

8. MAINTENANCE REQUIREMENTS OF DRAINAGE COMPONENTS

8.1 Cellular Tanks and Catchpits

Regular Maintenance

- A system of regular inspections should be established to prevent siltation of the system which, if allowed to develop, would reduce effectiveness.
- Inspection of the tank structures should be carried out via the manufacturers inspection regime and on a monthly basis for the first three months following commission. This can then be reduced to once every six months, and following every major storm event.
- The pipe work, gullies, manhole chambers and catch-pits should be inspected on a monthly basis for the first three months following commission. This can then be reduced to once every six months, and following every major storm event.
- Debris removal from the catchment (where may cause a risk to performance) should be undertaken on a monthly basis.

Inspection/Testing

- Inspect all inlets, outlets, vents, overflows and chambers to ensure that they are in good condition and operating as designed.
- Inspect all catch-pit sumps for any sediment, trash, debris and any other pollutant.

Remediation

- Silt accumulation within pipework, gullies, manhole chambers and catch-pits should be removed in order to ensure correct performance of the system.
- Repair inlets, outlets, vents, overflows and chambers as required.

8.2 Light Liquid Separators

Regular Maintenance

- A system of regular inspections should be established to ensure correct operation of the separator, oil filters and alarm system which, if allowed to develop, would reduce effectiveness.
- Inspection of the separator structures should be carried out on a monthly basis for the first three months following commission. This can then be reduced to once every six months, and following every major storm event for surface water pumps.
- The separator and oil filters and alarm systems should be inspected on a monthly basis for the first three months following commissioning. This can then be reduced to once every six months, and following every major storm event for surface water pumps.
- Debris removal from the separators (where may cause a risk to performance) should be undertaken on a monthly basis.

Inspection/Testing

- Inspect all inlets, outlets, vents, overflows oil alarms and primary silt chamber to ensure that they are in good condition and operating as designed.
- Inspect all separator for any sediment, trash, debris and any other pollutant.

Remediation

- Silt accumulation within separator and should be removed in order to ensure correct performance of the system.
- Repair inlets, outlets, vents, overflows oil alarms and primary silt chamber as required.

9. APPROVALS

This form is part of the Drainage Philosophy Document. It should be signed and dated by the Project Drainage Engineers to confirm that the content of this report has been read, explained and is understood.

The signed form should be returned to Ramboll and appended to the Project File.

PROJECT No: 1620004716

PROJECT Title: Station Hill Reading (Phase 1)

STAGE: Planning

DATE of SUBMISSION: 04.03.2019

Project Engineer:

Date 04.03.2019

Printed Name: L. February

I have read and understood the content of this report and the impact of the drainage philosophy on the development.

Signature:



Project Manager:

Date: 04.03.2019

Printed Name: G. Chisholm

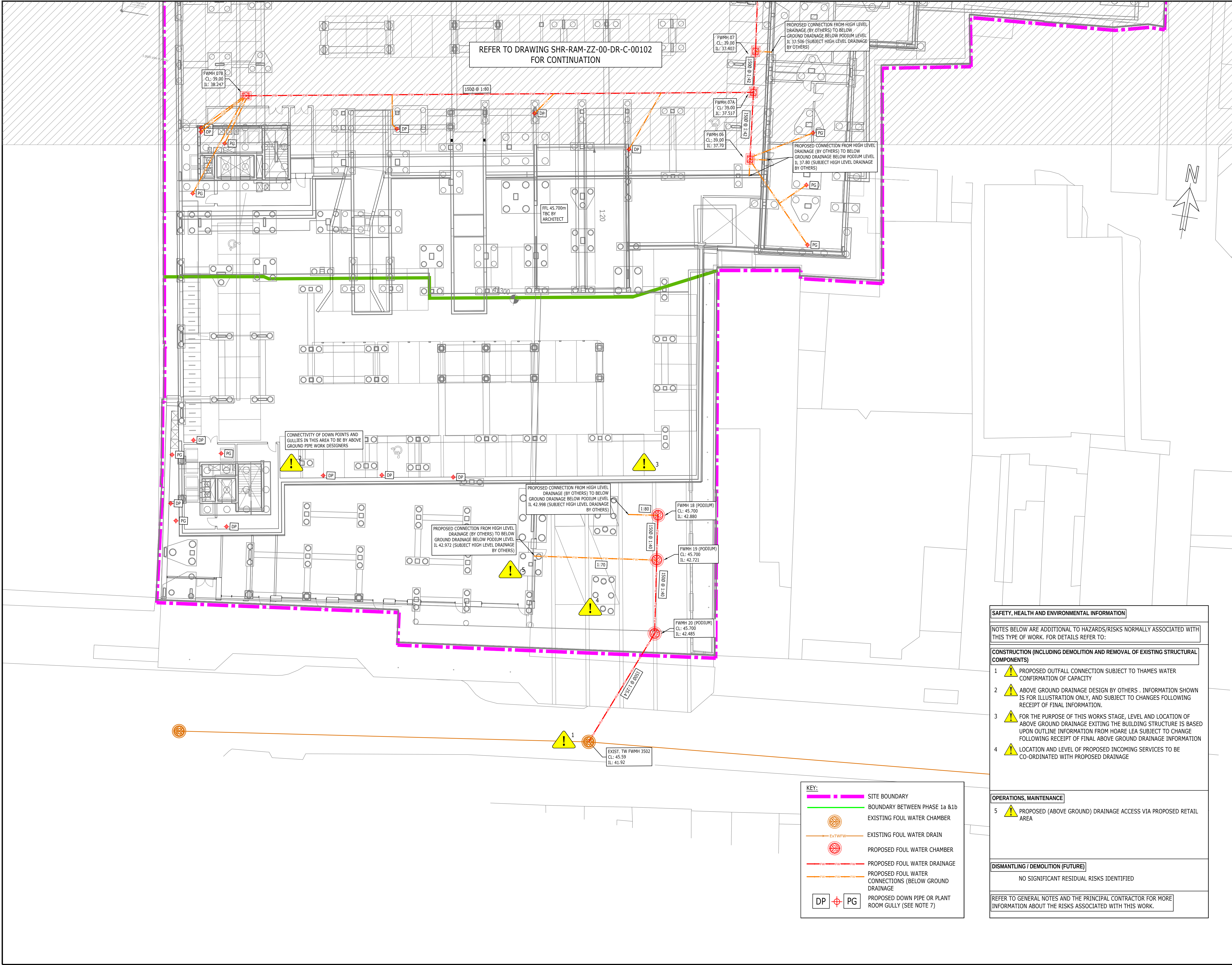
I have read and understood the content of this report and the impact of the drainage philosophy on the development.

Signature:



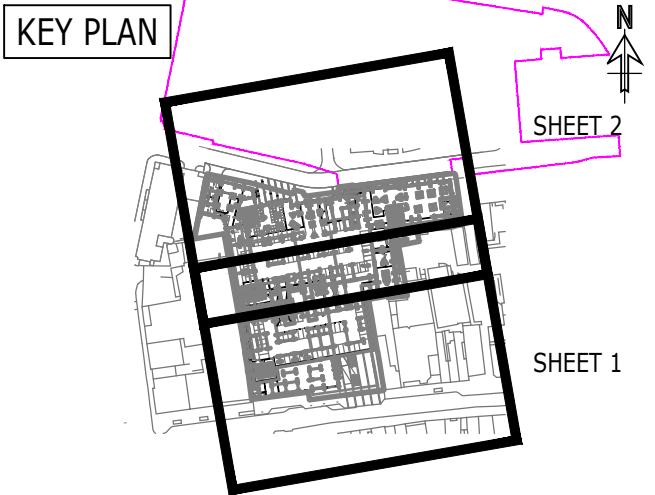
**PHASE 1 DRAINAGE STRATEGY AND SUDS REPORT REV.03
STATION HILL, READING**

**APPENDIX 1
DRAINAGE STRATEGY PLAN**



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 - THIS IS NOT AN INSTALLATION DRAWING NOR A CO-ORDINATION DRAWING.
 - THIS DRAWING IS BASED ON,
 - PLOWMAN CRAVEN UNDERGROUND SERVICES SURVEY '40652-01T-01', REVISION A, DATED 13.11.2018.
 - ARCHITECTURAL LAYOUT SHR-CRL-SB-00-DR-A-113-103 RECEIVED 20.11.18
 - THE INFORMATION INCLUDED ON THIS DRAWING IS IN SUPPORT OF THE PHASE 1 STAGE 3 SUBMISSION ONLY.
 - THE BELOW GROUND DRAINAGE DESIGN IS BASED ON INFORMATION RECEIVED FROM THE MEP ENGINEERS, DATED 30 JANUARY 2019. THE INFORMATION RECEIVED ON THIS DATE WAS IDENTIFIED AS WORK IN PROGRESS, AND SUBJECT TO CHANGE.
 - ALL ABOVE GROUND / INTERNAL DRAINAGE IS DESIGNED BY HOARE LEA. LOCATIONS OF OUTLETS ARE SHOWN BASED UPON AVAILABLE INFORMATION AND ARE SUBJECT TO CHANGE / FINAL CO-ORDINATION.
 - WHERE PROPOSED DRAINAGE IS SHOWN EXITTING THE BUILDING, THE PIPE INVERT LEVEL AND GRADIENTS AT THESE LOCATIONS HAVE BEEN DESIGNED BASED ON THE AVAILABLE INFORMATION.
 - THE UNDERCOVER CAR PARK AREAS ARE NOT PROVIDED WITH POSITIVE DRAINAGE, EXCEPT FOR THE PROPOSED CAR WASHING BAY. REFER TO FOUL WATER DRAINAGE LAYOUTS.
 - THE PROPOSED BELOW GROUND DRAINAGE DESIGN IS SUBJECT TO ONGOING DISCUSSIONS WITH THAMES WATER TO AGREE THE PROPOSED OUTFALL LOCATIONS, AND THAMES WATER APPROVAL.
 - ALL PROPOSED COVER AND INVERT LEVELS ARE SUBJECT TO CHANGE PENDING FURTHER CO-ORDINATION DURING STAGE 4 DESIGN.
 - PRE-DEVELOPMENT ENQUIRY HAS BEEN SUBMITTED TO THAMES WATER TO CONFIRM THE CAPACITY OF EXISTING SEWER.
 - PRESENCE AND SIZE OF EXISTING DOWNPIPES SERVING ADJOINING SITE TO BE CONFIRMED. DEDICATED DRAINAGE TO BE INSTALLED AS REQUIRED. TYPICAL ARRANGEMENT SHOWN.



P03	STAGE 3 ISSUE	28.02 2019	LF	SH
P02	STAGE 3 ISSUE	09.01. 2019	CS	EK
P01	STAGE 3 ISSUE	10.12. 2018	CS	PC
Rev	Description	Date	By	App
			CHK	

STAGE 3

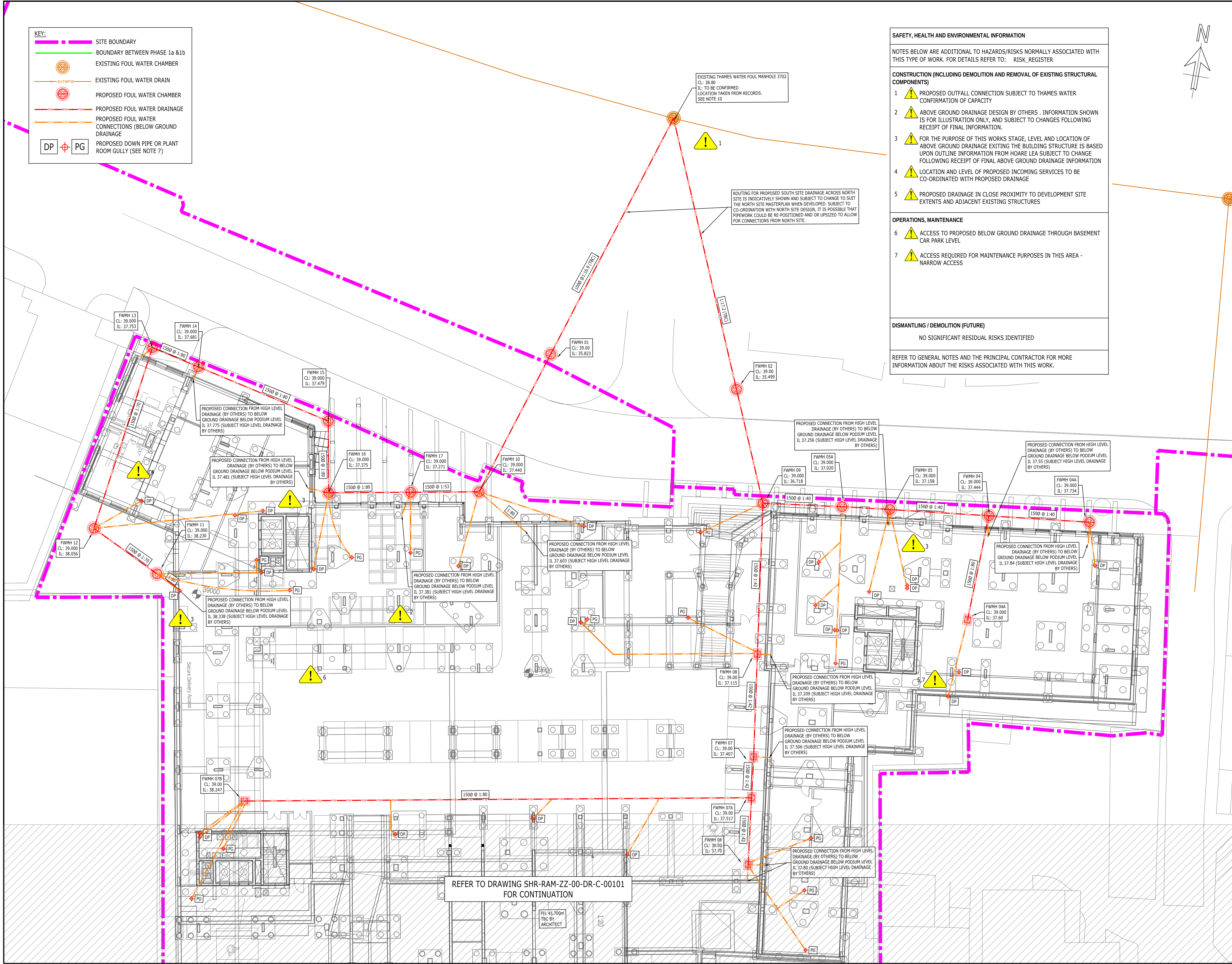
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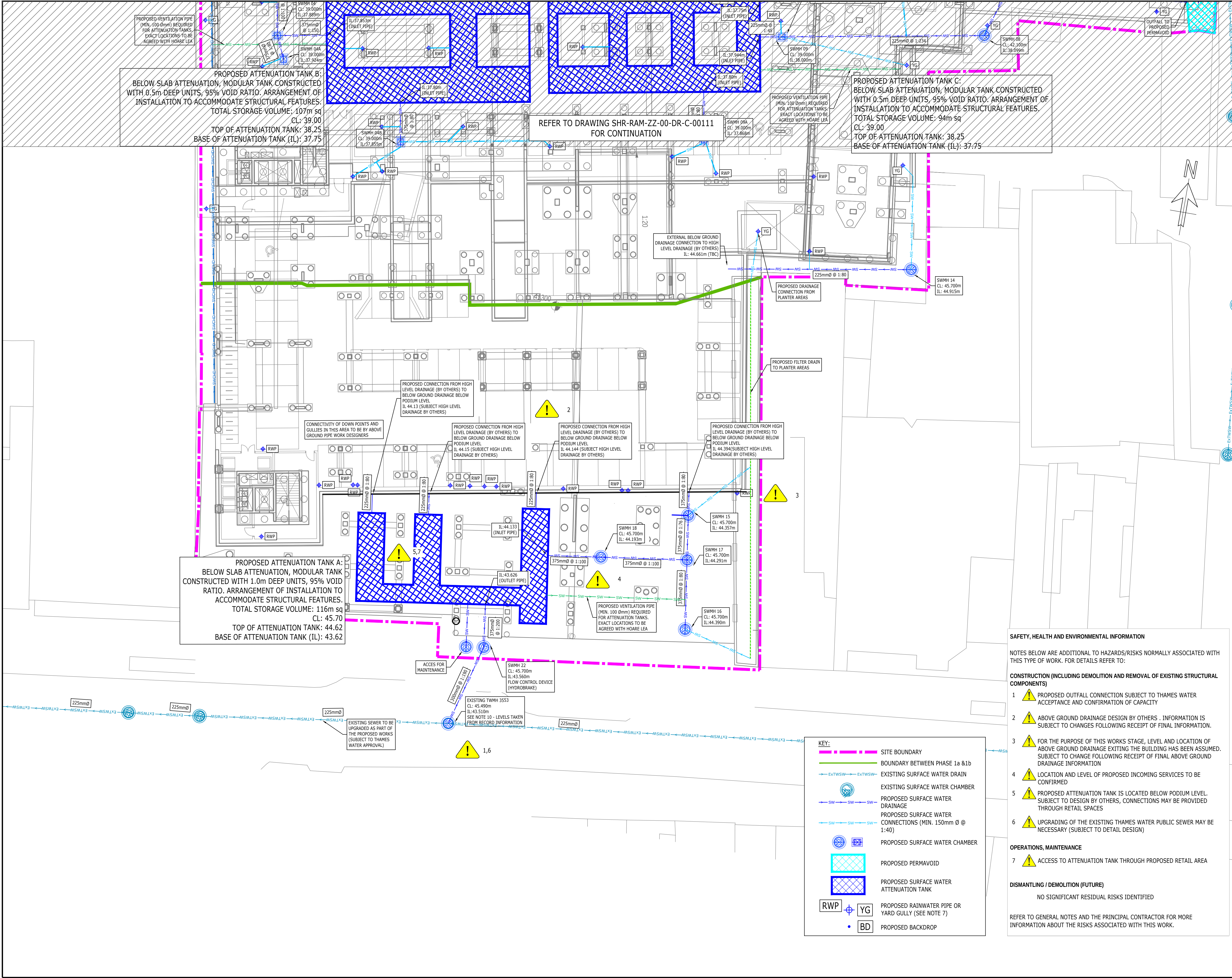


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BLOCK E & F
PROPOSED FOUL WATER DRAINAGE LAYOUT
SHEET 1 OF 2

Project No:	Scale (@A1):	Drawn:	Date:
1620004716	1:200	CS	DEC 2018
Drawing No:	Rev:		
SHR-RAM-ZZ-00-DR-C-000101	P03		





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- ARCHITECTURAL LAYOUT SHR-CRL-SB-00-DR-A-113-103 RECEIVED 20.11.18

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13. PRESENCE AND SIZE OF EXISTING DOWNPIPES SERVING ADJOINING SITE TO BE CONFIRMED. DEDICATED DRAINAGE TO BE INSTALLED AS REQUIRED. TYPICAL ARRANGEMENT SHOWN.

KEY PLAN

SHEET 2

SHEET 1

Rev	Description	Date	By	App
P03	STAGE 3 ISSUE	28.02.2019	LF	EK
P02	STAGE 3 ISSUE	09.01.2019	CS	EK
P01	STAGE 3 ISSUE	10.12.2018	CS	PC

STAGE 3

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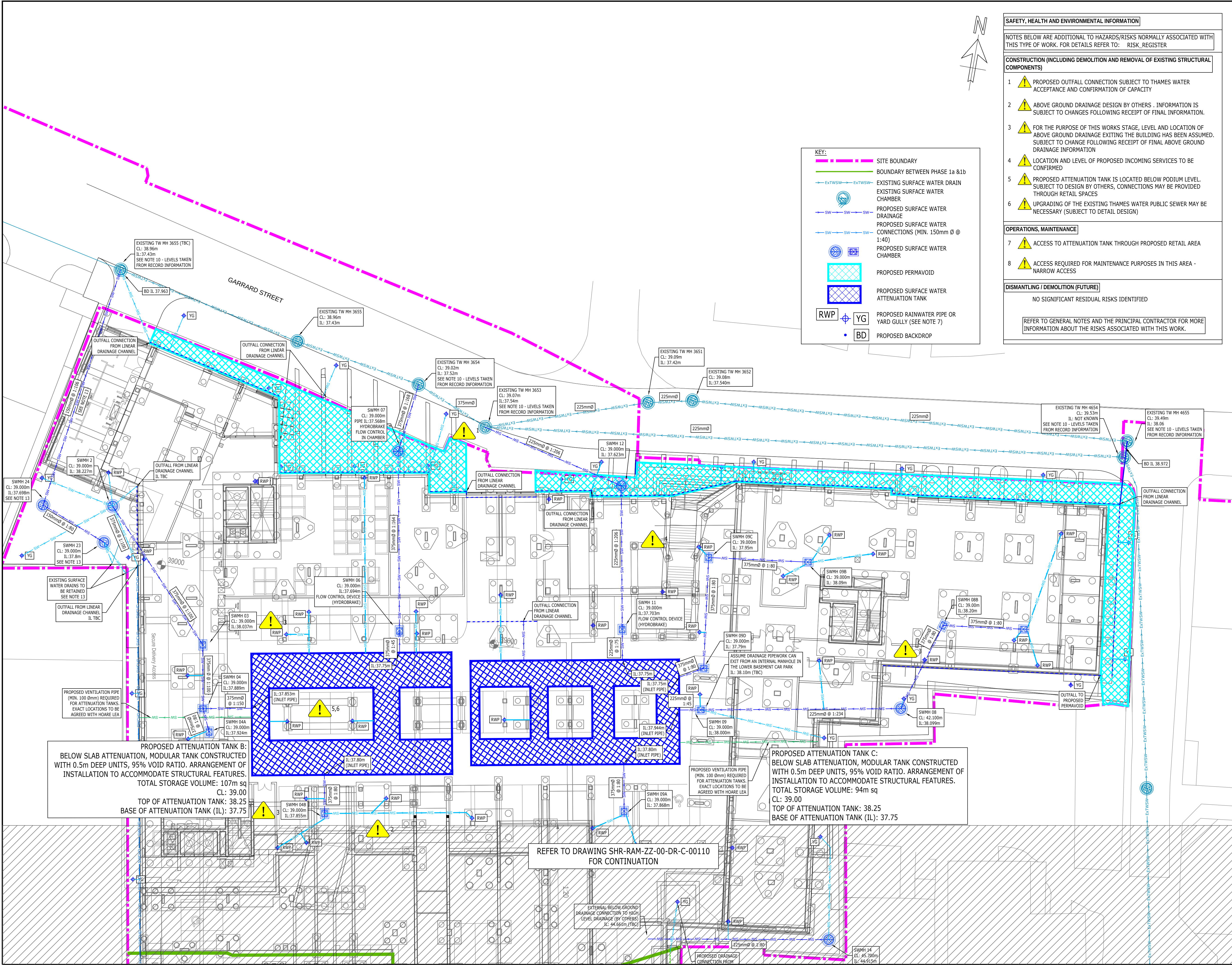
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BLOCK E & F
PROPOSED SURFACE WATER DRAINAGE LAYOUT
SHEET 1 OF 2

Project No:	Scale (@A1):	Drawn:	Date:
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Drawing No:	Rev:
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KEY PLAN

SHEET 2

SHEET 1

Rev	Description	Date	By	App
P03	STAGE 3 ISSUE	28.02.2019	LF	SH
P02	STAGE 3 ISSUE	09.01.2019	CS	EK
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STAGE 3

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**BLOCK E & F
PROPOSED SURFACE WATER
DRAINAGE LAYOUT
SHEET 2 OF 2**

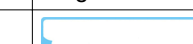
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1620004716	1:200	CS	DEC 2018

Drawing No:	Rev:
SHR-RAM-ZZ-00-DR-C-000111	P03

28/02/2019 17:21:01

**PHASE 1 DRAINAGE STRATEGY AND SUDS REPORT REV.03
STATION HILL, READING**

**APPENDIX 2
FOUL WATER CALCULATIONS**

Ramboll UK Ltd		Page 1
240 Blackfriars Road London SE1 8NW		
Date 04/03/2019 11:08 File SHR FW LAYOUT.MDX	Designed by LF Checked by LF	
Micro Drainage	Network 2018.1	

FOUL SEWERAGE DESIGN

Design Criteria for Foul - Main

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.000
Flow Per Person (l/per/day)	222.00	Maximum Backdrop Height (m)	0.000
Persons per House	3.00	Min Design Depth for Optimisation (m)	0.900
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	1.00
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	100

Designed with Level Soffits

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F2.000	11.583	0.290	40.0	0.000	0	0.0	1.500	0	150	Pipe/Conduit	
F2.001	14.384	0.364	39.5	0.000	0	3.0	1.500	0	150	Pipe/Conduit	
F2.002	14.480	0.362	40.0	0.000	0	3.9	1.500	0	150	Pipe/Conduit	
F3.000	12.422	0.293	42.4	0.000	0	0.8	1.500	0	150	Pipe/Conduit	
F3.001	12.422	0.292	42.5	0.000	0	2.4	1.500	0	150	Pipe/Conduit	
F3.002	16.836	0.397	42.4	0.000	0	1.4	1.500	0	150	Pipe/Conduit	
F2.003	13.199	1.219	10.8	0.000	0	0.0	1.500	0	150	Pipe/Conduit	
F2.004	28.740	1.219	23.6	0.000	0	0.0	1.500	0	150	Pipe/Conduit	
F4.000	8.906	0.169	52.7	0.000	0	5.6	1.500	0	150	Pipe/Conduit	
F5.000	10.880	0.174	62.5	0.000	0	7.7	1.500	0	150	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F2.000	37.734	0.000	0.0	0	0.0	0	0.00	1.39	24.5	0.0
F2.001	37.444	0.000	3.0	0	0.0	35	0.94	1.40	24.7	3.0
F2.002	37.080	0.000	6.9	0	0.0	54	1.19	1.39	24.5	6.9
F3.000	37.700	0.000	0.8	0	0.0	19	0.61	1.35	23.8	0.8
F3.001	37.407	0.000	3.2	0	0.0	37	0.93	1.35	23.8	3.2
F3.002	37.115	0.000	4.6	0	0.0	45	1.04	1.35	23.8	4.6
F2.003	36.718	0.000	11.5	0	0.0	51	2.20	2.67	47.2	11.5
F2.004	35.499	0.000	11.5	0	0.0	62	1.66	1.81	32.0	11.5
F4.000	37.440	0.000	5.6	0	0.0	53	1.02	1.21	21.4	5.6
F5.000	38.230	0.000	7.7	0	0.0	65	1.04	1.11	19.6	7.7

Ramboll UK Ltd		Page 2
240 Blackfriars Road London SE1 8NW		
Date 04/03/2019 11:08 File SHR FW LAYOUT.MDX	Designed by LF Checked by LF	
Micro Drainage	Network 2018.1	

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F5.001	21.197	0.303	69.8	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F5.002	5.725	0.072	79.5	0.000	0	2.2	1.500	o	150	Pipe/Conduit	
F5.003	16.187	0.202	80.1	0.000	0	4.0	1.500	o	150	Pipe/Conduit	
F5.004	8.244	0.103	80.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F5.005	8.394	0.104	80.7	0.000	0	2.0	1.500	o	150	Pipe/Conduit	
F4.001	21.141	1.448	14.6	0.000	0	7.3	1.500	o	150	Pipe/Conduit	
F4.002	28.670	1.448	19.8	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F6.000	6.351	0.159	39.9	0.000	0	11.5	1.500	o	150	Pipe/Conduit	
F6.001	9.454	0.236	40.1	0.000	0	8.9	1.500	o	150	Pipe/Conduit	
F6.002	14.353	0.565	25.4	0.000	0	0.0	1.500	o	150	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F5.001	38.056	0.000	7.7	0	0.0	67	1.00	18.5	7.7
F5.002	37.753	0.000	9.9	0	0.0	81	1.02	17.4	9.9
F5.003	37.681	0.000	13.9	0	0.0	102	1.09	17.3	13.9
F5.004	37.479	0.000	13.9	0	0.0	102	1.09	17.3	13.9
F5.005	37.375	0.000	15.9	0	0.0	114	1.11	17.2	15.9
F4.001	37.271	0.000	28.8	0	0.0	93	2.50	40.7	28.8
F4.002	35.823	0.000	28.8	0	0.0	104	2.21	34.9	28.8
F6.000	42.880	0.000	11.5	0	0.0	72	1.37	24.5	11.5
F6.001	42.721	0.000	20.4	0	0.0	105	1.55	24.5	20.4
F6.002	42.485	0.000	20.4	0	0.0	89	1.86	30.8	20.4

Free Flowing Outfall Details for Foul - Main

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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F2.004	F	0.000	34.280	0.000	0	0
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Free Flowing Outfall Details for Foul - Main

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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F4.002	F	0.000	34.375	0.000	0	0
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**PHASE 1 DRAINAGE STRATEGY AND SUDS REPORT REV.03
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**APPENDIX 3
SURFACE WATER (MICRODRAINAGE) CALCULATIONS**

Ramboll UK Ltd		Page 1
240 Blackfriars Road London SE1 8NW		
Date 04/03/2019 10:59	Designed by LF	
File PHASE 1 SW (BELOW GROUN...	Checked by LF	
Micro Drainage		Network 2018.1

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	18.800	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm at outfall S (pipe S1.006)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.279	4-8	0.067

Total Area Contributing (ha) = 0.345

Total Pipe Volume (m³) = 9.685

Time Area Diagram at outfall S (pipe S2.004)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.116	4-8	0.062

Total Area Contributing (ha) = 0.177

Total Pipe Volume (m³) = 3.077

Time Area Diagram at outfall S (pipe S3.001)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.036	4-8	0.013

Total Area Contributing (ha) = 0.050

Total Pipe Volume (m³) = 1.237

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240 Blackfriars Road London SE1 8NW																																						
Date 04/03/2019 10:59 File PHASE 1 SW (BELOW GROUN...	Designed by LF Checked by LF																																					
Micro Drainage Network 2018.1																																						
<u>Time Area Diagram at outfall S (pipe S4.004)</u> <table><tr><th>Time (mins)</th><th>Area (ha)</th><th>Time (mins)</th><th>Area (ha)</th></tr><tr><td>0-4</td><td>0.210</td><td>4-8</td><td>0.091</td></tr></table> Total Area Contributing (ha) = 0.301 Total Pipe Volume (m³) = 5.340 <u>Time Area Diagram at outfall S (pipe S6.001)</u> <table><tr><th>Time (mins)</th><th>Area (ha)</th></tr><tr><td>0-4</td><td>0.000</td></tr></table> Total Area Contributing (ha) = 0.000 Total Pipe Volume (m³) = 0.648 <u>Time Area Diagram at outfall S (pipe S7.000)</u> <table><tr><th>Time (mins)</th><th>Area (ha)</th><th>Time (mins)</th><th>Area (ha)</th></tr><tr><td>0-4</td><td>0.012</td><td>4-8</td><td>0.004</td></tr></table> Total Area Contributing (ha) = 0.017 Total Pipe Volume (m³) = 0.363 <u>Time Area Diagram at outfall S (pipe S8.000)</u> <table><tr><th>Time (mins)</th><th>Area (ha)</th><th>Time (mins)</th><th>Area (ha)</th></tr><tr><td>0-4</td><td>0.005</td><td>4-8</td><td>0.002</td></tr></table> Total Area Contributing (ha) = 0.007 Total Pipe Volume (m³) = 0.321 <u>Time Area Diagram at outfall S (pipe S9.000)</u> <table><tr><th>Time (mins)</th><th>Area (ha)</th><th>Time (mins)</th><th>Area (ha)</th></tr><tr><td>0-4</td><td>0.012</td><td>4-8</td><td>0.005</td></tr></table> Total Area Contributing (ha) = 0.016 Total Pipe Volume (m³) = 0.557			Time (mins)	Area (ha)	Time (mins)	Area (ha)	0-4	0.210	4-8	0.091	Time (mins)	Area (ha)	0-4	0.000	Time (mins)	Area (ha)	Time (mins)	Area (ha)	0-4	0.012	4-8	0.004	Time (mins)	Area (ha)	Time (mins)	Area (ha)	0-4	0.005	4-8	0.002	Time (mins)	Area (ha)	Time (mins)	Area (ha)	0-4	0.012	4-8	0.005
Time (mins)	Area (ha)	Time (mins)	Area (ha)																																			
0-4	0.210	4-8	0.091																																			
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Time (mins)	Area (ha)	Time (mins)	Area (ha)																																			
0-4	0.005	4-8	0.002																																			
Time (mins)	Area (ha)	Time (mins)	Area (ha)																																			
0-4	0.012	4-8	0.005																																			
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Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	7.324	0.073	100.3	0.000	5.00	0.0	0.600	o	375	Pipe/Conduit	
S1.001	18.997	0.190	100.0	0.013	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.002	7.343	0.073	100.6	0.182	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.003	21.300	0.139	153.2	0.150	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.004	9.179	0.056	163.9	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.005	20.651	0.126	163.9	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.006	8.032	0.048	167.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	22.922	0.099	231.5	0.091	5.00	0.0	0.600	o	225	Pipe/Conduit	
S2.001	11.182	0.250	44.7	0.086	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.002	9.704	0.047	206.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.003	16.538	0.080	206.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.004	17.032	0.083	205.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.000	10.831	0.135	80.2	0.050	5.00	0.0	0.600	o	225	Pipe/Conduit	
S3.001	20.273	0.253	80.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S4.000	5.045	0.066	76.4	0.153	5.00	0.0	0.600	o	375	Pipe/Conduit	
S5.000	7.887	0.099	79.7	0.148	5.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.07	38.300	0.000	0.0	0.0	0.0	1.81	199.8	0.0
S1.001	50.00	5.24	38.227	0.013	0.0	0.0	0.0	1.81	200.1	1.8
S1.002	50.00	5.31	38.037	0.196	0.0	0.0	0.0	1.81	199.5	26.5
S1.003	50.00	5.55	37.889	0.345	0.0	0.0	0.0	1.46	161.4	46.8
S1.004	50.00	5.66	37.750	0.345	0.0	0.0	0.0	1.41	156.0	46.8
S1.005	50.00	5.90	37.694	0.345	0.0	0.0	0.0	1.41	156.0	46.8
S1.006	50.00	6.04	37.568	0.345	0.0	0.0	0.0	1.01	40.1«	46.8
S2.000	50.00	5.45	38.099	0.091	0.0	0.0	0.0	0.86	34.0	12.3
S2.001	50.00	5.54	38.000	0.177	0.0	0.0	0.0	1.96	78.0	24.0
S2.002	50.00	5.72	37.750	0.177	0.0	0.0	0.0	0.91	36.1	24.0
S2.003	50.00	6.02	37.703	0.177	0.0	0.0	0.0	0.91	36.1	24.0
S2.004	50.00	6.34	37.623	0.177	0.0	0.0	0.0	0.91	36.1	24.0
S3.000	50.00	5.12	45.050	0.050	0.0	0.0	0.0	1.46	58.1	6.7
S3.001	50.00	5.35	44.915	0.050	0.0	0.0	0.0	1.46	58.1	6.7
S4.000	50.00	5.04	44.357	0.153	0.0	0.0	0.0	2.07	229.1	20.7
S5.000	50.00	5.06	44.390	0.148	0.0	0.0	0.0	2.03	224.4	20.0

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Synthetic Rainfall Details

Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.800	Cv (Winter)	0.840
Ratio R	0.400	Storm Duration (mins)	30
Profile Type	Summer		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S6, DS/PN: S1.005, Volume (m³): 2.7

Unit Reference	MD-SHE-0194-2050-1500-2050
Design Head (m)	1.500
Design Flow (l/s)	20.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	194
Invert Level (m)	37.694
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	20.5
Flush-Flo™	0.451	20.5
Kick-Flo®	0.983	16.8
Mean Flow over Head Range	-	17.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.7	1.200	18.4	3.000	28.6	7.000	43.0
0.200	18.0	1.400	19.8	3.500	30.7	7.500	44.4
0.300	19.9	1.600	21.1	4.000	32.8	8.000	45.8
0.400	20.4	1.800	22.4	4.500	34.7	8.500	47.2
0.500	20.4	2.000	23.5	5.000	36.5	9.000	48.5
0.600	20.2	2.200	24.6	5.500	38.2	9.500	49.8
0.800	19.3	2.400	25.7	6.000	39.9		
1.000	16.9	2.600	26.7	6.500	41.4		

Hydro-Brake® Optimum Manhole: S7, DS/PN: S1.006, Volume (m³): 4.2

Unit Reference	MD-SHE-0201-2050-1000-2050
Design Head (m)	1.000
Design Flow (l/s)	20.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	201
Invert Level (m)	37.568
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

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Hydro-Brake® Optimum Manhole: S7, DS/PN: S1.006, Volume (m³): 4.2

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	20.5
Flush-Flo™	0.344	20.4
Kick-Flo®	0.721	17.5
Mean Flow over Head Range	-	17.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.9	1.200	22.4	3.000	34.7	7.000	52.2
0.200	19.0	1.400	24.1	3.500	37.4	7.500	54.0
0.300	20.4	1.600	25.6	4.000	39.8	8.000	55.7
0.400	20.4	1.800	27.1	4.500	42.2	8.500	57.4
0.500	20.0	2.000	28.5	5.000	44.4	9.000	59.0
0.600	19.4	2.200	29.9	5.500	46.5	9.500	60.6
0.800	18.4	2.400	31.1	6.000	48.5		
1.000	20.5	2.600	32.4	6.500	50.4		

Hydro-Brake® Optimum Manhole: S11, DS/PN: S2.003, Volume (m³): 1.8

Unit Reference	MD-SHE-0192-2020-1500-2020
Design Head (m)	1.500
Design Flow (l/s)	20.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	192
Invert Level (m)	37.703
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	20.2
Flush-Flo™	0.450	20.1
Kick-Flo®	0.979	16.5
Mean Flow over Head Range	-	17.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.7	0.300	19.5	0.500	20.1	0.800	18.9
0.200	17.8	0.400	20.0	0.600	19.8	1.000	16.6

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Hydro-Brake® Optimum Manhole: S11, DS/PN: S2.003, Volume (m³): 1.8

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	18.2	2.400	25.3	5.000	35.9	8.000	45.1
1.400	19.5	2.600	26.2	5.500	37.6	8.500	46.5
1.600	20.8	3.000	28.1	6.000	39.3	9.000	47.8
1.800	22.0	3.500	30.3	6.500	40.8	9.500	49.0
2.000	23.2	4.000	32.3	7.000	42.3		
2.200	24.2	4.500	34.2	7.500	43.7		

Hydro-Brake® Optimum Manhole: S22, DS/PN: S4.004, Volume (m³): 4.2

Unit Reference	MD-SHE-0195-2200-1800-2200
Design Head (m)	1.800
Design Flow (l/s)	22.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	195
Invert Level (m)	43.560
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	22.0
Flush-Flo™	0.529	22.0
Kick-Flo®	1.138	17.7
Mean Flow over Head Range	-	19.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.8	1.200	18.1	3.000	28.1	7.000	42.2
0.200	18.2	1.400	19.5	3.500	30.2	7.500	43.7
0.300	20.8	1.600	20.8	4.000	32.2	8.000	45.1
0.400	21.7	1.800	22.0	4.500	34.1	8.500	46.4
0.500	22.0	2.000	23.1	5.000	35.9	9.000	47.7
0.600	21.9	2.200	24.2	5.500	37.6	9.500	49.0
0.800	21.3	2.400	25.2	6.000	39.2		
1.000	19.9	2.600	26.2	6.500	40.8		

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Storage Structures for Storm

Cellular Storage Manhole: S5, DS/PN: S1.004

Invert Level (m) 37.750 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	214.0	0.0	0.501	0.0	0.0
0.500	214.0	0.0			

Cellular Storage Manhole: S10, DS/PN: S2.002

Invert Level (m) 37.750 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	188.0	0.0	0.501	0.0	0.0
0.500	188.0	0.0			

Cellular Storage Manhole: S21, DS/PN: S4.003

Invert Level (m) 43.620 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	116.0	0.0	1.001	0.0	0.0
1.000	116.0	0.0			

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 3
 Number of Online Controls 4 Number of Time/Area Diagrams 0
 Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 18.900 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 DVD Status ON
 Inertia Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600,
 720, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	120 Winter	1	+0%					38.300
S1.001	S2	15 Winter	1	+0%					38.243
S1.002	S3	15 Winter	1	+0%	100/15 Summer				38.152
S1.003	S4	15 Winter	1	+0%	100/15 Summer				38.024
S1.004	S5	60 Winter	1	+0%	100/30 Summer				37.845
S1.005	S6	60 Winter	1	+0%	100/15 Winter				37.831
S1.006	S7	60 Winter	1	+0%	100/15 Winter				37.695
S2.000	S8	15 Winter	1	+0%	100/15 Summer				38.196
S2.001	S9	15 Winter	1	+0%	100/15 Summer				38.089
S2.002	S10	60 Winter	1	+0%	100/30 Summer				37.813
S2.003	S11	60 Winter	1	+0%	100/15 Winter				37.786
S2.004	S12	60 Winter	1	+0%					37.681
S3.000	S13	15 Winter	1	+0%					45.105
S3.001	S14	15 Winter	1	+0%					44.968
S4.000	S15	15 Winter	1	+0%	100/15 Summer				44.467
S5.000	S16	15 Winter	1	+0%	100/15 Summer				44.490
S4.001	S17	15 Winter	1	+0%	100/15 Summer				44.438
S4.002	S18	15 Winter	1	+0%	100/15 Summer				44.350

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Surcharged		Flooded		Pipe		Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status	
S1.000	S1	-0.375	0.000	0.00		0.0	OK	
S1.001	S2	-0.359	0.000	0.01		1.5	OK	
S1.002	S3	-0.260	0.000	0.20		21.7	OK	
S1.003	S4	-0.240	0.000	0.28		38.3	OK	
S1.004	S5	-0.280	0.000	0.10		10.5	OK	
S1.005	S6	-0.238	0.000	0.08		10.4	OK	
S1.006	S7	-0.098	0.000	0.34		10.4	OK	
S2.000	S8	-0.128	0.000	0.38		11.7	OK	
S2.001	S9	-0.136	0.000	0.32		21.4	OK	
S2.002	S10	-0.162	0.000	0.16		4.8	OK	
S2.003	S11	-0.142	0.000	0.15		4.8	OK	
S2.004	S12	-0.167	0.000	0.15		4.8	OK	
S3.000	S13	-0.170	0.000	0.13		6.5	OK	
S3.001	S14	-0.172	0.000	0.12		6.5	OK	
S4.000	S15	-0.265	0.000	0.19		19.9	OK	
S5.000	S16	-0.275	0.000	0.16		19.2	OK	
S4.001	S17	-0.228	0.000	0.32		39.3	OK	
S4.002	S18	-0.218	0.000	0.37		39.6	OK	

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S4.003	S21	30 Winter	1	+0%	100/15 Summer				43.738
S4.004	S22	30 Winter	1	+0%	30/15 Winter				43.722
S6.000	S23	120 Winter	1	+0%					37.800
S6.001	S24	120 Winter	1	+0%					37.698
S7.000	S25	15 Winter	1	+0%					38.254
S8.000	S26	15 Winter	1	+0%					39.399
S9.000	S27	15 Winter	1	+0%					38.631

		Surcharged		Flooded	Pipe		Level	
PN	US/MH Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status	Exceeded
S4.003	S21	-0.257	0.000	0.14		14.5	OK	
S4.004	S22	-0.138	0.000	0.24		14.4	OK	
S6.000	S23	-0.150	0.000	0.00		0.0	OK	
S6.001	S24	-0.150	0.000	0.00		0.0	OK	
S7.000	S25	-0.116	0.000	0.12		2.2	OK	
S8.000	S26	-0.131	0.000	0.04		0.9	OK	
S9.000	S27	-0.119	0.000	0.09		2.1	OK	

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Micro Drainage		Network 2018.1

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 3
 Number of Online Controls 4 Number of Time/Area Diagrams 0
 Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 18.900 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 DVD Status ON
 Inertia Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600,
 720, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	120 Winter	30	+0%					38.300
S1.001	S2	15 Winter	30	+0%					38.277
S1.002	S3	15 Winter	30	+0%	100/15 Summer				38.253
S1.003	S4	15 Winter	30	+0%	100/15 Summer				38.160
S1.004	S5	60 Winter	30	+0%	100/30 Summer				37.989
S1.005	S6	60 Winter	30	+0%	100/15 Winter				37.979
S1.006	S7	60 Winter	30	+0%	100/15 Winter				37.761
S2.000	S8	15 Winter	30	+0%	100/15 Summer				38.273
S2.001	S9	15 Winter	30	+0%	100/15 Summer				38.165
S2.002	S10	60 Winter	30	+0%	100/30 Summer				37.888
S2.003	S11	60 Winter	30	+0%	100/15 Winter				37.873
S2.004	S12	60 Winter	30	+0%					37.718
S3.000	S13	15 Winter	30	+0%					45.139
S3.001	S14	15 Winter	30	+0%					45.000
S4.000	S15	15 Winter	30	+0%	100/15 Summer				44.557
S5.000	S16	15 Winter	30	+0%	100/15 Summer				44.565
S4.001	S17	15 Winter	30	+0%	100/15 Summer				44.545
S4.002	S18	15 Winter	30	+0%	100/15 Summer				44.470

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**30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm**

PN	US/MH Name	Surcharged		Flooded		Pipe		Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status	
S1.000	S1	-0.375	0.000	0.00		0.0	OK	
S1.001	S2	-0.325	0.000	0.03		4.5	OK	
S1.002	S3	-0.159	0.000	0.63		67.1	OK	
S1.003	S4	-0.104	0.000	0.86		118.0	OK	
S1.004	S5	-0.136	0.000	0.17		18.5	OK	
S1.005	S6	-0.090	0.000	0.14		18.3	OK	
S1.006	S7	-0.032	0.000	0.59		18.3	OK	
S2.000	S8	-0.051	0.000	0.92		28.7	OK	
S2.001	S9	-0.060	0.000	0.87		57.1	OK	
S2.002	S10	-0.087	0.000	0.40		12.0	OK	
S2.003	S11	-0.055	0.000	0.37		12.0	OK	
S2.004	S12	-0.130	0.000	0.37		12.0	OK	
S3.000	S13	-0.136	0.000	0.32		15.9	OK	
S3.001	S14	-0.140	0.000	0.30		15.8	OK	
S4.000	S15	-0.175	0.000	0.45		48.7	OK	
S5.000	S16	-0.200	0.000	0.38		46.9	OK	
S4.001	S17	-0.121	0.000	0.78		95.5	OK	
S4.002	S18	-0.098	0.000	0.89		96.2	OK	

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**30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm**

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S4.003	S21	30 Winter	30	+0%	100/15 Summer				43.937
S4.004	S22	30 Winter	30	+0%	30/15 Winter				43.909
S6.000	S23	120 Winter	30	+0%					37.800
S6.001	S24	120 Winter	30	+0%					37.698
S7.000	S25	15 Winter	30	+0%					38.275
S8.000	S26	15 Winter	30	+0%					39.411
S9.000	S27	15 Winter	30	+0%					38.649

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S4.003	S21	-0.058	0.000	0.21		22.9	OK	
S4.004	S22	0.049	0.000	0.35		21.3	SURCHARGED	
S6.000	S23	-0.150	0.000	0.00		0.0	OK	
S6.001	S24	-0.150	0.000	0.00		0.0	OK	
S7.000	S25	-0.095	0.000	0.28		5.3	OK	
S8.000	S26	-0.119	0.000	0.09		2.3	OK	
S9.000	S27	-0.101	0.000	0.23		5.1	OK	

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Micro Drainage		Network 2018.1

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 3
 Number of Online Controls 4 Number of Time/Area Diagrams 0
 Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 18.900 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 DVD Status ON
 Inertia Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600,
 720, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	100	+40%					38.526
S1.001	S2	15 Winter	100	+40%					38.527
S1.002	S3	15 Winter	100	+40%	100/15 Summer				38.522
S1.003	S4	15 Winter	100	+40%	100/15 Summer				38.427
S1.004	S5	60 Winter	100	+40%	100/30 Summer				38.237
S1.005	S6	60 Winter	100	+40%	100/15 Winter				38.235
S1.006	S7	60 Winter	100	+40%	100/15 Winter				37.842
S2.000	S8	15 Winter	100	+40%	100/15 Summer				38.828
S2.001	S9	15 Winter	100	+40%	100/15 Summer				38.556
S2.002	S10	60 Winter	100	+40%	100/30 Summer				38.015
S2.003	S11	60 Winter	100	+40%	100/15 Winter				37.992
S2.004	S12	60 Winter	100	+40%					37.742
S3.000	S13	15 Winter	100	+40%					45.176
S3.001	S14	15 Winter	100	+40%					45.035
S4.000	S15	15 Winter	100	+40%	100/15 Summer				44.946
S5.000	S16	15 Winter	100	+40%	100/15 Summer				44.959
S4.001	S17	15 Winter	100	+40%	100/15 Summer				44.854
S4.002	S18	15 Winter	100	+40%	100/15 Summer				44.661

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Micro Drainage	Network 2018.1	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged		Flooded		Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)			
S1.000	S1	-0.149	0.000	0.02		2.1	OK	
S1.001	S2	-0.075	0.000	0.07		12.1	OK	
S1.002	S3	0.110	0.000	1.07		114.3	SURCHARGED	
S1.003	S4	0.163	0.000	1.46		199.1	SURCHARGED	
S1.004	S5	0.112	0.000	0.21		22.2	SURCHARGED	
S1.005	S6	0.166	0.000	0.15		20.3	SURCHARGED	
S1.006	S7	0.049	0.000	0.66		20.2	SURCHARGED	
S2.000	S8	0.504	0.000	1.64		51.2	SURCHARGED	
S2.001	S9	0.331	0.000	1.51		99.7	SURCHARGED	
S2.002	S10	0.040	0.000	0.59		17.8	SURCHARGED	
S2.003	S11	0.064	0.000	0.55		17.8	SURCHARGED	
S2.004	S12	-0.106	0.000	0.55		17.8	OK	
S3.000	S13	-0.099	0.000	0.59		28.8	OK	
S3.001	S14	-0.105	0.000	0.54		28.6	OK	
S4.000	S15	0.214	0.000	0.80		85.9	SURCHARGED	
S5.000	S16	0.194	0.000	0.67		82.7	SURCHARGED	
S4.001	S17	0.188	0.000	1.38		168.7	SURCHARGED	
S4.002	S18	0.093	0.000	1.56		168.2	SURCHARGED	

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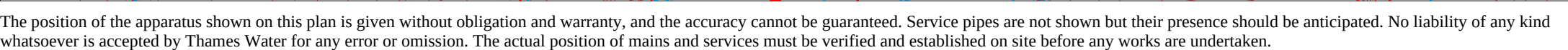
100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S4.003	S21	60 Winter	100	+40%	100/15 Summer				44.328
S4.004	S22	60 Winter	100	+40%	30/15 Winter				44.322
S6.000	S23	120 Winter	100	+40%					37.800
S6.001	S24	120 Winter	100	+40%					37.698
S7.000	S25	15 Winter	100	+40%					38.298
S8.000	S26	15 Winter	100	+40%					39.421
S9.000	S27	15 Winter	100	+40%					38.668

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S4.003	S21	0.333	0.000	0.23		24.3	SURCHARGED	
S4.004	S22	0.462	0.000	0.36		21.9	SURCHARGED	
S6.000	S23	-0.150	0.000	0.00		0.0	OK	
S6.001	S24	-0.150	0.000	0.00		0.0	OK	
S7.000	S25	-0.072	0.000	0.52		9.7	OK	
S8.000	S26	-0.109	0.000	0.17		4.1	OK	
S9.000	S27	-0.082	0.000	0.42		9.3	OK	

**PHASE 1 DRAINAGE STRATEGY AND SUDS REPORT REV.03
STATION HILL, READING**

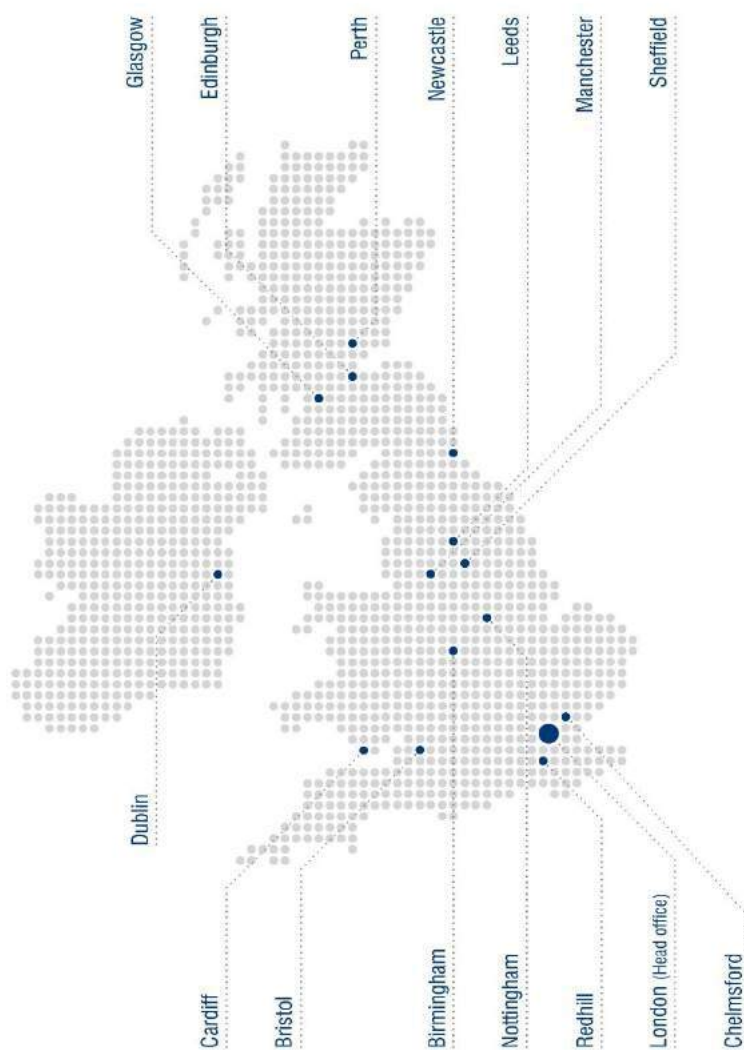
**APPENDIX 4
THAMES WATER ASSET PLAN**



PROPOSED SURFACE WATER DRAINAGE

PROPOSED FOUL WATER DRAINAGE

UK and Ireland Office Locations





Technical Appendix 15.1 Pedestrian Level Wind Microclimate Assessment

STATION HILL - PLOT E AND F

READING, UK

PEDESTRIAN LEVEL WIND MICROCLIMATE ASSESSMENT

RWDI #1803688 PLW REV-C

15TH FEBRUARY 2019

ON BEHALF OF

Michael Dillon

Associate Director
Michael.Dillon@crtkl.com

CallisonRTKL-UK Ltd.

10th Floor, Nexus Place
25 Farringdon Street
London
EC4A 4AB
T: +44 (0)20 7306 3520
M: +44 (0)7788 291497

SUBMITTED BY

Boris Tane, M.Sc.,

Project Engineer
boris.tane@rwdi.com

Krishan Jayyaratnam, M.Eng.,

Project Engineer
krishan.jayyaratnam@rwdi.com

Daniel Hackett, M.Eng.,

Senior Project Engineer
Daniel.hackett@rwdi.com

Ruth Shilston, C.Eng

Project Manager
ruth.shilston@rwdi.com

RWDI

Unit 1 Tilers Road
Milton Keynes
MK11 3LH
T: +44 (0)1908 776970



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VERSION HISTORY

RWDI Project #1803688		
Station Hill Reading, UK		
Report	Releases	Dated
Reports	Rev A	24 th January 2019
	Rev B	31 st January 2019
	Rev C	15 th February 2019
Project Team	Boris Tane	Project Engineer
	Krishan Jayyaratnam	Project Engineer
	Daniel Hackett	Senior Project Engineer
	Ruth Shilston	Project Manager

1. EXECUTIVE SUMMARY

Physical wind tunnel testing of plots E and F of the Reading Station Hill development was undertaken to comply with the requirements of condition 18 of the planning permission. The objective of this study was to determine the ground, terrace and balcony levels wind environment within and around the Proposed Development in Reading, UK.

This report presents a description of the methodology used and the results of four configurations tested in the wind tunnel, namely:

- Configuration 1: Existing Baseline comprising the existing Site incorporating the Temporary Events Space with existing surrounding buildings;
- Configuration 2: Proposed Development without Mitigation comprising reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters) in place;
- Configuration 3: Proposed Development with Mitigation comprising reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters) in place and wind mitigation measures; and
- Configuration 4: Cumulative Scenario comprising the Reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters but with Plot B in accordance with the reserved matters consent for that plot) plus Cumulative Surrounds.

The meteorological data for the Site indicate strong prevailing winds from the south-west quadrant throughout the year with secondary winds from the north-east direction which are more prevalent during the spring months.

All locations in and around the Existing Site (Configuration 1) have wind conditions generally suitable for the intended use.

With the introduction of the Proposed Development devoid of any landscaping, windier conditions arise across the Site. Wind conditions exceeding the pedestrian comfort criteria occurring at thoroughfares and terrace amenity spaces in and around the Proposed Development. These occur across the northern site, at thoroughfare locations around Plots A and B (Locations 51, 54, 80 and 81) and on the roof terraces of Plot E (Locations 167, 168, 173 and 174)..

As such, areas where wind mitigation measures are required have been identified as existing and proposed thoroughfares within the northern part of the Site and the roof terraces of Plot E.

Mitigation measures on the roof terraces of Plot E were developed through further wind tunnel testing. They comprise:

- Porous screens, approximately 1.2m tall and 50% porous on the roof terraces; and
- Shrubs, approximately 1.2m tall on the roof terraces.

Wind mitigation measures for the northern part of the Site will be developed with the detailed design of the northern Site, including Plot A.



With the mitigation measures in place (Configuration 3) wind conditions are improved on the roof terrace of Plot E. As such, it has been identified that in order to achieve wind conditions suitable for amenity space use on the terraces, landscaping in the form of porous screens or shrubs around the sitting areas would be required. Further landscaping now proposed on the roof terraces are anticipated to alleviate the localised remaining windy conditions.

Conditions exceeding the pedestrian safety and comfort criteria persist across the northern site; wind mitigation measures would be required when the detailed design of the northern site comes forward.

With the introduction of cumulative surrounding building including the detailed design of Plot B and in the absence of wind mitigation measures, wind conditions across the Site are improved. All locations become suitable in terms of pedestrian safety and conditions exceeding the pedestrian comfort criteria at ground level persist at a single location, to the east of Plot B (location 80). There are areas at terrace levels where the pedestrian comfort criteria are exceeded (Locations 167, 168 and 173). Wind mitigation measures would be required in the northern site and will be implemented when its detailed design comes forward.

2. INTRODUCTION

RWDI was retained by CallisonRTKL to conduct a pedestrian level wind microclimate assessment for the Proposed Development in Reading, UK. This report presents the background, objectives, results and discussion from RWDI's assessment. A discussion of the overall results from the study is presented in Section 6, "Conclusion".

3. BACKGROUND AND APPROACH

Wind tunnel tests were conducted on a 1:300 scale model of the Proposed Development in Reading. The investigation quantifies the wind conditions within and around the Site, by comparing the measured wind speed and frequency of occurrence with the Criteria. Meteorological data for Reading has been analysed from the London Heathrow meteorological station, and adjusted to the Site conditions by modelling the effect of terrain roughness on the wind speeds approaching the Site.

Measurements were taken at up to 181 locations for 36 wind directions, in 10° increments. The measurements covered ground level locations along the building facades and at corners, near main entrances, on pedestrian routes within and around the Site, roof top terraces and balconies. Analysis was conducted on a seasonal basis but the report focuses on the windiest season results (i.e. winter) and those for the summer season, when pedestrian activity generally requires calmer conditions.

This report presents a description of the methodology used and the results of four configurations tested in the wind tunnel, namely:

- Configuration 1: Existing Baseline comprising the existing Site incorporating the Temporary Events Space with existing surrounding buildings;
- Configuration 2: Proposed Development without Mitigation comprising reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters) in place;
- Configuration 3: Proposed Development with Mitigation comprising reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters) in place and wind mitigation measures; and
- Configuration 4: Cumulative Scenario comprising the Reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters but with Plot B in accordance with the reserved matters consent for that plot) plus Cumulative Surrounds.

3.1 Site Description and Surroundings

The Site is located in Reading and the OS Landranger Grid Reference to the Site is SU714737.

The Site is located approximately 100m to the south of Reading Train Station. It is bound by Garrard Street to the north, buildings on Greyfriars Road to the west, Friars Street to the south and buildings to the east.

The surrounding area is generally low- to mid-rise residential. Further afield, the surrounding area is generally low-rise suburban residential, which is typically characterised by lower mean wind speeds and stronger gusts, when compared with open country.

As such, the Site is relatively exposed to oncoming prevailing south westerly winds above ~15m in height, which can proceed unimpeded towards the Site.

3.2 The Proposed Development

The Proposed Development consists of two residential blocks, Block E to the west and Block F to the east of the Site. Block E consists of three towers, ranging from 5 storeys to 11 storeys and linked by large podiums, whilst Block F is a single tower, rising 12 storeys above ground level.

There are amenity spaces on the podiums of Block E and on the roof terraces of both Blocks E and F.

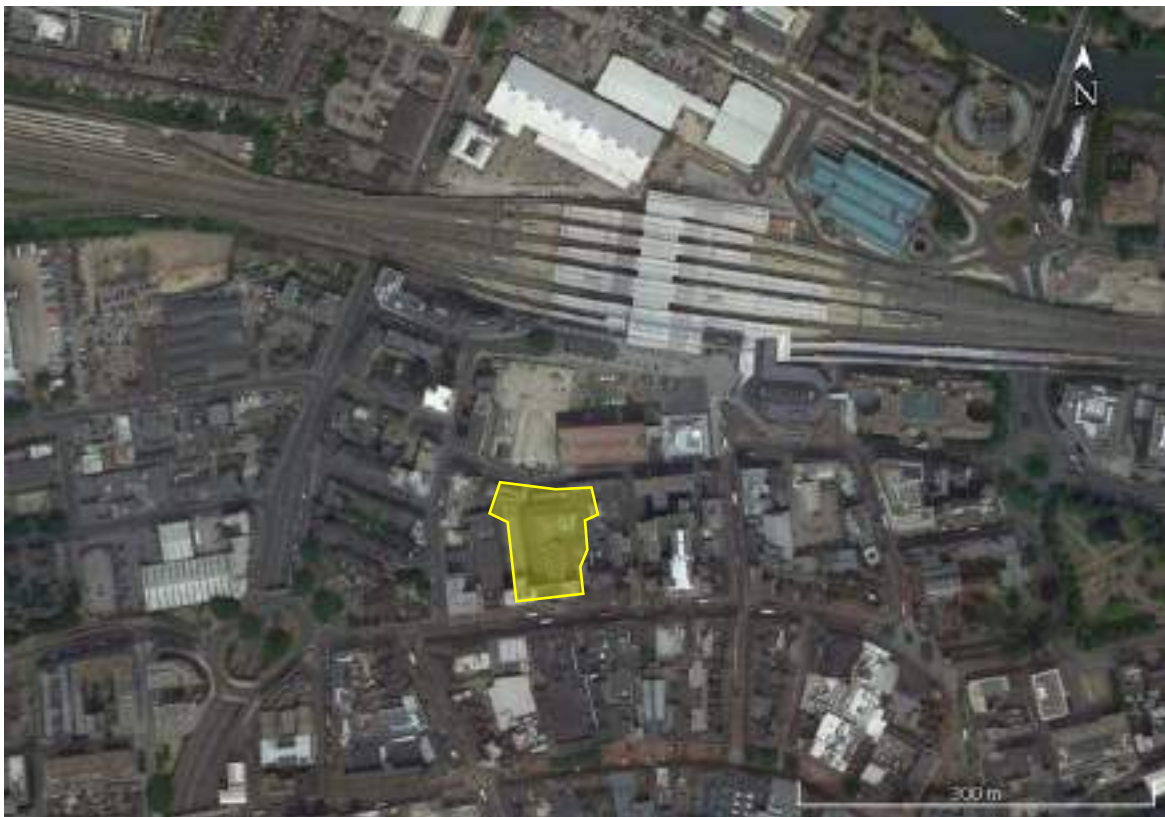


Figure 1: Site Location with the approximate Site highlighted in yellow.

4. METHODOLOGY AND ASSESSMENT CRITERIA

Wind tunnel testing is the most well-established and robust means of assessing the pedestrian wind microclimate. It enables the wind conditions at the Site to be quantified and classified in accordance with the Criteria. To produce the results within the tunnel, a 1:300 scale model was constructed which included the existing buildings at the Site and the surrounding area within a 360 metre (m) radius of the model target (centre).

The basic methodology for quantifying the pedestrian level wind environment is outlined below:

1. Measure the wind speeds at pedestrian level in the wind tunnel relative to a reference wind speed;
2. Adjust standard meteorological data to account for conditions at the Site;
3. Combine these to obtain the expected frequency and magnitude of wind speeds at pedestrian level; and
4. Compare the results with the Criteria to 'grade' conditions around the Site.

4.1 Simulation of Atmospheric Winds

The wind is turbulent, or gusty, and this turbulence varies depending upon the Site. It is necessary to reflect these differences in the wind tunnel test. In addition, the atmospheric boundary layer is a shear flow which means that the mean wind speed increases with height. Modelling these effects is achieved by a combination of spires and floor roughness elements to create a naturally-grown boundary layer that is representative of urban or open country conditions, as appropriate. The detailed contoured proximity model around the Site is used to fine-tune the flow and create conditions similar to those expected at full scale (as shown in Figure 2).

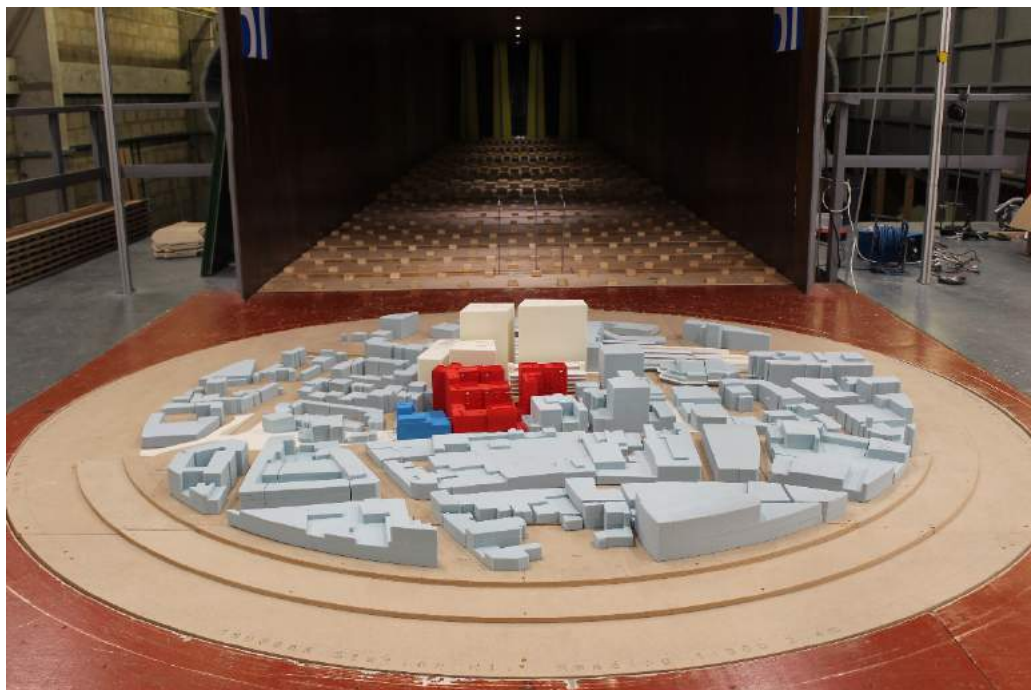


Figure 2: Proposed Development without Mitigation comprising reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters) in place. (View in the wind tunnel from south)

4.2 Measurement Technique

Wind speed measurements were made using Irwin probes. For pedestrian comfort studies, both the mean wind speed and the peak wind speed are measured at selected locations at the Site and surrounding area to represent sensitive receptors, such as entrances, amenity areas and thoroughfares, at a scaled height of 1.5m above ground level. The typical equivalent full-scale time period for measuring the mean wind speed is around 90 minutes, whereas the peak wind speed is taken as the wind speed exceeded for 1% of the time.

Wind speed at each location was measured for 36 wind directions in 10° increments, with 0° representing wind blowing from the north and 90° wind blowing from the east.

4.3 Scaling

The length scale of the model was 1:300 and the velocity scale was approximately 1:2 for strong winds. Consequently, the time scale for the tests was 1:150, or in other words 1 second in the wind tunnel is equivalent to 150 seconds at full scale.

4.4 Meteorological Data

Approximately 30 years of meteorological data for Reading (gathered from the London Heathrow meteorological station) was used in this report and is presented in Appendix B as wind roses by season. The radial axis indicates the directional distribution of winds. The seasons are defined as spring (March, April and May), summer (June, July and August), autumn (September, October and November) and winter (December, January and February). The data has been corrected to standard conditions of 10m above open flat level country terrain, over which pedestrian level wind speeds are greatest.

The combined wind data derived from meteorological station of London airports has been corrected to standard conditions of 10m above open flat level country terrain. The meteorological station data are then adjusted to site conditions by assessing the terrain in all directions around the Development using the methodology implemented in the BREVe3 software package. Pedestrian level wind speeds at open, flat, level country terrain are typically greater than at an inner city environment with low to medium rise buildings, due to the difference in boundary layer thickness for the vertical wind profile. Hence roughness lengths, a parameter for the wind profile equations that specifies the type of terrain, were estimated in all directions for appropriate upwind distances by use of virtual geographical software, and input into calculations for the wind profiles.

The meteorological data indicate that the prevailing wind direction throughout the year is from the south-west, which is consistent feature of met stations within the London area.

The combination of meteorological data and velocity ratios permits the percentage of time that wind speeds are exceeded on the site to be evaluated. The locations can then be assessed using the Criteria, as described below.

4.5 Pedestrian Comfort

The assessment of the wind conditions requires a standard against which the measurements can be compared. This report uses the Lawson Comfort Criteria, which have been established for over thirty years. The Criteria, which seek to define the reaction of an average pedestrian to the wind, are described in Table 1. If the measured wind conditions exceed the threshold wind speed for more than 5% of the time, then they are unacceptable for the stated pedestrian activity and the expectation is that there may be complaints of nuisance or people will not use the area for its intended purpose.

The Criteria sets out four pedestrian activities and reflect the fact that less active pursuits require more benign wind conditions. The four categories are sitting, standing, strolling and walking, in ascending order of activity level, with a fifth category for conditions that are uncomfortable for all uses. In other words, the wind conditions in an area for sitting need to be calmer than a location that people merely walk past.

The distinction between strolling and walking is that in the strolling scenario pedestrians are more likely to take on a leisurely pace, with the intention of taking time to move through the area, whereas in the walking scenario pedestrians are intending to move through the area quickly and are therefore expected to be more tolerant of stronger winds.

The Criteria are derived for open air conditions and assume that pedestrians will be suitably dressed for the season. Thermal comfort is discussed with reference to acceptable wind environments but not evaluated as part of the assessment.

The coloured key in Table 1 corresponds to the presentation of wind tunnel test results described later in this report.

Table 1: Lawson Comfort Criteria

Key	Comfort Category	Threshold	Description
	Sitting	0-4 m/s	Light breezes desired for outdoor restaurants and seating areas where one can read a paper or comfortably sit for long periods
	Standing	4-6 m/s	Gentle breezes acceptable for main building entrances, pick-up/drop-off points and bus stops
	Strolling	6-8 m/s	Moderate breezes that would be appropriate for window shopping and strolling along a city/town centre street, plaza or park
	Walking	8-10 m/s	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering
	Uncomfortable	>10 m/s	Winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended

4.6 Strong Winds

Lawson¹ also specified a lower limit strong wind threshold when winds exceed 15m/s for more than 2.2 hours of the year. Exceedance of this threshold may indicate a need for remedial measures or a careful assessment of the expected use of that location; e.g. is it reasonable to expect elderly or very young pedestrians to be present at the location on the windiest day of the year?

Wind speeds that exceed 20m/s for more than 2 hours of the year represent a safety issue for all members of the population, which would require mitigation to provide an appropriate wind environment.

Strong winds are generally associated with areas which would be classified as acceptable for walking or as uncomfortable. In a mixed-use urban development scheme, walking and uncomfortable conditions would not usually form part of the 'target' wind environment and would usually require mitigation due to pedestrian comfort considerations. This mitigation would also reduce the frequency of, or even eliminate, any strong winds.

¹ Lawson T.V. (April 2001), Building Aerodynamics, Imperial College Press

5. RESULTS

5.1 Details of Analysis

To account for the difference in height and terrain roughness between meteorological conditions at the airports and the Site, it is necessary to apply adjustment factors to the wind tunnel velocity ratios. Adjustment factors (mean factors) were computed for wind directions from 0° through to 360°. The reference height in the wind tunnel was at the equivalent full-scale height of 120 metres. Table 2 presents the mean factors for the Site.

Table 2: BREVe3 mean factors at 120m above ground level

Wind Direction	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°
Mean Factor at 120 m	1.41	1.42	1.44	1.43	1.39	1.45	1.46	1.51	1.46	1.41	1.41	1.40

5.2 Desired Pedestrian Activity around the Development

Generally, for the Development, the target conditions are:

1. Strolling during the windiest season on pedestrian thoroughfares;
2. Standing conditions at main entrances, drop off areas or taxi ranks, and bus stops throughout the year; and
3. Sitting conditions at outdoor seating and amenity areas during the summer season when these areas are more likely to be frequently used by pedestrians.

The walking and uncomfortable classifications are usually avoided because of their association with occasional strong winds, unless they are on a minor pedestrian route or a route where pedestrian access could be controlled in the event of strong winds.

Achieving a sitting classification in the summer usually means that the same receptor would be acceptable for standing in the windiest season because winds are stronger at this time.

This is considered an acceptable occurrence for the majority of external amenity spaces because other factors such as air temperature and precipitation influence people's perceptions about the 'need' to use seating in the windiest season.

It should be noted that a mixture of sitting use and standing use is acceptable for larger amenity spaces, should designated seating not be located at the windier locations suitable for standing use. Furthermore, standing use conditions are also considered tolerable at private amenity areas (such as balconies) where the occupant has control over the use of the space.

5.3 Performance against the Lawson Criteria

The wind microclimate within and around the Site has been assessed and classified using the Lawson Criteria defined in Table 1. Significant features of the proposed landscaping scheme required for suitable wind conditions are shown in Appendix A.

5.4 Occurrence of Strong Winds

Strong winds exceeding 15m/s for more than 2.2 hours per year are listed in Table 3 below.

Table 3: Annual exceedance of strong winds

Location	Threshold Exceedance	Wind Direction (deg)	Hours per Annum
Configuration 1: Existing Baseline comprising the existing Site incorporating the Temporary Events Space with existing surrounding buildings			
There were no strong winds exceeding 15m/s for more than 2.2 hours in this configuration.			
Configuration 2: Proposed Development without Mitigation comprising reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters) in place			
51	S15	10	5.3
54	S15	0	10.9
80	S15	180	3.4
81	S15	0	3.5
89	S15	0	2.8
Configuration 3: Proposed Development with Mitigation comprising reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters) in place and wind mitigation measures			
51	S15	260	4.3
54	S15	0	9.4
80	S15	170	2.7
81	S15	0	2.7
89	S15	350	2.3
Configuration 4: Cumulative Scenario comprising the Reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters but with Plot B in accordance with the reserved matters consent for that plot) plus Cumulative Surrounds			
There were no strong winds exceeding 15m/s for more than 2.2 hours in this configuration.			

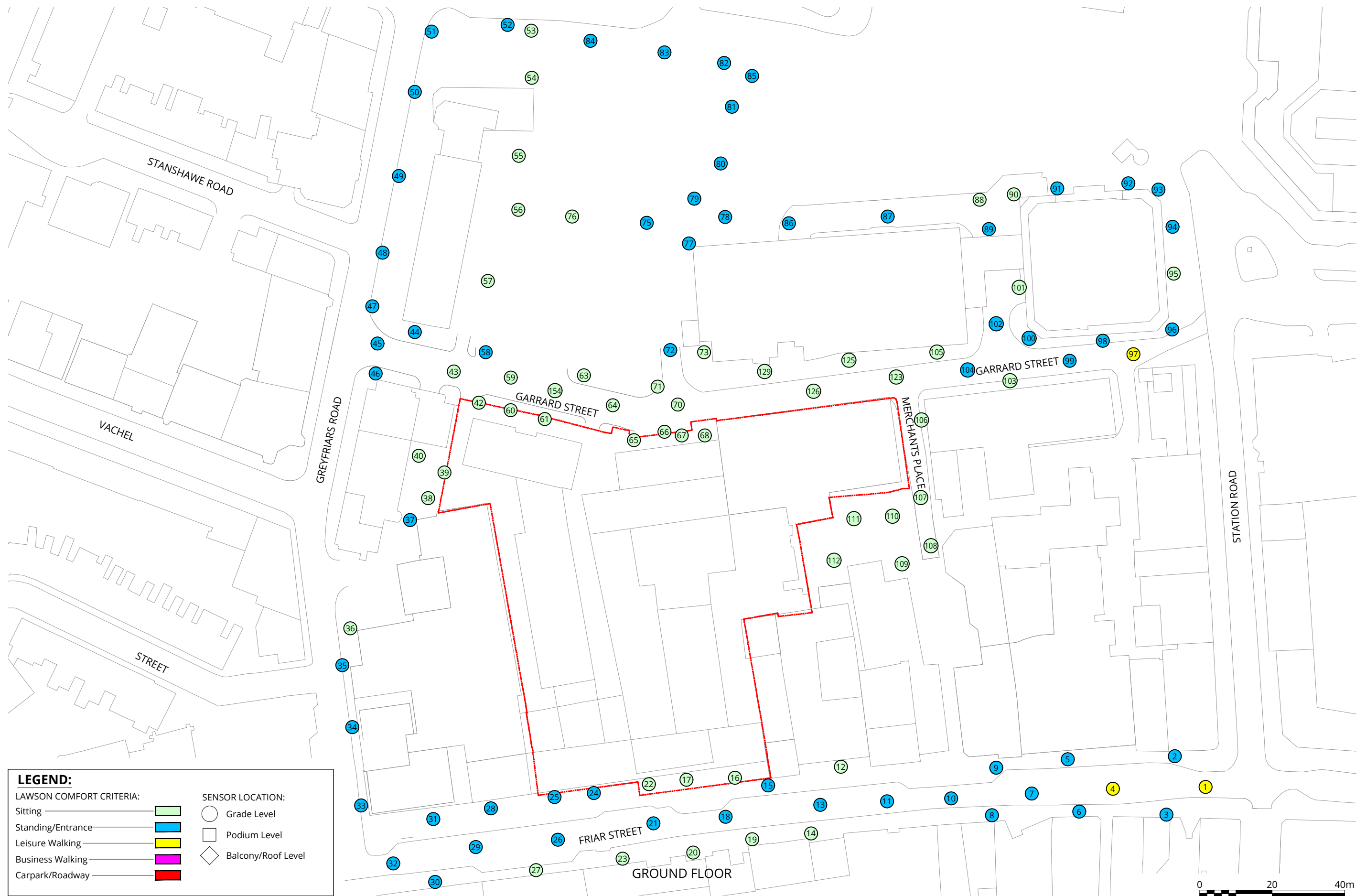
6. CONCLUSIONS

1. Meteorological data for the Site indicate strong prevailing winds from the south-west quadrant throughout the year with secondary winds from the north-east direction which are more prevalent during the spring months.
2. All locations in and around the Existing Site (Configuration 1) have wind conditions generally suitable for the intended use.
3. With the introduction of the Proposed Development devoid of any landscaping, windier conditions arise across the Site. Wind conditions exceeding the pedestrian comfort criteria occur at thoroughfares and terrace amenity spaces in and around the Proposed Development. These occur across the northern site, at thoroughfare locations around Plots A and B (Locations 51, 54, 80 and 81) and on the roof terraces of Plot E (Locations 167, 168, 173 and 174).
4. Moreover, wind conditions exceeding the pedestrian safety criteria occur within the northern part of the Proposed Site (locations 51, 54, 55 and 80).
5. As such, areas where wind mitigation measures are required have been identified as existing and proposed thoroughfares within the northern part of the site and the roof terraces of Plot E.
6. Mitigation measures on the roof terraces of Plot E were developed through further wind tunnel testing. They comprise:
 - Porous screens, approximately 1.2m tall and 50% porous on the roof terraces; and
 - Shrubs, approximately 1.2m tall on the roof terraces.
7. Wind mitigation measures for the northern part of the Site will be developed with the detailed design of the northern Site, including Plot A.
8. With the mitigation measures in place (Configuration 3) wind conditions are improved on the roof terrace of Plot E. As such, it has been identified that in order to achieve wind conditions suitable for amenity space use on the terraces, landscaping in the form of porous screens or shrubs around the sitting areas would be required. Further landscaping now proposed on the roof terraces² are anticipated to alleviate the localised remaining windy conditions.
9. Conditions exceeding the pedestrian safety and comfort criteria persist across the northern site; wind mitigation measures would be required when the detailed design of the northern site comes forward.
10. With the introduction of cumulative surrounding building including the detailed design of Plot B and in the absence of wind mitigation measures, wind conditions across the Site are improved. All locations become suitable in terms of pedestrian safety and conditions exceeding the pedestrian comfort criteria at ground level persist at a single location, to the east of Plot B (location 80). There are areas at terrace levels where the pedestrian comfort criteria are exceeded (Locations 167, 168 and 173). Wind mitigation measures would be required in the northern site and will be implemented when its detailed design comes forward.

² 6516_SHR_D&A Landscape_DRAFT_02_190121.pdf received on 21/01/2019

FIGURES





Pedestrian Wind Comfort Conditions - Ground Floor

Configuration 1: Existing Baseline comprising the Existing Site Incorporating the Temporary Events Space with Existing Surrounding Buildings
Windiest Season

Station Hill, Reading



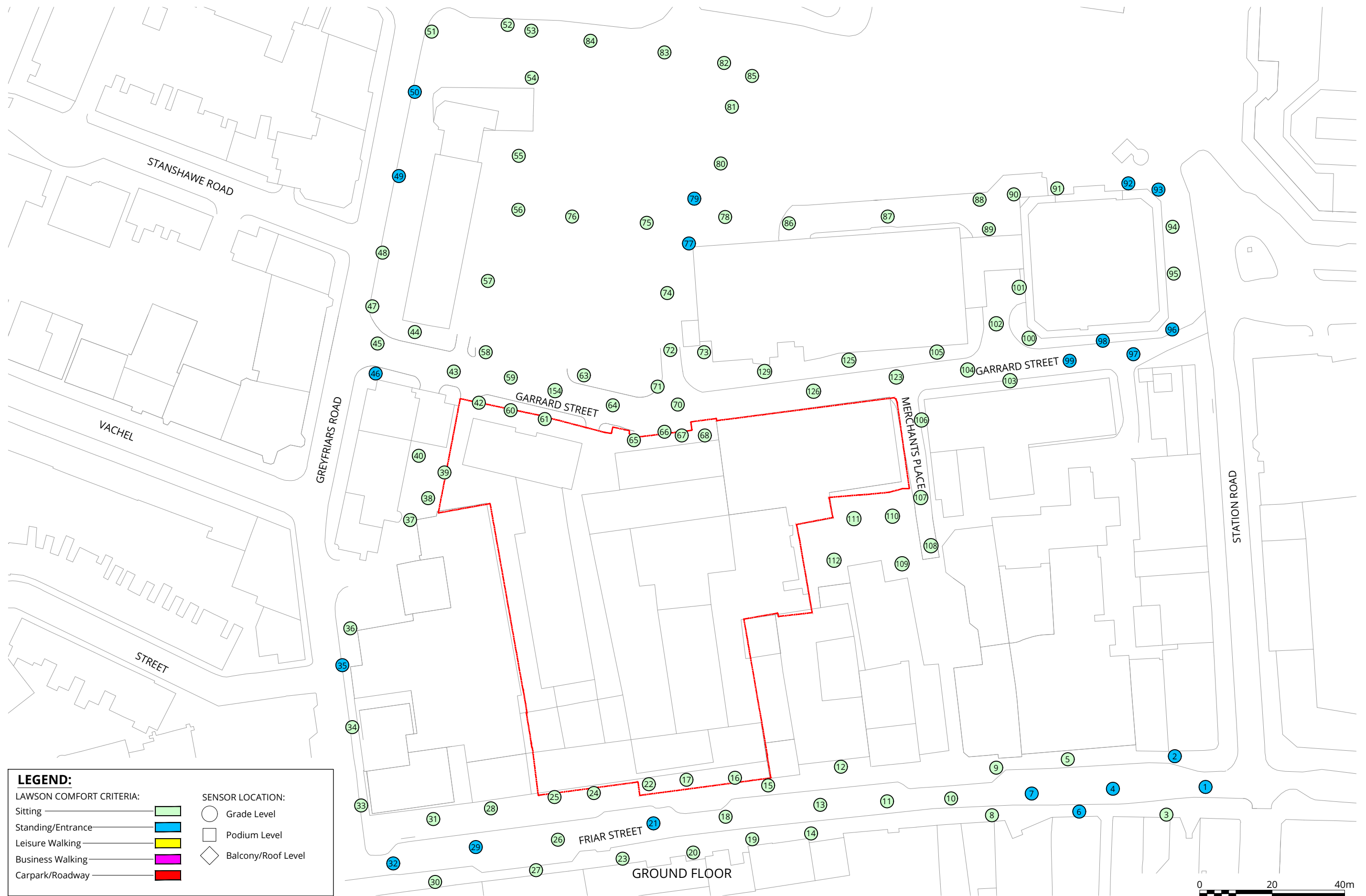
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Approx. Scale @A3: 1:1000

Project #1803688

Date Revised: Jan. 29, 2019





Pedestrian Wind Comfort Conditions - Ground Floor

Configuration 1: Existing Baseline comprising the Existing Site Incorporating the Temporary Events Space with Existing Surrounding Buildings
Summer Season

Station Hill, Reading



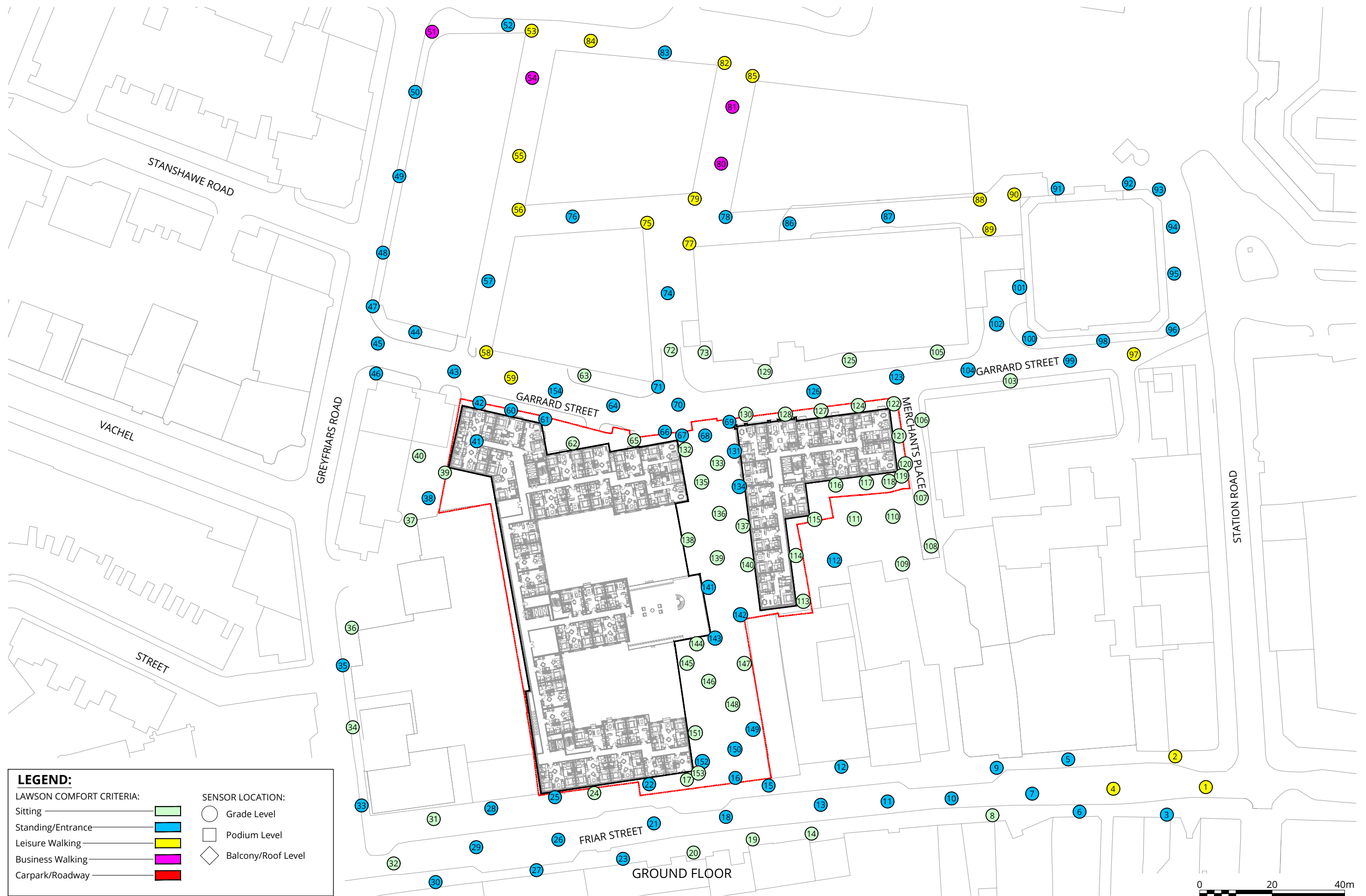
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Approx. Scale @A3: 1:1000

Project #1803688

Date Revised: Jan. 29, 2019





Pedestrian Wind Comfort Conditions - Ground Floor

Configuration 2: Proposed Development comprising reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters) in place
Windiest Season

Station Hill, Reading



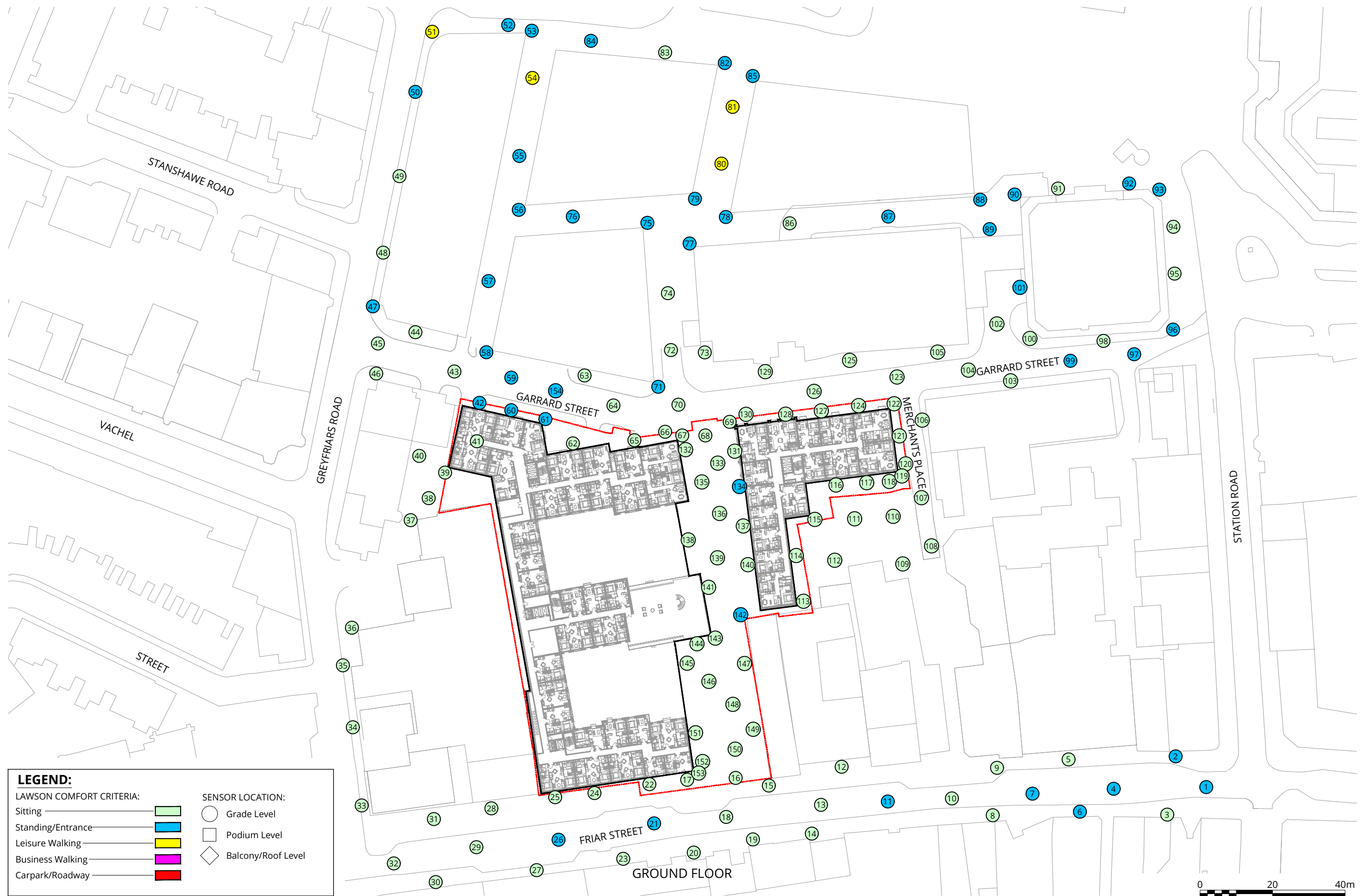
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Approx. Scale @A3: 1:1000

Project #1803688

Date Revised: Jan. 29, 2019





Pedestrian Wind Comfort Conditions - Ground Floor

Configuration 2: Proposed Development comprising reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters) in place
Summer Season

Station Hill, Reading



Drawn by: JLF Figure:6

Approx. Scale @A3: 1:1000

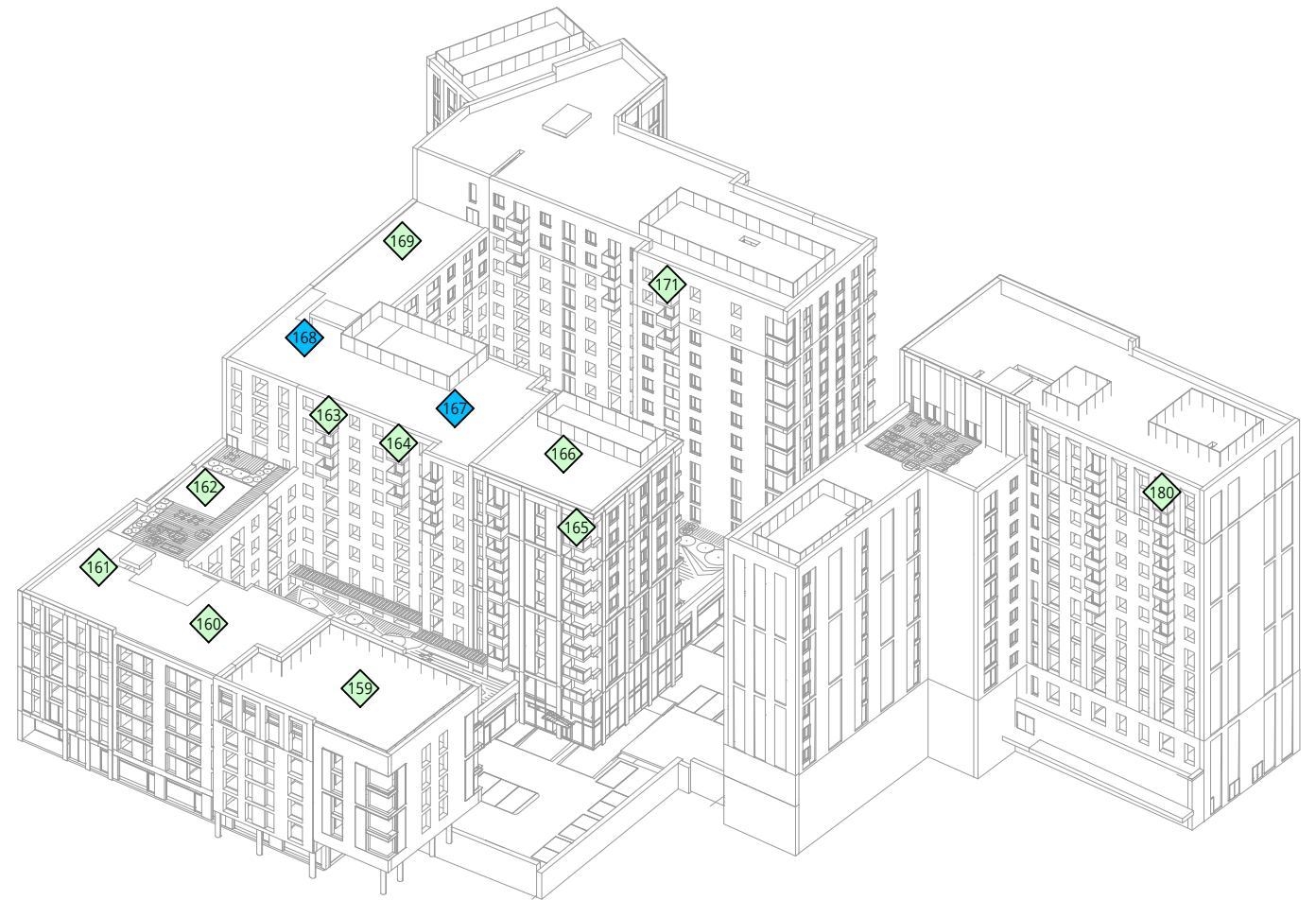
Project #1803688

Date Revised: Jan. 29, 2019





NORTH / EAST



SOUTH / EAST

LEGEND:	
LAWSON COMFORT CRITERIA:	
Sitting	
Standing/Entrance	
Leisure Walking	
Business Walking	
Carpark/Roadway	
SENSOR LOCATION:	
	Grade Level
	Podium Level
	Balcony/Roof Level



Pedestrian Wind Comfort Conditions - Balconies, Podium and Roof View

Configuration 2: Proposed Development comprising reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters) in place mitigation measures.

Summer Season
Station Hill, Reading

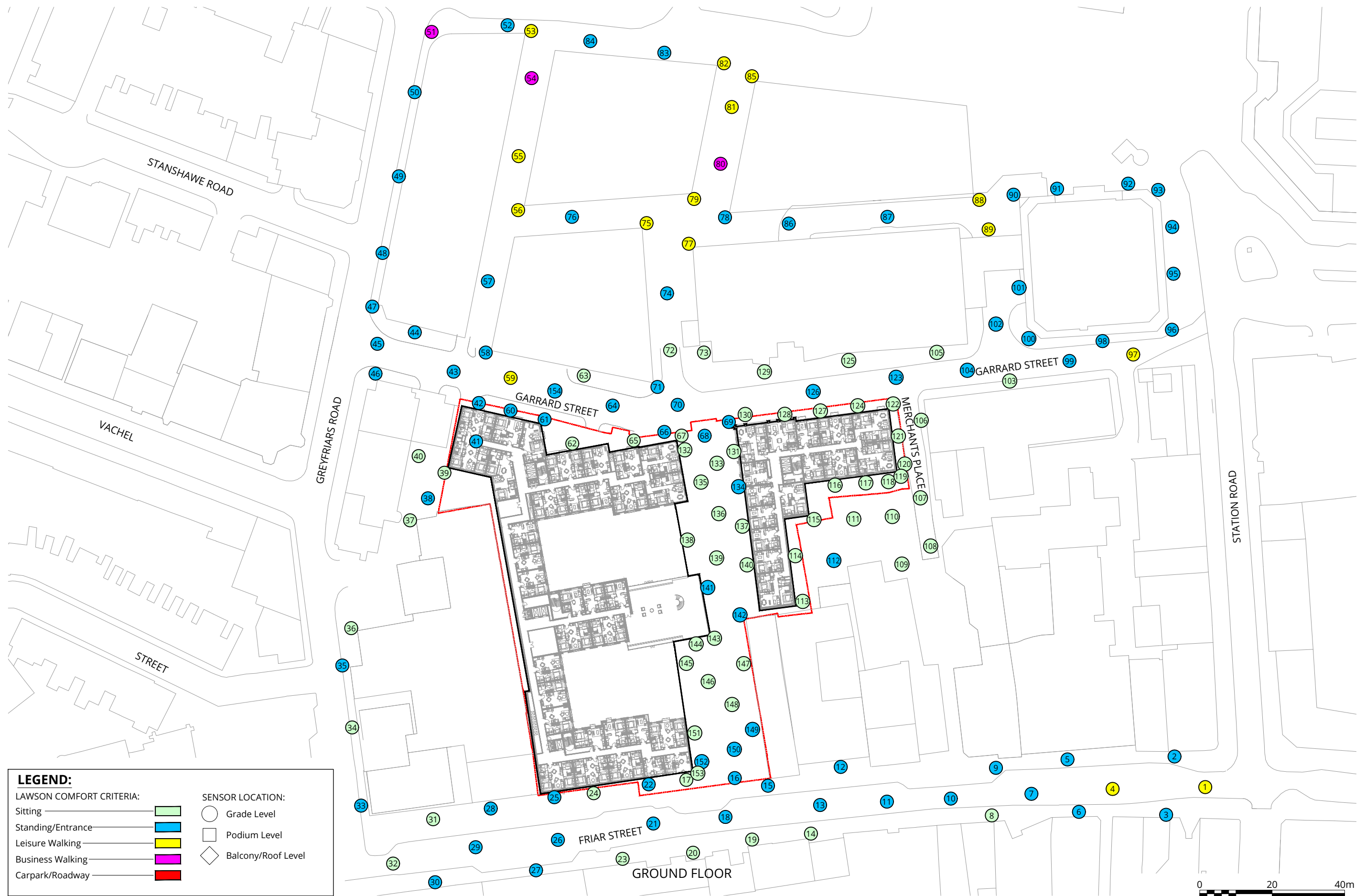
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Approx. Scale @A3: 1:800

Date Revised: Jan. 29, 2019

Project #1803688





Pedestrian Wind Comfort Conditions - Ground Floor

Configuration 3: Proposed Development comprising reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters) in place and wind mitigation measures.

Windiest Season
Station Hill, Reading



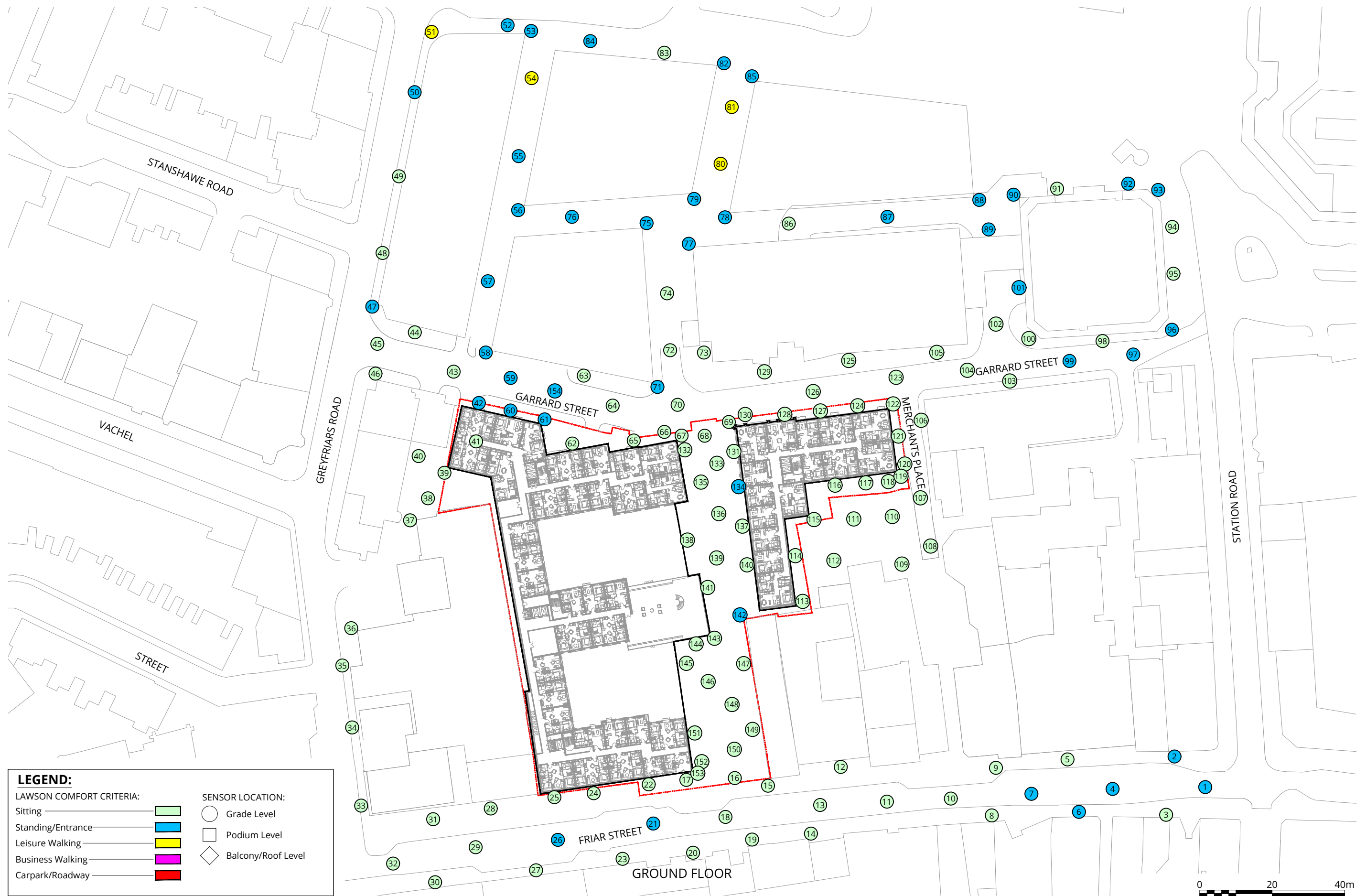
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Approx. Scale @A3: 1:1000

Project #1803688

Date Revised: Jan. 29, 2019





Pedestrian Wind Comfort Conditions - Ground Floor

Configuration 3: Proposed Development comprising reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters) in place and wind mitigation measures.

Summer Season
Station Hill, Reading



Drawn by: JLF Figure:9

Approx. Scale @A3: 1:1000

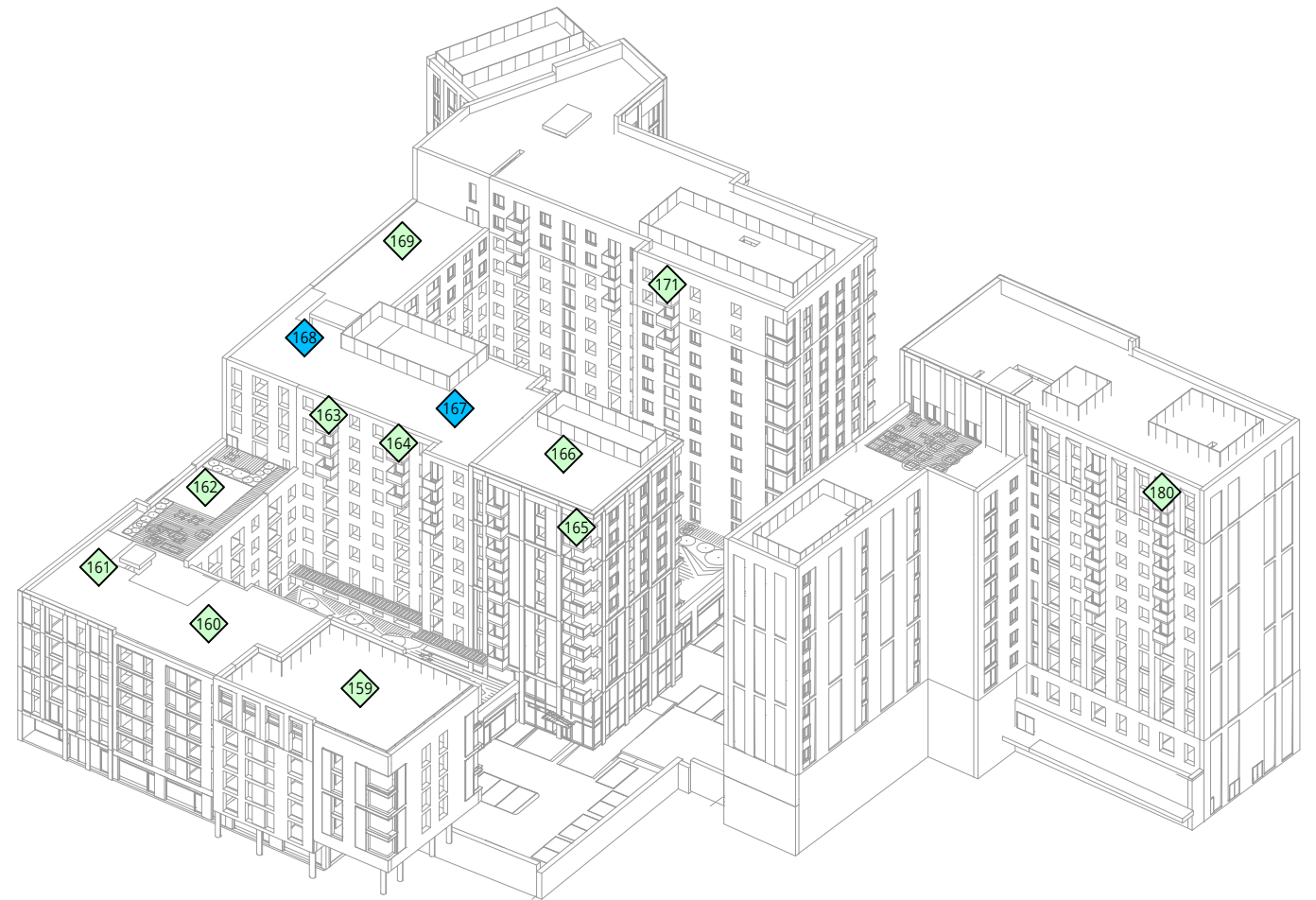
Date Revised: Jan. 29, 2019

Project #1803688





NORTH / EAST



SOUTH / EAST

LEGEND:	
LAWSON COMFORT CRITERIA:	
Sitting	
Standing/Entrance	
Leisure Walking	
Business Walking	
Carpark/Roadway	
SENSOR LOCATION:	
	Grade Level
	Podium Level
	Balcony/Roof Level



Pedestrian Wind Comfort Conditions - Balconies, Podium and Roof View

Configuration 3: Proposed Development comprising reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters) in place and wind mitigation measures.

Summer Season
Station Hill, Reading

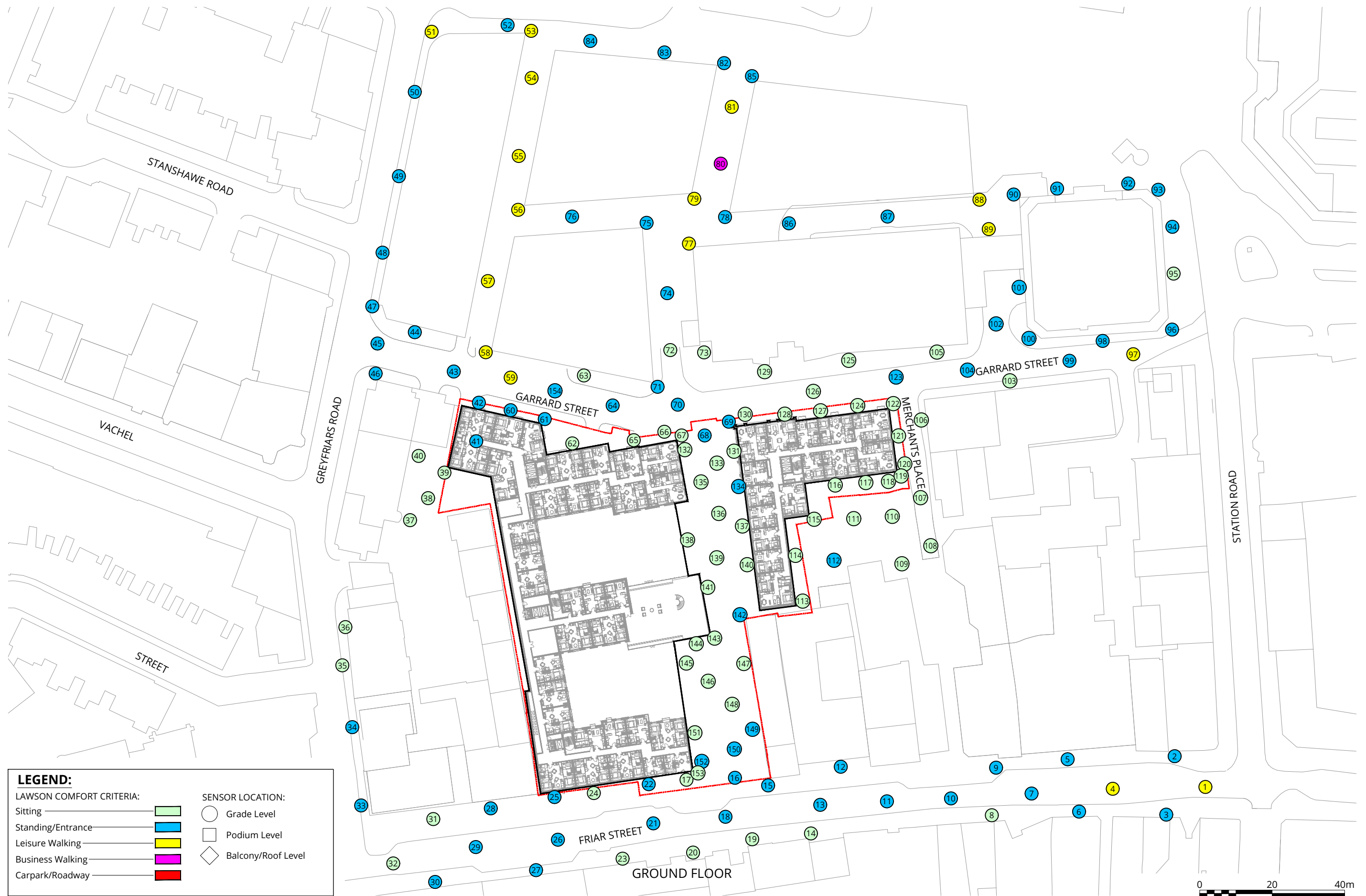
Drawn by: JLF Figure:10

Approx. Scale @A3: 1:800

Date Revised: Jan. 29, 2019

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Pedestrian Wind Comfort Conditions - Ground Floor

Configuration 4: Cumulative Scenario comprising the Reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters but with Plot B in accordance with the reserved matters consent for that plot) plus Cumulative Surrounds

Windiest Season
Station Hill, Reading



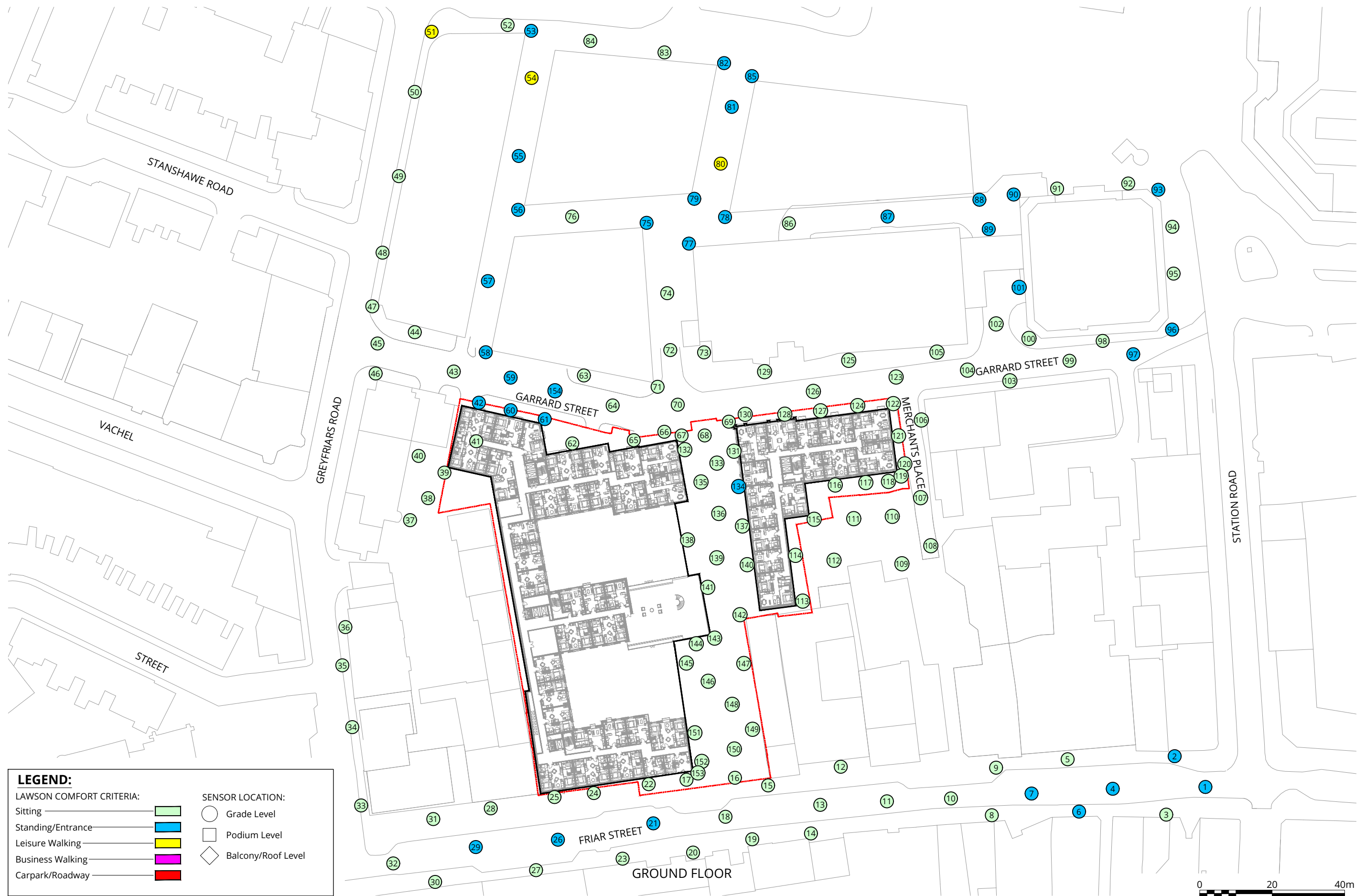
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Approx. Scale @A3: 1:1000

Project #1803688

Date Revised: Jan. 29, 2019





Pedestrian Wind Comfort Conditions - Ground Floor

Configuration 4: Cumulative Scenario comprising the Reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters but with Plot B in accordance with the reserved matters consent for that plot) plus Cumulative Surrounds

Summer Season
Station Hill, Reading



Drawn by: JLF Figure:12

Approx. Scale @A3: 1:1000

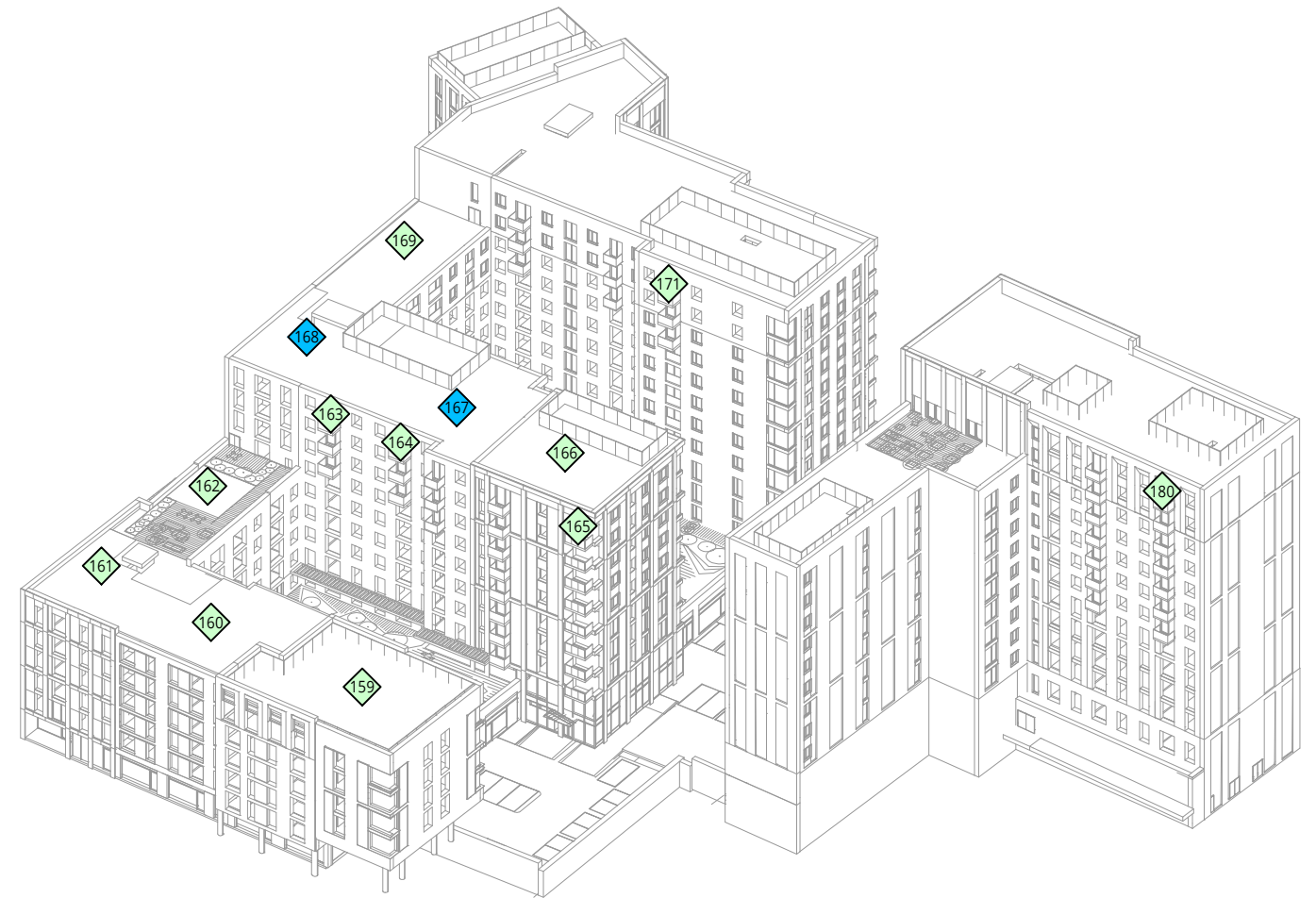
Project #1803688

Date Revised: Jan. 29, 2019





NORTH / EAST



SOUTH / EAST

LEGEND:

LAWSON COMFORT CRITERIA:

Sitting	
Standing/Entrance	
Leisure Walking	
Business Walking	
Carpark/Roadway	

SENSOR LOCATION:

	Grade Level
	Podium Level
	Balcony/Roof Level



Pedestrian Wind Comfort Conditions - Balconies, Podium and Roof View

Configuration 4: Cumulative Scenario comprising the Reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters but with Plot B mitigation measures).

Summer Season
Station Hill, Reading

Drawn by: JLF Figure:13

Approx. Scale @A3: 1:800

Date Revised: Jan. 29, 2019

Project #1803688



APPENDICES



APPENDIX A: WIND TUNNEL PHOTOS



Figure 14: Existing Baseline comprising the existing Site incorporating the Temporary Events Space with existing surrounding buildings (Configuration 1) – View in the Wind Tunnel (from the north)

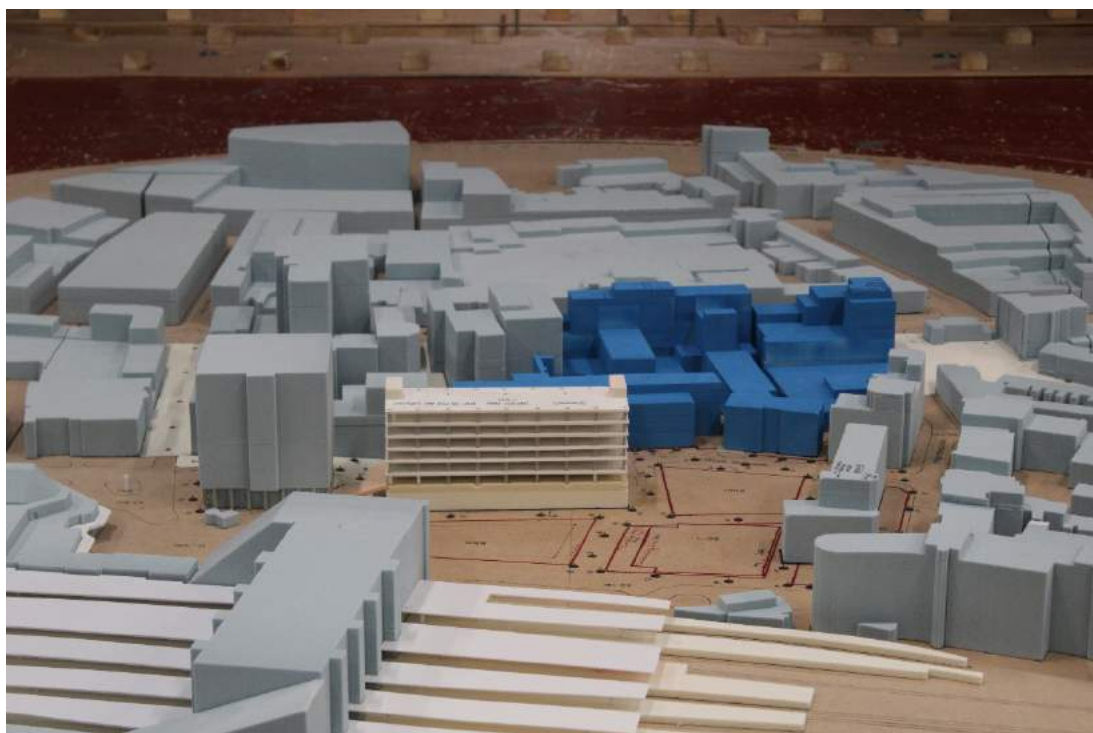


Figure 15: Existing Baseline comprising the existing Site incorporating the Temporary Events Space with existing surrounding buildings (Configuration 1) – View in the Wind Tunnel (from the south)

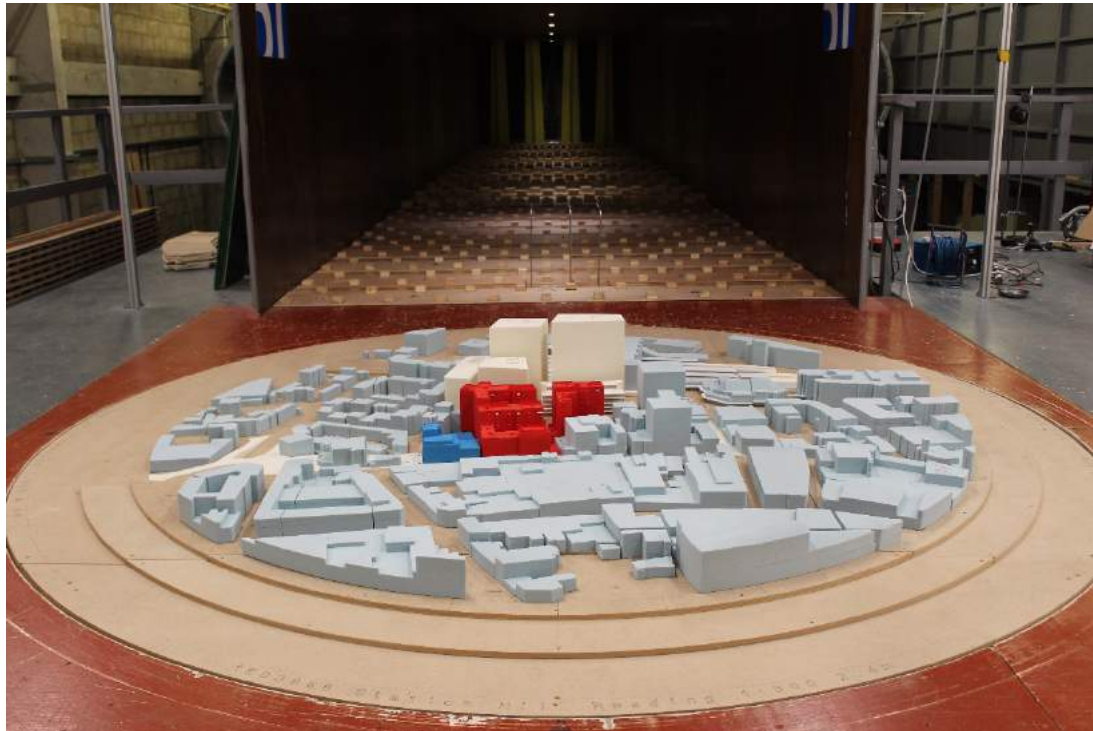


Figure 16: Proposed Development without Mitigation comprising reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters) in place (Configuration 2) – View in the Wind Tunnel (from the south)



Figure 17: Proposed Development without Mitigation comprising reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters) in place (Configuration 2) – View in the Wind Tunnel (from the south)

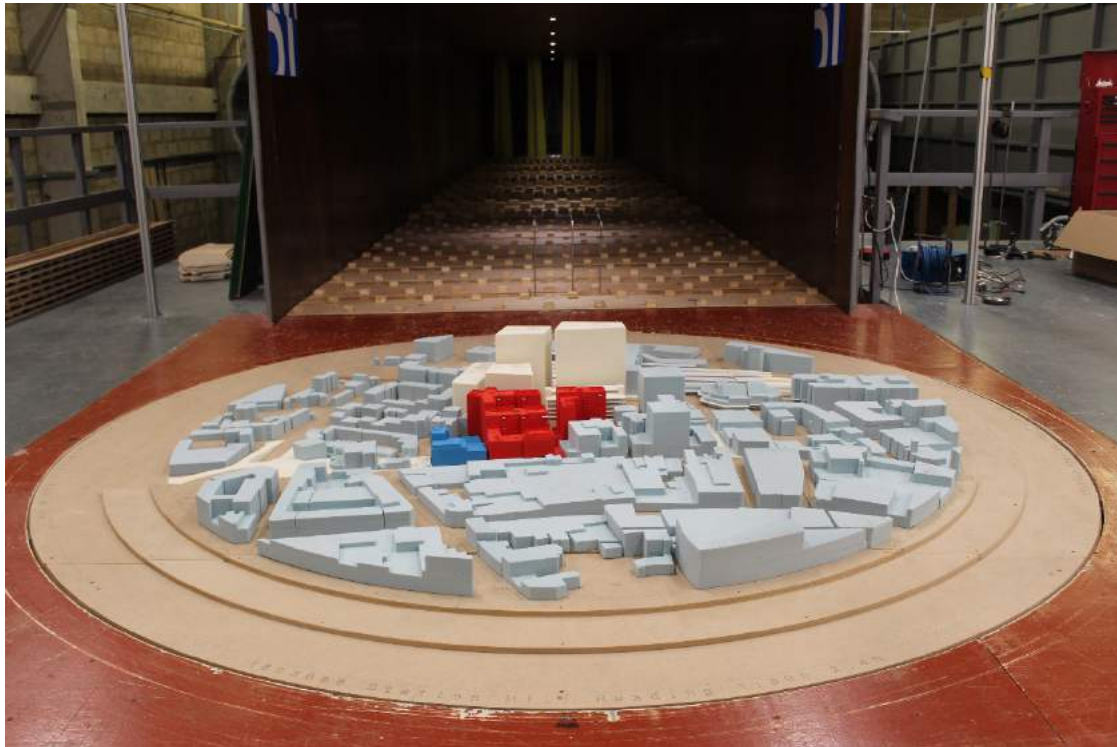


Figure 18: Proposed Development with Mitigation comprising reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters) in place and wind mitigation measures (Configuration 3) – View in the Wind Tunnel (from the south)



Figure 19: Proposed Development with Mitigation comprising reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters) in place and wind mitigation measures (Configuration 3) – View in the Wind Tunnel (from the south)



Figure 20: Cumulative Scenario comprising the Reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters but with Plot B in accordance with the reserved matters consent for that plot) plus Cumulative Surrounds (Configuration 4) - View in the Wind Tunnel (from the south)



Figure 21: Cumulative Scenario comprising the Reserved matters details for Plots E and F with the remaining Station Hill Development (as maximum parameters but with Plot B in accordance with the reserved matters consent for that plot) plus Cumulative Surrounds (Configuration 4) - View in the Wind Tunnel (from the south)

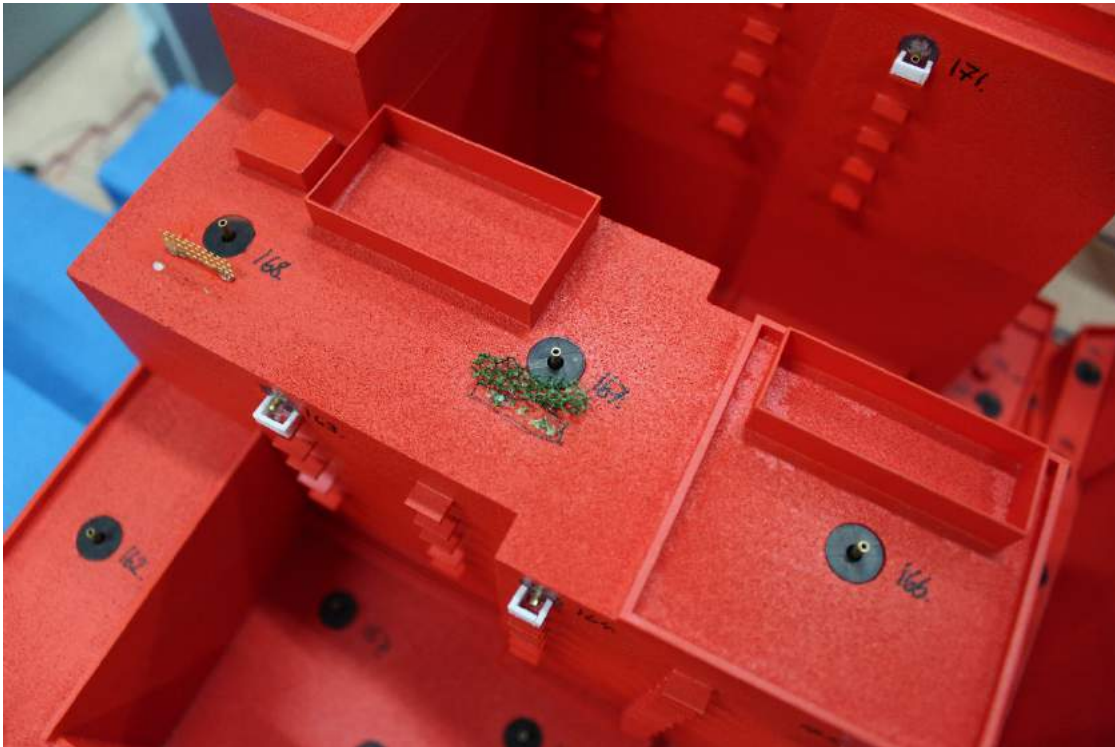


Figure 22: Mitigation measures



Figure 23: Mitigation measures



Figure 24: Mitigation measures

APPENDIX B: METEOROLOGICAL DATA

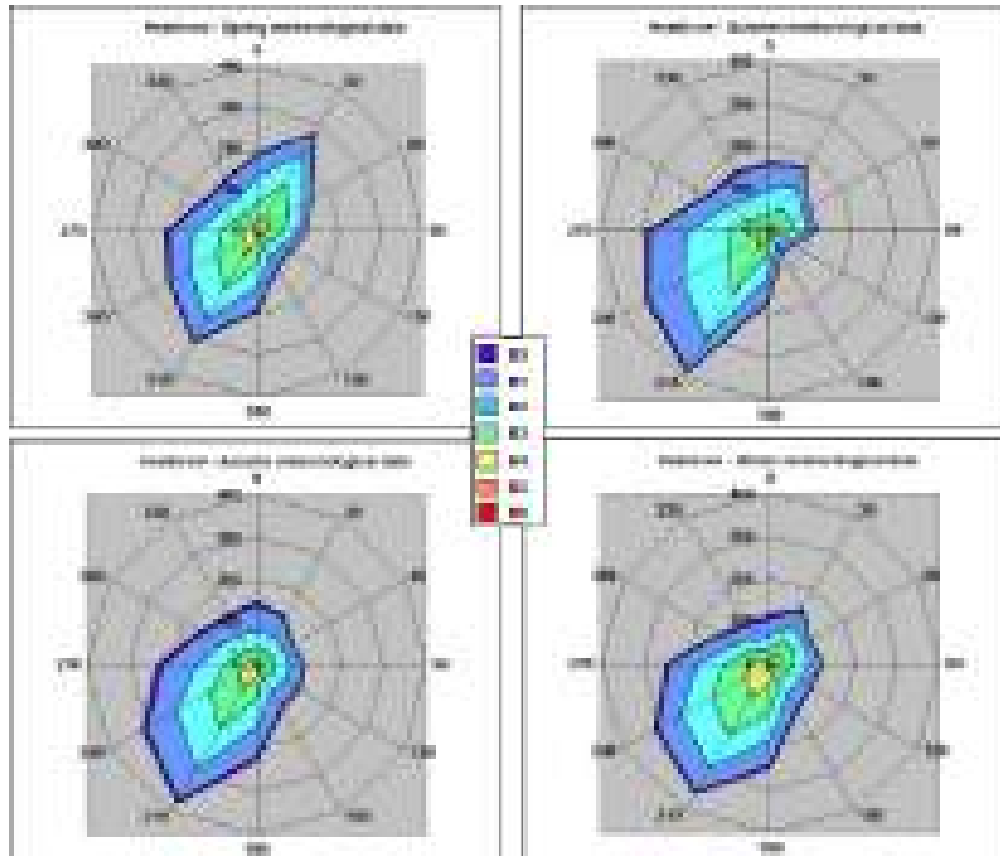


Figure 25: Seasonal wind roses for Reading (in Beaufort Force) - (Radial axis indicates the hours for which the stated Beaufort Range is exceeded)



Technical Appendix 16.1 Drawings of the Baseline, Proposed Development and Cumulative Scenario



SOURCES OF INFORMATION

GIA
IR01-5847 Site Survey
IR02-5847 Site Plan
Site Photography
PLANNING DOCUMENTS

ALLIES&MORRISON
IR53 - 150816 - ALLIES&MORRISON

CRTKL ARCHITECTS
IR90 - 01.02.19 - CRTKL - Updated massing for planning

NOTES:
EXISTING SCHEME SHOWN IN BROWN
ALL HEIGHTS AND DIMENSIONS GIVEN IN m AOD

N.B. DO NOT SCALE OFF THIS DRAWING

PROJECT:
STATION HILL
READING

DRAWING NAME:
PLAN VIEW
EXISTING SCENARIO

DWN BY	SCALE	CHK BY	STATUS	DATE
EVVE	1:1000@A3	MT	-	FEB 19
PROJ No.	REL No.	IS No.	DWG No.	REV No.
5847	60	01	01	-



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The Whitehouse
Belvedere Road
London SE1 8GA
t 020 7202 1400
f 020 7202 1401
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ALL HEIGHTS AND DIMENSIONS GIVEN IN m AOD

N.B. DO NOT SCALE OFF THIS DRAWING

PROJECT:
STATION HILL
READING

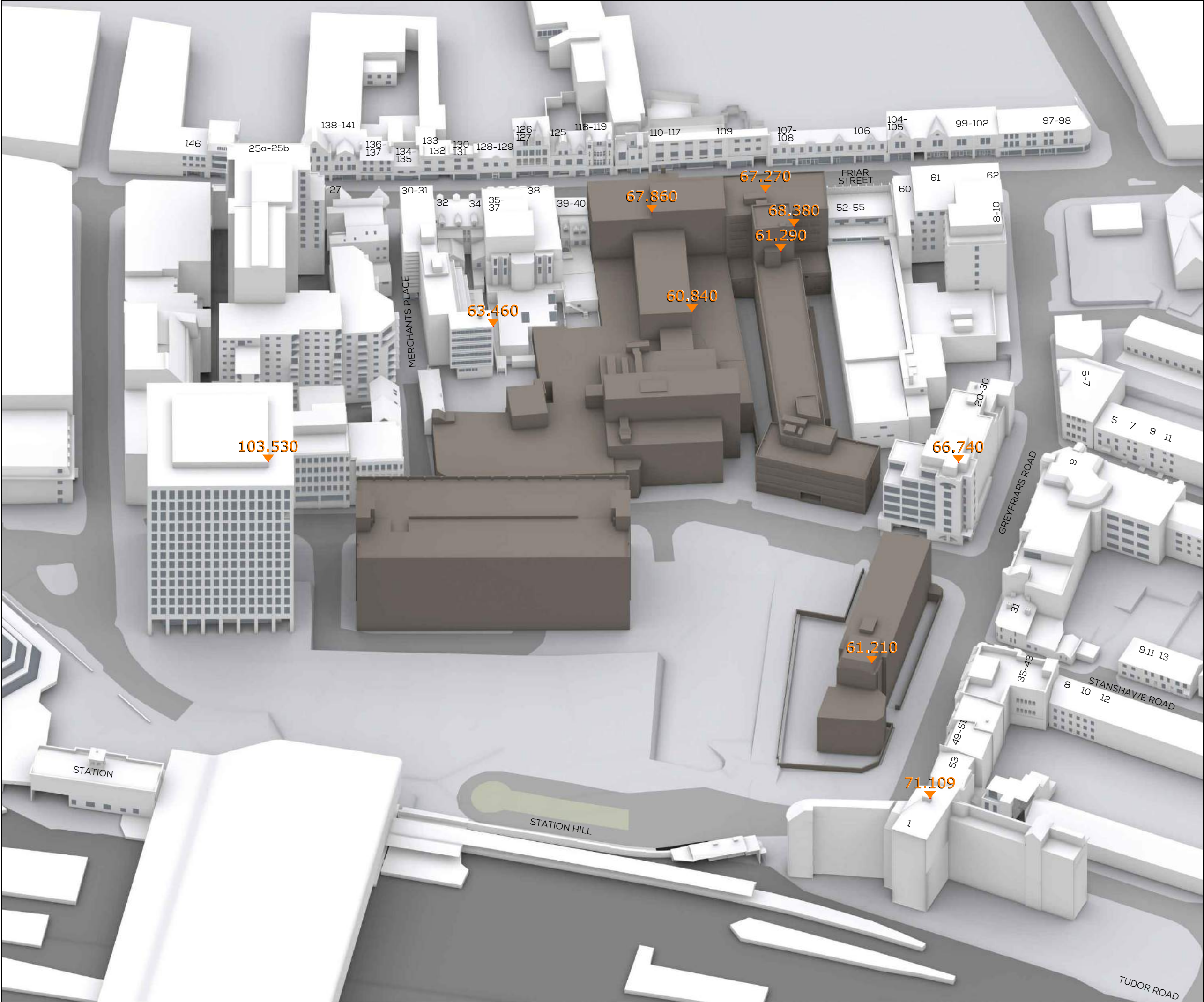
DRAWING NAME:
3D VIEW
EXISTING SCENARIO

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EVVE	NTS	MT	-	FEB 18
PROJ No.	REL No.	IS No.	DWG No.	REV No.
5847	60	01	02	-

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London SE1 8GA
t 020 7202 1400
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NOTES:
EXISTING SCHEME SHOWN IN BROWN
ALL HEIGHTS AND DIMENSIONS GIVEN IN m AOD

N.B. DO NOT SCALE OFF THIS DRAWING

PROJECT:
STATION HILL
READING

DRAWING NAME:
3D VIEW
EXISTING SCENARIO

DWN BY	SCALE	CHK BY	STATUS	DATE
EVVE	NTS	MT	-	FEB 18
PROJ No.	REL No.	IS No.	DWG No.	REV No.
5847	60	01	03	-

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Proposed



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NOTES:
PROPOSED SCHEME SHOWN IN TEAL
ALL HEIGHTS AND DIMENSIONS GIVEN IN m AOD

N.B. DO NOT SCALE OFF THIS DRAWING

PROJECT:
STATION HILL
READING

DRAWING NAME:
PLAN VIEW
PROPOSED SCENARIO

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PROJ No.	REL No.	IS No.	DWG No.	REV No.
5847	60	01	04	-



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t 020 7202 1400
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IR53 - 150816 - ALLIES&MORRISON

CRTKL ARCHITECTS
IR90 - 01.02.19 - CRTKL - Updated massing for planning

NOTES:
PROPOSED SCHEME SHOWN IN TEAL
ALL HEIGHTS AND DIMENSIONS GIVEN IN m AOD

N.B. DO NOT SCALE OFF THIS DRAWING

PROJECT:
STATION HILL
READING

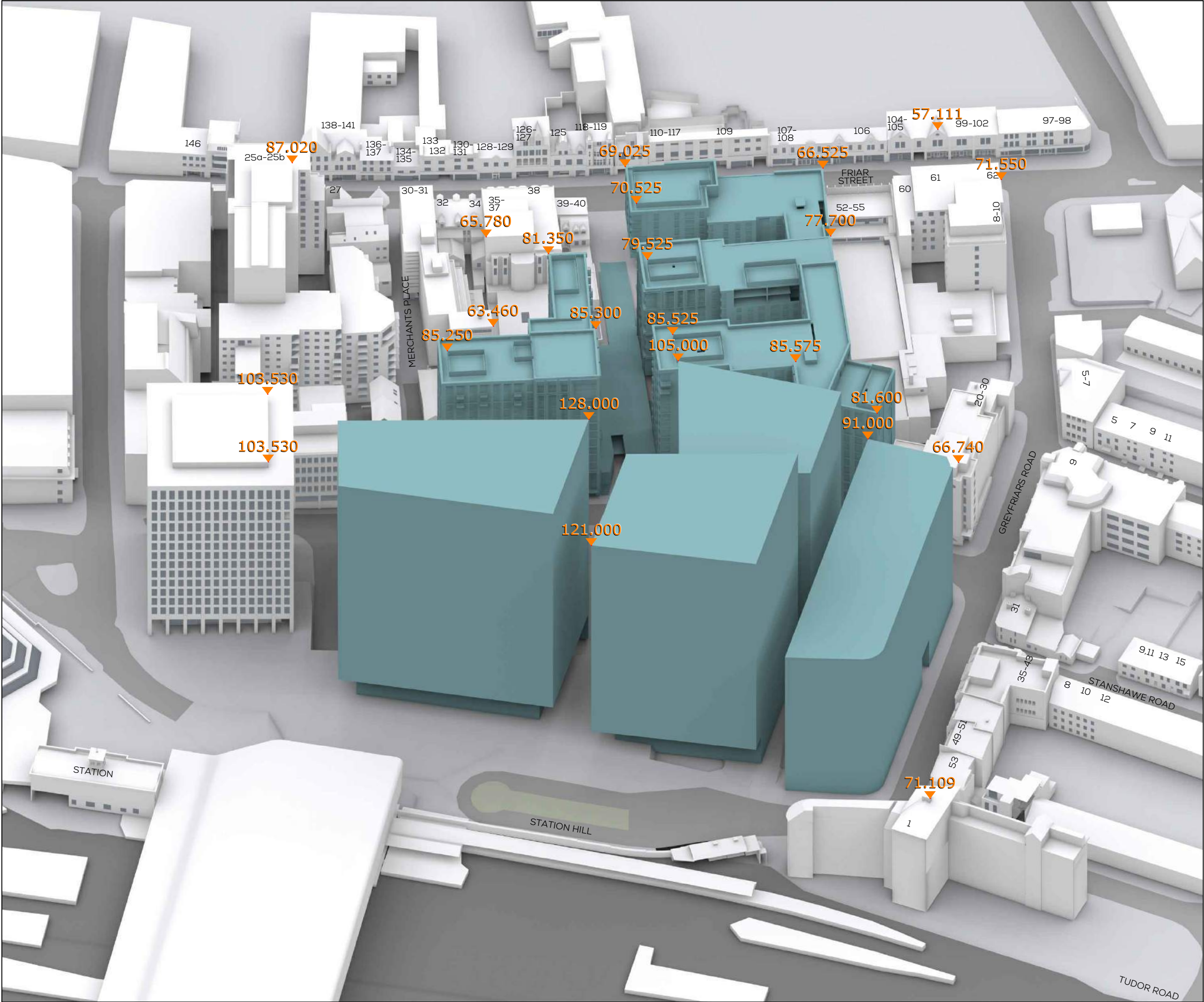
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3D VIEW
PROPOSED SCENARIO

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PROJ No.	REL No.	IS No.	DWG No.	REV No.
5847	60	01	05	-



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IR53 - 150816 - ALLIES&MORRISON

CRTKL ARCHITECTS
IR90 - 01.02.19 - CRTKL - Updated massing for planning

NOTES:
PROPOSED SCHEME SHOWN IN TEAL
ALL HEIGHTS AND DIMENSIONS GIVEN IN m AOD

N.B. DO NOT SCALE OFF THIS DRAWING

PROJECT:
STATION HILL
READING

DRAWING NAME:
3D VIEW
PROPOSED SCENARIO

DWN BY	SCALE	CHK BY	STATUS	DATE
EVVE	NTS	MT	-	FEB 18
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5847	60	01	06	-



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Site Photography
PLANNING DOCUMENTS

ALLIES&MORRISON
IR53 - 150816 - ALLIES&MORRISON
IR31-030315 - Allies&Morrison Illustrative and Max param
massing
698_Plot_B_In Context_Illustrative
scheme_150303.dwg

CRTLK ARCHITECTS
IR84 - 17.12.2018 - CRTKL - PLOTS E AND F UPDATED
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NOTES:
 PROPOSED SCHEME SHOWN IN TEAL
 CUMULATIVE SCHEME SHOWN IN ORANGE
 ALL HEIGHTS AND DIMENSIONS GIVEN IN m AOD

N.B. DO NOT SCALE OFF THIS DRAWING

PROJECT:

STATION HILL
READING

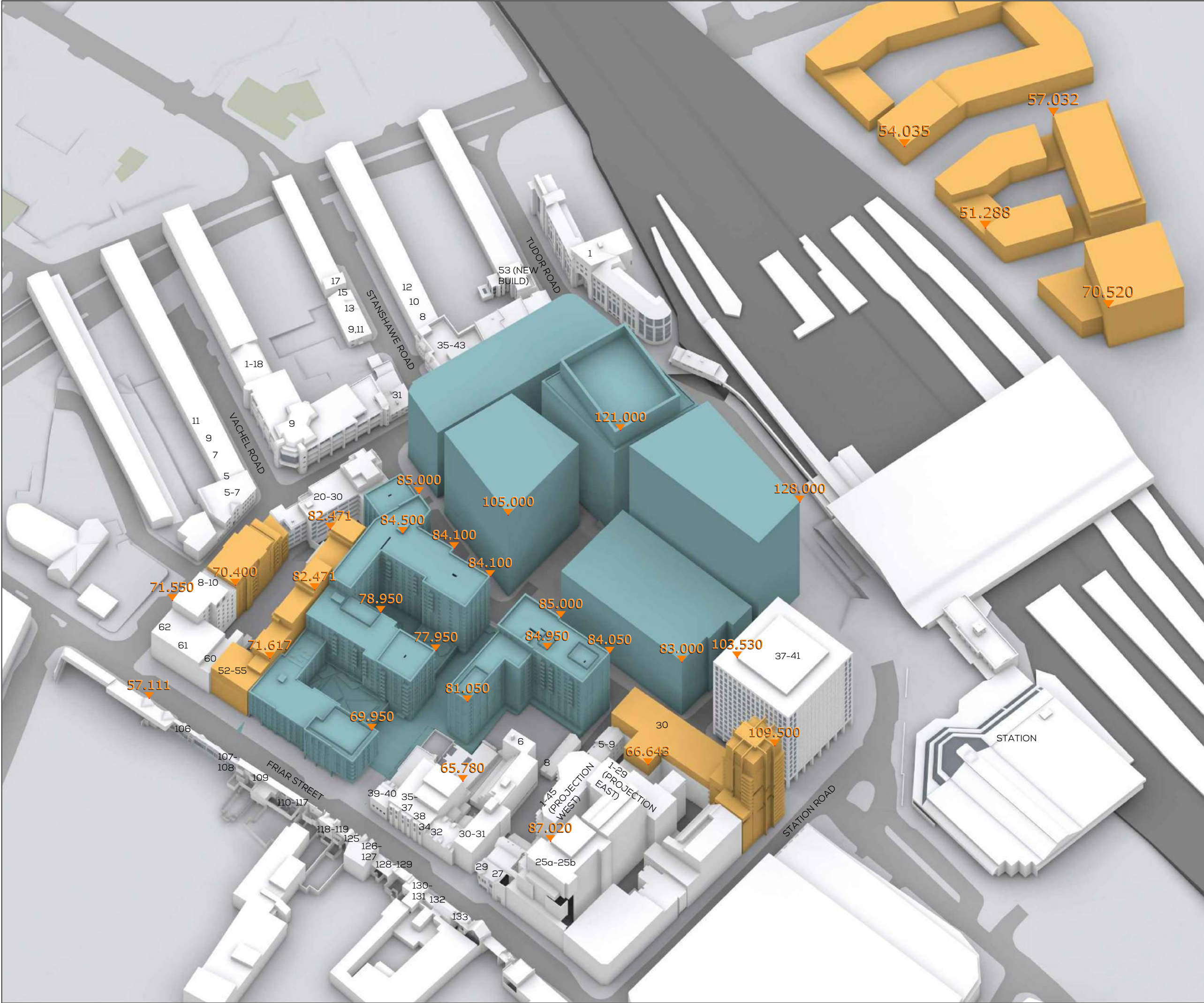
DRAWING NAME:
PLAN VIEW PROPOSED
CUMULATIVE SCENARIO
PROPOSED SCHEME IR84
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gia

The Whitehouse
Belvedere Road
London SE1 8GA
t 020 7202 1400
f 020 7202 1401
mail@gia.uk.com
www.gia.uk.com

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SOURCES OF INFORMATION

GIA
IR01-5847 Site Survey
IR02-5847 Site Plan
Site Photography
PLANNING DOCUMENTS

ALLIES&MORRISON
IR53 - 150816 - ALLIES&MORRISON
IR31-030315 - Allies&Morrison Illustrative and Max param
massing
698_Plot B_In Context_Illustrative
scheme_150303.dwg

CRTKL ARCHITECTS
IR84 - 17.12.2018 - CRTKL - PLOTS E AND F UPDATED
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PROJECT:
STATION HILL
READING

DRAWING NAME:
3D VIEW PROPOSED
CUMULATIVE SCENARIO
PROPOSED SCHEME IR84
RECEIVED 17.12.18

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MT	NTS	CRC	-	JAN 19
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