



**25 Dene Road, Northwood, HA6 3BX**

**Application no: 46479/APP/2021/2039**

**Pre-Commencement Conditions 9 Summary Report**

**Surface Water Drainage**

**Issue 1: 1st March 2023**

**1.0 Introduction**

- 1.1 Infrastructure Design Ltd (IDL) has been appointed by Gavacan Homes to prepare a Surface Water design for their proposed apartment scheme, in order to satisfy the planning condition imposed on the above Planning Consent.
- 1.2 A Surface Water Management Report prepared by Flo Consult UK Ltd was granted with condition.
- 1.3 This summary report supplies the information required to satisfy pre-commencement conditions 9.

**2.0 Condition 9**

*Prior to any superstructure works, the details of a scheme for the provision of sustainable water management shall be submitted to and approved in writing by the Local Planning Authority. The scheme shall clearly demonstrate how it manages water in the most sustainable*

*ways and is in compliance with the strategy set out in the Flo Consult UK Ltd Basement Impact Assessment and Surface Water Management Report, project no. 656 dated October 2020 rev A, showing that a suitable sustainable scheme can be provided onsite, which sets out the site will:*

- Achieve a minimum volume of storage of 57.60m<sup>3</sup>*
- Provided through the following SuDs elements: permeable surfacing cellular crates and Flow control device.*
- Be managed in accordance with Maintenance Plan Section 17 of the Flo Report.*

*Further details need to be provided on certain elements within the drainage design. Any changes to the strategy should be justified and evaluated and the final proposals must be integrated with provision of green infrastructure, air quality and urban greening requirements*

*to justify the most sustainable final solution is provided. Additional information should be provided on:*

- Achieve a greenfield run off rate from the site of 2.140 ha. site of to 0.5 l/s for the 1 in 1-year storm event; 1.5 l/s for the 1 in 30-year storm event, and 2.0 l/s for the 1 in 100-year storm event including 40% rainfall intensity increase.*
- Achieving more sustainable methods to control water*
- Confirmation of Thames Water approval to discharge to a Foul Sewer.*
- Rainwater harvesting*
- Methods to minimise the use of potable water through:*
  - i. incorporating water saving measures and equipment.*
  - ii. Collecting water for use and recycling.*

*Thereafter the development shall be implemented and retained/maintained in accordance with these details for as long as the development remains in existence.*

#### **Condition 9 Response**

SuDS features such as permeable paving and below-ground attenuation storage have been used to store the surface water runoff before discharging it to the system.

The below-ground cellular storage is approximately (12.5m x 9.0m x 0.8m) 90m<sup>3</sup>, which will store the surface water runoff for storm events up to 1 in 100 year plus 40% climate change.

The control manhole (an orifice manhole) will restrict the proposed surface water runoff as agreed in the approved drainage strategy by the Flo consultant, dated October 2020.

The proposed runoff rate from the site will be:

- 0.8 l/s for 1 in 1 storm event
- 0.8 l/s for 1 in 2 storm event
- 1.3 l/s for 1 in 30 storm event
- 1.5l/s for 1 in 100 storm event
- 1.8 l/s for 1 in 100 + 40% climate change storm event

Permeable paving with a subbase lined in an impermeable membrane will be used in forming the new parking areas. This will serve delay runoff into the cellular storage and outfall via perforated pipes surrounded by granular material whilst also improving water quality.

Also, water butts are used to store and reuse surface water when required.

The proposed drainage system is now a gravity drainage to the downstream combined water system.

The sewer connection (an indirect connection) application has been made with the water authority. We are awaiting their response.

A detailed drainage layout, levels, and drainage calculation has been prepared based on the approved drainage strategy.

The drainage system has been designed up to 1 in 100 years + 40% climate change and critical storm events. Note that there is no flooding at any point on the system for all storm events, including the 1 in 100 years + 40% climate change event.

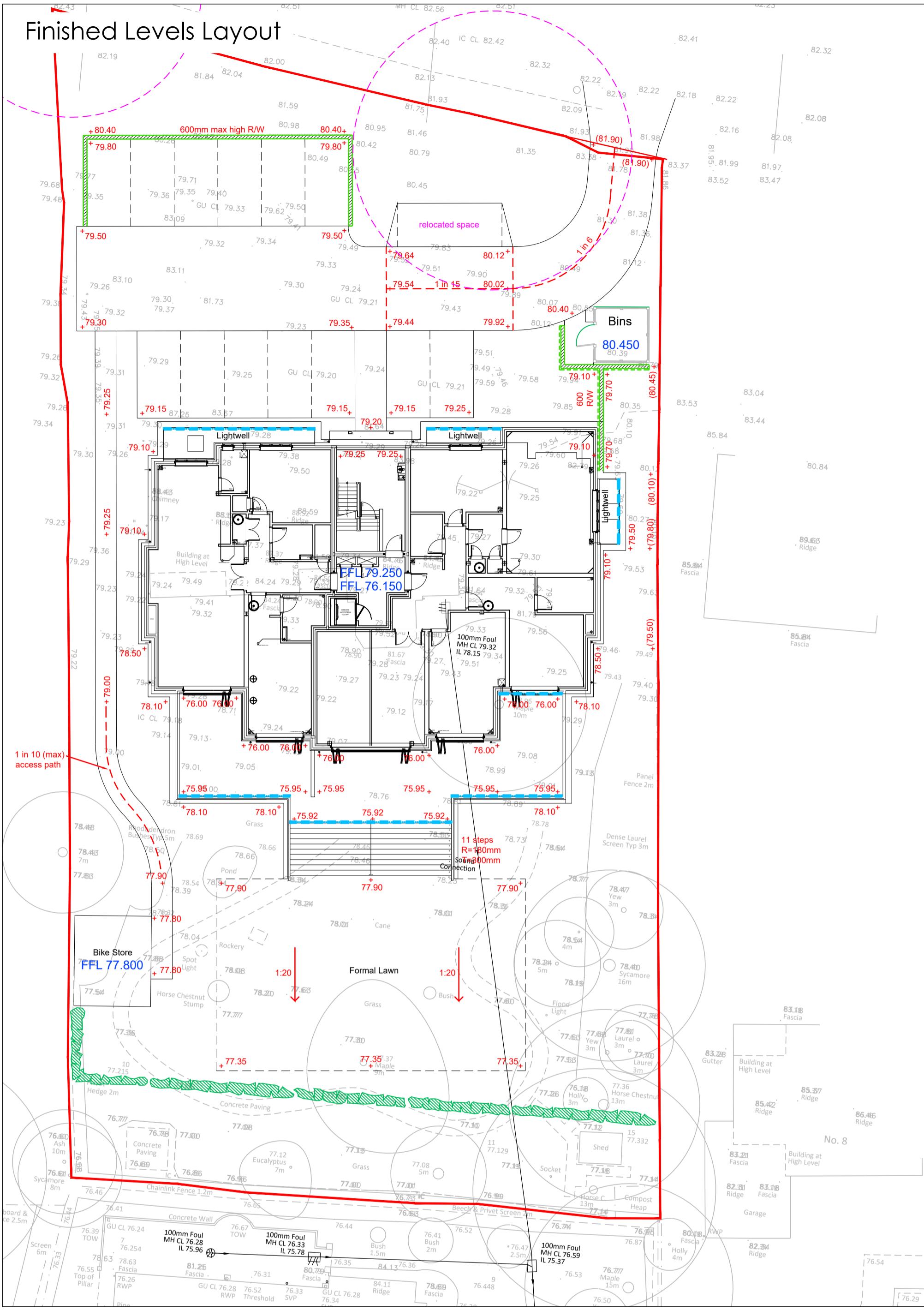
Refer to Appendix A for detailed plans and Appendix B for the latest drainage calculation.

A maintenance and management regime of all drainage elements, including the SuDS feature and control manhole, has been included in Appendix C.

Note that the responsibility for maintenance of all elements of the development remains with Gavacan Homes until handed over to the Management Company. Handover of the building to the Management Company typically takes place 4-8 weeks after the first occupation. Following the handover, the Management company is responsible for all aspects of the maintenance.

## Appendix A

### **Levels Layout, Drainage Layout and Construction Details**



**Surface Water Chamber Schedule**

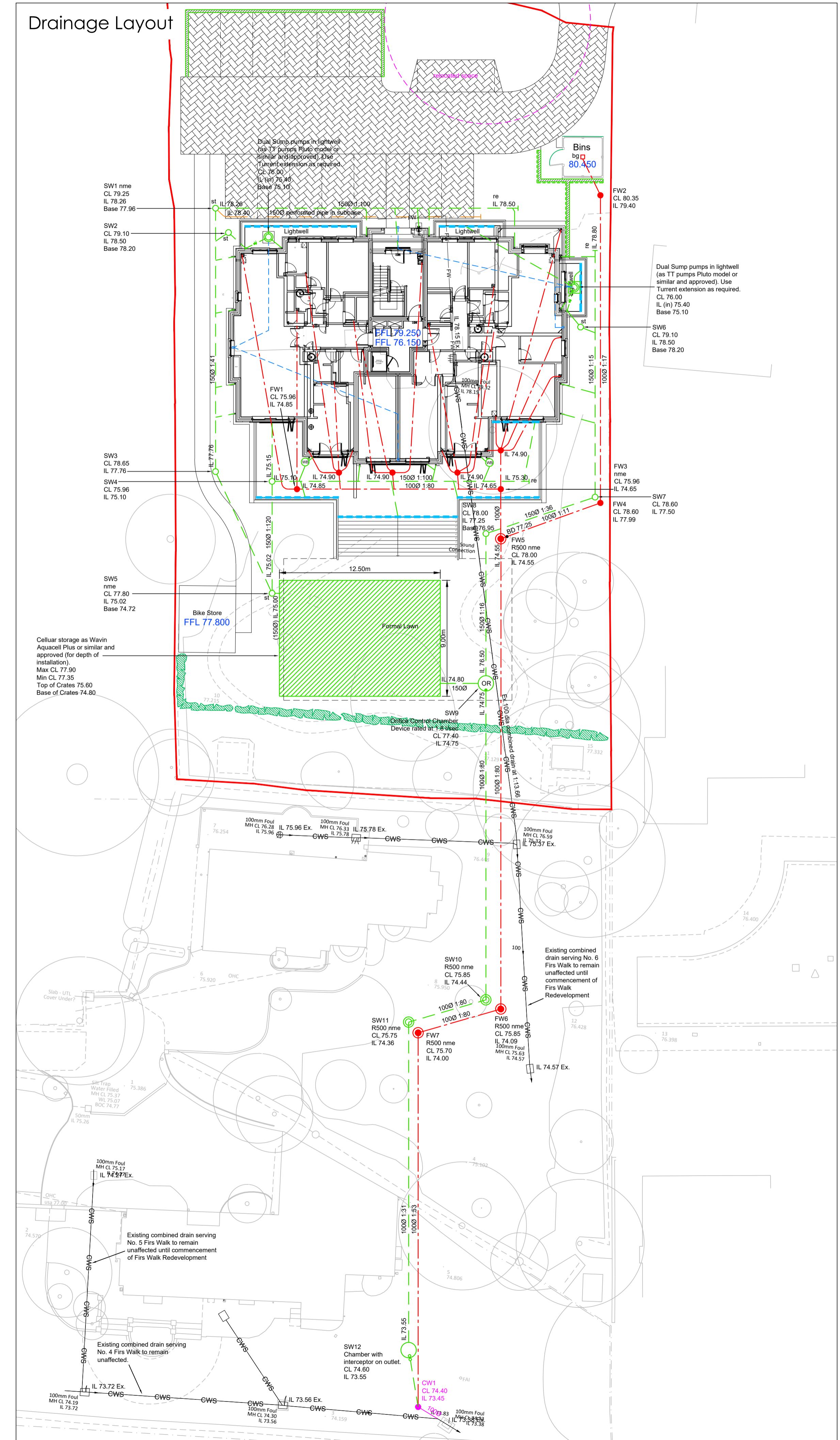
NO.	Cover Level	Invert Level	Chamber Type	Easting	Northing	Remarks
1	79.25	78.26	450 Silt Trap nme	508804.154	191724.798	300mm deep sump with non-man entry access cover
2	79.10	78.50	450 Silt Trap	508805.323	191723.006	300mm deep sump
3	78.65	77.76	450 IC	508805.981	191704.427	
4	75.96	75.10	450 IC	508810.423	191704.063	
5	77.80	75.02	450 IC nme	508811.199	191695.408	Non-man entry access cover
6	79.10	78.50	450 Silt Trap	508833.223	191718.139	300mm deep sump
7	78.60	77.50	450 IC	508835.526	191705.088	
8	78.00	77.25	450 Silt Trap	508827.334	191701.508	300mm deep sump
9	77.40	74.75	R500 Ridgstrom Orifice	508828.373	191689.920	Device rated 1 l/sec 32mm orifice size
10	75.85	74.44	R500 nme	508830.567	191665.451	Non-man entry access cover
11	75.75	74.36	R500 nme	508824.746	191663.197	Non-man entry access cover
12	74.60	73.55	1200 PCC	508827.021	191637.828	Interceptor to be included on outlet.

**Combined Water Chamber Schedule**

NO.	Cover Level	Invert Level	Chamber Type	Easting	Northing	Remarks
1	79.25	78.26	450 IC	508828.144	191633.498	

**Foul Water Chamber Schedule**

NO.	Cover Level	Invert Level	Chamber Type	Easting	Northing	Remarks
1	75.96	74.85	450 IC	508812.403	191703.636	
2	80.35	79.40	450 IC	508833.847	191728.470	
3	75.96	74.65	450 IC nme	508828.175	191705.050	Non-man entry access cover
4	78.60	77.99	450 IC	508835.981	191704.675	
5	78.00	74.55	R500 nme	508828.520	191701.210	Non-man entry access cover
6	75.85	74.09	R500 nme	508831.782	191664.846	Non-man entry access cover
7	75.70	74.00	R500 nme	508825.549	191662.433	Non-man entry access cover



**Key**

	Existing combined water drainage
	Private foul water drainage
	Private surface water drainage
	Private foul water discharge main
	Private surface water discharge main
	Subbase drain to permeable paving
	Cavity drainage outlets (taken from FIS design)
	Polypropylene universal inspection chamber 1200 deep max, 450 dia, 100 inlet / outlet connections (6 no. max) or 150 inlet/outlet connections (4 no max) as detailed on IDL/1005/07/02 construction details. Where greater than 1.2m deep chambers to be non-entry, 3000 deep max, 450 dia (with 300 dia, or square cover).
	Dual Sump pump in lightwell (as TT pumps Pluto model or similar and approved) and similar extension as required. C2, 70, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 210, 220, 230, 240, 250, 260, 270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420, 430, 440, 450, 460, 470, 480, 490, 500, 510, 520, 530, 540, 550, 560, 570, 580, 590, 600, 610, 620, 630, 640, 650, 660, 670, 680, 690, 700, 710, 720, 730, 740, 750, 760, 770, 780, 790, 800, 810, 820, 830, 840, 850, 860, 870, 880, 890, 900, 910, 920, 930, 940, 950, 960, 970, 980, 990, 1000, 1010, 1020, 1030, 1040, 1050, 1060, 1070, 1080, 1090, 1100, 1110, 1120, 1130, 1140, 1150, 1160, 1170, 1180, 1190, 1200, 1210, 1220, 1230, 1240, 1250, 1260, 1270, 1280, 1290, 1300, 1310, 1320, 1330, 1340, 1350, 1360, 1370, 1380, 1390, 1400, 1410, 1420, 1430, 1440, 1450, 1460, 1470, 1480, 1490, 1500, 1510, 1520, 1530, 1540, 1550, 1560, 1570, 1580, 1590, 1600, 1610, 1620, 1630, 1640, 1650, 1660, 1670, 1680, 1690, 1700, 1710, 1720, 1730, 1740, 1750, 1760, 1770, 1780, 1790, 1800, 1810, 1820, 1830, 1840, 1850, 1860, 1870, 1880, 1890, 1900, 1910, 1920, 1930, 1940, 1950, 1960, 1970, 1980, 1990, 2000, 2010, 2020, 2030, 2040, 2050, 2060, 2070, 2080, 2090, 2100, 2110, 2120, 2130, 2140, 2150, 2160, 2170, 2180, 2190, 2200, 2210, 2220, 2230, 2240, 2250, 2260, 2270, 2280, 2290, 2300, 2310, 2320, 2330, 2340, 2350, 2360, 2370, 2380, 2390, 2400, 2410, 2420, 2430, 2440, 2450, 2460, 2470, 2480, 2490, 2500, 2510, 2520, 2530, 2540, 2550, 2560, 2570, 2580, 2590, 2600, 2610, 2620, 2630, 2640, 2650, 2660, 2670, 2680, 2690, 2700, 2710, 2720, 2730, 2740, 2750, 2760, 2770, 2780, 2790, 2800, 2810, 2820, 2830, 2840, 2850, 2860, 2870, 2880, 2890, 2900, 2910, 2920, 2930, 2940, 2950, 2960, 2970, 2980, 2990, 3000, 3010, 3020, 3030, 3040, 3050, 3060, 3070, 3080, 3090, 3100, 3110, 3120, 3130, 3140, 3150, 3160, 3170, 3180, 3190, 3200, 3210, 3220, 3230, 3240, 3250, 3260, 3270, 3280, 3290, 3300, 3310, 3320, 3330, 3340, 3350, 3360, 3370, 3380, 3390, 3400, 3410, 3420, 3430, 3440, 3450, 3460, 3470, 3480, 3490, 3500, 3510, 3520, 3530, 3540, 3550, 3560, 3570, 3580, 3590, 3600, 3610, 3620, 3630, 3640, 3650, 3660, 3670, 3680, 3690, 3700, 3710, 3720, 3730, 3740, 3750, 3760, 3770, 3780, 3790, 3800, 3810, 3820, 3830, 3840, 3850, 3860, 3870, 3880, 3890, 3900, 3910, 3920, 3930, 3940, 3950, 3960, 3970, 3980, 3990, 4000, 4010, 4020, 4030, 4040, 4050, 4060, 4070, 4080, 4090, 4100, 4110, 4120, 4130, 4140, 4150, 4160, 4170, 4180, 4190, 4200, 4210, 4220, 4230, 4240, 4250, 4260, 4270, 4280, 4290, 4300, 4310, 4320, 4330, 4340, 4350, 4360, 4370, 4380, 4390, 4400, 4410, 4420, 4430, 4440, 4450, 4460, 4470, 4480, 4490, 4500, 4510, 4520, 4530, 4540, 4550, 4560, 4570, 4580, 4590, 4600, 4610, 4620, 4630, 4640, 4650, 4660, 4670, 4680, 4690, 4700, 4710, 4720, 4730, 4740, 4750, 4760, 4770, 4780, 4790, 4800, 4810, 4820, 4830, 4840, 4850, 4860, 4870, 4880, 4890, 4900, 4910, 4920, 4930, 4940, 4950, 4960, 4970, 4980, 4990, 5000, 5010, 5020, 5030, 5040, 5050, 5060, 5070, 5080, 5090, 5100, 5110, 5120, 5130, 5140, 5150, 5160, 5170, 5180, 5190, 5200, 5210, 5220, 5230, 5240, 5250, 5260, 5270, 5280, 5290, 5300, 5310, 5320, 5330, 5340, 5350, 5360, 5370, 5380, 5390, 5400, 5410, 5420, 5430, 5440, 5450, 5460, 5470, 5480, 5490, 5500, 5510, 5520, 5530, 5540, 5550, 5560, 5570, 5580, 5590, 5600, 5610, 5620, 5630, 5640, 5650, 5660, 5670, 5680, 5690, 5700, 5710, 5720, 5730, 5740, 5750, 5760, 5770, 5780, 5790, 5800, 5810, 5820, 5830, 5840, 5850, 5860, 5870, 5880, 5890, 5900, 5910, 5920, 5930, 5940, 5950, 5960, 5970, 5980, 5990, 6000, 6010, 6020, 6030, 6040, 6050, 6060, 6070, 6080, 6090, 6100, 6110, 6120, 6130, 6140, 6150, 6160, 6170, 6180, 6190, 6200, 6210, 6220, 6230, 6240, 6250, 6260, 6270, 6280, 6290, 6300, 6310, 6320, 6330, 6340, 6350, 6360, 6370, 6380, 6390, 6400, 6410, 6420, 6430, 6440, 6450, 6460, 6470, 6480, 6490, 6500, 6510, 6520, 6530, 6540, 6550, 6560, 6570, 6580, 6590, 6600, 6610, 6620, 6630, 6640, 6650, 6660, 6670, 6680, 6690, 6700, 6710, 6720, 6730, 6740, 6750, 6760, 6770, 6780, 6790, 6800, 6810, 6820, 6830, 6840, 6850, 6860, 6870, 6880, 6890, 6900, 6910, 6920, 6930, 6940, 6950, 6960, 6970, 6980, 6990, 7000, 7010, 7020, 7030, 7040, 7050, 7060, 7070, 7080, 7090, 7100, 7110, 7120, 7130, 7140, 7150, 7160, 7170, 7180, 7190, 7200, 7210, 7220, 7230, 7240, 7250, 7260, 7270, 7280, 7290, 7300, 7310, 7320, 7330, 7340, 7350, 7360, 7370, 7380, 7390, 7400, 7410, 7420, 7430, 7440, 7450, 7460, 7470, 7480, 7490, 7500, 7510, 7520, 753

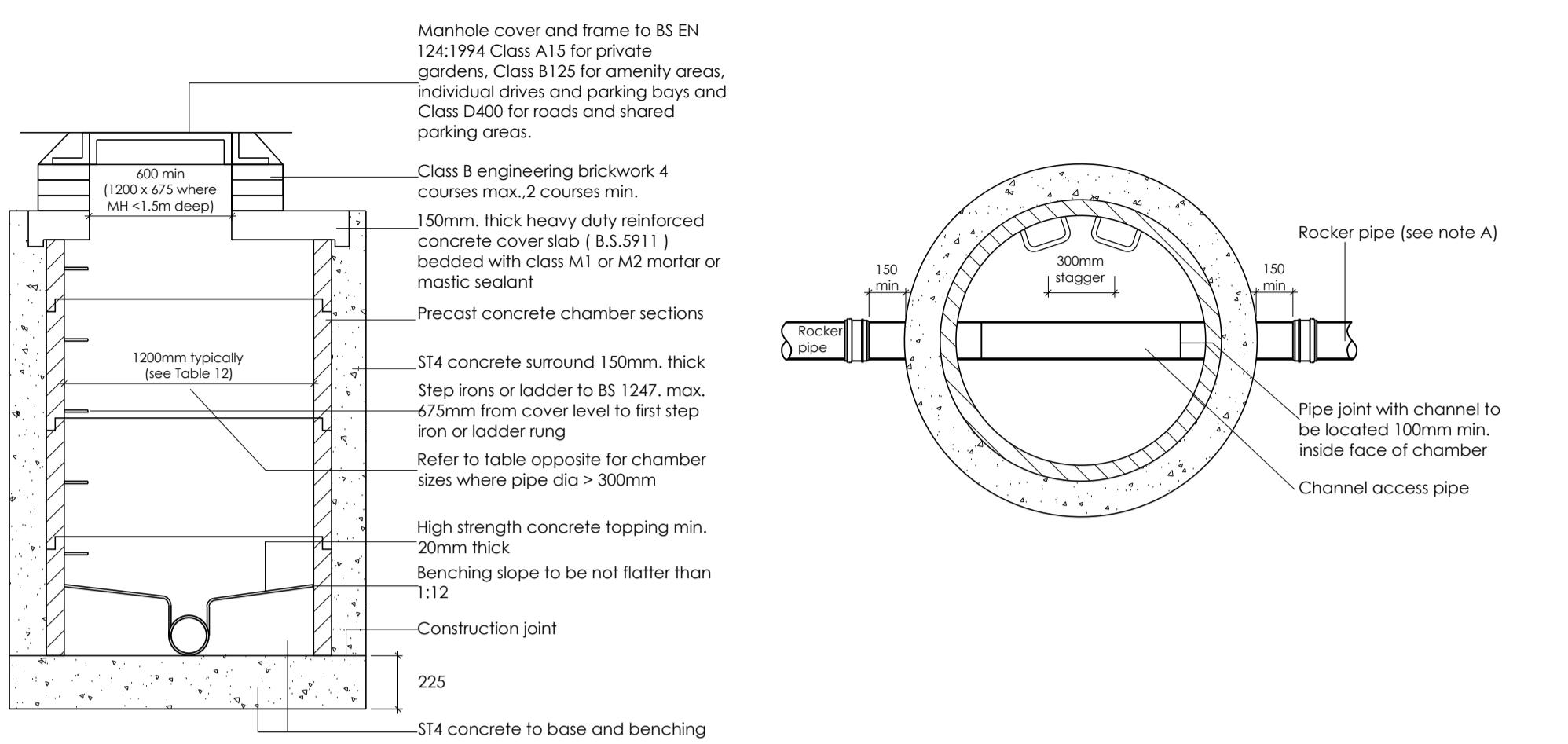


## Notes

- This drawing is to be read in conjunction with the private and drainage construction details.
- All private drainage works to be carried out in accordance with the provisions laid down in BS EN 752 & The Building Regulations, Part H.
- Levels shown in buildings are Finished Floor Level.
- Drainage under adopted roads to be either:
  - Vitrified Clayware to BSEN295.
  - Concrete to BS 5911, Class M. Laterals to be formed of either vitrified clay or 'Extra Strength', concrete 'Class M'.
- Before commencing any sewer or drainage works, the Developer's Groundworker must satisfy themselves, the developer and the Local Authority of actual levels and conditions of existing works.
- Buried concrete to satisfy the requirements of BRE Special Digest 1 as predetermined by the site's Geotechnical Report
- All concrete buried structures, constructed during the construction of Highway & Drainage Works are to be broken out to bed level of roads and sewers, and to the formation of car parks and drives etc., and to sufficient depth to allow for laying service company's mains and services.
- Depth and Location of existing services to be traced prior to any excavation.
- All private drainage to be laid to levels shown using flexibly jointed pipes, either UPVC to BS 6660 and BS 5481 or vitrified clayware to BS 295.
- Generally pipes to have granular Bed & Surround in accordance with manufacturers recommendations, ensuring adequate protection with respect to depth and location. Where bedding material is placed at depths susceptible to ground water ingress, it is to be wrapped in a geotextile (Teram 700 or better).
- Preformed concrete manholes and catchpits to be constructed using conc. box sections or circular rings to BS 5911-200, with 150mm conc. surround, size and construction to comply with Table 12 of Approved Document, Part H.
- Rodding eyes, etc. to be laid to manufacturers minimum cover and depth to allow adequate fall from adjoining unit.
- Access panels are to be provided to all rainwater pipes, a max. 600 above finished ground level.
- All manholes / inspection chambers in block paved areas, to have recessed covers. These are to be orientated such as to minimise cut blocks.
- All pipework to be 100mmØ (150Ø from road gullies) unless otherwise stated.
- All levels in metres (m) unless specified otherwise.
- All drain and invert levels shown are in metres. All pipe diameters are in millimetres U.N.C.
- All chambers located in trafficked areas to have concrete surround as detailed on IDL/1005/07 construction details.
- IMPORTANT NOTE:**  
At depths where groundwater ingress is encountered, consider the use of a sump / pump arrangement. Advice and a Geotechnical Report to be made to the Interpretative Geotechnical Report for supplementary measures in such instances.  
Where excavations are >1m deep, consider the use of full perimeter trench support.
- IMPORTANT NOTE:**  
The new sewer connections are to be successfully made prior to commencing any upstream drainage works.

TABLE 11 MIN. DIMENSIONS FOR ACCESS FITTINGS AND INSPECTION CHAMBERS					
TYPE	DEPTH TO INVERT FROM COVER LEVEL (m)	INTERNAL SIZES		COVER SIZES	
		RECTANGULAR LENGTH AND WIDTH	CIRCULAR DIAMETER	RECTANGULAR LENGTH AND WIDTH	CIRCULAR DIAMETER
Rodding Eye		As drain but min 100			Same size as pipework (1)
Access Fittings small	0.4 or less, except where situated in a chamber	150x100	150	150x100 (1)	Same size as access fitting
large	1.50x100	225x100	225	225x100 (1)	
Inspection Chamber Shallow	0.6 or less	225x100	190 (1)	-	190 (1)
Deep	1.2 or less	450x450	450	430	430
	>1.2 but <3.0	450x450	450	max 300x300 (1)	Access restricted to max 350 (1)

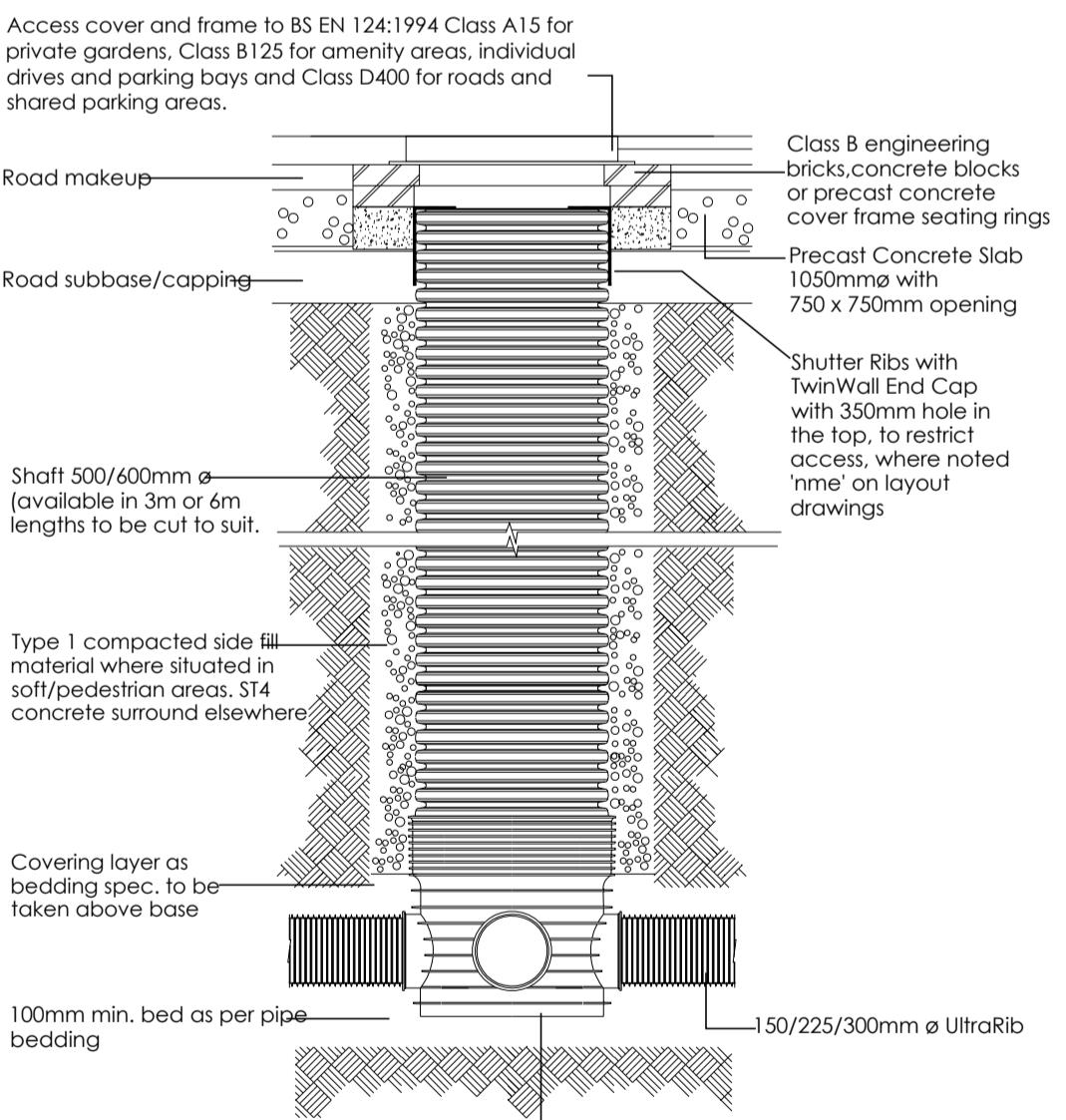
Notes:  
 (1) The clear opening may be reduced by 20mm in order to provide proper support for the cover and frame.  
 (2) Drains upto 150mm.  
 (3) A larger clear opening may be used in conjunction with a restricted access. The size is restricted for health and safety reasons to deter entry.



Typical Precast Concrete Manhole Detail

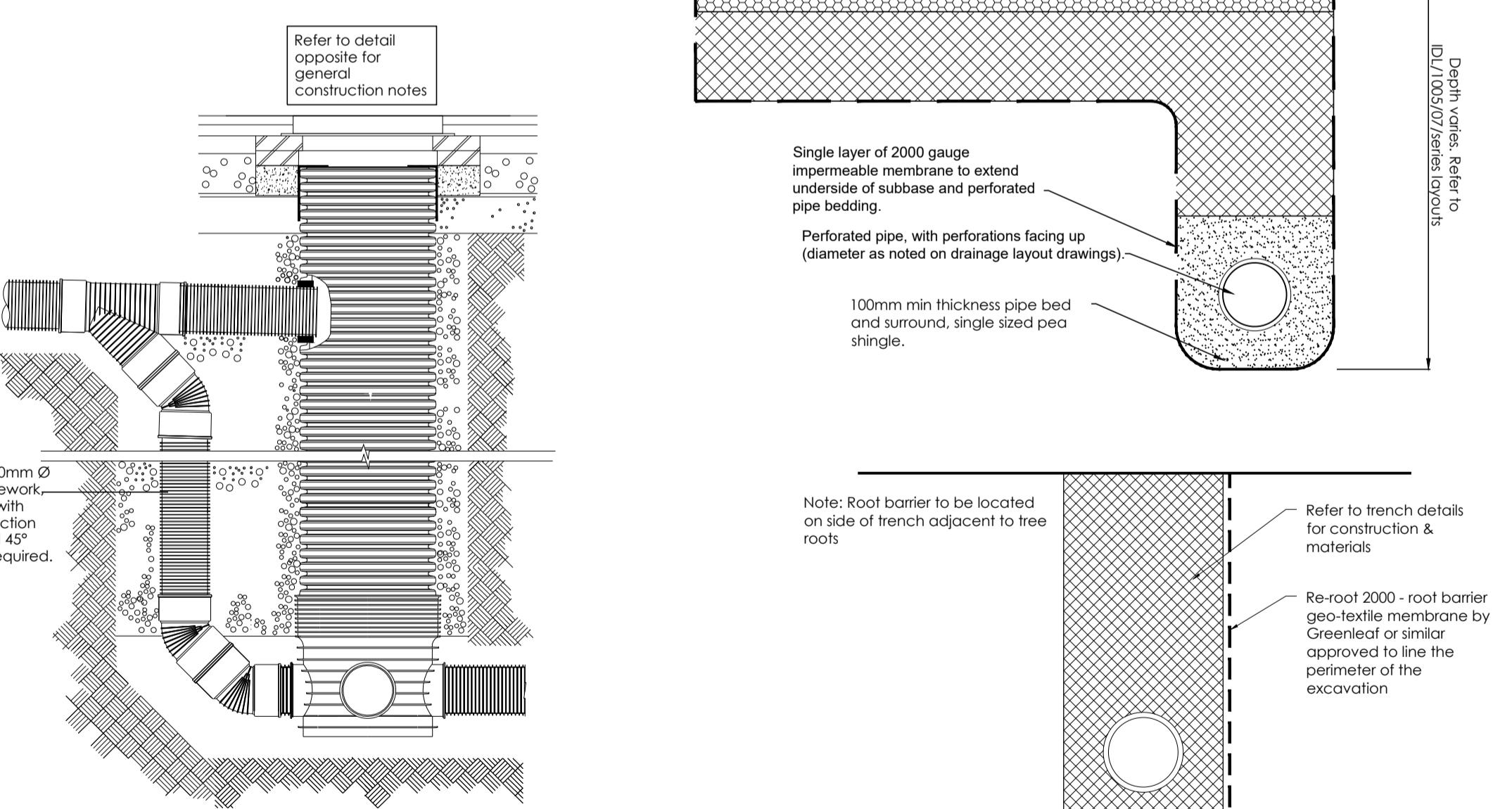
TABLE 12 MINIMUM DIMENSIONS FOR MANHOLES					
TYPE	SIZE OF LARGEST PIPE (DN)	MIN. INTERNAL DIMENSIONS (1)		MIN. CLEAR OPENING SIZE (1)	
		RECTANGULAR LENGTH AND WIDTH	CIRCULAR DIAMETER	RECTANGULAR LENGTH AND WIDTH	CIRCULAR DIAMETER
MANHOLE <1.5m deep to soffit	<= 150	750 x 675 (7)	1000 (7)	750 x 675 (2)	na (3)
	225	1200 x 675	1200	1200 x 675 (2)	
	300	1200 x 750	1200		
	>300	1800 x (DN+450)	The larger of 1800 or (DN+450)		
>1.5m deep to soffit	<= 225	1200 x 1000	1200	600 x 600	600
	300	1200 x 1075	200		
	375-450	1350 x 1225	1200		
	>450	1800 x (DN+775)	The larger of 1800 or (DN+775)		
MANHOLE SHAFT (4)	Steps (5)	1050 x 800	1050	600 x 600	600
>3.0m deep to soffit of pipe	Ladder (5)	1200 x 800	1200		
	Winch (6)	900 x 800	900	600 x 600	600

Notes:  
 (1) Larger sizes may be required for manholes on bends or where there are junctions.  
 (2) May be reduced to 400 by 600 where required by highway loading considerations, subject to a safe system of work being specified.  
 (3) Not applicable due to working space needed.  
 (4) Minimum height of chamber in shafted manhole 2m from benching to underside of reducing slab.  
 (5) Min clear space between ladder or steps and the opposite face of the shaft should be 600mm.  
 (6) Winch only - no steps of ladders, permanent or removable.  
 (7) The minimum size of any manhole serving a sewer (i.e. any drain serving more than one property) should be 1200mm x 675mm rectangular or 1200mm diameter.

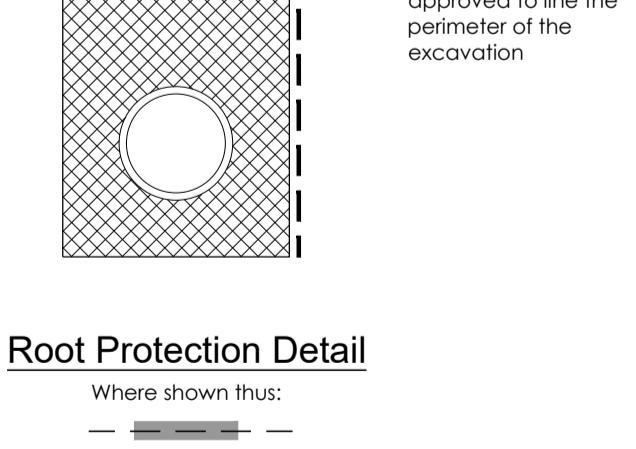


Messrs Wavin 'Range500 or Range600' Inspection chamber

For use in any trafficked areas (up to D400 rating) and / or where pipe diameters >150 and up to 300mm dia. Range500 suitable for 100 and 150mm dia pipes. Range600 suitable also for 225 and 300mm diameter pipes. Where noted 'R500' or 'R600' on layouts.



Messrs Wavin 'Range500 or Range600' IC with External Backdrop



Root Protection Detail

Where shown thus:

2 Orifice control manhole added 01.03.23  
1 Issued for comment. 27.10.22

REV DESCRIPTION DATE  
SCALE: 1:200@A1  
DATE: Oct 2022  
DRAWN: IDL  
TITLE: Drainage Details Sheet 2 of 2

PROJECT: Dene Road, Northwood  
Client: Gavacan Homes  
Draw No.: IDL/1005/07/06 Rev 2

Ref. No.: 1005-07-06

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**Appendix B**

**Surface Water Drainage Calculations**

**Design Settings**

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

**Nodes**

Name	Area (ha)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.110	77.400	1200	1.000	1.000	2.600

**Simulation Settings**

Rainfall Methodology	FEH-13	Analysis Speed	Normal	Additional Storage (m <sup>3</sup> /ha)	20.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	240	Check Discharge Volume	x

**Storm Durations**

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

**Node 1 Online Orifice Control**

Flap Valve	x	Design Depth (m)	1.200	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	1.8		
Invert Level (m)	74.750	Diameter (m)	0.032		

**Node 1 Depth/Area Storage Structure**

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	74.800
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )
0.000	112.5	0.0	0.400	112.5	0.0	0.800	112.5	0.0	0.801	0.0	0.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.57%

Node	Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
120 minute winter		1	114	74.893	0.093	5.0	10.2291	0.0000	OK
<hr/>									
<hr/>									
Link Event		US	Link	Outflow	Discharge				
(Upstream Depth)		Node		(l/s)	Vol (m <sup>3</sup> )				
120 minute winter		1	Orifice	0.8	12.9				

Results for 2 year Critical Storm Duration. Lowest mass balance: 98.29%

Node	Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
240 minute winter		1	188	74.922	0.122	3.8	13.3079	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m <sup>3</sup> )
240 minute winter	1	Orifice	0.8	18.7

Results for 30 year Critical Storm Duration. Lowest mass balance: 98.29%

Node	Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
240 minute winter		1	228	75.135	0.335	8.6	36.4990	0.0000	OK

Link	Event	US (Upstream Depth)	Link Node	Outflow (l/s)	Discharge Vol (m <sup>3</sup> )
	240 minute winter		1 Orifice	1.3	29.4

Results for 100 year Critical Storm Duration. Lowest mass balance: 98.29%

Node	Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
240 minute winter		1	232	75.267	0.467	11.4	50.8537	0.0000	OK

Link	Event	US (Upstream Depth)	Link Node	Outflow (l/s)	Discharge Vol (m <sup>3</sup> )
	240 minute winter		1 Orifice	1.5	34.4

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 98.29%

Node	Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
360 minute winter		1	336	75.486	0.686	11.8	74.7080	0.0000	OK

Link	Event	US (Upstream Depth)	Link Node	Outflow (l/s)	Discharge Vol (m <sup>3</sup> )
	360 minute winter		1 Orifice	1.8	50.1

## **Appendix C – Maintenance and Management Requirements**

### **The Management Company**

The responsibility for maintenance of all elements of the development remains with Gavacan Homes until handed over to the Management Company. Following the handover, the Management Company is responsible for all aspects of the maintenance. Handover of the building to the Management Company typically takes place 4-8 weeks after the first occupation. At handover, the Management Company and Managing Agent receive as-built information and operating and maintenance manuals detailing all maintenance protocols.

Within the first two years from the first occupation, there is a two-year warranty on the communal parts of the building. There is also a two-year warranty on the individual apartments, which commences from the date of legal completion of the individual apartment. Defects should be reported to the House Manager, who is an employee of the Management Company, and they will log the defect with Gavacan Home's Customer Services team

### **Crate Attenuation system (and surface water drainage system generally)**

The principle means of surface water disposal from the development is by way of attenuation to the infiltration techniques. Surface water storage will take the form of buried crate soakaway-based storage system

The Management Company will ensure that the following measures are undertaken to ensure the longevity of the surface water drainage system;

#### **Quarterly**

- i) Inspect the performance of the cellular system by lifting the cover of the chamber(s) immediately upstream of each feature and check that the outlet pipe (into the crates) is free of obstruction and visible (ie not submerged). If the outlet pipe is submerged then remedial action may be required. Remedial advice to be sought from a suitably qualified consulting infrastructure engineer.

#### **Every 6 months**

- i) Remove silt build up from ***all*** catchpits and silt traps

#### **Annually**

- i) Select approx. 20% of the development's surface water inspection chambers (situated in accessible non-private areas) and inspect for blockages / silt build up. Remove silt and debris. Rotate on a 5 yearly cycle to cover all such chambers over this period.

#### **Every 2-5 years (depending on outcome of aforementioned inspections)**

- i) Commission a CCTV survey and report on condition of the surface water piped drainage system upstream of the soakaways to check for structural integrity and hydraulic fluidity. Carry out promptly any remedial work as advised by CCTV company.

### **Permeable Paving**

Access Roads and parking areas are to be constructed of permeable block paving. This approach serves to;

- a) Delay the surface water runoff from these areas, into the ground below, and
- b) Enhance the quality of the rainwater percolating through the surface before discharging into the downstream drainage system.

The Management Company will ensure that the following measures are undertaken to ensure the longevity of the pervious pavement;

#### **Quarterly**

- i) Inspect the pervious pavement for signs of ponding and ensure there is no migration of soils from adjacent landscaped areas or other deleterious material that may prematurely clog up the jointing stone situated in the gaps between the blocks. Ideally this type of inspection should be undertaken immediately following a heavy rainfall event.

- ii) Commission vacuum sweeping and brushing of the pervious pavement to ensure joints are kept free of silt. Minimum 3 sweeping per year, thus;
  - a) End of Winter (April) – to collect winter debris
  - b) Mid-Summer (July/August) – to collect dust, flower and grass-type deposits.
  - c) After Autumn leaf fall (November)

The company commissioned to carry out this work should ensure that their vacuum equipment is adjusted accordingly to avoid removal of jointing material. Any lost material should be replaced promptly to avoid the blocks from being dislodged.

#### **Last Resort Remedial Action**

- i) Should a portion of the pervious pavement become substantially impervious due to excessive siltation, the following procedure should be followed;
  - a) Lift block paving and laying course
  - b) Break out underlying bitmac base layer and replace with similar compacted depth of course aggregate subbase material to BS EN 13242:2002 Type 4/20, wrapped in geotextile as Terram 1000 or similar.
  - c) Renew laying course, replace blocks and renew jointing material

NB. Material removed from the voids or the layers below the surface may contain heavy metals and hydrocarbons and as such may need to be disposed of as 'controlled waste'. Sediment testing should be carried out before disposal to confirm its classification and appropriate disposal methods.

#### **Flow Control Chamber (Orifice Manhole)**

Flow control chambers are to be maintained. Their maintenance regime shall be as follows:

Following installation of the Flow Controls any extraneous material i.e. Building materials are removed from the unit and the chamber. After the system is made live, the unit is to be inspected monthly for three months and thereafter at six monthly intervals with hose down if required.

The chambers are to be cleared checked for structural integrity at the six monthly interval. Any damage/problems should be made good as per the original design drawings.