
Technical Note

Project:	Finchwood, Parcel 13	SMA Ref:	7292.TN01
Subject:	Parcel 13 Drainage Strategy	Revised:	03.03.2025
Prepared by:	Aiden Simmons	Date:	14.02.2025
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INTRODUCTION

This Technical Note (TN) has been prepared by Stuart Michael Associates Limited (SMA) on behalf of Countryside Properties (UK) Ltd to support the reserved matters planning application for Parcel 13 of the Finchwood Development. This is related to planning application ref: 181194 under a section 73 agreement for the erection of up to 56no. dwellings and connection to the existing associated accesses, with all other matters reserved. This is in relation to one of the parcels that sit as part of the wider development which benefits from outline planning permission.

The TN confirms the compliance of the proposed surface water drainage strategy for Parcel 13 with the approved drainage strategy as part of the flood risk assessment (Ref C85672-R001A prepared by JNP group) submitted as part of the outline planning application 140764, permitted in January 2017.

For ease of reference, drawing: 'C85672-SK-204 rev B' from the outline strategy is included in appendix I.

ICOSA have obtained a NAV agreement for the entirety of the Finchwood development. As such, Parcel 13 has been designed in accordance with ICOSA's requirements and the Design and Construction Guidance for foul and surface water drainage systems, published by Water UK.

DRAINAGE STRATEGY SUMMARY:

Finchwood parcel 13 contains an overall 56 dwellings split between parcel 13A and 13B by 43 and 13 respectively. The surface water drainage for these areas is separated due to a proposed underground diversion of a HV electrical line creating a circa 17m easement through the middle of the parcel (which is to be clear of any structures or drainage features). As-built information has now been received for the surrounding drainage (drawing ref: WMHP-PBA-NMRE-DR-DD-0508,0510,0517 & 0519), in turn the outfalls are based on these details. Further to this, the assumed invert levels of the existing drainage within the Nine Mile Road Extension immediately to the south, are shallow and as a result the surface water drainage for Parcel 13B is required to split into two separate networks (B & C / parcel 13B.1 & 13B.2).

The foul water strategy is also split, between 13A and 13B, with 13A discharging into the existing network contained within the NMRE to the west and 13B discharging south out of the parcel to another existing network also contained within the NMRE. As originally proposed in the foul drainage strategy, parcel 13B's foul drainage will run through parcels 11 & 12 to the south and eventually connect to 'Foul Pump Station 2' located at the south of parcel 11.

SURFACE WATER DRAINAGE:

To confirm the strategy approved to date that parcel 13 follows, the surface water runoff from the site has been separated into 3 networks.

- A. One network serving surface water runoff for 46 plots (parcel 13A) and associated roads, discharging west into an existing surface water manhole constructed within the existing parcel access road.
- B. A second network serving surface water runoff for 8 plots (within parcel 13B) and associated roads. This discharges south out of the parcel into an existing surface water sewer within the Nine Mile Road Extension.
- C. The third network is located within the eastern end of the parcel serving 5 plots as part of parcel 13b. This area is predominantly drained using permeable paving due to a significantly shallow outfall within the Nine Mile Road Extension and connects to a surface water sewer located directly south of the eastern end of the parcel.

The reserved matters surface water drainage strategy follows the principles and details set out during the outline application with a slight deviation to parcel 13b's strategy to split the networks.

Network A is comprised of SuDS features for storage & treatment such as porous pavements and attenuation crates before discharging at an agreed restricted rate of 5l/s into the existing sewer. Network B is also comprised of porous pavements and attenuation crates and discharges at 3.3l/s whilst network C utilises only porous pavements and discharges at 1.7l/s. In the drainage strategy network B & C were originally connected and were restricted to an overall discharge rate of 5l/s, now these are split, the discharge rate has been divided based on the network catchment area's impermeable area. The networks have been designed to allow for storage of the surface water for all storm events up to and including the 1:100 year plus 40% climate change.

The table below shows the comparison between the discharge rates and storage volumes estimated during the outline strategy and calculated in detail for this reserved matter strategy.

Item	Outline Strategy	Reserved Matters Strategy
Impermeable Area	0.697ha	0.511ha
Catchment Discharge Rate	5.0 l/s	5.0 l/s
Storage provided with Porous Paving	N/A	173m ³
Storage provided with Attenuation Crates	N/A	297m ³
Total Storage	Min 410m ³	470m ³

Comparison of discharge rates and volumes for **Network A** (P13A)

Item	Outline Strategy	Reserved Matters Strategy (B)	Reserved Matters Strategy (C)
Impermeable Area	0.250ha	0.149ha	0.073ha
Catchment Discharge Rate	5.0 l/s	3.3 l/s	1.7 l/s
Storage provided with Attenuation Crates	N/A	99m ³	N/A
Storage provided with Porous Paving	N/A	9m ³	57m ³
Total Storage	Min 110m ³	165 m ³	

Comparison of discharge rates and volumes for **Network B** (P13B.1) & **C** (P13B.2)

KEY DESIGN INPUTS:

The overall Finchwood Development greenfield run-off rates are as follows:

QBAR Discharge Rate = 2.04l/s/ha

Q1 Discharge Rate = 1.74/s/ha

Q30 Discharge Rate = 4.7/s/ha

Q100 Discharge Rate = 6.52/s/ha

At outline planning approval stage, a discharge rate of 5.0 l/s was agreed for parcel 13a and a rate of 5.0 l/s was also agreed for parcel 13b in line with the surface water drainage strategy. The reserve matters and agreement going forward has spilt parcel 13b's 5l/s proposal to 3.3l/s discharging out in front of plot 45 and 1.7l/s discharging out in front of plot 50.

An extract of the impermeable area plan, to exhibit the contributing areas to each network, is presented below as figure 1 and as **Appendix G**.



Figure 1 - Extract from Impermeable Areas plan (Appendix I) drawing 7292.028

CAUSEWAY FLOW CALCULATIONS:

The detailed Causeway Flow calculations for this parcel showing the maximum discharge rate and storage volume compliance are presented as **Appendix B, C & D**. Flow calculations for the foul networks are also presented within **Appendix E & F**. FEH22 model characteristics have been used throughout the modelling process.

EXCEEDANCE ROUTING:

All storms up to and including the 100-year + 40% climate change storm event are contained within the drainage system and there is no flooding which negates the requirement for an exceedance routing plan.

SURFACE WATER DISCHARGE QUALITY:

The quality of surface water collected and discharged to the surrounding environment, by direct discharge to watercourses or by infiltration into the ground water, should be managed such that the receiving bodies are protected from pollution. ICOSA also encourage the reduction of hydrocarbons prior to the outfall into their network. The implementation and installation of suitable SuDS features within the overall surface water drainage network can improve water quality through the removal of pollutants.

'The SuDS Manual' (CIRIA 753) has been developed which includes details of the pollution hazard indices for various land uses. The types of pollution hazards assessed include Total Suspended Solids (TSS), Metals and Hydrocarbons. The pollution indices range between 0 (no pollution) and 1 (high pollution) and are included in Table 26.2 of the SuDS Manual.

The various SuDS features available have been assessed for their suitability and effectiveness for the removal of pollutants from surface water discharge. These pollution mitigation indices are included in Table 26.3 of the SuDS Manual.

To deliver suitable treatment, the proposed SuDS features should provide total pollution mitigation index equal to or that exceed the pollution hazard indices for each contaminant type. (The pollution mitigation and pollution indices should always be assessed for each contaminant type).

The proposed development site has been assessed, and the relevant pollution hazard indices present on the developed site have been shown below in the table below, which is an extract from Table 26.2 of the SuDS Manual.

Land use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons HCs
Residential Roofs	Very Low	0.2	0.2	0.05
Individual property highways, car parks, low traffic roads.	Low	0.5	0.4	0.4

Pollution Hazard Indices for **Network A, B & C**

To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard indices (for each contaminant type):

$$\text{Total SuDS mitigation indices (for each contaminant type)} \geq \text{Pollution hazard indices (for each contaminant type)}$$

The proposed SuDS features to be included in the surface water drainage strategy have been shown below in the table below. (This table is an extract from Table 26.3 of the SuDS Manual).

Type of SuDS Component	Mitigation Indices 1		
	TSS	Metals	Hydrocarbons HCs
Permeable Pavement	0.7	0.6	0.7

Indicative SuDS Mitigation Indices for **Network A, B & C**

The total pollution hazard indices for **Network A, B & C** are low, so the permeable pavement alone provides sufficient treatment for the surface water prior to discharge into the wider network.

The SuDS management train provides a total pollution mitigation index that exceeds the pollution hazard indices for each contaminant, therefore, the proposed surface water drainage system is considered suitable and sufficient to allow for the discharge to the environment.

Furthermore, the wider development surface water drainage system drains south through other parcels which include other SuDS components such as attenuation basins and swales. As Parcel 13 is at the head of run, the discharged surface water will also benefit from all downstream treatment trains before exiting the overall development.

SuDS MAINTENANCE:

It is anticipated that the Client will seek to have the surface water infrastructure adopted and therefore maintained by ICOSA.

The long-term management of surface water drainage assets, including any SuDS components, is essential to ensure they continue to function to their design standard. As such, a management and maintenance plan will need to be developed to ensure the systems continue to work effectively. A summary of the maintenance requirements is summarised in the table below.

Feature	Schedule	Required Action	Frequency
Permeable Pavements <i>Intended to be covered by Management company</i>	Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
	Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
		Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
	Remedial actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
		Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
		Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
	Monitoring	Initial inspection	Monthly for three months after installation
		Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
		Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
		Monitor inspection chambers	Annually
Attenuation storage tanks <i>Intended to be covered by ICOSA under S104</i>	Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
		Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
		For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
		Remove sediment from pre-treatment structures and/ or internal forebays	Annually, or as required
	Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
	Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
		Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required
Hydrobrake flow control Chamber <i>Intended to</i>	Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Six-monthly
		Remove sediment and debris from flow control chamber.	Annually (or as required after heavy rainfall events).

<i>be covered by ICOSA under S104</i>	Remedial actions	Repair/rehabilitation of inlets.	As required.
	Monitoring	Inspect inlets for blockages, and clear if required. If faults persist jetting an CCTV survey may be required.	Monthly and after large storms.

Summary of SuDS Maintenance Requirements.

SUMMARY

The attached reserved matters drainage strategy for parcel 13 and accompanying calculations show that the proposed development can be drained effectively and complies with the overall approved outline application strategy.

The surface water discharge rate from the proposed parcel will be controlled by hydrobrakes at a restricted flow rate of 5.0 l/s for parcel 13A, 3.3 l/s for parcel 13B.1 and 1.7 l/s for parcel 13B.2, during all event up to the 1 in 100 year plus 40% climate change in accordance with the SuDS manual CIRIA C753.

For all networks, during the 1 in 30-year storm event, there is no flooding.

For all networks, during the 100-year plus 40% climate change storm event, there is no flooding.

For return periods greater than the 100-year plus 40% climate change, the finished levels have been designed to direct the surface water toward the NMRE which will eventually flow to the wider development swales and basins.

Permeable paving alone provides sufficient treatment for the surface water discharge of Networks A, B & C as the total mitigation indices exceed the pollution hazard indices for each contaminant; therefore, the proposed surface water drainage system is considered suitable and sufficient to allow for the discharge to the environment.

The foul water will be collected by gravity via a proposed piped foul network and will discharge to pump stations contained within the wider development.

It is assumed no section 106 applications will likely be required for discharge connections to existing sewers.

This drainage strategy together with accompanying appendices complies with the SuDS manual and the planning conditions.

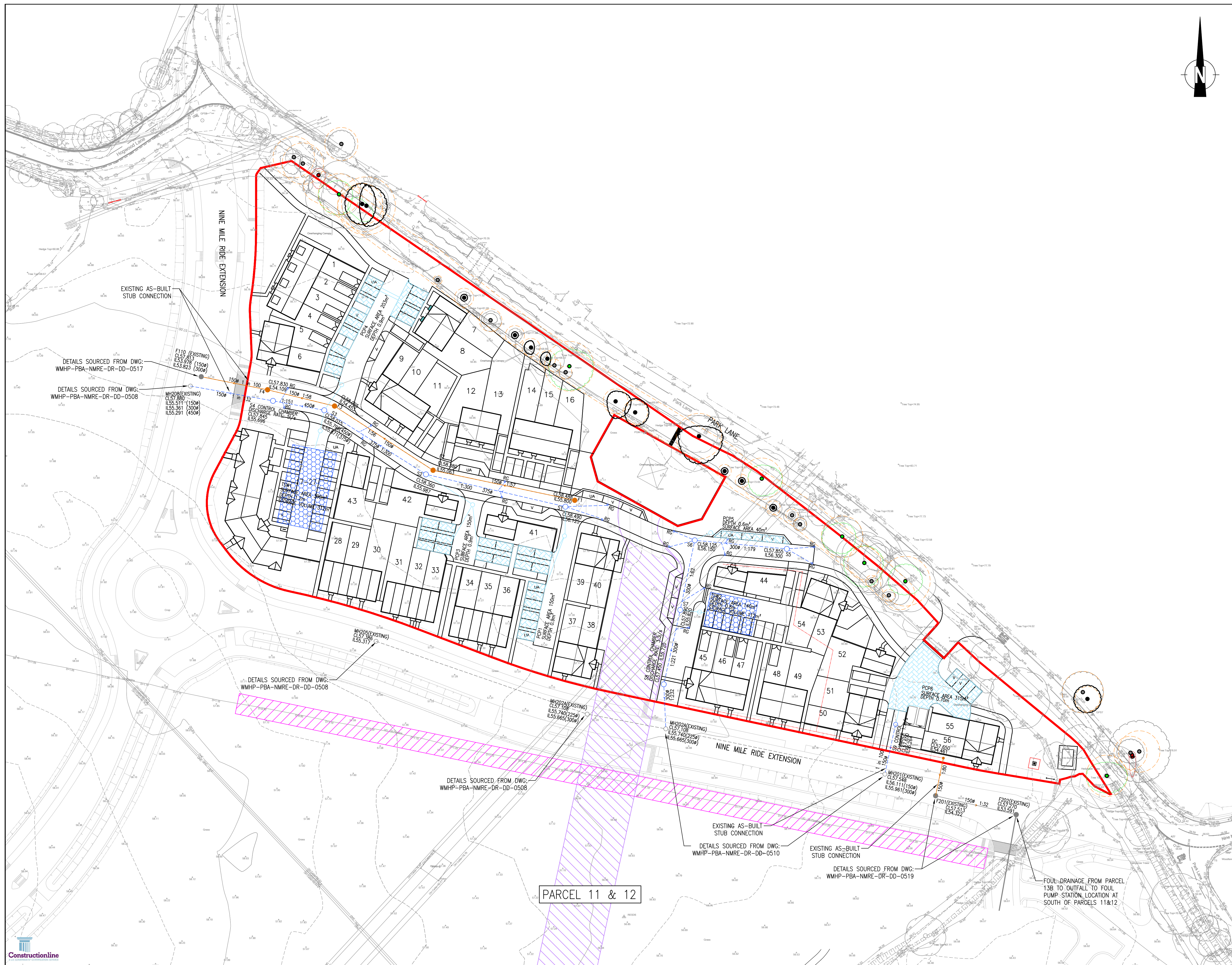
The pre-development consultation recommendations from Wokingham Borough Council (dated 28.01.25) can be found in appendix H, have been understood and responded throughout the technical note.

Further to discussions with Wokingham Borough Council, the request for SuDS features and drainage integration within landscaping areas has been reviewed thoroughly. Parcel 13 is a relatively small parcel of land compared to the parcels that the surface water drainage connects into, meaning space to

incorporate above ground/visible SuDS features is limited. The parcel has a few short sections of verge proposed that could be utilised as raingardens but would only be able to take small catchments of highway drainage and in the interest of a consistent drainage strategy for ease of maintenance the highway drainage has been left as gully pots. Permeable paving is incorporated where possible in car park areas, shared driveways and laybys. Locations of trees where integrated perforated pipes could be used are either adjacent to permeable paving so adding additional SuDS features in these areas would provide minimal benefit and incur unnecessary cost or are in open landscape areas which would have a detrimental impact to the surrounding landscape proposal. In turn, as proposed within the original planning application, SuDS features will be incorporated into the wider downstream network to improve both the storage and treatment of surface water runoff. There will be ample treatment to any surface water runoff as a whole site. At detailed design stage, the potential for small on-plot SuDS is to be reviewed and incorporated if possible - features such as water butts and rain gardens may provide significant additional benefit when capturing rainwater at its source.

Appendix A

DRAINAGE STRATEGY DRAWINGS



- NOTES:
1. DO NOT SCALE FROM THIS DRAWING.
 2. ALL DIMENSIONS ARE IN METRES, UNLESS STATED OTHERWISE.
 3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT SCHEME DRAWINGS AND SPECIFICATIONS.
 4. AS-BUILT NMRE LEVELS AND LAYOUT BASED ON DRAWINGS: 'WMHP-PBA-NMRE-DR-HI-0118-0120' DRAWN BY STANTEC.
 5. AS-BUILT EASTERN TURNING HEAD LEVELS AND LAYOUT BASED ON DRAWINGS: 'WMHP-PBA-NMRE-DR-HI-0160-0161' DRAWN BY STANTEC.
 6. TREE CONSTRAINTS BASED ON DRAWINGS: '5287_701-704' DRAWN BY RPS.
 7. DRAWING BASED ON TOPOGRAPHICAL SURVEY TITLED 'XREF 18215-Hogwood Farm 2D 21.12.17' RECEIVED ON 25.10.2024.
 8. DRAWING BASED ON AS-BUILT DRAINAGE PLANS REF: 'WMHP-PBA-NMRE-DR-DD-0508, 0510, 0517 & 0519'.

- KEY
- PARCEL BOUNDARY
 - UNDERGROUND DIVERSION EASEMENT OF EXISTING OVERHEAD ELECTRIC CABLE
 - EXISTING OIL MAIN EASEMENT
 - PROPOSED PERMEABLE PAVING
 - PROPOSED ATTENUATION TANK
 - PROPOSED INDICATIVE ROAD GULLY
 - PROPOSED SW SEWER
 - PROPOSED FW SEWER
 - ESTIMATED EXISTING SW SEWER POSITION
 - ESTIMATED EXISTING FW SEWER POSITION
 - INDICATIVE TANKING/PERMEABLE PAVING CONNECTION DRAIN
 - TREE ROOT PROTECTION AREA
 - SCHEMATIC PRIVATE FW DRAIN

PO3	SITE LAYOUT UPDATED, EASTERN FW DRAINAGE STRATEGY UPDATED	AS	TA	28.02.25
PO2	SITE LAYOUT UPDATED	AS	TA	14.02.25
ST Rev	Description	Dm	Chk	Date
REVISIONS				
Preliminary Issue	✓	Submitted for S104		
Planning Issue	✓	Issued for Tender		
Submitted for S38		Issued for Construction		
Submitted for S278		As Built		
DRAWING STATUS				

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FINCHWOOD PARCELS 11, 12 & 13

PARCEL 13
PROPOSED DRAINAGE

DATE FEB 2025 DRAWN AS CHECKED KJM SCALE 1:500 ©A1

7292.026 P03 SO

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Appendix B

CAUSEWAY FLOW CALCULATIONS FOR PARCEL 13A SW Network

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	10	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.143	5.00	58.490	1500	477561.632	164599.454	2.365
2	0.112	5.00	58.360	1500	477521.199	164608.504	2.373
3	0.226	5.00	58.015	1500	477491.692	164627.094	2.219
4	0.030	5.00	57.845	1500	477476.854	164629.854	2.149
MH208			57.810		477452.891	164634.083	2.299

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	2	41.433	0.600	56.125	55.987	0.138	300.0	375	5.66	50.0
1.001	2	3	34.875	0.600	55.987	55.871	0.116	300.0	375	6.22	50.0
1.002	3	4	15.093	0.600	55.796	55.696	0.100	150.9	450	6.37	50.0
1.003	4	MH208	24.333	0.600	55.696	55.511	0.185	131.5	150	6.84	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.041	114.9	21.3	1.990	1.998	0.143	0.0	109	0.801
1.001	1.041	114.9	38.0	1.998	1.769	0.255	0.0	148	0.938
1.002	1.652	262.8	71.7	1.769	1.699	0.481	0.0	160	1.414
1.003	0.874	15.5	76.2	1.999	2.149	0.511	0.0	150	0.891

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)
Rainfall Events	Singular	Skip Steady State	✓	Check Discharge Rate(s) x
Summer CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume x
Winter CV	1.000	Additional Storage (m³/ha)	0.0	

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	10	0
30	0	10	0
100	40	10	0

Node 4 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	55.696	Product Number	CTL-SHE-0090-5000-2149-5000
Design Depth (m)	2.149	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.0	Min Node Diameter (mm)	1200

Node 1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	56.125	Slope (1:X)	500.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.900
Safety Factor	2.0	Width (m)	15.000	Inf Depth (m)	
Porosity	0.30	Length (m)	10.000		

Node 3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	55.796
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	300.0	0.0	1.200	300.0	0.0	1.201	0.0	0.0

Node 3 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	55.796	Slope (1:X)	500.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.900
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	20.300		

Node 2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	55.987	Slope (1:X)	500.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.900
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	15.000		

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year +10% A 15 minute summer	107.269	30.354
2 year +10% A 15 minute winter	75.277	30.354
2 year +10% A 30 minute summer	68.871	19.488
2 year +10% A 30 minute winter	48.330	19.488
2 year +10% A 60 minute summer	45.364	11.988
2 year +10% A 60 minute winter	30.139	11.988
2 year +10% A 120 minute summer	32.376	8.556
2 year +10% A 120 minute winter	21.510	8.556
2 year +10% A 180 minute summer	26.144	6.728
2 year +10% A 180 minute winter	16.994	6.728
2 year +10% A 240 minute summer	21.096	5.575
2 year +10% A 240 minute winter	14.016	5.575
2 year +10% A 360 minute summer	16.228	4.176
2 year +10% A 360 minute winter	10.549	4.176

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year +10% A 480 minute summer	12.715	3.360
2 year +10% A 480 minute winter	8.447	3.360
2 year +10% A 600 minute summer	10.333	2.826
2 year +10% A 600 minute winter	7.060	2.826
2 year +10% A 720 minute summer	9.135	2.448
2 year +10% A 720 minute winter	6.139	2.448
2 year +10% A 960 minute summer	7.393	1.947
2 year +10% A 960 minute winter	4.897	1.947
2 year +10% A 1440 minute summer	5.274	1.413
2 year +10% A 1440 minute winter	3.544	1.413
2 year +10% A 2160 minute summer	3.739	1.033
2 year +10% A 2160 minute winter	2.576	1.033
2 year +10% A 2880 minute summer	3.112	0.834
2 year +10% A 2880 minute winter	2.091	0.834
2 year +10% A 4320 minute summer	2.410	0.630
2 year +10% A 4320 minute winter	1.587	0.630
2 year +10% A 5760 minute summer	2.049	0.524
2 year +10% A 5760 minute winter	1.326	0.524
2 year +10% A 7200 minute summer	1.803	0.460
2 year +10% A 7200 minute winter	1.164	0.460
2 year +10% A 8640 minute summer	1.632	0.416
2 year +10% A 8640 minute winter	1.053	0.416
2 year +10% A 10080 minute summer	1.508	0.385
2 year +10% A 10080 minute winter	0.974	0.385
30 year +10% A 15 minute summer	309.903	87.692
30 year +10% A 15 minute winter	217.476	87.692
30 year +10% A 30 minute summer	201.605	57.047
30 year +10% A 30 minute winter	141.477	57.047
30 year +10% A 60 minute summer	134.629	35.578
30 year +10% A 60 minute winter	89.444	35.578
30 year +10% A 120 minute summer	82.152	21.710
30 year +10% A 120 minute winter	54.580	21.710
30 year +10% A 180 minute summer	62.218	16.011
30 year +10% A 180 minute winter	40.443	16.011
30 year +10% A 240 minute summer	48.395	12.789
30 year +10% A 240 minute winter	32.153	12.789
30 year +10% A 360 minute summer	35.710	9.189
30 year +10% A 360 minute winter	23.212	9.189
30 year +10% A 480 minute summer	27.314	7.218
30 year +10% A 480 minute winter	18.147	7.218
30 year +10% A 600 minute summer	21.826	5.970
30 year +10% A 600 minute winter	14.913	5.970
30 year +10% A 720 minute summer	19.047	5.105
30 year +10% A 720 minute winter	12.801	5.105
30 year +10% A 960 minute summer	15.114	3.980
30 year +10% A 960 minute winter	10.012	3.980
30 year +10% A 1440 minute summer	10.473	2.807
30 year +10% A 1440 minute winter	7.038	2.807
30 year +10% A 2160 minute summer	7.195	1.988
30 year +10% A 2160 minute winter	4.957	1.988
30 year +10% A 2880 minute summer	5.842	1.566
30 year +10% A 2880 minute winter	3.926	1.566

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +10% A 4320 minute summer	4.343	1.135
30 year +10% A 4320 minute winter	2.860	1.135
30 year +10% A 5760 minute summer	3.574	0.915
30 year +10% A 5760 minute winter	2.313	0.915
30 year +10% A 7200 minute summer	3.062	0.781
30 year +10% A 7200 minute winter	1.976	0.781
30 year +10% A 8640 minute summer	2.708	0.691
30 year +10% A 8640 minute winter	1.748	0.691
30 year +10% A 10080 minute summer	2.454	0.626
30 year +10% A 10080 minute winter	1.584	0.626
100 year +40% CC +10% A 15 minute summer	558.488	158.033
100 year +40% CC +10% A 15 minute winter	391.921	158.033
100 year +40% CC +10% A 30 minute summer	367.311	103.936
100 year +40% CC +10% A 30 minute winter	257.762	103.936
100 year +40% CC +10% A 60 minute summer	245.915	64.988
100 year +40% CC +10% A 60 minute winter	163.380	64.988
100 year +40% CC +10% A 120 minute summer	146.828	38.802
100 year +40% CC +10% A 120 minute winter	97.549	38.802
100 year +40% CC +10% A 180 minute summer	110.109	28.335
100 year +40% CC +10% A 180 minute winter	71.574	28.335
100 year +40% CC +10% A 240 minute summer	85.217	22.520
100 year +40% CC +10% A 240 minute winter	56.616	22.520
100 year +40% CC +10% A 360 minute summer	62.647	16.121
100 year +40% CC +10% A 360 minute winter	40.722	16.121
100 year +40% CC +10% A 480 minute summer	47.778	12.626
100 year +40% CC +10% A 480 minute winter	31.742	12.626
100 year +40% CC +10% A 600 minute summer	38.083	10.416
100 year +40% CC +10% A 600 minute winter	26.020	10.416
100 year +40% CC +10% A 720 minute summer	33.163	8.888
100 year +40% CC +10% A 720 minute winter	22.287	8.888
100 year +40% CC +10% A 960 minute summer	26.220	6.904
100 year +40% CC +10% A 960 minute winter	17.369	6.904
100 year +40% CC +10% A 1440 minute summer	18.044	4.836
100 year +40% CC +10% A 1440 minute winter	12.127	4.836
100 year +40% CC +10% A 2160 minute summer	12.279	3.394
100 year +40% CC +10% A 2160 minute winter	8.461	3.394
100 year +40% CC +10% A 2880 minute summer	9.891	2.651
100 year +40% CC +10% A 2880 minute winter	6.647	2.651
100 year +40% CC +10% A 4320 minute summer	7.250	1.895
100 year +40% CC +10% A 4320 minute winter	4.774	1.895
100 year +40% CC +10% A 5760 minute summer	5.899	1.510
100 year +40% CC +10% A 5760 minute winter	3.818	1.510
100 year +40% CC +10% A 7200 minute summer	5.007	1.277
100 year +40% CC +10% A 7200 minute winter	3.232	1.277
100 year +40% CC +10% A 8640 minute summer	4.395	1.121
100 year +40% CC +10% A 8640 minute winter	2.837	1.121
100 year +40% CC +10% A 10080 minute summer	3.956	1.009
100 year +40% CC +10% A 10080 minute winter	2.553	1.009

Results for 2 year +10% A Critical Storm Duration. Lowest mass balance: 99.01%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	12	56.234	0.109	27.6	4.6289	0.0000	OK
30 minute summer	2	21	56.122	0.135	37.2	5.6275	0.0000	OK
360 minute summer	3	272	56.033	0.237	25.6	81.1827	0.0000	OK
360 minute summer	4	264	56.041	0.345	11.5	0.6100	0.0000	SURCHARGED
360 minute summer	MH208	256	55.562	0.051	3.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	21.3	0.721	0.185	1.2416	
30 minute summer	2	1.001	3	30.3	0.896	0.263	1.1780	
360 minute summer	3	1.002	4	11.5	0.246	0.044	1.6233	
360 minute summer	4	1.003	MH208	3.9	0.730	0.253	0.1303	112.2

Results for 30 year +10% A Critical Storm Duration. Lowest mass balance: 99.01%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	1	240	56.378	0.253	14.0	11.3740	0.0000	OK
240 minute winter	2	240	56.378	0.391	24.9	17.6070	0.0000	SURCHARGED
240 minute winter	3	240	56.378	0.582	45.2	201.0883	0.0000	SURCHARGED
240 minute winter	4	240	56.378	0.682	8.5	1.2050	0.0000	SURCHARGED
30 minute summer	MH208	115	55.563	0.052	4.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
240 minute winter	1	1.000	2	13.9	0.576	0.121	3.9221	
240 minute winter	2	1.001	3	23.3	0.746	0.203	3.8466	
240 minute winter	3	1.002	4	6.6	0.174	0.025	2.3914	
240 minute winter	4	1.003	MH208	4.0	0.734	0.257	0.1319	101.0

Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 99.01%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	1	472	56.936	0.811	13.9	37.4922	0.0000	SURCHARGED
480 minute winter	2	472	56.936	0.949	20.0	41.5264	0.0000	SURCHARGED
480 minute winter	3	472	56.936	1.140	36.4	380.5995	0.0000	SURCHARGED
480 minute winter	4	472	56.936	1.240	10.5	2.1916	0.0000	SURCHARGED
2880 minute winter	MH208	3120	55.563	0.052	4.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
480 minute winter	1	1.000	2	11.1	0.502	0.096	4.5699	
480 minute winter	2	1.001	3	14.7	0.593	0.128	3.8466	
480 minute winter	3	1.002	4	9.4	0.251	0.036	2.3914	
480 minute winter	4	1.003	MH208	4.0	0.734	0.257	0.1319	147.5

Appendix C

CAUSEWAY FLOW CALCULATIONS FOR PARCEL 13B.1 SW Network

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	10	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	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)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
5	0.061	5.00	57.855	1500	477625.796	164586.940	1.555
6	0.029	5.00	58.125	1500	477599.115	164589.414	1.975
7	0.044	5.00	57.890	1500	477594.911	164569.255	2.070
8	0.028	5.00	57.450	1500	477590.143	164547.707	1.730
MH202A			57.108		477590.808	164534.993	1.443

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	5	6	26.795	0.600	56.300	56.150	0.150	178.6	300	5.38	50.0
1.001	6	7	20.593	0.600	56.150	55.820	0.330	62.4	300	5.55	50.0
1.002	7	8	22.069	0.600	55.820	55.720	0.100	220.7	300	5.90	50.0
1.003	8	MH202A	12.731	0.600	55.720	55.665	0.055	231.5	300	6.11	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.173	82.9	9.1	1.255	1.675	0.061	0.0	67	0.776
1.001	1.993	140.9	13.4	1.675	1.770	0.090	0.0	62	1.267
1.002	1.054	74.5	20.0	1.770	1.430	0.134	0.0	106	0.897
1.003	1.029	72.7	24.2	1.430	1.143	0.162	0.0	119	0.927

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)
Rainfall Events	Singular	Skip Steady State	✓	Check Discharge Rate(s) x
Summer CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume x
Winter CV	1.000	Additional Storage (m³/ha)	0.0	

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	10	0
30	0	10	0
100	40	10	0

Node 8 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	55.720	Product Number	CTL-SHE-0077-3300-1730-3300
Design Depth (m)	1.730	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	3.3	Min Node Diameter (mm)	1200

Node 7 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	55.820
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	140.0	0.0	0.800	140.0	0.0	0.801	0.0	0.0

Node 5 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	56.300	Slope (1:X)	500.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	52	Depth (m)	0.600
Safety Factor	2.0	Width (m)	4.000	Inf Depth (m)	
Porosity	0.30	Length (m)	10.000		

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year +10% A 15 minute summer	107.269	30.354
2 year +10% A 15 minute winter	75.277	30.354
2 year +10% A 30 minute summer	68.871	19.488
2 year +10% A 30 minute winter	48.330	19.488
2 year +10% A 60 minute summer	45.364	11.988
2 year +10% A 60 minute winter	30.139	11.988
2 year +10% A 120 minute summer	32.376	8.556
2 year +10% A 120 minute winter	21.510	8.556
2 year +10% A 180 minute summer	26.144	6.728
2 year +10% A 180 minute winter	16.994	6.728
2 year +10% A 240 minute summer	21.096	5.575
2 year +10% A 240 minute winter	14.016	5.575
2 year +10% A 360 minute summer	16.228	4.176
2 year +10% A 360 minute winter	10.549	4.176
2 year +10% A 480 minute summer	12.715	3.360
2 year +10% A 480 minute winter	8.447	3.360
2 year +10% A 600 minute summer	10.333	2.826
2 year +10% A 600 minute winter	7.060	2.826
2 year +10% A 720 minute summer	9.135	2.448
2 year +10% A 720 minute winter	6.139	2.448
2 year +10% A 960 minute summer	7.393	1.947
2 year +10% A 960 minute winter	4.897	1.947
2 year +10% A 1440 minute summer	5.274	1.413
2 year +10% A 1440 minute winter	3.544	1.413
2 year +10% A 2160 minute summer	3.739	1.033
2 year +10% A 2160 minute winter	2.576	1.033
2 year +10% A 2880 minute summer	3.112	0.834
2 year +10% A 2880 minute winter	2.091	0.834

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year +10% A 4320 minute summer	2.410	0.630
2 year +10% A 4320 minute winter	1.587	0.630
2 year +10% A 5760 minute summer	2.049	0.524
2 year +10% A 5760 minute winter	1.326	0.524
2 year +10% A 7200 minute summer	1.803	0.460
2 year +10% A 7200 minute winter	1.164	0.460
2 year +10% A 8640 minute summer	1.632	0.416
2 year +10% A 8640 minute winter	1.053	0.416
2 year +10% A 10080 minute summer	1.508	0.385
2 year +10% A 10080 minute winter	0.974	0.385
30 year +10% A 15 minute summer	309.903	87.692
30 year +10% A 15 minute winter	217.476	87.692
30 year +10% A 30 minute summer	201.605	57.047
30 year +10% A 30 minute winter	141.477	57.047
30 year +10% A 60 minute summer	134.629	35.578
30 year +10% A 60 minute winter	89.444	35.578
30 year +10% A 120 minute summer	82.152	21.710
30 year +10% A 120 minute winter	54.580	21.710
30 year +10% A 180 minute summer	62.218	16.011
30 year +10% A 180 minute winter	40.443	16.011
30 year +10% A 240 minute summer	48.395	12.789
30 year +10% A 240 minute winter	32.153	12.789
30 year +10% A 360 minute summer	35.710	9.189
30 year +10% A 360 minute winter	23.212	9.189
30 year +10% A 480 minute summer	27.314	7.218
30 year +10% A 480 minute winter	18.147	7.218
30 year +10% A 600 minute summer	21.826	5.970
30 year +10% A 600 minute winter	14.913	5.970
30 year +10% A 720 minute summer	19.047	5.105
30 year +10% A 720 minute winter	12.801	5.105
30 year +10% A 960 minute summer	15.114	3.980
30 year +10% A 960 minute winter	10.012	3.980
30 year +10% A 1440 minute summer	10.473	2.807
30 year +10% A 1440 minute winter	7.038	2.807
30 year +10% A 2160 minute summer	7.195	1.988
30 year +10% A 2160 minute winter	4.957	1.988
30 year +10% A 2880 minute summer	5.842	1.566
30 year +10% A 2880 minute winter	3.926	1.566
30 year +10% A 4320 minute summer	4.343	1.135
30 year +10% A 4320 minute winter	2.860	1.135
30 year +10% A 5760 minute summer	3.574	0.915
30 year +10% A 5760 minute winter	2.313	0.915
30 year +10% A 7200 minute summer	3.062	0.781
30 year +10% A 7200 minute winter	1.976	0.781
30 year +10% A 8640 minute summer	2.708	0.691
30 year +10% A 8640 minute winter	1.748	0.691
30 year +10% A 10080 minute summer	2.454	0.626
30 year +10% A 10080 minute winter	1.584	0.626
100 year +40% CC +10% A 15 minute summer	558.488	158.033
100 year +40% CC +10% A 15 minute winter	391.921	158.033
100 year +40% CC +10% A 30 minute summer	367.311	103.936
100 year +40% CC +10% A 30 minute winter	257.762	103.936

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC +10% A 60 minute summer	245.915	64.988
100 year +40% CC +10% A 60 minute winter	163.380	64.988
100 year +40% CC +10% A 120 minute summer	146.828	38.802
100 year +40% CC +10% A 120 minute winter	97.549	38.802
100 year +40% CC +10% A 180 minute summer	110.109	28.335
100 year +40% CC +10% A 180 minute winter	71.574	28.335
100 year +40% CC +10% A 240 minute summer	85.217	22.520
100 year +40% CC +10% A 240 minute winter	56.616	22.520
100 year +40% CC +10% A 360 minute summer	62.647	16.121
100 year +40% CC +10% A 360 minute winter	40.722	16.121
100 year +40% CC +10% A 480 minute summer	47.778	12.626
100 year +40% CC +10% A 480 minute winter	31.742	12.626
100 year +40% CC +10% A 600 minute summer	38.083	10.416
100 year +40% CC +10% A 600 minute winter	26.020	10.416
100 year +40% CC +10% A 720 minute summer	33.163	8.888
100 year +40% CC +10% A 720 minute winter	22.287	8.888
100 year +40% CC +10% A 960 minute summer	26.220	6.904
100 year +40% CC +10% A 960 minute winter	17.369	6.904
100 year +40% CC +10% A 1440 minute summer	18.044	4.836
100 year +40% CC +10% A 1440 minute winter	12.127	4.836
100 year +40% CC +10% A 2160 minute summer	12.279	3.394
100 year +40% CC +10% A 2160 minute winter	8.461	3.394
100 year +40% CC +10% A 2880 minute summer	9.891	2.651
100 year +40% CC +10% A 2880 minute winter	6.647	2.651
100 year +40% CC +10% A 4320 minute summer	7.250	1.895
100 year +40% CC +10% A 4320 minute winter	4.774	1.895
100 year +40% CC +10% A 5760 minute summer	5.899	1.510
100 year +40% CC +10% A 5760 minute winter	3.818	1.510
100 year +40% CC +10% A 7200 minute summer	5.007	1.277
100 year +40% CC +10% A 7200 minute winter	3.232	1.277
100 year +40% CC +10% A 8640 minute summer	4.395	1.121
100 year +40% CC +10% A 8640 minute winter	2.837	1.121
100 year +40% CC +10% A 10080 minute summer	3.956	1.009
100 year +40% CC +10% A 10080 minute winter	2.553	1.009

Results for 2 year +10% A Critical Storm Duration. Lowest mass balance: 97.57%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	5	11	56.375	0.075	11.8	0.9191	0.0000	OK
15 minute summer	6	10	56.227	0.077	16.3	0.1369	0.0000	OK
240 minute summer	7	164	55.958	0.138	8.5	18.5455	0.0000	OK
240 minute summer	8	168	55.957	0.237	2.8	0.4196	0.0000	OK
240 minute summer	MH202A	164	55.702	0.037	2.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	5	1.000	6	11.1	0.802	0.133	0.3776	
15 minute summer	6	1.001	7	16.7	1.789	0.118	0.2204	
240 minute summer	7	1.002	8	2.3	0.126	0.031	1.0075	
240 minute summer	8	1.003	MH202A	2.6	0.495	0.035	0.0659	39.0

Results for 30 year +10% A Critical Storm Duration. Lowest mass balance: 97.57%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	5	11	56.437	0.137	34.0	1.7706	0.0000	OK
15 minute summer	6	10	56.281	0.131	48.5	0.2317	0.0000	OK
180 minute winter	7	176	56.253	0.433	16.8	58.3031	0.0000	SURCHARGED
180 minute winter	8	176	56.252	0.532	3.4	0.9409	0.0000	SURCHARGED
120 minute summer	MH202A	68	55.703	0.038	2.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	5	1.000	6	33.2	1.107	0.400	0.8144	
15 minute summer	6	1.001	7	49.3	2.028	0.350	0.7210	
180 minute winter	7	1.002	8	2.7	0.112	0.036	1.5541	
180 minute winter	8	1.003	MH202A	2.7	0.500	0.037	0.0683	61.0

Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 97.57%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	5	236	57.306	1.006	10.6	8.8642	0.0000	SURCHARGED
240 minute winter	6	236	57.306	1.156	15.6	2.0419	0.0000	SURCHARGED
240 minute winter	7	236	57.305	1.485	23.6	109.0911	0.0000	SURCHARGED
240 minute winter	8	236	57.305	1.585	5.2	2.8008	0.0000	FLOOD RISK
240 minute winter	MH202A	236	55.707	0.042	3.1	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
240 minute winter	5	1.000	6	10.6	0.825	0.128	1.8869	
240 minute winter	6	1.001	7	14.7	1.081	0.104	1.4501	
240 minute winter	7	1.002	8	3.8	0.108	0.051	1.5541	
240 minute winter	8	1.003	MH202A	3.1	0.523	0.043	0.0764	66.9

Appendix D

CAUSEWAY FLOW CALCULATIONS FOR PARCEL 13B.2 SW Network

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	10	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	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)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
9	0.073	5.00	57.650	1200	477657.346	164536.107	1.386
MH201			57.540	1200	477654.133	164521.287	1.429

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	9	MH201	15.164	0.600	56.264	56.111	0.153	99.1	150	5.25	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.009	17.8	10.9	1.236	1.279	0.073	0.0	85	1.058

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)
Rainfall Events	Singular	Skip Steady State	✓	Check Discharge Rate(s) x
Summer CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume x
Winter CV	1.000	Additional Storage (m³/ha)	0.0	

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	10	0
30	0	10	0
100	40	10	0

Node 9 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	56.264	Product Number	CTL-SHE-0062-1700-1000-1700
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.7	Min Node Diameter (mm)	1200

Node 9 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	56.264	Slope (1:X)	500.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.700
Safety Factor	2.0	Width (m)	31.500	Inf Depth (m)	
Porosity	0.30	Length (m)	10.000		

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year +10% A 15 minute summer	107.269	30.354
2 year +10% A 15 minute winter	75.277	30.354
2 year +10% A 30 minute summer	68.871	19.488
2 year +10% A 30 minute winter	48.330	19.488
2 year +10% A 60 minute summer	45.364	11.988
2 year +10% A 60 minute winter	30.139	11.988
2 year +10% A 120 minute summer	32.376	8.556
2 year +10% A 120 minute winter	21.510	8.556
2 year +10% A 180 minute summer	26.144	6.728
2 year +10% A 180 minute winter	16.994	6.728
2 year +10% A 240 minute summer	21.096	5.575
2 year +10% A 240 minute winter	14.016	5.575
2 year +10% A 360 minute summer	16.228	4.176
2 year +10% A 360 minute winter	10.549	4.176
2 year +10% A 480 minute summer	12.715	3.360
2 year +10% A 480 minute winter	8.447	3.360
2 year +10% A 600 minute summer	10.333	2.826
2 year +10% A 600 minute winter	7.060	2.826
2 year +10% A 720 minute summer	9.135	2.448
2 year +10% A 720 minute winter	6.139	2.448
2 year +10% A 960 minute summer	7.393	1.947
2 year +10% A 960 minute winter	4.897	1.947
2 year +10% A 1440 minute summer	5.274	1.413
2 year +10% A 1440 minute winter	3.544	1.413
2 year +10% A 2160 minute summer	3.739	1.033
2 year +10% A 2160 minute winter	2.576	1.033
2 year +10% A 2880 minute summer	3.112	0.834
2 year +10% A 2880 minute winter	2.091	0.834
2 year +10% A 4320 minute summer	2.410	0.630
2 year +10% A 4320 minute winter	1.587	0.630
2 year +10% A 5760 minute summer	2.049	0.524
2 year +10% A 5760 minute winter	1.326	0.524
2 year +10% A 7200 minute summer	1.803	0.460
2 year +10% A 7200 minute winter	1.164	0.460
2 year +10% A 8640 minute summer	1.632	0.416
2 year +10% A 8640 minute winter	1.053	0.416
2 year +10% A 10080 minute summer	1.508	0.385
2 year +10% A 10080 minute winter	0.974	0.385
30 year +10% A 15 minute summer	309.903	87.692
30 year +10% A 15 minute winter	217.476	87.692
30 year +10% A 30 minute summer	201.605	57.047
30 year +10% A 30 minute winter	141.477	57.047
30 year +10% A 60 minute summer	134.629	35.578
30 year +10% A 60 minute winter	89.444	35.578
30 year +10% A 120 minute summer	82.152	21.710

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +10% A 120 minute winter	54.580	21.710
30 year +10% A 180 minute summer	62.218	16.011
30 year +10% A 180 minute winter	40.443	16.011
30 year +10% A 240 minute summer	48.395	12.789
30 year +10% A 240 minute winter	32.153	12.789
30 year +10% A 360 minute summer	35.710	9.189
30 year +10% A 360 minute winter	23.212	9.189
30 year +10% A 480 minute summer	27.314	7.218
30 year +10% A 480 minute winter	18.147	7.218
30 year +10% A 600 minute summer	21.826	5.970
30 year +10% A 600 minute winter	14.913	5.970
30 year +10% A 720 minute summer	19.047	5.105
30 year +10% A 720 minute winter	12.801	5.105
30 year +10% A 960 minute summer	15.114	3.980
30 year +10% A 960 minute winter	10.012	3.980
30 year +10% A 1440 minute summer	10.473	2.807
30 year +10% A 1440 minute winter	7.038	2.807
30 year +10% A 2160 minute summer	7.195	1.988
30 year +10% A 2160 minute winter	4.957	1.988
30 year +10% A 2880 minute summer	5.842	1.566
30 year +10% A 2880 minute winter	3.926	1.566
30 year +10% A 4320 minute summer	4.343	1.135
30 year +10% A 4320 minute winter	2.860	1.135
30 year +10% A 5760 minute summer	3.574	0.915
30 year +10% A 5760 minute winter	2.313	0.915
30 year +10% A 7200 minute summer	3.062	0.781
30 year +10% A 7200 minute winter	1.976	0.781
30 year +10% A 8640 minute summer	2.708	0.691
30 year +10% A 8640 minute winter	1.748	0.691
30 year +10% A 10080 minute summer	2.454	0.626
30 year +10% A 10080 minute winter	1.584	0.626
100 year +40% CC +10% A 15 minute summer	558.488	158.033
100 year +40% CC +10% A 15 minute winter	391.921	158.033
100 year +40% CC +10% A 30 minute summer	367.311	103.936
100 year +40% CC +10% A 30 minute winter	257.762	103.936
100 year +40% CC +10% A 60 minute summer	245.915	64.988
100 year +40% CC +10% A 60 minute winter	163.380	64.988
100 year +40% CC +10% A 120 minute summer	146.828	38.802
100 year +40% CC +10% A 120 minute winter	97.549	38.802
100 year +40% CC +10% A 180 minute summer	110.109	28.335
100 year +40% CC +10% A 180 minute winter	71.574	28.335
100 year +40% CC +10% A 240 minute summer	85.217	22.520
100 year +40% CC +10% A 240 minute winter	56.616	22.520
100 year +40% CC +10% A 360 minute summer	62.647	16.121
100 year +40% CC +10% A 360 minute winter	40.722	16.121
100 year +40% CC +10% A 480 minute summer	47.778	12.626
100 year +40% CC +10% A 480 minute winter	31.742	12.626
100 year +40% CC +10% A 600 minute summer	38.083	10.416
100 year +40% CC +10% A 600 minute winter	26.020	10.416
100 year +40% CC +10% A 720 minute summer	33.163	8.888
100 year +40% CC +10% A 720 minute winter	22.287	8.888
100 year +40% CC +10% A 960 minute summer	26.220	6.904

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC +10% A 960 minute winter	17.369	6.904
100 year +40% CC +10% A 1440 minute summer	18.044	4.836
100 year +40% CC +10% A 1440 minute winter	12.127	4.836
100 year +40% CC +10% A 2160 minute summer	12.279	3.394
100 year +40% CC +10% A 2160 minute winter	8.461	3.394
100 year +40% CC +10% A 2880 minute summer	9.891	2.651
100 year +40% CC +10% A 2880 minute winter	6.647	2.651
100 year +40% CC +10% A 4320 minute summer	7.250	1.895
100 year +40% CC +10% A 4320 minute winter	4.774	1.895
100 year +40% CC +10% A 5760 minute summer	5.899	1.510
100 year +40% CC +10% A 5760 minute winter	3.818	1.510
100 year +40% CC +10% A 7200 minute summer	5.007	1.277
100 year +40% CC +10% A 7200 minute winter	3.232	1.277
100 year +40% CC +10% A 8640 minute summer	4.395	1.121
100 year +40% CC +10% A 8640 minute winter	2.837	1.121
100 year +40% CC +10% A 10080 minute summer	3.956	1.009
100 year +40% CC +10% A 10080 minute winter	2.553	1.009

Results for 2 year +10% A Critical Storm Duration. Lowest mass balance: 97.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
240 minute summer	9	156	56.373	0.109	4.7	9.5181	0.0000	OK
15 minute summer	MH201	1	56.111	0.000	1.1	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Discharge Vol (m ³)
240 minute summer	9	Hydro-Brake®	MH201	1.4	17.5

Results for 30 year +10% A Critical Storm Duration. Lowest mass balance: 97.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	9	118	56.554	0.290	12.1	26.8339	0.0000	SURCHARGED
15 minute summer	MH201	1	56.111	0.000	1.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Discharge Vol (m³)
120 minute winter	9	Hydro-Brake®	MH201	1.6	29.4

Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 97.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	9	180	56.855	0.591	15.7	55.5660	0.0000	SURCHARGED
15 minute summer	MH201	1	56.111	0.000	1.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	9	Hydro-Brake®	MH201	1.6	33.2

Appendix E

CAUSEWAY FLOW CALCULATIONS FOR PARCEL 13A FW Network

Design Settings

Frequency of use (kDU)	0.00	Minimum Velocity (m/s)	0.75
Flow per dwelling per day (l/day)	4000	Connection Type	Level Soffits
Domestic Flow (l/s/ha)	9.9	Minimum Backdrop Height (m)	0.200
Industrial Flow (l/s/ha)	0.0	Preferred Cover Depth (m)	1.200
Additional Flow (%)	0	Include Intermediate Ground	✓

Nodes

Name	Dwellings	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	4	58.488	1200	477564.383	164600.969	2.688
2	13	58.380	1200	477523.290	164609.664	3.317
3	6	58.025	1200	477494.690	164628.303	3.572
4	20	57.830	1200	477475.260	164633.046	3.721
110		57.813		477455.980	164636.836	3.835

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
1.000	1	2	42.003	1.500	55.800	55.063	0.737	57.0	150
1.001	2	3	34.138	1.500	55.063	54.453	0.610	56.0	150
1.002	3	4	20.001	1.500	54.453	54.109	0.344	58.1	150
1.003	4	110	19.649	1.500	54.109	53.978	0.131	150.0	150

Name	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.233	1.162	20.5	0.2	2.538	3.167	0.000	4	0.0	0.0	10	0.341
1.001	0.386	1.172	20.7	0.8	3.167	3.422	0.000	17	0.0	0.0	20	0.552
1.002	0.429	1.150	20.3	1.1	3.422	3.571	0.000	23	0.0	0.0	24	0.602
1.003	0.373	0.714	12.6	2.0	3.571	3.685	0.000	43	0.0	0.0	40	0.516

Appendix F

CAUSEWAY FLOW CALCULATIONS FOR PARCEL 13B FW Network

Design Settings

Frequency of use (kDU)	0.00	Minimum Velocity (m/s)	0.75
Flow per dwelling per day (l/day)	4000	Connection Type	Level Soffits
Domestic Flow (l/s/ha)	9.9	Minimum Backdrop Height (m)	0.200
Industrial Flow (l/s/ha)	0.0	Preferred Cover Depth (m)	1.200
Additional Flow (%)	0	Include Intermediate Ground	✓

Nodes

Name	Dwellings	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
201	13	57.513	1200	477668.868	164515.567	3.191
202		57.270		477692.111	164510.101	3.679

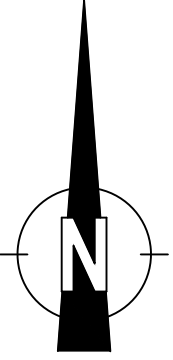
Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
1.000	201	202	23.877	1.500	54.322	53.591	0.731	32.7	100

Name	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.456	1.167	9.2	0.6	3.091	3.579	0.000	13	0.0	0.0	18	0.645

Appendix G

IMPERMEABLE AREAS PLAN



- NOTES:**
1. DO NOT SCALE FROM THIS DRAWING.
 2. ALL DIMENSIONS ARE IN METRES, UNLESS STATED OTHERWISE.
 3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT SCHEME DRAWINGS AND SPECIFICATIONS.
 4. AS-BUILT NMRE LEVELS AND LAYOUT BASED ON DRAWINGS: 'WMHP-PBA-NMRE-DR-HI-0118-0120' DRAWN BY STANTEC.
 5. AS-BUILT EASTERN TURNING HEAD LEVELS AND LAYOUT BASED ON DRAWINGS: 'WMHP-PBA-NMRE-DR-HI-0160-0161' DRAWN BY STANTEC.
 6. TREE CONSTRAINTS BASED ON DRAWINGS: '5287_701-704' DRAWN BY RPS.
 7. DRAWING BASED ON TOPOGRAPHICAL SURVEY TITLED 'XREF 18215-Hogwood Farm 2D 21.12.17' RECEIVED ON 25.10.2024.

- KEY**
- PARCEL BOUNDARY
 - NETWORK A (PARCEL 13A)**
 - CONTRIBUTING AREAS FROM ADOPTABLE HIGHWAYS
 - CONTRIBUTING AREAS FROM PRIVATE PLOTS/DRIVEWAYS/PARKING
 - NETWORK B (PARCEL 13B.1)**
 - CONTRIBUTING AREAS FROM ADOPTABLE HIGHWAYS
 - CONTRIBUTING AREAS FROM PRIVATE PLOTS/DRIVEWAYS/PARKING
 - NETWORK C (PARCEL 13B.2)**
 - CONTRIBUTING AREAS FROM PRIVATE PLOTS/DRIVEWAYS/PARKING

S0	P03	CONTRIBUTING AREAS UPDATED	AS	TA	03.03.25
S01	P02	SITE LAYOUT UPDATED	AS	TA	28.02.25
ST	Rev	Description	Dm	Chk	Date
REVISIONS					
Preliminary Issue		Submitted for S104			
Planning Issue	✓	Issued for Tender			
Submitted for S38		Issued for Construction			
Submitted for S278		As Built			
DRAWING STATUS					



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Part of the Vistry Group

FINCHWOOD PARCELS 11, 12 & 13

PARCEL 13 IMPERMEABLE AREAS PLAN

DATE	7292.028	DRAWN	AS	CHECKED	TA	SCALE	1:500	SHEET	0A1
P03 SO									
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Appendix H

PRE-DEVELOPMENT CONSULTATION WITH WBC

Date: 28 January 2025
Application: 250163



**WOKINGHAM
BOROUGH COUNCIL**

SDL Flood Risk Officer

Development Management &
Compliance

P.O. Box 157

Shute End, Wokingham

Berkshire, RG40 1BN

Tel: (0118) 974 6000

Minicom No: (0118) 974 6991

Dear SDL Flood Risk Officer,

Pre-app consultation Consultation

Application Number: 250163

Applicant: Vistry Thames Valley

Site Address: Parcels 11 12 and 13, Finchwood Park, Finchampstead

Parish: Finchampstead

Grid Reference: Easting - 477375, Northing - 164400

Type of Development:

Proposal: Pre-application advice for the proposed erection of circa. 217no. residential dwellings, ancillary structures, internal roads, car parking, landscaping and public open space, drainage features, and associated works split across Parcels 11, 12 and 13.

Case Officer: Nick Chancellor

Development Management has received the above application and we require your comments on the proposal using the recommended memorandum below. The documents associated with this are available to view in NEC DM using the application number 250163. Alternatively, public documents are available to view on the Council's planning application search page: [Wokingham Borough Council Online Planning](#).

Please index your response into NEC DM against the application. If you are recommending conditions, you should give a reason with reference to relevant policies. A list of standard conditions can be found on the Z Drive at: [Z:\Standard Planning Conditions](#).

Your observations are required in respect of this application within **10 working days** of the above date or **15 working days** if the development type is classed as a major development. As this is a pre-application request, you are reminded that all correspondence should be through the case officer. If the developer contacts you direct, please refer them to the case officer unless otherwise directed. It is possible

you will be required to attend a meeting with the developer as part of the pre-application process and you will be contacted if this is the case.

Yours sincerely,
Development Management & Compliance

MEMORANDUM

From:	Boniface Ngu Flood Risk & Drainage		
Service	SDL Flood Risk Officer	App No:	250163
Address:	Parcels 11 12 and 13, Finchwood Park, Finchampstead.		
Proposal:	Pre-application advice for the proposed erection of circa. 217no. residential dwellings, ancillary structures, internal roads, car parking, landscaping and public open space, drainage features, and associated works split across Parcels 11, 12 and 13.		
Type of Development:			
Site Visit Made:	No		

Summary Of Recommendations

Comments On Proposal

The site is within flood zone 1 and we note that there is an existing outline planning application for the wider site with approved overall sitewide drainage strategy.

Site layout drawings PL1004 D dated 17/01/2025 (Parcel 13) and PL04 J dated 17/01/2025 (parcels 11 & 12) show the general proposed development layout.

We would need to see how the proposed development of parcels 11, 12 and 13 feed into the most up to date approved sitewide drainage strategy, taking the SuDS management train into consideration, ensuring that runoff is attenuated and discharge controlled at the approved greenfield rates.

Attenuation provided should include various forms of SuDS, designed to cater for the 1 in 100-year flood event with a 40 % allowance for climate change, with adequate freeboard (minimum 300mm) and shallow side slopes (minimum 1:3).

We would also require understanding the drainage maintenance details for the SuDS features within the parcels, who will be responsible for the maintenance and adequate maintenance access for the attenuation features.

In calculating the attenuation volumes, we need to see a clear demonstration of the impermeable areas considered, with calculations making use of FEH 22 model characteristics.

There should be no surcharging for events up to the 1 in 30 flood event and ideally no flooding for the 1 in 100-year flood event with a 40% allowance for climate change.

If there is however flooding for the 1 in 100-year + 40% climate change, it should be demonstrated how this flooding will be catered for within the development boundary, so that flood risk is not increased elsewhere.

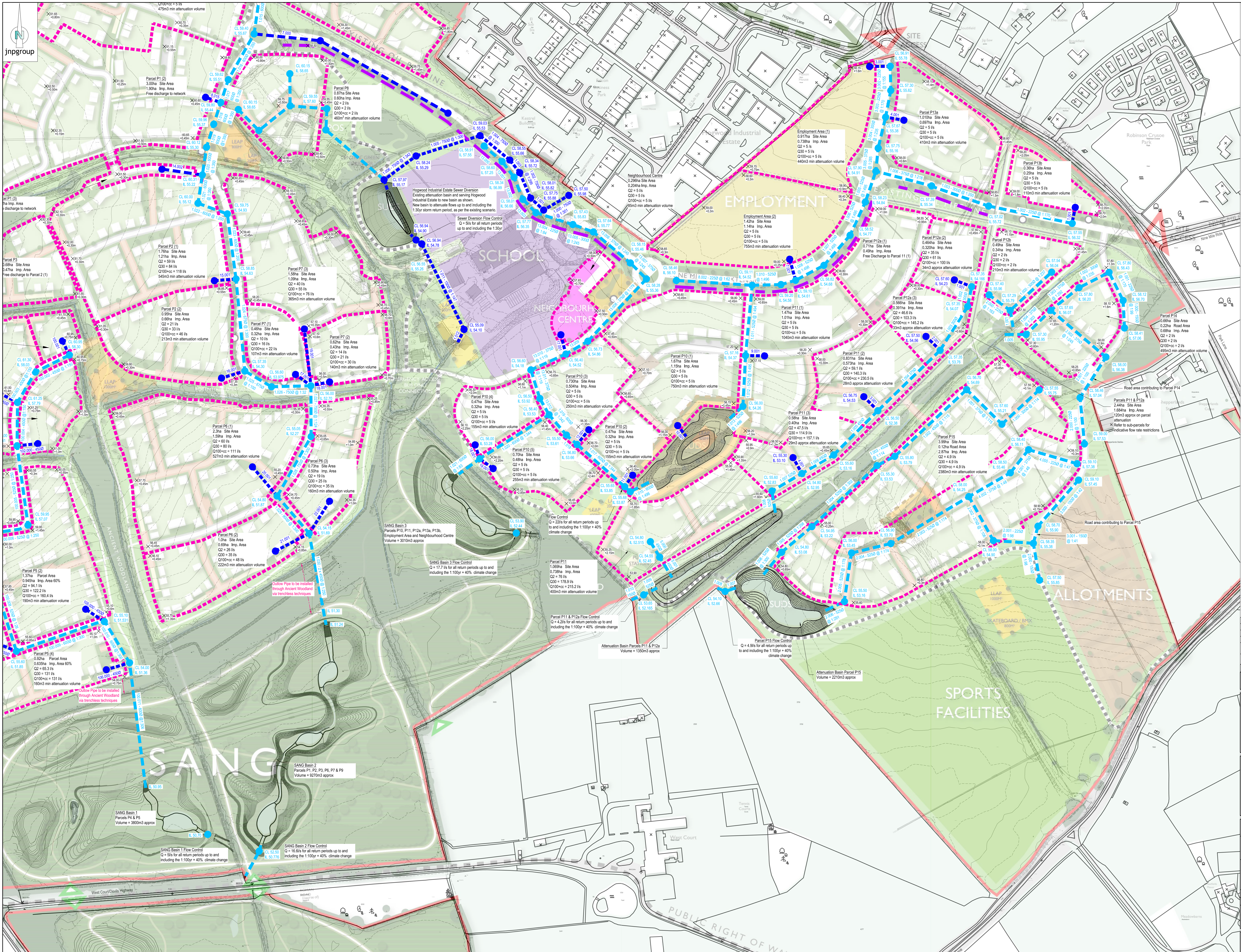
Conditions & Reasons (if required)

Please use this section to detail any conditions that are required to make this development acceptable in planning terms. All conditions should be accompanied by reasons.

Date:	30/01/2025	Signed:	Boniface Ngu
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Appendix I

OUTLINE PLANNING SURFACE WATER DRAINAGE STRATEGY



Notes:

- Where this drawing has been issued in electronic .dwg format it has been done so in good faith. jnp group do not take any responsibility for any inaccuracies in the electronic data, which should be checked against the paper (or .pdf) drawing issue. Any apparent discrepancies should be immediately reported to jnp group. The electronic .dwg file should not be assumed to be to scale and should not be used for overlaying, setting out or checking of any third party information. All dimensions should be taken from the paper (or .pdf) version of the drawing. Electronic drawings may contain third party information, jnp group take no responsibility for this information, which should be checked against the originators paper drawing(s).
- All working dimensions to be checked on site.
- Do not scale.
- Any discrepancies between drawings of different scales, and between drawings and specification where appropriate to be notified to The Engineer for decision.
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- This drawing should only be used for construction if the drawing status is "Construction". jnp group take no responsibility for construction works undertaken to drawings which are not marked with this status.

Health and Safety Note:
The details on this drawing have been prepared on the assumption that a competent contractor will be carrying out the works. If the contractor considers that there is insufficient Health and Safety information on this drawing, this should be immediately brought to the attention of the designer.

Key

- Surface Water Lateral
- Surface Water Storage
- Surface Water Main Sewer
- Surface Water Network Label
- Development Parcel
- Parcel P10 Catchment Area
- Possible Levels
- Proposed Levels
- Existing Contours

CATCHMENT ANALYSIS NOTES

1. Impervious areas for different land use is based on:
1.1. 60% of residential parcel area
1.2. 60% of neighbourhood centre area
1.3. 70% of employment area

Further allowances for urban creep (10%) and POS (5%) have been included in the impervious area figures.

2. Impervious areas from the spine road are in addition to the impervious areas indicated and are not subject to POS or urban creep allowances.

3. Refer to MicroDrainage calculations for full contributing areas.

4. Flow controls for each parcel are based on Hydrobrake or similar with either 'Linear Discharge Profile' or 'Minimise Upstream Storage' flow curves. Refer to parcel specific notes for flow rates for given return periods.

5. On parcel attenuation volumes indicated represent the minimum volumes required.

6. This drawing is indicative only and subject to development of the site-wide Masterplan and Detailed design.

Rev.	Date	Amendment	By	CHK.
A	02.10.19	Strategy updated to suit removal of permeable paving and site masterplan.	KM	KT
B	08.08.18	Site layout updated and SUDs basin contours indicated.	MIT	MV

Status Preliminary

Legal & General HOMES

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Client Legal & General Homes

Job Hogwood Farm, Finchampstead

Title Outline Drainage Strategy

Scale 1:1250 Date April 2018

Drawn by HS Checked by MV Approved by MV

Drawing No. C85672-SK-204

Rev. B