - 13:30

Arm	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1	1.65	0.03	0.29	1.65	1.65			N/A	N/A
2	1.96	0.03	0.30	1.96	1.96			N/A	N/A
3	0.47	0.03	0.28	0.50	0.53			N/A	N/A

13:30 - 13:45

Arm	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1	1.67	0.03	0.29	1.67	1.67			N/A	N/A
2	1.98	0.03	0.29	1.98	1.98			N/A	N/A
3	0.47	0.03	0.35	1.49	1.87			N/A	N/A

13:45 - 14:00

Arm	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1	1.05	0.13	1.05	1.52	1.93			N/A	N/A
2	1.21	0.12	1.12	1.94	2.36			N/A	N/A
3	0.33	0.00	0.00	0.33	0.33			N/A	N/A

14:00 - 14:15

Arm	Mean (PCU)	Q05 (PCU)	Q50 (PCU)	Q90 (PCU)	Q95 (PCU)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1	0.75	0.06	0.69	1.43	1.43			N/A	N/A
2	0.84	0.06	0.69	1.41	1.96			N/A	N/A
3	0.25	0.00	0.00	0.25	0.25			N/A	N/A

Appendix 15.3

Trip Rate Information Computer System (TRICS) Output Files

JB Barry Consulting Engineers

TRIP RATE for Land Use 04 - EDUCATION/D - NURSERY
VEHICLES
Calculation factor: 100 sqm
Estimated TRIP rate value per 820 SQM shown in shaded columns
BOLD print indicates peak (busiest) period

	ARRIVALS				DEPARTURES				TOTALS			
Time Range	No. Days	Ave. GFA	Trip Rate	Estimated Trip Rate	No. Days	Ave. GFA	Trip Rate	Estimated Trip Rate	No. Days	Ave. GFA	Trip Rate	Estimated Trip Rate
00:00 - 01:00												
01:00 - 02:00												
02:00 - 03:00												
03:00 - 04:00												
04:00 - 05:00												
05:00 - 06:00												
06:00 - 07:00	2	328	0.152	1.250	2	328	0.000	0.000	2	328	0.152	1.250
07:00 - 08:00	22	462	1.742	14.288	22	462	0.788	6.458	22	462	2.530	20.746
08:00 - 09:00	22	462	3.396	27.850	22	462	2.806	23.006	22	462	6.202	50.856
09:00 - 10:00	22	462	1.782	14.611	22	462	1.644	13.481	22	462	3.426	28.092
10:00 - 11:00	22	462	0.502	4.117	22	462	0.374	3.068	22	462	0.876	7.185
11:00 - 12:00	22	462	0.689	5.651	22	462	0.522	4.278	22	462	1.211	9.929
12:00 - 13:00	22	462	1.299	10.656	22	462	1.427	11.705	22	462	2.726	22.361
13:00 - 14:00	22	462	0.876	7.184	22	462	1.309	10.736	22	462	2.185	17.920
14:00 - 15:00	22	462	0.650	5.328	22	462	0.640	5.247	22	462	1.290	10.575
15:00 - 16:00	22	462	0.847	6.942	22	462	1.034	8.476	22	462	1.881	15.418
16:00 - 17:00	22	462	1.496	12.270	22	462	1.644	13.481	22	462	3.140	25.751
17:00 - 18:00	22	462	2.412	19.778	22	462	2.904	23.814	22	462	5.316	43.592
18:00 - 19:00	21	477	0.160	1.311	21	477	0.759	6.227	21	477	0.919	7.538
19:00 - 20:00	1	400	0.000	0.000	1	400	0.000	0.000	1	400	0.000	0.000
20:00 - 21:00												
21:00 - 22:00												
22:00 - 23:00												
23:00 - 24:00												
Total Rates:			16.003	131.236			15.851	129.977			31.854	261.213

Parameter summary

Trip rate parameter range selected:	150 - 1300 (units: sqm)
Survey date date range:	01/01/12 - 27/09/19
Number of weekdays (Monday-Friday):	22
Number of Saturdays:	0
Number of Sundays:	0
Surveys automatically removed from selection:	1
Surveys manually removed from selection:	0

Calculation Reference: AUDIT-729001-220322-0327

TRIP RATE CALCULATION SELECTION PARAMETERS:

Land Use : 03 - RESIDENTIAL
Category : C - FLATS PRIVATELY OWNED
TOTAL VEHICLES

Selected regions and areas:

02	SOUTH EAST		
	BD	BEDFORDSHIRE	3 days
	ES	EAST SUSSEX	1 days
	EX	ESSEX	1 days
	HC	HAMPSHIRE	1 days
	HF	HERTFORDSHIRE	2 days
04	EAST ANGLIA		
	CA	CAMBRIDGESHIRE	1 days
	NF	NORFOLK	2 days
	SF	SUFFOLK	3 days
05	EAST MIDLANDS		
	NT	NOTTINGHAMSHIRE	2 days
06	WEST MIDLANDS		
	WM	WEST MIDLANDS	1 days
07	YORKSHIRE & NORTH LINCOLNSHIRE		
	SY	SOUTH YORKSHIRE	1 days
08	NORTH WEST		
	MS	MERSEYSIDE	1 days
11	SCOTLAND		
	SA	SOUTH AYRSHIRE	1 days
	SR	STIRLING	2 days
13	MUNSTER		
	WA	WATERFORD	1 days
14	LEINSTER		
	LU	LOUTH	1 days
15	GREATER DUBLIN		
	DL	DUBLIN	5 days

This section displays the number of survey days per TRICS® sub-region in the selected set

Primary Filtering selection:

This data displays the chosen trip rate parameter and its selected range. Only sites that fall within the parameter range are included in the trip rate calculation.

Parameter: No of Dwellings
Actual Range: 51 to 332 (units:)
Range Selected by User: 50 to 372 (units:)

Parking Spaces Range: All Surveys Included

Parking Spaces per Dwelling Range: All Surveys Included

Bedrooms per Dwelling Range: All Surveys Included

Percentage of dwellings privately owned: All Surveys Included

Public Transport Provision:
Selection by: Include all surveys

Date Range: 01/01/13 to 23/06/21

This data displays the range of survey dates selected. Only surveys that were conducted within this date range are included in the trip rate calculation.

Selected survey days:

Monday	2 days
Tuesday	15 days
Wednesday	5 days
Thursday	5 days
Friday	2 days

This data displays the number of selected surveys by day of the week.

Selected survey types:

Manual count	29 days
Directional ATC Count	0 days

This data displays the number of manual classified surveys and the number of unclassified ATC surveys, the total adding up to the overall number of surveys in the selected set. Manual surveys are undertaken using staff, whilst ATC surveys are undertaking using machines.

Selected Locations:

Edge of Town Centre	14
Suburban Area (PPS6 Out of Centre)	11
Edge of Town	1
Neighbourhood Centre (PPS6 Local Centre)	3

This data displays the number of surveys per main location category within the selected set. The main location categories consist of Free Standing, Edge of Town, Suburban Area, Neighbourhood Centre, Edge of Town Centre, Town Centre and Not Known.

Selected Location Sub Categories:

Development Zone	2
Residential Zone	16
Built-Up Zone	6
No Sub Category	5

This data displays the number of surveys per location sub-category within the selected set. The location sub-categories consist of Commercial Zone, Industrial Zone, Development Zone, Residential Zone, Retail Zone, Built-Up Zone, Village, Out of Town, High Street and No Sub Category.

Secondary Filtering selection:

Use Class:

C3	29 days

This data displays the number of surveys per Use Class classification within the selected set. The Use Classes Order 2005 has been used for this purpose, which can be found within the Library module of TRICS®.

Population within 500m Range:
All Surveys Included

Secondary Filtering selection (Cont.):

Population within 1 mile:

1,001 to 5,000	3 days
5,001 to 10,000	1 days
10,001 to 15,000	3 days
15,001 to 20,000	2 days
20,001 to 25,000	3 days
25,001 to 50,000	15 days
50,001 to 100,000	2 days

This data displays the number of selected surveys within stated 1-mile radii of population.

Population within 5 miles:

25,001 to 50,000	1 days
50,001 to 75,000	7 days
75,001 to 100,000	1 days
125,001 to 250,000	8 days
250,001 to 500,000	6 days
500,001 or More	6 days

This data displays the number of selected surveys within stated 5-mile radii of population.

Car ownership within 5 miles:

0.6 to 1.0	13 days
1.1 to 1.5	15 days
1.6 to 2.0	1 days

This data displays the number of selected surveys within stated ranges of average cars owned per residential dwelling, within a radius of 5-miles of selected survey sites.

Travel Plan:

Yes	3 days
No	26 days

This data displays the number of surveys within the selected set that were undertaken at sites with Travel Plans in place, and the number of surveys that were undertaken at sites without Travel Plans.

PTAL Rating:

No PTAL Present	29 days

This data displays the number of selected surveys with PTAL Ratings.

Covid-19 Restrictions	Yes	At least one survey within the selected data set was undertaken at a time of Covid-19 restrictions

TRIP RATE for Land Use 03 - RESIDENTIAL/C - FLATS PRIVATELY OWNED
TOTAL VEHICLES
Calculation factor: 1 DWELLS
Estimated TRIP rate value per 1007 DWELLS shown in shaded columns
BOLD print indicates peak (busiest) period

	ARRIVALS				DEPARTURES				TOTALS			
Time Range	No. Days	Ave. DWELLS	Trip Rate	Estimated Trip Rate	No. Days	Ave. DWELLS	Trip Rate	Estimated Trip Rate	No. Days	Ave. DWELLS	Trip Rate	Estimated Trip Rate
00:00 - 01:00												
01:00 - 02:00												
02:00 - 03:00												
03:00 - 04:00												
04:00 - 05:00												
05:00 - 06:00												
06:00 - 07:00												
07:00 - 08:00	29	97	0.041	41.095	29	97	0.154	155.445	29	97	0.195	196.540
08:00 - 09:00	29	97	0.063	63.250	29	97	0.196	197.255	29	97	0.259	260.505
09:00 - 10:00	29	97	0.065	65.394	29	97	0.080	80.760	29	97	0.145	146.154
10:00 - 11:00	29	97	0.059	59.677	29	97	0.076	76.115	29	97	0.135	135.792
11:00 - 12:00	29	97	0.060	60.034	29	97	0.076	76.829	29	97	0.136	136.863
12:00 - 13:00	29	97	0.088	88.264	29	97	0.086	86.835	29	97	0.174	175.099
13:00 - 14:00	29	97	0.074	74.328	29	97	0.081	81.832	29	97	0.155	156.160
14:00 - 15:00	29	97	0.081	81.832	29	97	0.077	77.544	29	97	0.158	159.376
15:00 - 16:00	29	97	0.094	95.054	29	97	0.066	66.109	29	97	0.160	161.163
16:00 - 17:00	29	97	0.118	118.996	29	97	0.073	73.613	29	97	0.191	192.609
17:00 - 18:00	29	97	0.164	165.094	29	97	0.079	79.331	29	97	0.243	244.425
18:00 - 19:00	29	97	0.162	162.950	29	97	0.096	96.483	29	97	0.258	259.433
19:00 - 20:00												
20:00 - 21:00												
21:00 - 22:00												
22:00 - 23:00												
23:00 - 24:00												
Total Rates:			1.069	1075.968			1.140	1148.151			2.209	2224.119

This section displays the trip rate results based on the selected set of surveys and the selected count type (shown just above the table). It is split by three main columns, representing arrivals trips, departures trips, and total trips (arrivals plus departures). Within each of these main columns are three sub-columns. These display the number of survey days where count data is included (per time period), the average value of the selected trip rate calculation parameter (per time period), and the trip rate result (per time period). Total trip rates (the sum of the column) are also displayed at the foot of the table.

*To obtain a trip rate, the average (mean) trip rate parameter value (TRP) is first calculated for all selected survey days that have count data available for the stated time period. The average (mean) number of arrivals, departures or totals (whichever applies) is also calculated (COUNT) for all selected survey days that have count data available for the stated time period. Then, the average count is divided by the average trip rate parameter value, and multiplied by the stated calculation factor (shown just above the table and abbreviated here as FACT). So, the method is: COUNT/TRP*FACT. Trip rates are then rounded to 3 decimal places.*

Parameter summary

Trip rate parameter range selected:	51 - 332 (units:)
Survey date date range:	01/01/13 - 23/06/21
Number of weekdays (Monday-Friday):	29
Number of Saturdays:	0
Number of Sundays:	0
Surveys automatically removed from selection:	0
Surveys manually removed from selection:	0

This section displays a quick summary of some of the data filtering selections made by the TRICS® user. The trip rate calculation parameter range of all selected surveys is displayed first, followed by the range of minimum and maximum survey dates selected by the user. Then, the total number of selected weekdays and weekend days in the selected set of surveys are show. Finally, the number of survey days that have been manually removed from the selected set outside of the standard filtering procedure are displayed.

Appendix 16.1

Construction and Demolition Waste Management Plan

AWN Consulting

CONSTRUCTION & DEMOLITION WASTE MANAGEMENT PLAN FOR A PROPOSED RESIDENTIAL DEVELOPMENT

BALDOYLE-STAPOLIN, DUBLIN 13.

"GROWTH AREA 2"

Report Prepared For

Lismore Homes Ltd.

Report Prepared By

Chonaill Bradley, Principal Environmental Consultant

Our Reference

CB/21/12473WMR01

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Title	Principal Environmental Consultant	Director
Date	22 March 2022	22 March 2022

Contents Page

1.0 INTRODUCTION

AWN Consulting Ltd. (AWN) has prepared this Construction & Demolition Waste Management Plan (C&D WMP) on behalf of Lismore Homes Ltd. for a proposed residential development. The proposed development consists of the construction of 1,007 residential apartments, communal residential community rooms, and a ground floor creche in 16 no. buildings with heights varying from 4 to 12 storeys, basement and surface level car parking, secure bicycle parking, landscaping, water supply connection at Red Arches Road, and all ancillary site development works on a site located in the townland of Stapolin, Coast Road, Baldoyle, Dublin.

This plan will provide information necessary to ensure that the management of C&D waste at the site is undertaken in accordance with the current legal and industry standards including the *Waste Management Acts 1996 - 2011* and associated Regulations [1], *Protection of the Environment Act 2003* as amended [2], *Litter Pollution Act 1997* as amended [3] and the *Eastern-Midlands Region Waste Management Plan 2015 – 2021* [4]. In particular, this Plan aims to ensure maximum recycling, reuse and recovery of waste with diversion from landfill, wherever possible. It also seeks to provide guidance on the appropriate collection and transport of waste from the site to prevent issues associated with litter or more serious environmental pollution (e.g. contamination of soil and/or water).

This C&D WMP includes information on the legal and policy framework for C&D waste management in Ireland, estimates of the type and quantity of waste to be generated by the proposed development and makes recommendations for management of different waste streams. The C&D WMP should be viewed as a live document that will be update by the site construction contractor as and when changing site conditions require it to do so.

2.0 CONSTRUCTION & DEMOLITION WASTE MANAGEMENT IN IRELAND

2.1 National Level

The Irish Government issued a policy statement in September 1998*, Changing Our Ways*[5], which identified objectives for the prevention, minimisation, reuse, recycling, recovery and disposal of waste in Ireland. The target for C&D waste in this report was to recycle at least 50% of C&D waste within a five year period (by 2003), with a progressive increase to at least 85% over fifteen years (i.e. 2013).

In response to the *Changing Our Ways* report, a task force (Task Force B4) representing the waste sector of the already established Forum for the Construction Industry, released a report entitled '*Recycling of Construction and Demolition Waste'* [6] concerning the development and implementation of a voluntary construction industry programme to meet the Government's objectives for the recovery of C&D waste.

In September 2020, the Irish Government published a policy document outlining a new action plan for Ireland to cover the period of 2020-2025. This plan, *'A Waste Action Plan for a Circular Economy'* [7] (WAPCE), replaces the previous national waste management plan, *"A Resource Opportunity"* (2012), and was prepared in response to the 'European Green Deal' which sets a roadmap for a transition to an altered economical model, where climate and environmental challenges are turned into opportunities.

The WAPCE sets the direction for waste planning and management in Ireland up to 2025. This reorientates policy from a focus on managing waste to a much greater focus on creating circular patterns of production and consumption. Other policy statements of a number of public bodies already acknowledge the circular economy as a national policy priority.

The policy document contains over 200 measures across various waste areas including circular economy, municipal waste, consumer protection and citizen engagement, plastics and packaging, construction and demolition, textiles, green public procurement and waste enforcement.

One of the first actions to be taken was the development of the Whole of Government Circular Economy Strategy 2022-2023 'Living More, Using Less' (2021) [8] to set a course for Ireland to transition across all sectors and at all levels of Government toward circularity and was issued in December 2021. It is anticipated that the Strategy will be updated in full every 18 months to 2 years.

The Environmental Protection Agency (EPA) of Ireland issued '*Best Practice Guidelines for the Preparation of Resource & Waste Management Plans for Construction & Demolition Projects' in November 2021* [9]. These guidelines replace the previous 2006 guidelines issued by The National Construction and Demolition Waste Council (NCDWC) and the Department of the Environment, Heritage and Local Government (DoEHLG) in 2006 [10]. The guidelines provide a practical approach which is informed by best practice in the prevention and management of C&D wastes and resources from design to construction of a project, including consideration of the deconstruction of a project. These guidelines have been followed in the preparation of this document and include the following elements:

- Predicted C&D wastes and procedures to prevent, minimise, recycle and reuse wastes;
- Design teams roles and approach;
- Relevant EU, national and local waste policy, legislation and guidelines;
- Waste disposal/recycling of C&D wastes at the site;
- Provision of training for Resource Waste Manager (RM) and site crew;
- Details of proposed record keeping system;
- Details of waste audit procedures and plan; and
- Details of consultation with relevant bodies i.e. waste recycling companies, Local Authority, etc.

Section 3 of the Guidelines identifies thresholds above which there is a requirement for the preparation of a bespoke C&D WMP for developments. The new guidance classifies developments on a two-tiered system. Developments which do not exceed any of the following thresholds may be classed as Tier 1 development, which require a simplified C&D WMP:

- New residential development of less than 10 dwellings.
- Retrofit of 20 dwellings or less.
- New commercial, industrial, infrastructural, institutional, educational, health and other developments with an aggregate floor area less than 1,250m^2.

- Retrofit of commercial, industrial, infrastructural, institutional, educational, health and other developments with an aggregate floor area less than 2,000m^2; and
- Demolition projects generating in total less than 100m^3 in volume of C&D waste.

A development which exceeds one or more of these thresholds is classed as Tier-2 projects.

This development requires a C&D WMP as a Tier 2 development as it is above following criterion:

- New residential development of less than 10 dwellings.

Other guidelines followed in the preparation of this report include *'Construction and Demolition Waste Management – a handbook for Contractors and Site Managers'* [11] , published by FÁS and the Construction Industry Federation in 2002 and the previous guidelines, 'Best Practice Guidelines for the Preparation of Waste Management Plans for Construction and Demolition Projects' (2006).

These guidance documents are considered to define best practice for C&D projects in Ireland and describe how C&D projects are to be undertaken such that environmental impacts and risks are minimised and maximum levels of waste recycling are achieved.

2.2 Regional Level

The proposed development is located in the Local Authority area of Fingal County Council (FCC). The *Eastern-Midlands Region Waste Management Plan 2015 – 2021* is the regional waste management plan to the administrative area, published in May 2015. Currently the EMR and other regional waste management plans are under review and the Regional Waste Management Planning Offices expect to publish the final plan in early 2022.

The Regional Plan sets out the strategic targets for waste management in the region and sets a specific target for C&D waste of *"70% preparing for reuse, recycling and other recovery of construction and demolition waste"* (excluding natural soils and stones and hazardous wastes) to be achieved by 2020.

Municipal landfill charges in Ireland are based on the weight of waste disposed. In the Leinster Region, charges are approximately €130 - €150 per tonne of waste, which includes a €75 per tonne landfill levy introduced under the *Waste Management (Landfill Levy) (Amendment) Regulations 2012.*

The *Fingal Development Plan 2017 – 2023* [13] came into effect on March 2017 and sets out a number of policies and objectives for the Fingal region in line with the objectives of the regional waste management plan.

Waste objectives with a particular relevance to the proposed development are:

Objectives:

- *Objective **WM03** Implement the provisions of the Eastern Midlands Region Waste Management Plan 2015 -2021 or any subsequent Waste Management Plan applicable within the lifetime of the Development Plan. All prospective developments in the County will be expected to take account of the provisions of*

the Regional Waste Management Plan and adhere to the requirements of that Plan.

- *Objective **WM05** Prevent and minimise the generation of waste in accordance with the Eastern Midlands Region Waste Management Plan 2015 -2021 (or any subsequent plans).*
- *Objective **WM07** Promote the increased re-use of waste in accordance with the Eastern Midlands Region Waste Management Plan 2015-2021 (or any subsequent plan)."*
- *Objective **DMS36** Ensure all new residential schemes include appropriate design measures for refuse storage areas, details of which should be clearly shown at pre-planning and planning application stage. Ensure refuse storage areas are not situated immediately adjacent to the front door or ground floor window, unless adequate screened alcoves or other such mitigation measures are provided.*
- *Objective **DMS37** Ensure the maximum distance between the front door to a communal bin area does not exceed 50 metres.*

2.3 Legislative Requirements

The primary legislative instruments that govern waste management in Ireland and applicable to the development are:

- Waste Management Act 1996 (No. 10 of 1996) as amended.
- Environmental Protection Act 1992 (No. 7 of 1992) as amended.
- Litter Pollution Act 1997 (No. 12 of 1997) as amended.
- Planning and Development Act 2000 (No. 30 of 2000) as amended [11].

One of the guiding principles of European waste legislation, which has in turn been incorporated into the *Waste Management Act 1996 - 2001* and subsequent Irish legislation, is the principle of *"Duty of Care"*. This implies that the waste producer is responsible for waste from the time it is generated through until its legal recycling, recovery or disposal (including its method of disposal). As it is not practical in most cases for the waste producer to physically transfer all waste from where it is produced to the final destination, waste contractors will be employed to physically transport waste to the final destination. Following on from this is the concept of *"Polluter Pays"* whereby the waste producer is liable to be prosecuted for pollution incidents, which may arise from the incorrect management of waste produced, including the actions of any contractors engaged (e.g. for transportation and disposal/recovery/recycling of waste).

It is therefore imperative that the Developer ensures that the waste contractors engaged by demolition and construction contractors are legally compliant with respect to waste transportation, recycling, recovery and disposal. This includes the requirement that a contractor handle, transport and recycle/recover/dispose of waste in a manner that ensures that no adverse environmental impacts occur as a result of any of these activities.

A collection permit to transport waste must be held by each waste contractor which is issued by the National Waste Collection Permit Office (NWCPO). Waste receiving facilities must also be appropriately permitted or licensed. Operators of such facilities cannot receive any waste, unless in possession of a Certificate of Registration (COR) or waste permit granted by the relevant Local Authority under the *Waste Management (Facility Permit & Registration) Regulations 2007 and Amendments* or a Waste or Industrial Emissions Licence granted by the EPA. The COR / permit / licence held will specify the

type and quantity of waste able to be received, stored, sorted, recycled, recovered and/or disposed of at the specified site.

3.0 Design Approach

The client and the design team have integrated the *'Best Practice Guidelines for the Preparation of Resource & Waste Management Plans for Construction & Demolition Projects'* guidelines into the design workshops, to help review processes, identify and evaluate resource reduction measures and investigate the impact on cost, time, quality, buildability, second life and management post demolition and construction. Further details on these design principals can be found within the aforementioned guidance document.

The design team have undertaken the design process in line with the international best practice principles to firstly prevent wastes, reuse where possible and thereafter sustainably reduce and recover materials. The below sections have been the focal point of the design process and material selections and will continued to be analysed and investigated throughout the design process and when selecting material.

The approaches presented are based on international principles of optimising resources and reducing waste on construction projects through:

- Prevention;
- Reuse;
- Recycling;
- Green Procurement Principles;
- Off-Site Construction;
- Materials Optimisation; and
- Flexibility and Deconstruction.

3.1 Designing For Prevention, Reuse and Recycling

Undertaken at the outset and during project feasibility and evaluation the Client and Design Team considered:

- Establishing the potential for any reusable site assets (buildings, structures, equipment, materials, soils, etc.);
- The potential for refurbishment and refit of existing structures or buildings rather than demolition and new build;
- Assessing any existing buildings on the site that can be refurbished either in part or wholly to meet the Client requirements; and
- Enabling the optimum recovery of assets on site.

3.2 Designing for Green Procurement

Waste prevention and minimisation pre-procurement have been discussed and will be further discussed in this section. The Design Team will discuss proposed design solutions, encourage innovation in tenders and incentivise competitions to recognise sustainable approaches. They should also discuss options for packaging reduction with the main Contractor and subcontractors/suppliers using measures such as 'Just-in-Time' delivery and use ordering procedures that avoid excessive waste. The Green procurement extends from the planning stage into the detailed design and tender stage and will be an ongoing part of the long-term design and selection process for this development.

3.3 Designing for Off-Site Construction

Use of off-site manufacturing has been shown to reduce residual wastes by up to 90% (volumetric building versus traditional). The decision to use offsite construction is typically cost led but there are significant benefits for resource management. Some further considerations for procurement which are being investigated as part of the planning stage design process are listed as follows:

- Modular buildings as these can displace the use of concrete and the resource losses associated with concrete blocks such as broken blocks, mortars, etc.;
  - Modular buildings are typically pre-fitted with fixed plasterboard and installed insulation, eliminating these residual streams from site.
- Use of pre-cast structural concrete panels which can reduce the residual volumes of concrete blocks, mortars, plasters, etc.;
- The use of prefabricated composite panels for walls and roofing to reduce residual volumes of insulation and plasterboards;
- Using pre-cast hollow-core flooring instead of in-situ ready mix flooring or timber flooring to reduce the residual volumes of concrete/formwork and wood/packaging, respectively; and
- Designing for the preferential use of offsite modular units.

3.4 Designing for Materials Optimisation During Construction

To ensure manufacturers and construction companies adopt lean production models, including maximising the reuse of materials onsite.. This helps to reduce the environmental impacts associated with transportation of materials and from waste management activities. This includes investigating the use of standardised sizes for certain materials to help reduce the amount of offcuts produced on site, focusing on promotion and development of off-site manufacture.

3.5 Designing for Flexibility and Deconstruction

Design flexibility has and will be investigated throughout the design process to ensure that where possible products (including buildings) only contain materials that can be recycled and are designed to be easily disassembled. Material efficiency is being considered for the duration and end of life of a building project to produce; flexible, adaptable spaces that enable a resource-efficient, low-waste future change of use; durability of materials and how they can be recovered effectively when maintenance and refurbishment are undertaken and during disassembly/deconstruction.

4.0 DESCRIPTION OF THE DEVELOPMENT

4.1 Location, Size and Scale of the Development

The development will consit of A Strategic Housing Development for the construction of 1,007 residential apartments (consisting of 58 no. studio units, 247 no. 1 bedroom units, 94 no. 2 bedroom 3 person units, 563 no. 2 bedroom 4 person units, and 45 no. 3 bedroom units), communal residential community rooms, and a ground floor creche in 16 no. buildings with heights varying from 4 to 12 storeys, basement and surface level car parking, secure bicycle parking, landscaping, water supply connection at Red Arches Road, and all ancillary site development works on a site located in the townland of Stapolin, Baldoyle, Dublin 13.

4.2 Details of the Non-Hazardous Wastes to be Produced

There will be soil, stones, clay and made ground excavated to facilitate construction of new foundations, underground services, and the installation of the proposed basements. The development engineers have estimated that 135,000m^3 of material will need to be excavated to do so. It is currently envisaged that 6,000m^3 will be able to be retained and reused onsite for landscaping purposes the remaining material, will need to be removed offsite due to the limited opportunities for reuse on site. This will be taken for appropriate offsite reuse, recovery, recycling and / or disposal.

During the construction phase there may be a surplus of building materials, such as timber off-cuts, broken concrete blocks, cladding, plastics, metals and tiles generated. There may also be excess concrete during construction which will need to be disposed of. Plastic and cardboard waste from packaging and supply of materials will also be generated. The contractor will be required to ensure that oversupply of materials is kept to a minimum and opportunities for reuse of suitable materials is maximised.

Waste will also be generated from construction workers e.g. organic / food waste, dry mixed recyclables (waste paper, newspaper, plastic bottles, packaging, aluminium cans, tins and Tetra Pak cartons), mixed non-recyclables and potentially sewage sludge from temporary welfare facilities provided on site during the construction phase. Waste printer / toner cartridges, waste electrical and electronic equipment (WEEE) and waste batteries may also be generated infrequently from site offices.

4.3 Potential Hazardous Wastes Arising

4.3.1 Contaminated Soil

Ground Investigations Ireland (GII) carried out an environmental site investigation directly to the east of the proposed development site between October 2019 and February 2020 (BSM, 2021). The scope of works included trial pitting, borehole drilling, subsoil sampling, interpretation of chemical data and reporting. Site investigation works also entailed Geotechnical & Environmental Laboratory testing (12 No in total for environmental testing).

During the 2019 and 2020 site investigations, samples were recovered from the on-site trial pit and borehole locations and sent for analysis. In order to assess materials, which may be excavated and removed from Site, in terms of waste classification, a selection of samples collected were analysed for a suite of parameters which allows for the assessment of the soils in terms of total pollutant content for classification of materials as hazardous or non-hazardous referred to as the 'RILTA Suite'. The parameter list for the RILTA suite includes analysis of the solid samples for arsenic, barium, cadmium, chromium, copper, cyanide, lead, nickel, mercury, zinc, speciated aliphatic and aromatic petroleum hydrocarbons, pH, sulphate, sulphide, moisture content, soil organic matter and an asbestos screen. The total pollutant content analysis also provides analytical data which can be used to assess the quality of the subsoils underlying the Site and allow an assessment of their suitability for a range of proposed uses against generic assessment criteria.

The RILTA Suite also includes those parameters specified in the EU Council Decision Establishing Criteria for the Acceptance of Waste at Landfills (Council Decision 2003/33/EC), referred to as Waste Acceptance Criteria (WAC), which for the solid samples are pH; total organic carbon (TOC); speciated aliphatic and aromatic petroleum

hydrocarbons; benzene, toluene, ethylbenzene and xylene (BTEX); phenol; polychlorinated biphenyls (PCB); and polycyclic aromatic hydrocarbons (PAH).

In line with the requirement of Council Decision 2003/33/EC, leachate was generated from the solid samples, which was in turn analysed for antimony, arsenic, barium, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, chloride, fluoride, soluble sulphate, sulphide, phenols, dissolved organic carbon (DOC) and total dissolved solids (TDS). The suite was selected due to the unknown origin of the material underlying the Site and no evidence of specific contaminants of concern highlighted in the Site history. The laboratory testing was competed by Element Materials Technology (EMT) in the UK; EMT is a UKAS accredited laboratory(BSM, 2021)

The laboratory analysis did not identify any asbestos containing materials (ACMs) in any of the samples tested.

All of the samples collected at the site were categorised as inert (as per Council Decision annex 2003/33/EC). There was no evidence of waste deposited on-site during Site investigation works (BSM, 2021).
If any potentially contaminated material is encountered, it will need to be segregated from clean/inert material, tested and classified as either non-hazardous or hazardous in accordance with the EPA publication entitled *'Waste Classification: List of Waste & Determining if Waste is Hazardous or Non-Hazardous'* [12] using the *HazWasteOnline* application (or similar approved classification method). The material will then need to be classified as clean, inert, non-hazardous or hazardous in accordance with the *EC Council Decision 2003/33/EC* [13], which establishes the criteria for the acceptance of waste at landfills.

In the event that Asbestos Containing Materials (ACMs) are found, the removal will only be carried out by a suitably permitted waste contractor, in accordance with *S.I. No. 386 of 2006 Safety, Health and Welfare at Work (Exposure to Asbestos) Regulations 2006-2010.* All asbestos will be taken to a suitably licensed or permitted facility.

In the event that hazardous soil, or historically deposited waste is encountered during the construction phase, the contractor will notify FCC and provide a Hazardous/Contaminated Soil Management Plan, to include estimated tonnages, description of location, any relevant mitigation, destination for disposal/treatment, in addition to information on the authorised waste collector(s).

4.3.2 Fuel/Oils

Fuels and oils are classed as hazardous materials; any on-site storage of fuel / oil, and all storage tanks and all draw-off points will be bunded and located in a dedicated, secure area of the site. Provided that these requirements are adhered to and the site crew are trained in the appropriate refuelling techniques, it is not expected that there will be any fuel / oil waste generated at the site.

4.3.3 Invasive Plant Species

A site invasive species surveys were undertaken by Altemar Ltd. This included a site walkover survey of the entire site, and around part of the outside perimeter to search for any invasive species listed on the Third Schedule of the European Communities (Birds

and Natural Habitats) Regulations 2011 and specifically for the presence of Japanese Knotweed. There was no Japanese Knotweed recorded as part of the site survey.

4.3.4 Other Known Hazardous Substances

Paints, glues, adhesives and other known hazardous substances will be stored in designated areas. They will generally be present in small volumes only and associated waste volumes generated will be kept to a minimum. Wastes will be stored in appropriate receptacles pending collection by an authorised waste contractor.

In addition, WEEE (containing hazardous components), printer toner / cartridges, batteries (Lead, Ni-Cd or Mercury) and / or fluorescent tubes and other mercury containing waste may be generated from during C&D activities or temporary site offices. These wastes, if generated, will be stored in appropriate receptacles in designated areas of the site pending collection by an authorised waste contractor.

5.0 Roles and Responsibilities

The *Best Practice Guidelines on the Preparation of Resource Waste Management Plans for Construction and Demolition Projects* promotes that a RM should be appointed. The RM may be performed by number of different individuals over the life-cycle of the Project, however it is intended to be a reliable person chosen from within the Planning/Design/Contracting Team, who is technically competent and appropriately trained, who takes the responsibility to ensure that the objectives and measures within the Project C&D WMP are complied with. The RM is assigned the requisite authority to meet the objective and obligations of the C&D WMP. The role will include the important activities of conducting waste checks/audits and adopting construction and demolition methodology that is designed to facilitate maximum reuse and/or recycling of waste.

5.1 Role of the Client

The Client are the body establishing the aims and the performance targets for the project.

- The Client has commissioned the preparation and submission of a preliminary C&D WMP as part of the design and planning submission;
- The Client is to commission the preparation and submission of an updated C&D WMP as part of the construction tendering process;
- The Client will ensure that the C&D WMP is agreed on and submitted to the local authority prior to commencement of works on site;
- The Client is to request the end-of-project C&D WMP from the Contractor.

5.2 Role of the Client Advisory Team

The Client Advisory Team or Design Team is formed of architects, consultants, quantity surveyors and engineers and is responsible for:

- Drafting and maintaining the C&D WMP through the design, planning and procurement phases of the project;
- Appointing a RM to track and document the design process, inform the Design Team and prepare the C&D WMP.

- Including details and estimated quantities of all projected waste streams with the support of environmental consultants/scientists. This should also include data on waste types (e.g. waste characterisation data, contaminated land assessments, site investigation information) and prevention mechanisms (such as by-products) to illustrate the positive circular economy principles applied by the Design Team;
- Managing and valuing the demolition work with the support of quantity surveyors;
- Handing over of the C&D WMP to the selected Contractor upon commencement of construction of the development, in a similar fashion to how the safety file is handed over to the Contractor;
- Working with the Contractor as required to meet the performance targets for the project.

5.3 Future Role of the Contractor

The future demolition and construction Contractors have not yet been decided upon for this C&D WMP. However, once select they will have major roles to fulfil. They will be responsible for:

- Preparing, implementing and reviewing the (including the Pre-Demolition) C&D WMP throughout the demolition and construction phases (including the management of all suppliers and sub-contractors) as per the requirements of these guidelines;
- Identifying a designated and suitably qualified RM who will be responsible for implementing the C&D WMP;
- Identifying all hauliers to be engaged to transport each of the resources / wastes off-site;
- Implementing waste management policies whereby waste materials generated on site are to be segregated as far as practicable;
- Renting and operating a mobile-crusher to crush concrete for temporary reuse onsite during construction and reduce the amount of HGV loads required to remove material from site;
- Applying for the appropriate waste permit to crush concrete onsite;
- Identifying all destinations for resources taken off-site. As above, any resource that is legally classified as a ‘waste’ must only be transported to an authorised waste facility;
- End-of-waste and by-product notifications addressed with the EPA where required;
- Clarification of any other statutory waste management obligations, which could include on-site processing;
- Full records of all resources (both wastes and other resources) should be maintained for the duration of the project; and
- Preparing a C&D WMP Implementation Review Report at project handover.

6.0 Key Materials & Quantities

6.1 Project Resource Targets

Project specific resource and waste management targets for the site have not yet been set and this information should be updated for these targets once these targets have been confirmed by the client. However, it is expected for projects of this nature that a minimum

of 70% of waste is fully re-used, recycled or recovered. Target setting will inform the setting of project-specific benchmarks to track target progress. Typical Key Performance Indicators (KPIs) that may be used to set targets include (as per guidelines):

- Weight (tonnes) or Volume (m^3) of waste generated per construction value;
- Weight (tonnes) or Volume (m^3) of waste generated per construction floor area (m^2);
- Fraction of resource reused on site;
- Fraction of resource notified as by-product;
- Fraction of waste segregated at source before being sent off-site for recycling/recovery; and
- Fraction of waste recovered, fraction of waste recycled, or fraction of waste disposed.

6.2 Main Construction and Demolition Waste Categories

The main non-hazardous and hazardous waste streams that could be generated by the construction activities at a typical site are shown in Table 6.1. The List of Waste (LoW) code (applicable as of 1 June 2015) (also referred to as the European Waste Code (EWC)) for each waste stream is also shown.

Table 6.1 *Typical waste types generated and LoW codes (individual waste types may contain hazardous substances)*

Waste Material	LoW/EWC Code
Concrete, bricks, tiles, ceramics	17 01 01-03 & 07
Wood, glass and plastic	17 02 01-03
Treated wood, glass, plastic, containing hazardous substances	17-02-04*
Bituminous mixtures, coal tar and tarred products	17 03 01*, 02 & 03*
Metals (including their alloys) and cable	17 04 01-11
Soil and stones	17 05 03* & 04
Gypsum-based construction material	17 08 01* & 02
Paper and cardboard	20 01 01
Mixed C&D waste	17 09 04
Green waste	20 02 01
Electrical and electronic components	20 01 35 & 36
Batteries and accumulators	20 01 33 & 34
Liquid fuels	13 07 01-10
Chemicals (solvents, pesticides, paints, adhesives, detergents etc.)	20 01 13, 19, 27-30
Insulation materials	17 06 04
Organic (food) waste	20 01 08
Mixed Municipal Waste	20 03 01

** Individual waste type may contain hazardous substances*

7.0 WASTE MANAGEMENT

7.1 Demolition Waste Generation

There will be demolition required as part of the proposed development.

7.2 Construction Waste Generation

Table 7.1 shows the breakdown of C&D waste types produced on a typical site based on data from the EPA *National Waste Reports* [14] *and the joint EPA & GMIT study* [15].

Table 7.1: *Waste materials generated on a typical Irish construction site*

Waste Types	%
Mixed C&D	33
Timber	28
Plasterboard	10
Metals	8
Concrete	6
Other	15
Total	**100**

Table 7.2, below, shows the estimated construction waste generation for the proposed Project based on the gross floor area of construction and other information available to date, along with indicative targets for management of the waste streams. The estimated amounts for the main waste types (with the exception of soils and stones) are based on an average large-scale development waste generation rate per m^2, using the waste breakdown rates shown in Table 7.1. These have been calculated from the schedule of development areas provided by the architect.

Table 7.1*: Predicted on and off-site reuse, recycle and disposal rates for construction waste*

Waste Type	Tonnes	Reuse		Recycle / Recovery		Disposal	
		%	Tonnes	%	Tonnes	%	Tonnes
Mixed C&D	2133.0	10	213.3	80	1706.4	10	213.3
Timber	1809.8	40	723.9	55	995.4	5	90.5
Plasterboard	646.4	30	193.9	60	387.8	10	64.6
Metals	517.1	5	25.9	90	465.4	5	25.9
Concrete	387.8	30	116.3	65	252.1	5	19.4
Other	969.5	20	193.9	60	581.7	20	193.9
Total	**6463.6**		**1467.2**		**4388.8**		**607.6**

In addition to the waste streams in Table 7.2, there will be c. 135,000 m^3 of soil, stones, clay and made ground excavated to facilitate construction of new foundations, underground services, and the installation of the proposed basements. Any suitable excavated material will be temporarily stockpiled for reuse as fill or landscaping, where possible, but reuse on site is expected to be limited and all of the excavated material

except for 6,000 m^3 is expected to be removed off- site for appropriate reuse, recovery and / or disposal.

It should be noted that until final materials and detailed construction methodologies have been confirmed, it is difficult to predict with a high level of accuracy the construction waste that will be generated from the proposed works as the exact materials and quantities may be subject to some degree of change and variation during the construction process.

7.3 Proposed Resource and Waste Management Options

Waste materials generated will be segregated on- site, where it is practical. Where the on-site segregation of certain wastes types is not practical, off- site segregation will be carried out. There will be skips and receptacles provided to facilitate segregation at source, where feasible. All waste receptacles leaving site will be covered or enclosed. The appointed waste contractor will collect and transfer the wastes as receptacles are filled. There are numerous waste contractors in the Dublin and Leinster region that provide this service.

All waste arisings will be handled by an approved waste contractor holding a current waste collection permit. All waste arisings requiring disposal off- site will be reused, recycled, recovered or disposed of at a facility holding the appropriate registration, permit or licence, as required.

During construction, some of the sub-contractors on site will generate waste in relatively low quantities. The transportation of non-hazardous waste by persons who are not directly involved with the waste business, at weights less than or equal to 2 tonnes, and in vehicles not designed for the carriage of waste, are exempt from the requirement to have a waste collection permit (per Article 30 (1) (b) of the Waste Collection Permit Regulations 2007, as amended). Any sub-contractors engaged that do not generate more than 2 tonnes of waste at any one time can transport this waste off- site in their work vehicles (which are not designed for the carriage of waste). However, they are required to ensure that the receiving facility has the appropriate COR / permit / licence.

Written records will be maintained by the contractor(s), detailing the waste arising throughout the C&D phases, the classification of each waste type, waste collection permits for all waste contactors who collect waste from the site and COR / permit / licence for the receiving waste facility for all waste removed off- site for appropriate reuse, recycling, recovery and / or disposal

Dedicated bunded storage containers will be provided for hazardous wastes which may arise, such as batteries, paints, oils, chemicals, if required.

The anticipated management of the main waste streams is outlined as follows:

Soil, Stone, Gravel & Clay

The waste hierarchy states that the preferred option for waste management is prevention and minimisation of waste, followed by preparing for reuse and recycling / recovery, energy recovery (i.e. incineration) and, least favoured of all, disposal. The excavations are required to facilitate construction works so the preferred option (prevention and minimisation) cannot be accommodated for the excavation phase.

When material is removed off- site it could be reused as a by-product (and not as a waste). If this is done, it will be done in accordance with Article 27 of the *European Communities (Waste Directive) Regulations 2011*, which requires that certain conditions are met and that by-product notifications are made to the EPA via their online notification form. Excavated material should not be removed from site until approval from the EPA has been received. The potential to reuse material as a by-product will be confirmed during the course of the excavation works, with the objective of eliminating any unnecessary disposal of material.
The next option (beneficial reuse) may be appropriate for the excavated material, pending environmental testing to classify the material as hazardous or non-hazardous in accordance with the EPA *Waste Classification – List of Waste & Determining if Waste is Hazardous or Non-Hazardous* publication. Clean inert material may be used as fill material in other construction projects or engineering fill for waste licensed sites. Beneficial reuse of surplus excavation material as engineering fill may be subject to further testing to determine if materials meet the specific engineering standards for their proposed end use.

Any nearby sites requiring clean fill/capping material will be contacted to investigate reuse opportunities for clean and inert material. If any of the material is to be reused on another site as a by-product (and not as a waste), this will be done in accordance with Article 27. Similarly, if any soils/stones are imported onto the site from another construction site as a by-product, this will also be done in accordance with Article 27. Article 27 will be investigated to see if the material can be imported onto this site for beneficial reuse instead of using virgin materials.

If the material is deemed to be a waste, then removal and reuse / recovery / disposal of the material will be carried out in accordance with the *Waste Management Acts 1996 – 2011* as amended, the *Waste Management (Collection Permit) Regulations 2007* as amended and the *Waste Management (Facility Permit & Registration) Regulations 2007* as amended. Once all available beneficial reuse options have been exhausted, the options of recycling and recovery at waste permitted and licensed sites will be considered.

In the event that contaminated material is encountered and subsequently classified as hazardous, this material will be stored separately to any non-hazardous material. It will require off-site treatment at a suitable facility or disposal abroad via Transfrontier Shipment of Wastes (TFS).

Bedrock

While it is not envisaged that bedrock will be encountered, if bedrock is encountered, it is anticipated that it will not be crushed on site. Any excavated rock is expected to be removed off- site for appropriate reuse, recovery and / or disposal. If bedrock is to be crushed on- site, the appropriate mobile waste facility permit will be obtained from FCC.

Silt & Sludge

During the construction phase, silt and petrochemical interception will be carried out on run-off and pumped water from site works, where required. Sludge and silt will then be collected by a suitably licensed contractor and removed off- site.

Concrete Blocks, Bricks, Tiles & Ceramics

The majority of concrete blocks, bricks, tiles and ceramics generated as part of the construction works are expected to be clean, inert material and should be recycled, where possible. If concrete is to be crushed on- site, the appropriate mobile waste facility permit will be obtained from FCC.

Hard Plastic

As hard plastic is a highly recyclable material, much of the plastic generated will be primarily from material off-cuts. All recyclable plastic will be segregated and recycled, where possible.

Timber

Timber that is uncontaminated, i.e. free from paints, preservatives, glues, etc., will be disposed of in a separate skip and recycled off- site.

Metal

Metals will be segregated, where practical, and stored in skips. Metal is highly recyclable and there are numerous companies that will accept these materials.

Plasterboard

There are currently a number of recycling services for plasterboard in Ireland. Plasterboard from the construction phases will be stored in a separate skip, pending collection for recycling. The site Manager will ensure that oversupply of new plasterboard is carefully monitored to minimise waste.

Glass

Glass materials will be segregated for recycling, where possible.

Waste Electrical & Electronic Equipment (WEEE)

Any WEEE will be stored in dedicated covered cages / receptacles / pallets pending collection for recycling.

Other Recyclables

Where any other recyclable wastes, such as cardboard and soft plastic, are generated, these will be segregated at source into dedicated skips and removed off- site.

Non-Recyclable Waste

C&D waste which is not suitable for reuse or recovery, such as polystyrene, some plastics and some cardboards, will be placed in separate skips or other receptacles. Prior to removal from site, the non-recyclable waste skip / receptacle will be examined by a member of the waste team (see Section 9.0) to determine if recyclable materials have been placed in there by mistake. If this is the case, efforts will be made to determine the cause of the waste not being segregated correctly and recyclable waste will be removed and placed into the appropriate receptacle.

Other Hazardous Wastes

On-site storage of any hazardous wastes produced (i.e. contaminated soil if encountered and / or waste fuels) will be kept to a minimum, with removal off-site organised on a regular

basis. Storage of all hazardous wastes on-site will be undertaken so as to minimise exposure to on-site personnel and the public and to also minimise potential for environmental impacts. Hazardous wastes will be recovered, wherever possible, and failing this, disposed of appropriately.

On-Site Crushing

It is currently not envisaged that the crushing of waste materials will occur on- site. However, if the crushing of material is to be undertaken, a mobile waste facility permit will first be obtained from FCC and the destination of the accepting waste facility will be supplied to the FCC waste unit.

7.4 Tracking and Documentation Procedures for Off-Site Waste

All waste will be documented prior to leaving the site. Waste will be weighed by the contractor, either by a weighing mechanism on the truck or at the receiving facility. These waste records will be maintained on site by the nominated project RM (see Section 9.0).

All movement of waste and the use of waste contractors will be undertaken in accordance with the *Waste Management Acts 1996 - 2011*, *Waste Management (Collection Permit) Regulations 2007* as amended and *Waste Management (Facility Permit & Registration) Regulations 2007* and amended. This includes the requirement for all waste contractors to have a waste collection permit issued by the NWCPO. The nominated project RM (see Section 9.0) will maintain a copy of all waste collection permits on-Site.

If the waste is being transported to another site, a copy of the Local Authority waste COR / permit or EPA Waste / Industrial Emissions Licence for that site will be provided to the nominated project RM (see Section 9.0). If the waste is being shipped abroad, a copy of the Transfrontier Shipping (TFS) notification document will be obtained from DCC (as the relevant authority on behalf of all Local Authorities in Ireland) and kept on-Site along with details of the final destination (COR, permits, licences, etc.). A receipt from the final destination of the material will be kept as part of the on-Site waste management records.

All information will be entered in a waste management recording system to be maintained on-Site.

8.0 ESTIMATED COST OF WASTE MANAGEMENT

An outline of the costs associated with different aspects of waste management is outlined below. The total cost of C&D waste management will be measured and will take into account handling costs, storage costs, transportation costs, revenue from rebates and disposal costs.

8.1 Reuse

By reusing materials on site, there will be a reduction in the transport and recycle / recovery / disposal costs associated with the requirement for a waste contractor to take the material off-Site. Clean and inert soils, gravel, stones, etc., which cannot be reused on-Site may be used as access roads or capping material for landfill sites, etc. This material is often taken free of charge or at a reduced fee for such purposes, reducing final waste disposal costs.

8.2 Recycling

Salvageable metals will earn a rebate, which can be offset against the costs of collection and transportation of the skips.

Clean, uncontaminated cardboard and certain hard plastics can also be recycled. Waste contractors will charge considerably less to take segregated wastes, such as recyclable waste, from a site than mixed waste.

Timber can be recycled as chipboard. Again, waste contractors will charge considerably less to take segregated wastes, such as timber, from a site than mixed waste.

8.3 Disposal

Landfill charges are currently at around €130 - €150 per tonne which includes a €75 per tonne landfill levy specified in the *Waste Management (Landfill Levy) Regulations 2015*. In addition to disposal costs, waste contractors will also charge a collection fee for skips.

Collection of segregated C&D waste usually costs less than municipal waste. Specific C&D waste contractors take the waste off-site to a licensed or permitted facility and, where possible, remove salvageable items from the waste stream before disposing of the remainder to landfill. Clean soil, rubble, etc., is also used as fill / capping material, wherever possible.

9.0 TRAINING PROVISIONS

A member of the construction team will be appointed as the RM to ensure commitment, operational efficiency and accountability in relation to waste management during the C&D phases of the development.

9.1 Resource Manager Training and Responsibilities

The nominated RM will be given responsibility and authority to select a waste team if required, i.e. members of the site crew that will aid them in the organisation, operation and recording of the waste management system implemented on site.

The RM will have overall responsibility to oversee, record and provide feedback to the client on everyday waste management at the site. Authority will be given to the RM to delegate responsibility to sub-contractors, where necessary, and to coordinate with suppliers, service providers and sub-contractors to prioritise waste prevention and material salvage.

The RM will be trained in how to set up and maintain a record keeping system, how to perform an audit and how to establish targets for waste management on site. The RM will also be trained in the best methods for segregation and storage of recyclable materials, have information on the materials that can be reused on site and be knowledgeable in how to implement this C&D WMP.

9.2 Site Crew Training

Training of site crew in relation to waste is the responsibility of the RM and, as such, a waste training program should be organised. A basic awareness course will be held for all site crew to outline the C&D WMP and to detail the segregation of waste materials at source. This may be incorporated with other site training needs such as general site induction, health and safety awareness and manual handling.

This basic course will describe the materials to be segregated, the storage methods and the location of the Waste Storage Areas (WSAs). A sub-section on hazardous wastes will be incorporated into the training program and the particular dangers of each hazardous waste will be explained.

10.0 TRACKING AND TRACING / RECORD KEEPING

Records should be kept for all waste material which leaves the site, either for reuse on another site, recycling or disposal. A recording system will be put in place to record the waste arisings on Site.

A waste tracking log should be used to track each waste movement from the site. On exit from the site, the waste collection vehicle driver should stop at the site office and sign out as a visitor and provide the security personnel or RM with a waste docket (or Waste Transfer Form (WTF) for hazardous waste) for the waste load collected. At this time, the security personnel should complete and sign the Waste Tracking Register with the following information:

- Date
- Time
- Waste Contractor
- Company waste contractor appointed by, e.g. Contractor or subcontractor name
- Collection Permit No.
- Vehicle Reg.
- Driver Name
- Docket No.
- Waste Type
- EWC / LoW

The waste vehicle will be checked by security personal or the RM to ensure it has the waste collection permit no. displayed and a copy of the waste collection permit in the vehicle before they are allowed to remove the waste from the site.

The waste transfer dockets will be transferred to the RM on a weekly basis and can be placed in the Waste Tracking Log file. This information will be forwarded onto the DCC Waste Regulation Unit when requested.

Each subcontractor that has engaged their own waste contractor will be required to maintain a similar waste tracking log with the waste dockets / WTF maintained on file and available for inspection on site by the main contractor as required. These subcontractor logs will be merged with the main waste log.

Waste receipts from the receiving waste facility will also be obtained by the site contractor(s) and retained. A copy of the Waste Collection Permits, CORs, Waste Facility Permits and Waste Licences will be maintained on site at all times and will be periodically reviewed by the RM. Subcontractors who have engaged their own waste contractors, should provide the main contractor with a copy of the waste collection permits and COR / permit / licence for the receiving waste facilities and maintain a copy on file, available for inspection on site as required.

11.0 OUTLINE WASTE AUDIT PROCEDURE

11.1 Responsibility for Waste Audit

The appointed RM will be responsible for conducting a waste audit at the site during the C&D phase of the proposed Project. Contact details for the nominated RM will be provided to the FCC Waste Regulation Unit after the main contractor is appointed and prior to any material being removed from site.

11.2 Review of Records and Identification of Corrective Actions

A review of all waste management costs and the records for the waste generated and transported off-site should be undertaken mid-way through the demolition and construction phase of the proposed Project.

If waste movements are not accounted for, the reasons for this should be established in order to see if and why the record keeping system has not been maintained. The waste records will be compared with the established recovery / reuse / recycling targets for the site. Each material type will be examined, in order to see where the largest percentage waste generation is occurring. The waste management methods for each material type will be reviewed in order to highlight how the targets can be achieved.

Upon completion of the C&D phase, a final report will be prepared, summarising the outcomes of waste management processes adopted and the total recycling / reuse / recovery figures for the development.

12.0 CONSULTATION WITH RELEVANT BODIES

12.1 Local Authority

Once construction contractors have been appointed and have appointed waste contractors, and prior to removal of any C&D waste materials off-site, details of the proposed destination of each waste stream will be provided to the FCC Waste Regulation Unit.

FCC will also be consulted, as required, throughout the demolition, excavation and construction phases in order to ensure that all available waste reduction, reuse and recycling opportunities are identified and utilised and that compliant waste management practices are carried out.

12.2 Recycling / Salvage Companies

The appointed waste contractor for the main waste streams managed by the demolition and construction contractors will be audited in order to ensure that relevant and up-to-date waste collection permits and facility registrations / permits / licences are held. In addition, information will be obtained regarding the feasibility of recycling each material, the costs of recycling / reclamation, the means by which the wastes will be collected and transported off- site, and the recycling / reclamation process each material will undergo off- site.

13.0 REFERENCES

1. Waste Management Act 1996 (No. 10 of 1996) as amended.
2. Protection of the Environment Act 2003, (No. 27 of 2003) as amended.
3. Litter Pollution Act 1997 (S.I. No. 12 of 1997) as amended
4. Eastern-Midlands Region Waste Management Plan 2015 – 2021 (2015).
5. Department of Environment and Local Government (DoELG) *Waste Management – Changing Our Ways, A Policy Statement* (1998).
6. Forum for the Construction Industry – *Recycling of Construction and Demolition Waste.*
7. Department of Communications, Climate Action and Environment (DCCAE), *Waste Action Plan for the Circular Economy - Ireland's National Waste Policy 2020-2025* (Sept 2020).
8. Department of Environment, Heritage and Local Government, *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects* (2006).
9. FÁS and the Construction Industry Federation (CIF), *Construction and Demolition Waste Management – a handbook for Contractors and* site *Managers* (2002).
10. Environmental Protection Agency (EPA) *'Best Practice Guidelines for the Preparation of Resource and Waste Management Plans for Construction & Demolition Projects' (November 2021)*
11. Fingal County Council *(*FCC*), Fingal County Development Plan 2017 – 2023* (2017)
12. Planning and Development Act 2000 (S.I. No. 30 of 2000) as amended
13. EPA, *Waste Classification – List of Waste & Determining if Waste is Hazardous or Non-Hazardous* (2015)
14. Council Decision 2003/33/EC, establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC.
15. Environmental Protection Agency (EPA), *National Waste Database Reports 1998 – 2012*.
16. EPA and Galway-Mayo Institute of Technology (GMIT), *EPA Research Report 146 – A Review of Design and Construction Waste Management Practices in Selected Case Studies – Lessons Learned* (2015).

Appendix 16.2

Operational Waste Management Plan

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OPERATIONAL WASTE MANAGEMENT PLAN FOR A PROPOSED DEVELOPMENT

BALDOYLE-STAPOLIN, DUBLIN 13.

"GROWTH AREA 2"

Report Prepared For

Lismore Homes Ltd.

Report Prepared By

Chonaill Bradley, Principal Environmental Consultant

Our Reference

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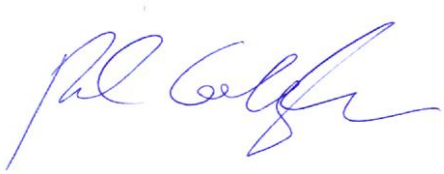
Signature		
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Date	22 March 2022	22 March 2022

CONTENTS

1.0 INTRODUCTION

AWN Consulting Ltd. (AWN) has prepared this Operational Waste Management Plan (OWMP) on behalf of Lismore Homes Ltd. for a proposed residential development. The proposed development consists of the construction of 1,007 residential apartments, communal residential community rooms, and a ground floor creche in 16 no. buildings with heights varying from 4 to 12 storeys, basement and surface level car parking, secure bicycle parking, landscaping, water supply connection at Red Arches Road, and all ancillary site development works on a site located in the townland of Stapolin, Coast Road, Baldoyle, Dublin.

This OWMP has been prepared to ensure that the management of waste during the operational phase of the proposed Development is undertaken in accordance with the current legal and industry standards including, the Waste Management Act 1996 – 2011 as amended and associated Regulations [1], Environmental Protection Agency Act 2003 as amended [2], Litter Pollution Act 1997 as amended [3], the *'Eastern-Midlands Region (EMR) Waste Management Plan 2015 – 2021'* [4] and the Fingal County Council (FCC) *Segregation Storage, Presentation and of Household and Commercial Waste (2019)* [5]. In particular, this OWMP aims to provide a robust strategy for the storage, handling, collection and transport of the wastes generated at Site.

This OWMP aims to ensure maximum recycling, reuse and recovery of waste with diversion from landfill, wherever possible. The OWMP also seeks to provide guidance on the appropriate collection and transport of waste to prevent issues associated with litter or more serious environmental pollution (e.g. contamination of soil or water resources). The plan estimates the type and quantity of waste to be generated from the proposed Development during the operational phase and provides a strategy for managing the different waste streams.

At present, there are no specific guidelines in Ireland for the preparation of OWMPs. Therefore, in preparing this document, consideration has been given to the requirements of national and regional waste policy, legislation and other guidelines.

2.0 OVERVIEW OF WASTE MANAGEMENT IN IRELAND

2.1 National Level

The Irish Government issued a policy statement in September 1998 entitled *'Changing Our Ways'* [6], which identified objectives for the prevention, minimisation, reuse, recycling, recovery and disposal of waste in Ireland. A heavy emphasis was placed on reducing reliance on landfill and finding alternative methods for managing waste. Amongst other things, *Changing Our Ways* stated a target of at least 35% recycling of municipal (i.e. household, commercial and non-process industrial) waste.

A further policy document, *'Preventing and Recycling Waste – Delivering Change'* was published in 2002 [7]. This document proposed a number of programmes to increase recycling of waste and allow diversion from landfill. The need for waste minimisation at source was considered a priority.

This view was also supported by a review of sustainable development policy in Ireland and achievements to date, which was conducted in 2002, entitled *'Making Irelands Development Sustainable – Review, Assessment and Future Action'* [8]. This document also stressed the need to decouple economic growth and waste generation, again through waste minimisation and reuse of discarded material.

In order to establish the progress of the Government policy document *Changing Our Ways*, a review document was published in April 2004 entitled *'Taking Stock and Moving Forward'* [9]. Covering the period 1998 – 2003, the aim of this document was to

assess progress to date with regard to waste management in Ireland, to consider developments since the policy framework and the local authority waste management plans were put in place, and to identify measures that could be undertaken to further support progress towards the objectives outlined in *Changing Our Ways*.

In particular, *Taking Stock and Moving Forward* noted a significant increase in the amount of waste being brought to local authority landfills. The report noted that one of the significant challenges in the coming years was the extension of the dry recyclable collection services.

In September 2020, the Irish Government published a new policy document outlining a new action plan for Ireland to cover the period of 2020-2025. This plan *'A Waste Action Plan for a Circular Economy'* [10] (WAPCE), was prepared in response to the 'European Green Deal' which sets a roadmap for a transition to a new economy, where climate and environmental challenges are turned into opportunities, replacing the previous national waste management plan *"A Resource Opportunity"* (2012).

The WAPCE sets the direction for waste planning and management in Ireland up to 2025. This reorientates policy from a focus on managing waste to a much greater focus on creating circular patterns of production and consumption. Other policy statements of a number of public bodies already acknowledge the circular economy as a national policy priority.

The policy document contains over 200 measures across various waste areas including circular economy, municipal waste, consumer protection and citizen engagement, plastics and packaging, construction and demolition, textiles, green public procurement and waste enforcement.

One of the first actions to be taken was the development of the Whole of Government Circular Economy Strategy 2022-2023 'Living More, Using Less' (2021) [11] to set a course for Ireland to transition across all sectors and at all levels of Government toward circularity and was issued in December 2021. It is anticipated that the Strategy will be updated in full every 18 months to 2 years.

Since 1998, the Environmental Protection Agency (EPA) has produced periodic *'National Waste (Database) Reports'* [12] detailing, among other things, estimates for household and commercial (municipal) waste generation in Ireland and the level of recycling, recovery and disposal of these materials. The *2019 National Waste Statistics*, which is the most recent study published, along with the national waste statistics web resource (November 2021) reported the following key statistics for 2019:

- **Generated –** Ireland produced 3,085,652 t of municipal waste in 2019. This is almost a 6% increase since 2018. This means that the average person living in Ireland generated 628 kg of municipal waste in 2019.
- **Managed –** Waste collected and treated by the waste industry. In 2019, a total of 3,036,991 t of municipal waste was managed and treated.
- **Unmanaged –**Waste that is not collected or brought to a waste facility and is, therefore, likely to cause pollution in the environment because it is burned, buried or dumped. The EPA estimates that 48,660 t was unmanaged in 2019.
- **Recovered –** The amount of waste recycled, used as a fuel in incinerators, or used to cover landfilled waste. In 2019, around 83% of municipal waste was recovered – a decrease from 84% in 2018.
- **Recycled –** The waste broken down and used to make new items. Recycling also includes the breakdown of food and garden waste to make compost. The recycling rate in 2019 was 37%, which is down from 38% in 2018.
- **Disposed –** Less than a sixth (15%) of municipal waste was landfilled in 2019. This is an increase from 14% in 2018.

2.2 Regional Level

The proposed Development is located in the Local Authority administrative area of Fingal County Council (FCC).

The *EMR Waste Management Plan 2015 – 2021* is the regional waste management plan applicable to the DCC administrative area, which was published in May 2015. Currently the EMR and other regional waste management plans are under review and the Regional Waste Management Planning Offices expect to publish the final plan in early 2022.

The regional plan sets out the following strategic targets for waste management in the region:

- A 1% reduction per annum in the quantity of household waste generated per capita over the period of the plan;
- Achieve a recycling rate of 50% of managed municipal waste by 2020; and
- Reduce to 0% the direct disposal of unprocessed residual municipal waste to landfill (from 2016 onwards) in favour of higher value pre-treatment processes and indigenous recovery practices.

Municipal landfill charges in Ireland are based on the weight of waste disposed. In the Leinster Region, charges are approximately €130 - €150 per tonne of waste which includes a €75 per tonne landfill levy introduced under the *Waste Management (Landfill Levy) (Amendment) Regulations 2012.*

The *Fingal Development Plan 2017 – 2023* [12] came into effect in 2017 and sets out a number of policies and objectives for the Fingal region in line with the objectives of the regional waste management plan, including the following:

- Objective **WM03:** *Implement the provisions of the Eastern Midlands Region Waste Management Plan 2015 -2021 or any subsequent Waste Management Plan applicable within the lifetime of the Development Plan. All prospective developments in the County will be expected to take account of the provisions of the Regional Waste Management Plan and adhere to the requirements of that Plan.*
- Objective **WM05**: *Prevent and minimise the generation of waste in accordance with the Eastern Midlands Region Waste Management Plan 2015 -2021 (or any subsequent plans).*
- Objective **WM07:** *Promote the increased re-use of waste in accordance with the Eastern Midlands Region Waste Management Plan 2015-2021 (or any subsequent plan)."*
- Objective **DMS36:** *Ensure all new residential schemes include appropriate design measures for refuse storage areas, details of which should be clearly shown at pre-planning and planning application stage. Ensure refuse storage areas are not situated immediately adjacent to the front door or ground floor window, unless adequate screened alcoves or other such mitigation measures are provided.*
- Objective **DMS37:** *Ensure the maximum distance between the front door to a communal bin area does not exceed 50 metres.*

2.3 Legislative Requirements

The primary legislative instruments that govern waste management in Ireland and applicable to the proposed Development are:

- Waste Management Act 1996 as amended.
- Environmental Protection Agency Act 1992 (S.I. No. 7 of 1992) as amended;

- Litter Pollution Act 1997 (Act No. 12 of 1997) as amended and
- Planning and Development Act 2000 (S.I. No. 30 of 2000) as amended [13]

These Acts and subordinate Regulations transpose the relevant European Union Policy and Directives into Irish law.

One of the guiding principles of European waste legislation, which has in turn been incorporated into the Waste Management Act 1996 - 2011 as amended and subsequent Irish legislation, is the principle of "Duty of Care". This implies that the waste producer is responsible for waste from the time it is generated through until its legal disposal (including its method of disposal.) As it is not practical in most cases for the waste producer to physically transfer all waste from where it is produced to the final disposal area, waste contractors will be employed to physically transport waste to the final waste disposal site.

It is, therefore, imperative that the residents, tenants and the proposed facilities management company undertake on-Site management of waste in accordance with all legal requirements and that the facilities management company employ suitably permitted / licenced contractors to undertake off-Site management of their waste in accordance with all legal requirements. This includes the requirement that a waste contactor handle, transport and reuse / recover / recycle / dispose of waste in a manner that ensures that no adverse environmental impacts occur as a result of any of these activities.

A collection permit to transport waste must be held by each waste contractor which is issued by the National Waste Collection Permit Office (NWCPO). Waste receiving facilities must also be appropriately permitted or licensed. Operators of such facilities cannot receive any waste, unless in possession of a Certificate of Registration (COR) or waste permit granted by the relevant Local Authority under the Waste Management (Facility Permit & Registration) Regulations 2007, as amended, or a Waste or Industrial Emissions (IE) Licence granted by the EPA. The COR / permit / licence held will specify the type and quantity of waste able to be received, stored, sorted, recycled, recovered and / or disposed of at the specified site.

2.3.1 Fingal County Council Waste Bye-Laws

The *Fingal County Council (Segregation Storage, Presentation and of Household and Commercial Waste) Bye-Laws (2020)* came into effect on the 1st of April 2020. These bye-laws repeal the previous *Fingal County Council Bye-Laws for the Storage, Presentation and Collection of Household Waste (2006)*. They set a number of enforceable requirements on waste holders with regard to storage, separation and presentation of waste within the FCC area. Key requirements under these bye-laws of relevance to the proposed Project include the following:

- Kerbside waste presented for collection shall not be presented for collection earlier than 6.00 pm on the day immediately preceding the designated waste collection day;
- All containers used for the presentation of kerbside waste and any uncollected waste shall be removed from any roadway, footway, footpath or any other public place no later than 9:00am on the day following the designated waste collection day, unless an alternative arrangement has been approved in accordance with bye-law 4;
- Documentation, including receipts, is obtained and retained for a period of no less than one year to provide proof that any waste removed from the premises has been managed in a manner that conforms to these bye-laws, to the Waste Management Act and, where such legislation is applicable to that person, to the European Union (Household Food Waste and Bio-Waste) Regulations 2015; and

- Adequate access and egress onto and from the premises by waste collection vehicles is maintained.

2.4 Regional Waste Management Service Providers and Facilities

Various contractors offer waste collection services for the residential sector in the FCC region. Details of waste collection permits (granted, pending and withdrawn) for the region are available from the NWCPO.

As outlined in the regional waste management plan, there is a decreasing number of landfills available in the region. Only three municipal solid waste landfills remain operational and all are operated by the private sector. There are a number of other licensed and permitted facilities in operation in the region including waste transfer stations, hazardous waste facilities and integrated waste management facilities. There are two existing thermal treatment facilities, one in Duleek, Co. Meath and a second in Poolbeg in Dublin.

The closest civic amenity centre can be found at Estuary Recycling Centre c. 6.80 km to the north-west. This can be used for the disposal of other household wastes, as outlines in Section 5.4

A copy of all CORs and waste permits issued by the Local Authorities are available from the NWCPO website and all Waste / Industrial Emissions Licenses issued are available from the EPA.

3.0 DESCRIPTION OF THE DEVELOPMENT

3.1 Location, Size and Scale of the Development

The development will consist of A Strategic Housing Development for the construction of 1,007 residential apartments (consisting of 58 no. studio units, 247 no. 1 bedroom units, 94 no. 2 bedroom 3 person units, 563 no. 2 bedroom 4 person units, and 45 no. 3 bedroom units), communal residential community rooms, and a ground floor creche in 16 no. buildings with heights varying from 4 to 12 storeys, basement and surface level car parking, secure bicycle parking, landscaping, water supply connection at Red Arches Road, and all ancillary site development works on a site located in the townland of Stapolin, Baldoyle, Dublin 13.

3.2 Typical Waste Categories

The typical non-hazardous and hazardous wastes that will be generated at the proposed Development will include the following:

- Dry Mixed Recyclables (DMR) - includes waste paper (including newspapers, magazines, brochures, catalogues, leaflets), cardboard and plastic packaging, metal cans, plastic bottles, aluminium cans, tins and Tetra Pak cartons;
- Organic waste – food waste and green waste generated from internal plants / flowers;
- Glass; and
- Mixed Non-Recyclable (MNR)/General Waste.

In addition to the typical waste materials that will be generated at the development on a daily basis, there will be some additional waste types generated less frequently / in smaller quantities which will need to be managed separately including:

- Green / garden waste may be generated from external landscaping;
- Batteries (both hazardous and non-hazardous);

- Waste electrical and electronic equipment (WEEE) (both hazardous and non-hazardous);
- Printer cartridges / toners;
- Chemicals (paints, adhesives, resins, detergents, etc.);
- Light bulbs;
- Textiles;
- Waste cooking oil (if any generated by the residents and tenants);
- Furniture (and, from time to time, other bulky wastes); and
- Abandoned bicycles.

Wastes should be segregated into the above waste types to ensure compliance with waste legislation and guidance while maximising the re-use, recycling and recovery of waste with diversion from landfill wherever possible.

3.3 European Waste Codes

In 1994, the *European Waste Catalogue* [14] and *Hazardous Waste List* [15] were published by the European Commission. In 2002, the EPA published a document titled the *European Waste Catalogue and Hazardous Waste List* [16], which was a condensed version of the original two documents and their subsequent amendments. This document has recently been replaced by the EPA '*Waste Classification – List of Waste & Determining if Waste is Hazardous or Non-Hazardous'* [17], applicable since the 1st June 2015. This waste classification system applies across the EU and is the basis for all national and international waste reporting, such as those associated with waste collection permits, CORs, permits and licences and the EPA National Waste Database.

Under the classification system, different types of wastes are fully defined by a code. The List of Waste (LoW) code (also referred to as European Waste Code (EWC)) for typical waste materials expected to be generated during the operation of the proposed development are provided in Table 3.1, below.

Table 3.1 Typical Waste Types Generated and LoW Codes

Waste Material	LoW/EWC Code
Paper and Cardboard	20 01 01
Plastics	20 01 39
Metals	20 01 40
Mixed Non-Recyclable Waste	20 03 01
Glass	20 01 02
Biodegradable Kitchen Waste	20 01 08
Oils and Fats	20 01 25
Textiles	20 01 11
Batteries and Accumulators*	20 01 33* - 34
Printer Toner/Cartridges*	20 01 27* - 28
Green Waste	20 02 01
WEEE*	20 01 35*-36
Chemicals (solvents, pesticides, paints & adhesives, detergents, etc.) *	20 01 13*/19*/27*/28/29*30
Fluorescent tubes and other mercury containing waste*	20 01 21*
Bulky Wastes	20 03 07

** Individual waste type may contain hazardous materials*

4.0 ESTIMATED WASTE ARISINGS

A waste generation model (WGM) developed by AWN has been used to predict waste types, weights and volumes expected to arise from operations within the proposed Development. The WGM incorporates building area and use and combines these with other data, including Irish and US EPA waste generation rates.

The estimated quantum / volume of waste that will be generated from the residential units has been determined based on the predicted occupancy of the units. While the floor area usage (m^2) has been used to estimate the waste arising from the crèche and retail units.

The estimated waste generation for the proposed Development for the main waste types is presented in Tables 4.1.

Table 4.1 *Estimated Waste Generation for Residential Sectors and Crèche*

Waste Type	Waste Volume (m^3 / week)			
	Residential Sector 6A & 6B (Combined)	**Residential Sector 7 & 8A (Combined)**	**Residential Sector 8A & 8B (Combined)**	**Crèche Sector 8 A**
Organic Waste	5.09	7.33	3.07	0.08
Dry Mixed Recyclables	36.07	51.98	21.74	2.76
Glass	0.98	1.42	0.59	0.01
Mixed Non-Recyclables	18.97	27.33	11.43	1.51
Total	**61.11**	**88.07**	**36.83**	**4.35**

BS5906:2005 Waste Management in Buildings – Code of Practice[18] has been considered in the calculations of waste estimates. AWN's modelling methodology is based on recently published data and data from numerous other similar developments in Ireland and is based on AWN's experience, it provides a more representative estimate of the likely waste arisings from the proposed Development.

5.0 WASTE STORAGE AND COLLECTION

This section provides information on how waste generated within the Site will be stored and collected. This has been prepared with due consideration of the proposed Site layout as well as best practice standards, local and national waste management requirements, including those of FCC. In particular, consideration has been given to the following documents:

- *BS 5906:2005 Waste Management in Buildings – Code of Practice,*
- *EMR Waste Management Plan 2015 – 2021;*
- FCC (2017). Fingal Development Plan 2017 – 2023; and
- FCC Segregation Storage, Presentation and of Household and Commercial Waste (2019) and
- *DoHLGH, Sustainable Urban Housing: Design Standards for New Apartments, Guidelines for Planning Authorities* (2020) [19].

Waste Storage Areas

Locations of all Waste Storage Areas (WSAs) can be viewed on the drawings submitted with the planning application under separate cover.

Residential Sector 6A and 6B

Two (2 no.) shared WSAs have been allocated within the development design for the residential units in the apartment blocks in these sectors. This shared residential WSA is located on the basement level. The sector has four (4 no.) additional room allocated for the storage of Flexible Intermediate Bulk Containers (FIBCs) or additional bins, this room will only be accessible to facilities management and waste contractors.

Residential Sector 7 and 8A

Three (3 no.) shared WSA has been allocated within the development design for the residential units in the apartment blocks in these sectors. This shared residential WSA is located on the basement level. The sector has four (4 no.) additional room allocated for the storage of FIBCs or additional bins, this room will only be accessible to facilities management and waste contractors.

Residential Sector 8B and C

One (1 no.) shared WSA has been allocated within the development design for the residential units in the apartment blocks in these sectors. This shared residential WSA is located on the basement level. The sector has one (1 no.) additional room allocated for the storage of FIBCs or additional bins, this room will only be accessible to facilities management and waste contractors.

Crèche Block 8A

One (1 no.) WSA has been allocated within the development design for the crèche unit. This has been strategically located at ground floor level, in close proximity to the crèche unit and staging area.

The waste receptacles from the WSA will be collected by facilities management, immediately prior to collection and brought through the adjacent carparks to where the bins will be staged/collected at grade close to the entrance to the carpark. The staging area is such that it will not obstruct traffic or pedestrians (allowing a footway path of at least 1.8m, the space needed for two wheelchairs to pass each other) as is recommended in the *Design Manual for Urban Roads and Streets* (2019) [20].

Using the estimated waste generation volumes in Tables 4.1, above, the waste receptacle requirements for MNR, DMR, organic waste and glass have been established for the WSA. It is envisaged that MNR, DMR, organic waste and glass will be collected on a weekly basis

Waste Storage Requirements

Estimated waste storage requirements for the operational phase of the proposed Development are detailed in Table 5.1, below.

Table 5.1 *Waste storage requirements for the proposed development*

Area/Use	Bins Required				
	Compactor	**Compacted Waste containers (circa 2m³ each) MNR[1]**	**Compacted Waste containers (circa 3m³ each) DMR[2]**	**Organic Bins**	**Glass Bins**
Residential Sector 6A & 6B (Combined)	2 no. for MNR[1] 2 no. for DMR[2]	3	3	22 x 240L	5 x 240L

Area/Use	Bins Required				
	Compactor	**Compacted Waste containers (circa 2m³ each) MNR[1]**	**Compacted Waste containers (circa 3m³ each) DMR[2]**	**Organic Bins**	**Glass Bins**
Residential Sector 7 & 8A (Combined)	3 no. for MNR[1] 3 no. for DMR[2]	4	4	31 x 240L	6 x 240L
Residential Sector 8A & 8B (Combined)	1 no. for MNR[1] 1 no. for DMR[2]	2	2	13 x 240L	3x 240L
Crèche Unit (A4)	-	2 x 1100 L Bins	3 x 1100 L Bins	1 no. 120 L	1 x 120 L

Note: 1 = Mixed Non-Recyclables
2 = Dry Mixed Recyclables

The waste receptacle requirements have been established from distribution of the total weekly waste generation estimate into the holding capacity of each receptacle type.

Waste storage receptacles as per Table 5.1 above (or similar appropriate approved containers) will be provided by the facilities management company in the residential WSA.

It is proposed that building management will avail of a commercially available mini compactor for the DMR and MNR waste streams in the residential WSA –referred to as an Epac compactor in this OWMP.

This option will significantly reduce the volume of waste and as such the number of bins stored on site and the number of bins that will need to be transported to the curb for collection. It compresses/compacts the waste into $2m^3$ and $3m^3$ bags (also called Flexible Intermediate Bulk Containers or FIBCs).

Alternative options can be considered in future by the building management company, as technologies are developed. Solely for the purpose of ensuring the WSA is sufficiently sized, this plan assumes that the Epac option will be utilised. If required, sufficient space has been allocated in the WSAs so that bins can be used for the storage of waste with a twice weekly waste collection if the Epac compactors are removed.

The types of bins used will vary in size, design and colour dependent on the appointed waste contractor. However, examples of typical receptacles to be provided in the WSAs are shown in Figure 5.1. All waste receptacles used will comply with the SIST EN 840-1:2020 and SIST EN 840-2:2020 as the standards for performance requirements of mobile waste containers, where appropriate.

Figure 5.1 Typical waste receptacles of varying size (240L and 1100L)

The Epac compactor referred to in the list of bins/equipment in the residential basement WSA is a compactor that compresses/compacts the waste into 2m^3 and 3m^3 skip bags (also called Flexible Intermediate Bulk Containers or FIBCs). A photo of the Epac mini compactor is provided as Figure 5.2.

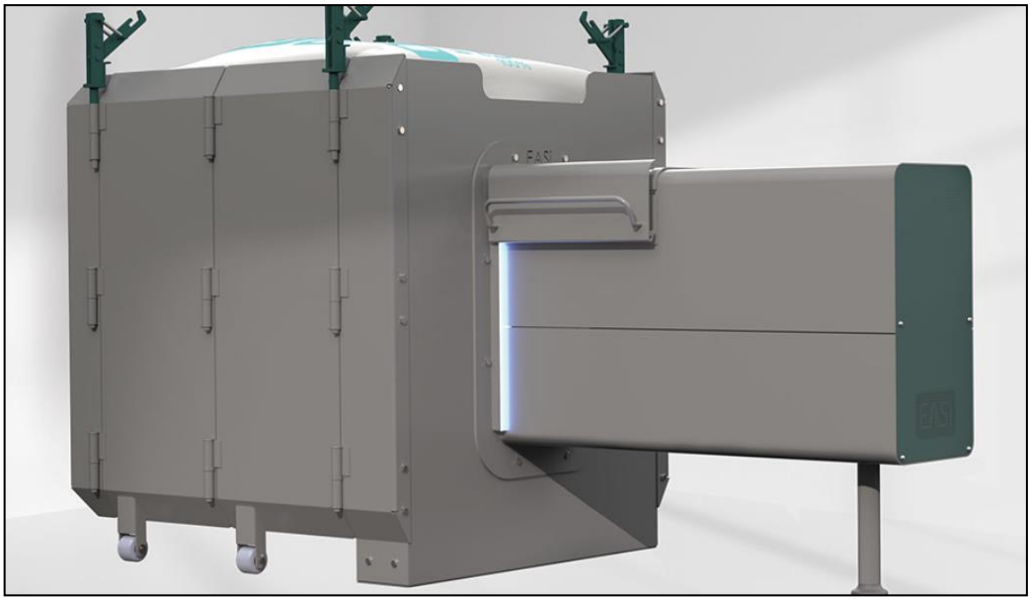

Figure 5.2 Photo of an Epac mini Compactor (*Source:* bnmrecyling Website)

Receptacles for organic, mixed dry recyclable, glass and mixed non-recyclable waste will be provided in the WSA's prior to first occupation of the development i.e. prior to the first residential unit being occupied.

This Plan will be provided to each resident from first occupation of the development i.e. once the first residential unit is occupied. This Plan will be supplemented, as required, by the property management company with any new information on waste segregation, storage, reuse and recycling initiatives that are subsequently introduced.

5.1 Waste Storage – Residential Units

Residents in the development will be required to segregate their waste into the following waste categories within their own units:

- DMR;
- MNR;
- Organic waste; and
- Glass.

As required, the residents will need to take segregated DMR, MNR, glass and organic waste to their allocated WSA adjacent to their unit.

Space will be provided in the residential units to accommodate 3 no. bin types to facilitate waste segregation at source.

It is proposed to use compactors to compress DMR and MNR waste into suitable containers. This equipment will be clearly labelled to identify which types of waste can be placed inside and the equipment will be suitable for use by all persons. It is intended that the equipment will be provided with an access control system to track equipment use and weights, where appropriate.

Full compacted waste bags will be moved by building management as required to the storage rooms located near or adjacent to compactor WSAs.

Access to the shared residential WSAs will be restricted to authorised residents, facilities management and waste contractors by means of a key or electronic fob access.

Each bin/container in the WSAs will be clearly labelled and colour coded to avoid cross contamination of the different waste streams. Signage will be posted above or on the bins to show exactly which waste types can be placed in each bin.

Other waste materials such as textiles, batteries, lightbulbs, cooking oil, printer cartridge/toner and WEEE may be generated infrequently by the residents. Residents will be required to identify suitable temporary storage areas for these waste items within their own units and dispose of them appropriately. Further details on additional waste types can be found in Section5.5.

5.2 Waste Storage – Crèche

Staff at the crèche will be required to segregate their waste into the following waste categories within their own units:

- DMR;
- MNR;
- Organic waste; and
- Glass.

As required, the staff will need to take segregated DMR, MNR, glass and organic waste to their allocated WSA adjacent to their unit.

Each bin / container in the WSA will be clearly labelled and colour coded to avoid cross contamination of the different waste streams. Signage will be posted above or on the bins to show exactly which waste types can be placed in each bin.

Other waste materials such as textiles, batteries, WEEE, lightbulbs, cooking oil and printer toner / cartridges may be generated infrequently by the tenants. Tenants will be required to identify suitable temporary storage areas for these waste items within the crèche and dispose of them appropriately. Further details on additional waste types can be found in Section 5.4.

5.3 Waste Collection

There are numerous private contractors that provide waste collection services in the Fingal County area. All waste contractors servicing the proposed development must hold a valid waste collection permit for the specific waste types collected. All waste collected must be transported to registered / permitted / licensed facilities only.

Waste repticals from the development will be brought to collection points by the waste contractor or facilities management, immediately prior to collection. The basement level carparks are insufficient in height for a waste truck to access; therefore, all waste will be collected at grade. All locations for collection can be viewed on the drawings submitted with the planning application under separate cover.

A trolley / tug or suitable vehicle will be required to convey the bins and FIBCs to and from the collection area. The facilities management or waste contractor will ensure that empty bins are promptly returned to the WSAs after collection / emptying.

Suitable access and egress has been provided to enable the waste receptacles to be moved easily from the WSAs to the waste staging areas and collection vehicles on the appropriate days. Waste will be collected at agreed days and times by the nominated waste contractors.

All waste receptacles should be clearly identified as required by waste legislation and the requirements of the FCC *Waste Bye-Laws*. Waste will be presented for collection in a manner that will not endanger health, create a risk to traffic, harm the environment or create a nuisance through odours or litter.

It is recommended that waste collection times are staggered to reduce the number of bins required to be emptied at once and the time the waste vehicle is on-Site. This will be determined during the process of appointment of a waste contractor.

5.4 Additional Waste Materials

In addition to the typical waste materials that are generated on a daily basis, there will be some additional waste types generated from time to time that will need to be managed separately. A non-exhaustive list is presented below.

Green Waste

Green waste may be generated from gardens, external landscaping and internal plants / flowers. Green waste generated from landscaping of external areas will be removed by external landscape contractors. Green waste generated from gardens internal plants / flowers can be placed in the organic waste bins.

Batteries

A take-back service for waste batteries and accumulators (e.g. rechargeable batteries) is in place in order to comply with the S.I. No. 283/2014 - European Union (Batteries and Accumulators) Regulations 2014, as amended. In accordance with these regulations, consumers are able to bring their waste batteries to their local civic amenity centre or can return them free of charge to retailers which supply the equivalent type of battery, regardless of whether or not the batteries were purchased at the retail outlet and regardless of whether or not the person depositing the waste battery purchases any product or products from the retail outlet.

The commercial tenants cannot use the civic amenity centre. They must segregate their waste batteries and either avail of the take-back service provided by retailers or arrange for recycling / recovery of their waste batteries by a suitably permited / licenced contractor. Facilties management may arrange collection, depending on the agreement.

Waste Electrical and Electronic Equipment (WEEE)

The WEEE Directive (Directive 2002/96/EC) and associated Waste Management (WEEE) Regulations have been enacted to ensure a high level of recycling of electronic and electrical equipment. In accordance with the regulations, consumers can bring their waste electrical and electronic equipment to their local recycling centre. In addition, consumers can bring back WEEE within 15 days to retailers when they

purchase new equipment on a like for like basis. Retailers are also obliged to collect WEEE within 15 days of delivery of a new item, provided the item is disconnected from all mains, does not pose a health and safety risk and is readily available for collection.

As noted above, the commercial tenants cannot use the civic amenity centre. They must segregate their WEEE and either avail of the take-back / collection service provided by retailers or arrange for recycling / recovery of their WEEE by a suitably permited / licenced contractor. Facilties management may arrange collection, depending on the agreement.

Printer Cartridge / Toners

It is recommended that a printer cartridge / toner bin is provided in the commercial unit, where appropriate. The commercial tenant will be required to store this waste within their unit and arrange for return to retailers or collection by an authorised waste contractor, as required.

Waste printer cartridge / toners generated by residents can usually be returned to the supplier free of charge or can be brought to a civic amenity centre.

Chemicals

Chemicals (such as solvents, paints, adhesives, resins, detergents, etc) are largely generated from building maintenance works. Such works are usually completed by external contractors who are responsible for the off-site removal and appropriate recovery / recycling / disposal of any waste materials generated.

Any waste cleaning products or waste packaging from cleaning products generated in the commercial units that is classed as hazardous (if they arise) will be appropriately stored within the tenants' own space. Facilties management may arrange collection, depending on the agreement.

Any waste cleaning products or waste packaging from cleaning products that are classed as hazardous (if they arise) generated by the residents should be brought to a civic amenity centre.

Light Bulbs

Waste light bulbs (fluorescent, incandescent and LED) may be generated by lighting at the commercial units. It is anticipated that commercial tenants will be responsible for the off-site removal and appropriate recovery / disposal of these wastes. Facilties management may arrange collection, depending on the agreement.

Light bulbs generated by residents should be taken to the nearest civic amenity centre for appropriate storage and recovery / disposal.

Textiles

Where possible, waste textiles should be recycled or donated to a charity organisation for reuse. Commercial and residential tenants will be responsible for disposing of waste textiles appropriately.

Waste Cooking Oil

If the commerial tenants use cooking oil, waste cooking oil will need to be stored within the unit on a bunded area or spill pallet and regular collections by a dedicated waste contractor will need to be organised as required. Under sink grease traps will be installed in any cooking space.

If the residents generate waste cooking oil, this can be brought to a civic amenity centre.

Furniture & Other Bulky Waste Items

Furniture and other bulky waste items (such as carpet, etc.) may occasionally be generated by the commercial tenant. The collection of bulky waste will be arranged, as required by the tenant. If residents wish to dispose of furniture, this can be brought a civic amenity centre.

Abandoned Bicycles

Bicycle parking areas are planned for the development. As happens in other developments, residents sometimes abandon faulty or unused bicycles, and it can be difficult to determine their ownership. Abandoned bicycles should be donated to charity if they arise or Facilties management willmay arrange collection by a licensed waste contractor.

Covid-19 Waste

Any waste generated by residential and commercial tenants that have tested positive for Covid-19 should be manged in accordance with the current Covid-19 HSE Guidelines at the time that that waste arises. At the time this report was prepared, the HSE Guidelines require the following procedure for any waste from a person that tests positive for Covid-19:

- Put all waste (gloves, tissues, wipes, masks) from that person in a bin bag and tie when almost full;
- Put this bin bag into a second bin bag and tie a knot;
- Store this bag safely for 3 days, then put the bag into the non-recyclable waste / general waste wheelie bin for collection / emptying.

Please note that this guidance is likely to be updated by the time the proposed Development is open and occupied and the relevant guidance at the time will need to be reviewed.

5.5 Waste Storage Area Design

The WSAs should be designed and fitted-out to meet the requirements of relevant design Standards, including:

- Be fitted with a non-slip floor surface;
- Provide ventilation to reduce the potential for generation of odours with a recommended 6-10 air changes per hour for a mechanical system for internal WSAs;
- Provide suitable lighting – a minimum Lux rating of 220 is recommended;
- Be easily accessible for people with limited mobility;
- Be restricted to access by nominated personnel only;
- Be supplied with hot or cold water for disinfection and washing of bins;
- Be fitted with suitable power supply for power washers;
- Have a sloped floor to a central foul drain for bins washing run-off;
- Have appropriate signage placed above and on bins indicating correct use;
- Have access for potential control of vermin, if required; and
- Be fitted with CCTV for monitoring.

The facilities management company, tenants and residents will be required to maintain the resident bins and storage areas in good condition as required by the FCC Waste Bye-Laws.

6.0 CONCLUSIONS

In summary, this OWMP presents a waste strategy that addresses all legal requirements, waste policies and best practice guidelines and demonstrates that the required storage areas have been incorporated into the design of the proposed Development.

Implementation of this OWMP will ensure a high level of recycling, reuse and recovery at the development. All recyclable materials will be segregated at source to reduce waste contractor costs and ensure maximum diversion of materials from landfill, thus contributing to the targets set out in the *EMR Waste Management Plan 2015 – 2021*.

Adherence to this plan will also ensure that waste management at the development is carried out in accordance with the requirements of the *FCC Waste Bye-Laws.*

The waste strategy presented in this document will provide sufficient storage capacity for the estimated quantity of segregated waste. The designated areas for waste storage will provide sufficient room for the required receptacles in accordance with the details of this strategy.

7.0 REFERENCES

1. Waste Management Act 1996 (S.I. No. 10 of 1996) as amended.
2. Environmental Protection Act 1992 (Act No. 7 of 1992) as amended;
2. Litter Pollution Act 1997 (Act No. 12 of 1997) as amended;
4. Eastern-Midlands Waste Region, *Eastern-Midlands Region (EMR) Waste Management Plan 2015 – 2021* (2015)
5. Fingal County Council (FCC) *Segregation, Storage, Presentation and of Household and Commercial Waste (2019).*

6. Department of Environment and Local Government (DoELG) *Waste Management – Changing Our Ways, A Policy Statement* (1998)
7. Department of Environment, Heritage and Local Government (DoEHLG) *Preventing and Recycling Waste - Delivering Change* (2002)
8. DoELG, *Making Ireland's Development Sustainable – Review, Assessment and Future Action (World Summit on Sustainable Development)* (2002)
9. DoEHLG, *Taking Stock and Moving Forward* (2004)
10. Department of Communications, Climate Action and Environment (DCCAE), *Waste Action Plan for the Circular Economy - Ireland's National Waste Policy 2020-2025* (2020).
11. Environmental Protection Agency (EPA), *National Waste Database Reports 1998 – 2012*.
12. FCC*, Fingal County Development Plan 2017 – 2023* (2017)
13. Planning and Development Act 2000 (S.I. No. 30 of 2000) as amended 2010 (S.I. No. 30 of 2010) and 2015 (S.I. No. 310 of 2015).
14. European Waste Catalogue - Council Decision 94/3/EC (as per Council Directive 75/442/EC).
15. Hazardous Waste List - Council Decision 94/904/EC (as per Council Directive 91/689/EEC).
16. EPA, *European Waste Catalogue and Hazardous Waste List* (2002)
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18. BS 5906:2005 Waste Management in Buildings – Code of Practice.
19. Department of Housing Local Government and Heritage *(DoHLGH) Design Manual for Urban Roads and Streets* (2019)
20. DoHLGH, *Sustainable Urban Housing: Design Standards for New Apartments, Guidelines for Planning Authorities* (2020).
21. DoHLGH, *Design Manual for Urban Roads and Streets* (2019)