Catena Rise - Surface Water Drainage Report

For the proposed development site located at:
Adjacent to: 1, Catena Rise, Lightwater, GU18 5RD
NGR 492914,162339

Client: Mr Rowly Brooks

Contents

Howard Lawton.
Orchard Developments and Consultancy
Former Environment Agency Flood Defence Engineer 1983-2020
[redacted] Orchard Barn Crosthwaite, Kendal Cumbria LA88HS – Mob [redacted]

Background

This statement is being prepared to comply with Planning Condition 8 on the decision notice for the "Erection of a detached, two bedroom dwelling with associated parking" on Land adjacent to 1 Catena Rise Lightwater GU18 5RD. Condition 8 states that:-

The development hereby permitted shall not commence until details of the design of a surface water drainage scheme have been submitted to and approved in writing by the planning authority. The design must satisfy the SuDS Hierarchy and be compliant with the national Non-Statutory Technical Standards for SuDS, NPPF and Ministerial Statement on SuDS. The required drainage details shall include:

a) Detailed drainage design drawings and calculations to include: a finalised drainage layout detailing the location of drainage elements, pipe diameters, levels, and long and cross sections of each element including details of any flow restrictions and maintenance/risk reducing features (silt traps, inspection chambers etc)

b) Details of how the drainage system will be protected during construction and how runoff (including any pollutants) from the development site will be managed before the drainage system is operational.

c) Details of drainage management responsibilities and maintenance regimes for the drainage system.

d) A plan showing exceedance flows (i.e. during rainfall greater than design events or during blockage) and how property on and off site will be protected. the developer should submit details of the sustainable drainage systems being installed on this site.

We have reviewed DEFRA's advice on Sustainable Drainage Systems (SUDS, March 2015) which is a non-statutory technical guidance. The proposals within this report are compliant with the technical guidance recommendations.

For the purposes of the report the "design storm" for the drainage system will be the 1 in 100-years 30min duration event + climate change. All references to the "design storm" within this report will be for this storm unless otherwise stated.

Note: All levels within this document are A.O.D.

Existing Situation

The site area for the proposed detached property is 240m2 and is currently a combination of unmaintained grass and concrete / tarmac hard standing that had until recently housed 2 detached garages as shown opposite. The impervious areas of the site currently cover 72m2 (or 30%) with the remaining 168m2 being free draining grass areas.

As a starting point and to show how the development will ultimately reduce site run off, calculations have been undertaken for both the current and proposed situation. Table 1 below indicates the runoff that would be expected from this site in its current configuration for both the "design storm" (highlighted) and for other storm events. The rainfall figures used in this and all other calculations within this report are based on recommendations contained within BRE365, a rainfall calculations explanatory note can be found on page 9.

Table 1 – Current discharge rates for the site

Calculate Design Storm for: Catena Rise (Existing)

"r" Value from rainfall data map "60min 2day rainfall that can be expected every 5 years" = 0.400

M5-60 rainfall for England = 20.00 mm

Table below shows the extrapolated rainfall values for a range of 1 in 100 year events including climate change at 40%

Storm duration D-min	Storm duration seconds	England M5-60min rate mm	"r" from table Z1	M5-D (20xZ1) mm	Z2 (interoperate from table Z2)	M100-D mm	+40% Climate Change mm
15	900	20	0.633	12.66	1.96	24.81	34.74
30	1800	20	0.803	16.06	2.00	32.12	44.97
60	3600	20	1.000	20.00	2.03	40.60	56.84
120	7200	20	1.207	24.14	2.01	48.52	67.93
240	14400	20	1.447	28.94	1.97	57.01	79.82
360	21600	20	1.603	32.06	1.95	62.52	87.52

Calculate total storm volumes

M100 Rainfall Totals + 40% climate change

Storm duration D-min	Rainfall intensity	Proposed sites Impermeable Area m2	Storm duration in seconds	This is the total m3 for the storms duration	Average impermeable site discharge ltr/s
15	34.74	72	900	2.50	2.78
30	44.97	72	1800	3.24	1.80
60	56.84	72	3600	4.09	1.14
120	67.93	72	7200	4.89	0.68
240	79.82	72	14400	5.75	0.40
360	87.52	72	21600	6.30	0.29

Proposed Development

Detached 2 Bedroom Property and Associated Parking Areas
Development Impermeable area 41m2
Overall development site area 240m2

The sites impermeable area comprises wholly of the new properties roof, with the remaining 199m2 comprising of 62m2 of pervious block pavers and 137m2 of free draining lawn and garden.

Table 2 below shows the runoff that would be expected from the developed site and indicates the reduced run off the development gives before any management of runoff is considered. It can be seen from the two tables that for the “design storm” the site reduces its runoff from 1.8 ltr/s to 1.02 ltr/s.

Table 2 – Site discharge improvements resulting from increased permeability.

Calculate Design Storm for: Catena Rise (Proposed)

"r" Value from rainfall data map "60min 2day rainfall that can be expected every 5 years" = 0.400

M5-60 rainfall for England = 20.00 mm

Table below shows the extrapolated rainfall values for a range of 1 in 100 year events including climate change at 40%

Storm duration D-min	Storm duration seconds	England M5-60min rate mm	"r" from table Z1	M5-D (20xZ1) mm	Z2 (interoperate from table Z2)	M100-D mm	+40% Climate Change mm
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360	21600	20	1.603	32.06	1.95	62.52	87.52

Calculate total storm volumes

M100 Rainfall Totals + 40% climate change

Storm duration D-min	Rainfall intensity	Proposed sites Impermeable Area m2	Storm duration in seconds	This is the total m3 for the storms duration	Average impermeable site discharge ltr/s
15	34.74	41	900	1.42	1.58
30	44.97	41	1800	1.84	1.02
60	56.84	41	3600	2.33	0.65
120	67.93	41	7200	2.79	0.39
240	79.82	41	14400	3.27	0.23
360	87.52	41	21600	3.59	0.17

Surface Water Management

This relatively small site is constrained to all sides and does not have the required open space to comply with soakaway proximity regulations, and with no adjacent watercourses the only practical way to manage flows is an attenuation system discharge to the Thames Water sewer in Catena Rise.. The proposed system will provide attenuation within extended drainage runs (see details on page 5) and will have an orifice plate controlled discharge (see details on page 7). The final connection to the 150mm diameter foul sewer will be via an existing 100mm diameter surface water connection servicing 1 Catena Rise; the connection (by owner agreement) will be made into an existing surface water manhole as shown on Page 5.

In addition to the nett gains made due to the positive reconfiguration of the site the surface water drainage will also provide further benefits, these benefits will however be limited due to the small flows involved. In order to restrict flows water management devices need to be used, for this site a 50mm orifice plate will be installed.

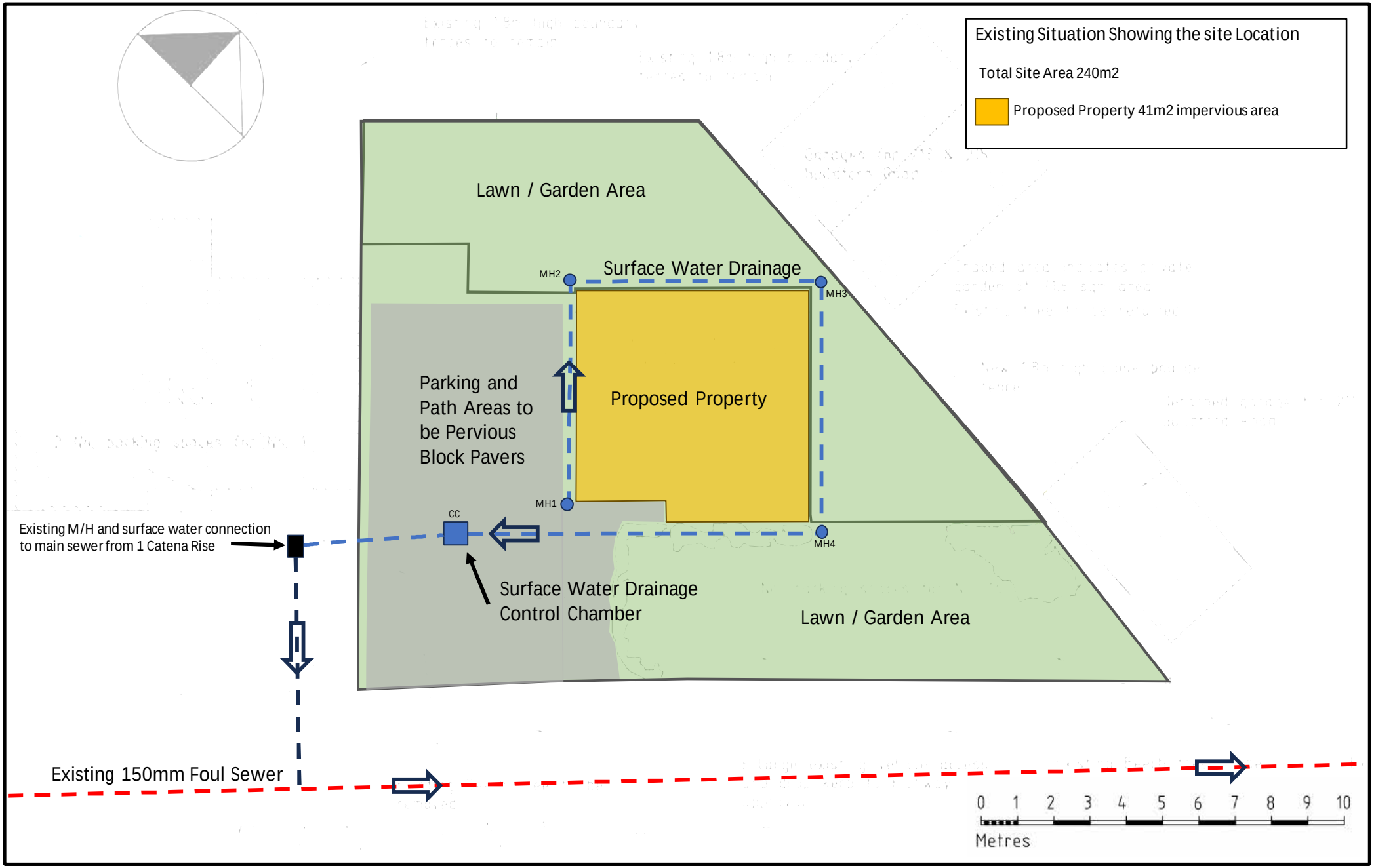
Orifice plates with aperture sizes below 50mm are extremely vulnerable to blockages and this is the reason for the selected size.
The attenuation system as designed will discharge an average of 0.99 ltr/s which is less than the 1.02 ltr/s from the unattenuated flow. This relatively modest reduction is a consequence of the need to provide a 50mm orifice plate, a further consequence of the plate size is the limited requirement for storage as can be seen in the discharge Table 3 below.

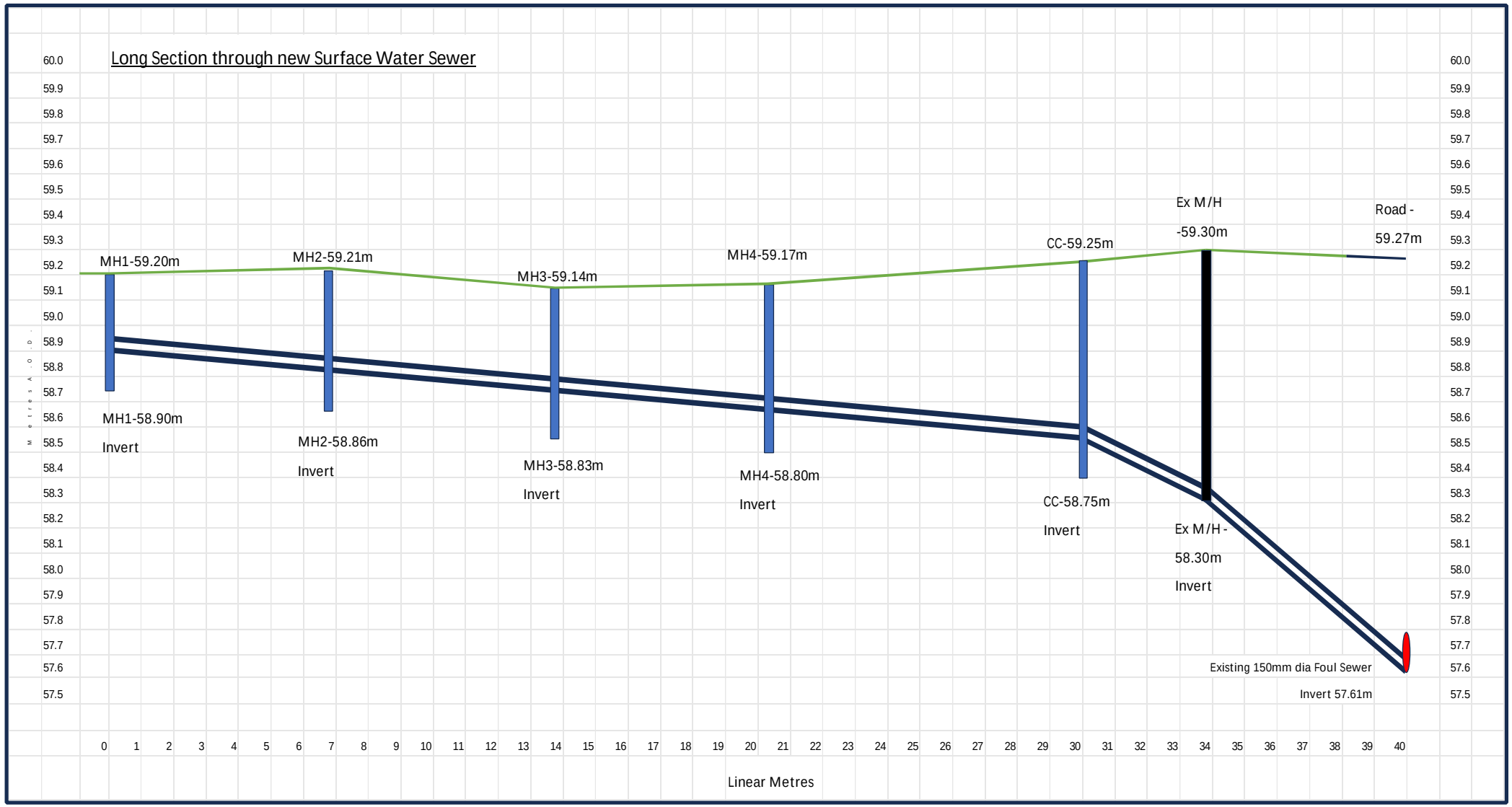
Table 3 – Actual Attenuation Discharge

System Characteristics		
Length of pipe / storage vessel	30.000	m
Diameter of storage pipe	0.100	m
Total pipe fall	0.150	m
Slope adjustment factor	2.500	-
Actual pipe capacity	0.236	m3
Diameter of orifice plate	50.000	mm

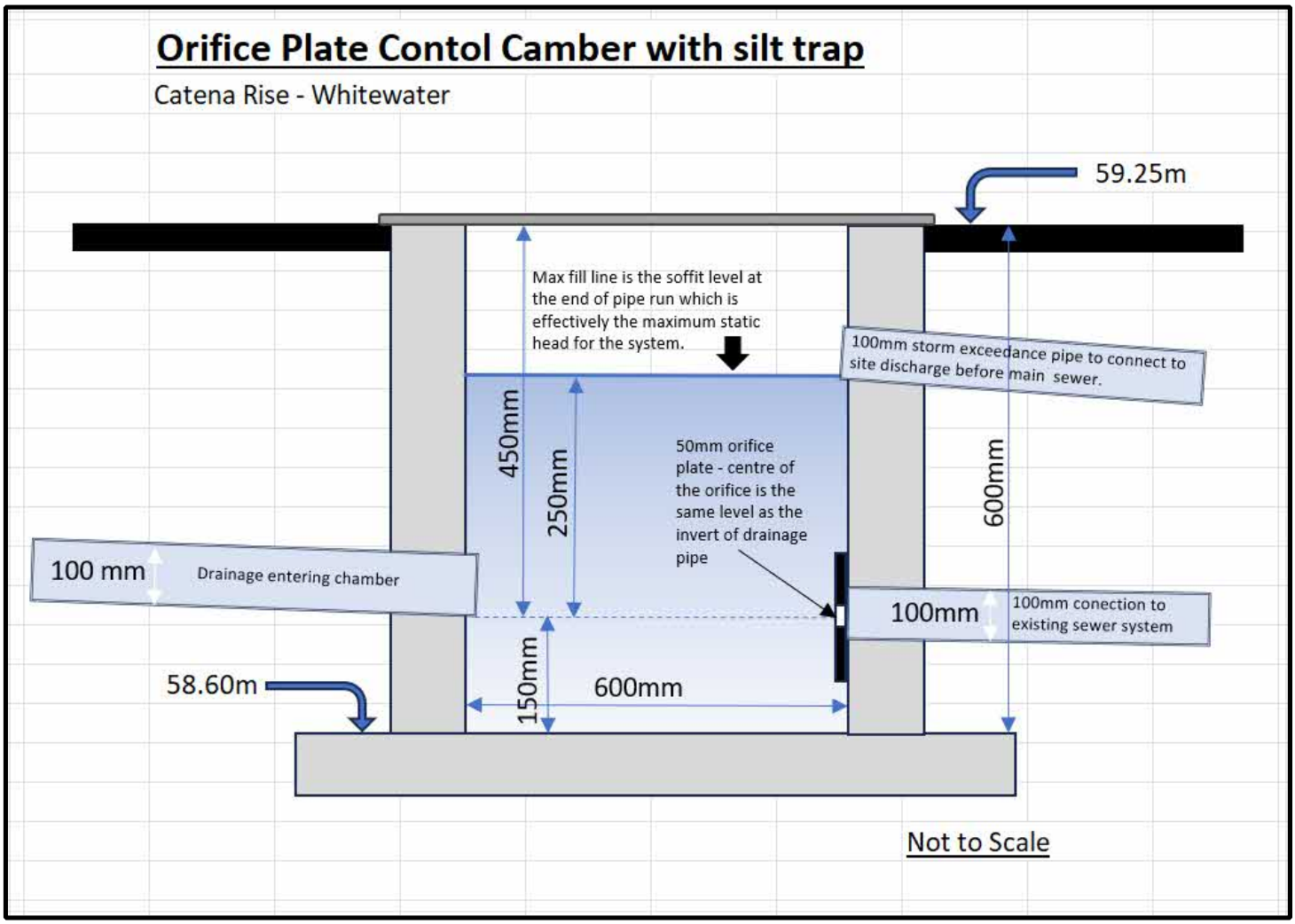
Total storm Volume m3 ↓	minutes	Vol in tank for design storm / m	Adjusted volume post discharge	Water depth in attenuation pipe for adjusted vol	water depth adjusted because of slope	Discharge m3/s through 41mm orifice plate	Discharge lt/s through 41mm orifice plate	Discharge through plate m3/min	Cumulative discharge total m3	Pipe capacity used
1.84	0	0	0	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0%
0.06133	1	0.0613	0.0149	18.78	46.95	0.0008	0.7732	0.0464	0.0464	9%
↑	2	0.12	0.0763	33.35	83.38	0.0013	1.2610	0.0757	0.1221	11%
	3	0.18	0.0619	33.46	83.65	0.0013	1.2639	0.0758	0.1979	9%
	4	0.25	0.0474	28.25	70.63	0.0011	1.1148	0.0669	0.2648	7%
volume	5	0.31	0.0419	24.46	61.15	0.0010	0.9923	0.0595	0.3243	6%
entering	6	0.37	0.0437	23.72	59.30	0.0010	0.9666	0.0580	0.3823	6%
/min for 30	7	0.43	0.0470	24.73	61.83	0.0010	1.0015	0.0601	0.4424	7%
min storm	8	0.49	0.0483	25.60	64.00	0.0010	1.0307	0.0618	0.5042	7%
	9	0.55	0.0478	25.50	63.75	0.0010	1.0274	0.0616	0.5659	7%
	10	0.61	0.0475	25.59	63.98	0.0010	1.0303	0.0618	0.6277	7%
	11	0.67	0.0470	25.44	63.60	0.0010	1.0254	0.0615	0.6892	7%
	12	0.74	0.0468	25.31	63.28	0.0010	1.0210	0.0613	0.7505	7%
	13	0.80	0.0469	25.29	63.23	0.0010	1.0204	0.0612	0.8117	7%
	14	0.86	0.0470	25.33	63.33	0.0010	1.0217	0.0613	0.8730	7%
	15	0.92	0.0470	25.35	63.38	0.0010	1.0224	0.0613	0.9344	7%
	16	0.98	0.0470	25.35	63.38	0.0010	1.0224	0.0613	0.9957	7%
	17	1.04	0.0470	25.35	63.38	0.0010	1.0224	0.0613	1.0570	7%
	18	1.10	0.0470	25.35	63.38	0.0010	1.0224	0.0613	1.1184	7%
	19	1.17	0.0470	25.35	63.38	0.0010	1.0224	0.0613	1.1797	7%
	20	1.23	0.0469	25.35	63.38	0.0010	1.0224	0.0613	1.2411	7%
	21	1.29	0.0469	25.35	63.38	0.0010	1.0224	0.0613	1.3024	7%
	22	1.35	0.0469	25.35	63.38	0.0010	1.0224	0.0613	1.3637	7%
	23	1.41	0.0469	25.35	63.38	0.0010	1.0224	0.0613	1.4251	7%
	24	1.47	0.0469	25.35	63.38	0.0010	1.0224	0.0613	1.4864	7%
	25	1.53	0.0469	25.35	63.38	0.0010	1.0224	0.0613	1.5478	7%
	26	1.59	0.0469	25.35	63.38	0.0010	1.0224	0.0613	1.6091	7%
	27	1.66	0.0469	25.35	63.38	0.0010	1.0224	0.0613	1.6705	7%
	28	1.72	0.0469	25.35	63.38	0.0010	1.0224	0.0613	1.7318	7%
	29	1.78	0.0469	25.35	63.38	0.0010	1.0224	0.0613	1.7931	7%
30 min totals	30	1.84	0.05	25.35	63.38	0.0010	1.0224	0.0613	1.8545	7%
			Average discharge through plate for the 1800 seconds of the storm is						0.9970	lt/s

The plans and cross sections below will detail how the attenuation system will be laid out. It should be noted that all manholes along the surface water drainage run will have silt traps to reduce the risk of blockages within the control chamber.


Existing Situation Showing the site Location
Total Site Area 240m2
Proposed Property 41m2 impervious area
Lawn / Garden Area
Surface Water Drainage
MH2
MH3
MH1
MH4
CC
Parking and Path Areas to be Pervious Block Pavers
Proposed Property
Existing M/H and surface water connection to main sewer from 1 Catena Rise
Surface Water Drainage Control Chamber
Lawn / Garden Area
Existing 150mm Foul Sewer
0 1 2 3 4 5 6 7 8 9 10
Metres


Long Section through new Surface Water Sewer
Metres A.O.D.
60.0
59.9
59.8
59.7
59.6
59.5
59.4
59.3
59.2
59.1
59.0
58.9
58.8
58.7
58.6
58.5
58.4
58.3
58.2
58.1
58.0
57.9
57.8
57.7
57.6
57.5
MH1-59.20m
MH2-59.21m
MH3-59.14m
MH4-59.17m
CC-59.25m
Ex M/H
-59.30m
Road -
59.27m
MH1-58.90m
Invert
MH2-58.86m
Invert
MH3-58.83m
Invert
MH4-58.80m
Invert
CC-58.75m
Invert
Ex M/H -
58.30m
Invert
Existing 150mm dia Foul Sewer
Invert 57.61m
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Linear Metres

Orifice Plate Chamber (not to scale)



Site Management

The proposed drainage system on this site will not have a live connection to the Thames Water sewer until the main construction and the roof structure is in place. The downpipes that service the guttering systems will have sealed connections to the underground drainage, this will prevent contamination/debris entering during and post construction.

During construction any surface water management required will be pumped to a designated area on site for filtration to ground.

The sealed drainage system will prevent debris entering the pipework; however it is inevitable that some debris will migrate from roof areas. There will be a management responsibility for the property owner to regularly inspect the Orifice Plate control chamber to remove debris that may have collected in the sump or be restricting flow through plate itself. The control chamber has a high-level overflow system that will operate during times of flow exceedance or Orifice Plate blockages; exceedance flows will be directed to the sewer.

Notes

The site on Catena Rise is in Flood Zone 1 and located well above any flood risk areas as can be seen on the Environment Agency flood risk map shown on page 10.

The Thames Water Sewer plans are located on Page 11

Correspondence from Thames Water is shown on Page 11 that indicates that surface water can be directed to their foul sewerage system that runs down Catena Rise.

Conclusions

It can be concluded from the evidence presented that the new development on Catena Rise will improve the current sites surface water management, this will result in a reduction in in the volumes of surface water that ultimately enter our increasingly pressurised sewerage systems. This development will reduce the surface water runoff from the site for the 1 in 100-year 30-minutes event from 1.80 l/s (Table 1) down to 0.99 l/s (Table 3) a reduction of 0.81 l/s or a 55% reduction in flow discharge.

This new development and attenuation system will contribute towards reducing flood risk in the catchment and is compliant with DEFRA's advice on Sustainable Drainage Systems (SUDS, March 2015) which is a non-statutory technical guidance; it also satisfies Condition 8 of the Planning condition.

Recommendations

That this surface water management system for the Catena Rise development is accepted as it offers catchment wide flood risk benefits and complies with all parts of Planning Condition 8.

Howard Lawton

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Appendix A

Rainfall Calculations Explanatory Note

The rainfall rates used within this report are calculated using M5-60min rainfall data. The basis of the calculation is that the M5-60min rainfall is 20mm for all parts of the UK and this rainfall amount is then adjusted to give a rainfall value for a specific location using ratios shown in the Z tables below.

The Rainfall map "Ratio of 60minute to 2-day rainfalls for a 5-year period" is then used to identify the ratio "r" which is used to adjust the 20mm rainfall figure for a specific location:

For this example, the "r" value from the map is 0.40 (as with Catena Rise) the multiplier for this from the Z1 table for the 30min storm is 0.803 - see table Z1 below.

Therefore:
20mm x 0.803 = 16.06mm which is the rainfall that can be expected during the 30-minute storm every 5 years.

This value is further adjusted for larger return periods, for this example the 100-year return period has been used as the appropriate storm to be analysed. Table Z2 provides the ratios for adjusting from the 5-year return period to the 100-year return period, this value for 16.06mm is 2.00 see below.

Therefore
16.06 x 2.00 = 32.12mm is the rainfall that can be expected during the 15-minute storm every 100 years.

To future proof this figure +40% has been added for climate change to give 44.97mm as the final rainfall amount, this figure has been used to calculate the storage for the Catena Rise development. Appropriate "r" and "Z" table values are used to calculate rainfall values for longer duration storms.

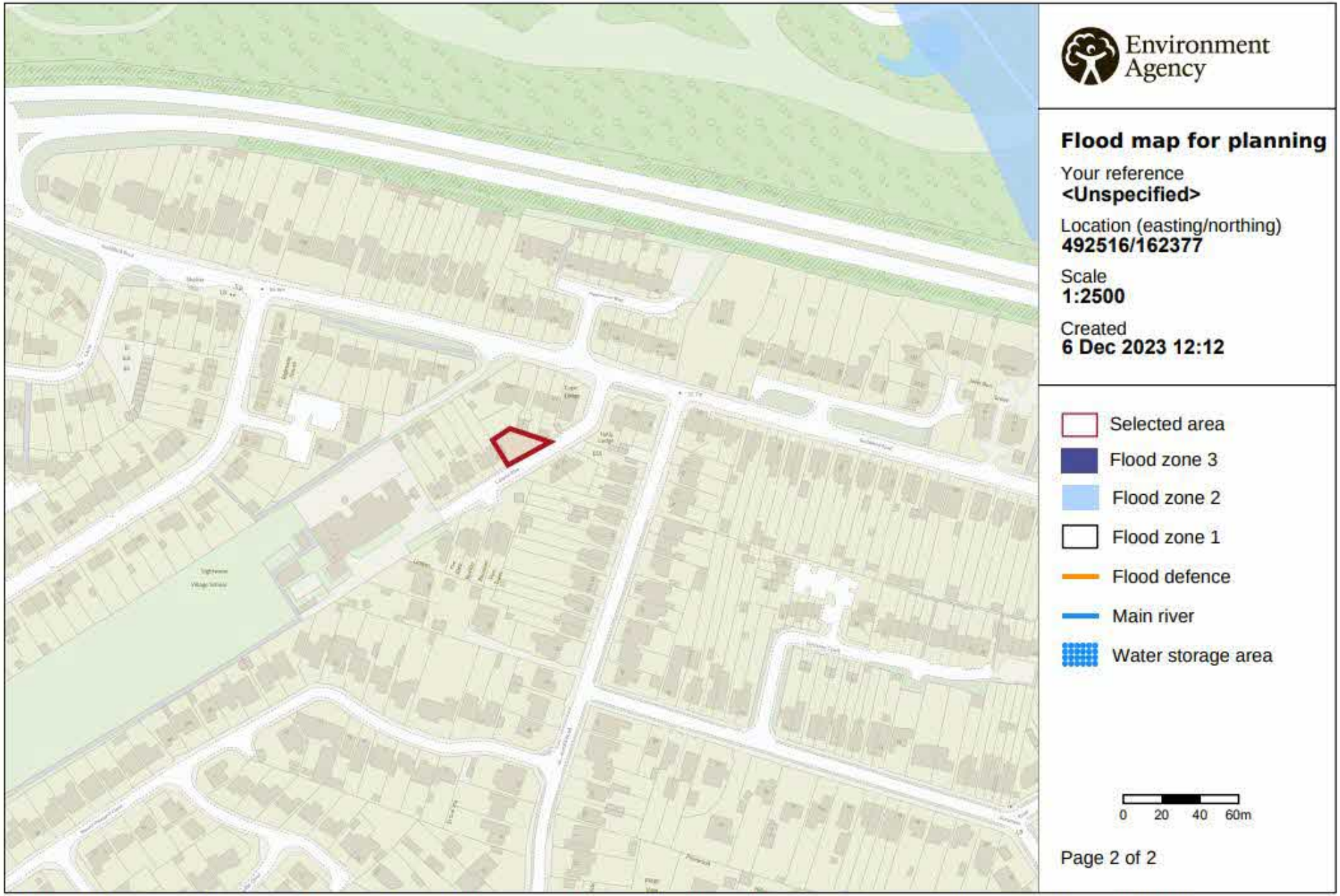
Z1 Factor for England & Wales (Values from BRE 365 - Table 1)

Ratio	Rainfall Duration (mins)					
r	15	30	60	120	240	360
0.12	0.450	0.670	1.000	1.480	2.170	2.750
0.15	0.480	0.690	1.000	1.420	2.020	2.460
0.18	0.510	0.710	1.000	1.360	1.860	2.250
0.20	0.530	0.723	1.000	1.340	1.800	2.163
0.21	0.540	0.730	1.000	1.330	1.770	2.120
0.24	0.560	0.750	1.000	1.300	1.710	2.000
0.25	0.567	0.753	1.000	1.290	1.687	1.960
0.27	0.580	0.760	1.000	1.270	1.640	1.880
0.30	0.590	0.770	1.000	1.250	1.570	1.780
0.33	0.610	0.780	1.000	1.230	1.530	1.730
0.35	0.617	0.787	1.000	1.223	1.497	1.690
0.36	0.620	0.790	1.000	1.220	1.480	1.670
0.39	0.630	0.800	1.000	1.210	1.460	1.620
0.40	0.633	0.803	1.000	1.207	1.447	1.603
0.42	0.640	0.810	1.000	1.200	1.420	1.570
0.45	0.650	0.820	1.000	1.190	1.380	1.510

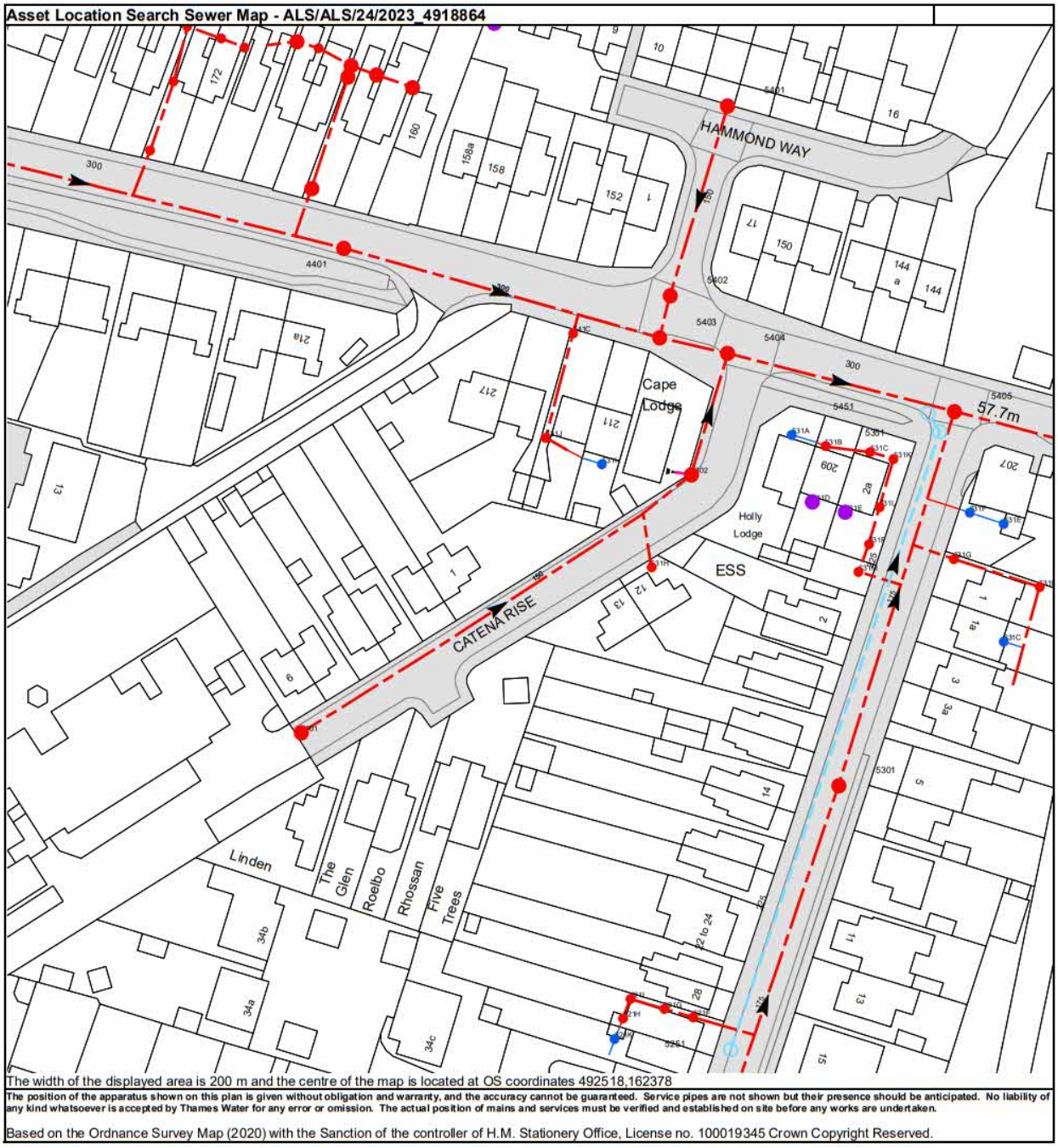
Z2 Factors for England & Wales from table 6.2 - Wallingford Procedure

M5 Rain (mm)	Diff (mm)	M1	M30	M100
		1	**30**	100
5.00	5	0.62	**1.45**	1.79
10.00	5	0.61	**1.52**	1.91
15.00	5	0.62	**1.55**	1.99
20.00	5	0.64	**1.58**	2.03
25.00	5	0.66	**1.57**	2.01
30.00	10	0.68	**1.55**	1.97
40.00	10	0.70	**1.50**	1.89
50.00	25	0.72	**1.45**	1.84
75.00	25	0.76	**1.36**	1.64
100.00	50	0.78	**1.32**	1.54
150.00	50	0.78	**1.26**	1.45
200.00		0.78	**1.24**	1.40
N.B. M30 Factors interpolated graphically				

Flood Risk Mapping



Thames Water Sewer Plan



From [redacted]
Sent: 04 December 2023 09:17
T[redacted]
Subject: Sewer connection application

Connecting to a sewer.

Site location: 1 CATENA RISE LIGHTWATER GU18 5RD

Dear Mr Lawton,

Thank you for your enquiry.

If you're planning to connect to one of our sewers, you'll need our consent before you go ahead. That's because we need to check the connection will work as planned, and that it won't potentially cause problems like sewer flooding or pollution.
To confirm with your query earlier, you can connect a surface water sewer into a foul sewer but not vice versa.