

Our Reference : D3985-L-01
Your Reference :

26 June 2023

Mr Power
36 Ashbourne Grove
Whitefield
M45 7WL

Dear Mr Power,

Lancaster Avenue – Whitefield
Drainage Design

Introduction

PSA Design Ltd has been commissioned by our Client, Mr Power, to prepare a drainage design for a single proposed dwelling on land adjacent to 1 Lancaster Avenue, Whitefield, Manchester, M45 6DX.

The development has application granted (Ref. 67976). This document, together with its associated drainage drawing, seeks to outline the drainage design philosophy and compliance with Condition 6 of the approved application.

Site Location & Description

The plot forms a vacant piece of land immediately to the west of 1 Lancaster Avenue and east of the railway siding. The site location, existing and proposed site can all be seen on the Architects drawings, included in **Appendix A**.

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Surface Water Management Strategy

National Planning Policy Framework (NPPF, 2019), outlines that SuDS must be included within any proposed development scheme where it is practicable to do so. In order to demonstrate that the development will meet with the requirements, the drainage strategy should show;

- That it will be feasible to balance surface water run-off to the Greenfield run-off rate, or reduce existing run-off rate in terms of a brownfield development for all events up to the 1 in 100 year storm, including an allowance for climate change and set out how this could be achieved.
- If there is potential for any additional impermeable area being introduced to the site in the future, then an appropriate allowance should be made to cover this. This is known as Urban Creep.

For new development, it may be necessary to provide surface water storage and/or infiltration to limit and reduce both the peak rate of run-off and the total volume discharged from the site.

As the development site is located within the Irwell Management Catchment area, reference to the peak rainfall allowance map sets out the allowances below:

Scenario	Event	Central Allowance	Upper End Allowance
3.3% annual exceedance rainfall event	2050s	25%	35%
	2070s	30%	40%
1% annual exceedance rainfall event	2050s	25%	40%
	2070s	30%	45%

Catchment Peak Rainfall Allowances - Use '2050s' for development with a lifetime up to 2060 and use the 2070s epoch for development with a lifetime between 2061 and 2125.

Therefore, CC should also be taken into account by increasing the proposed rainfall intensity by 40% when assessing against the 3.3% (1 in 33) storm event and 45% when assessing against the 1% (1 in 100) storm event.

Urban Creep (UC) should be taken into account by increasing the proposed rainfall intensity by 10% in line with best practice guidelines.

Existing Site Drainage & Hydrology

As previously discussed, the existing site is currently a vacant plot immediately to the east of No.1 Lancaster Avenue. It is understood that all the existing properties in the area drain to the adopted combined sewers.

United Utilities (UU) records have been acquired and an extract is included below. The mapping shows the residential areas around the site are well served by existing combined sewers, the nearest being a 525mm dia. combined sewer which runs westerly along Lancaster Avenue. This sewer has been transferred onto PSA Design drawing D3985-D-01, included within **Appendix B**.



Consideration of Sustainable Drainage Systems & Proposed Strategy

There are a number of options for the provision of surface water drainage for the proposed development:

- Soakaways for roof run-off and permeable surfacing for roads, drives, car parks and private access road.
- Discharge to local watercourse.
- Discharge to public sewer.

The first option to be considered for surface water disposal for all proposed development must be infiltration into the ground. Even when there are alternative sewer connections or watercourses available, infiltration must still be utilised unless it is proved unfeasible. Normally to identify the suitability of the ground for infiltration, percolation testing is carried out to calculate the infiltration rate. Where the underlying soil conditions are relatively impermeable, for example clay, the infiltration rate may be too low for soakaways to be designed to adequately cope with large storm events from the entire site.

Reference to “Soilscapes Mapping” indicates the soil is “Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils with impeded drainage”.

Reference to online British Geological mapping, highlights the soil characteristics of the site to be as follows:

Superficial Geology – Glaciofluvial Deposits, Devensian - Sand and gravel

Bedrock Geology – Nob End Rock – Sandstone

The above sources appear to contradict themselves and therefore we cannot categorically rule out soakaways purely based on soil characteristics. However, cognisance also needs to be taken of the site location and in particular the adjacent railway infrastructure. Network Rail guidelines state *“Soakaways, as a means of storm/surface water disposal must not be constructed within 20 metres of Network Rail’s boundary or at any point which could adversely affect the stability of Network Rail’s property”*.

The proposed site abuts Network Rail’s boundary and is just 13m from the track itself. This therefore rules out soakaways as a viable solution for draining surface water from the site.

There are no watercourses within or adjoining the applicant’s site. Given the scale and nature of the proposal it is not economically viable to broaden the search over third party land.

Therefore, the only reasonable solution for drainage from the site would be to the existing combined sewers.

To meet with the guidance set out above, any surface water discharge from the site (not to soakaways) must be restricted to existing greenfield run-off rates. It is proposed that the minimum allowable discharge rate for this site would be restricted to 1l/s. Any rate lower than this is likely to have maintenance issues in providing a compliant solution.

To restrict surface water run-off from the proposed development it will be necessary to provide some form of attenuation storage on site. There are numerous ways of providing this, the most common for small developments being cellular storage crates. In this instance we have proposed a pre-fabricated “Raintaina 1.6FC” storage system with in-built flow control device by SEL Environmental. The design of the system has ensure that run-off is limited to 1l/s and that there is no flooding of the site up to and including the 1 in 100yr storm + 45% CC + 10% UC.

A design based on the above criteria has been modelled and illustrated on PSA Design drawing D3522-D-01 within **Appendix B**. The supporting calculations are included as

Appendix C. The calculations demonstrate that the above storm criteria base on a 1l/s restriction is adequately contained and maintained within the system.

As per the Architects approved plans, it is also the developer's intention to provide a permeable driveway. This meets with best practice SuDS guidance and should work well in this location. In order to provide a robust assessment and cover any future eventualities, the drainage model has assumed that the driveway area is impermeable and thus is included in the contributing area.

Water Quality

The SuDS design should seek to provide an appropriate management train of SuDS components to effectively mitigate the pollution risks associated with the different site uses.

In accordance with Table 4.3 of The SuDS Manual CIRIA C753, the pollution hazard level is considered to be 'Low' to 'Very Low' for the proposed development. Therefore, the requirements for discharge to surface waters state that the 'Simple index approach' should be used.

The first step of the simple index approach is to identify the pollution hazard indices for the proposed land use. Table 26.2 of The SuDS Manual states the following

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential Roofs	Very Low	0.2	0.2	0.05
Individual property driveways, residential car parks, low traffic roads and non-residential car parking with infrequent change (i.e. <300 movements/day)	Low	0.5	0.4	0.4
Total		0.7	0.6	0.45

Total Pollution Hazard Indices

Suitable SuDS should then be selected with a total pollution mitigation index that equals or exceeds the pollution hazard index.

Table 26.3 of The SuDS Manual sets out the indices for proposed SuDS features. Those features included on the proposed design presented are listed in the table below. Where treatment components are used together in series a factor of 0.5 is used to account for the reduced performance of the secondary or tertiary components.

Type of SuDS Component	Total suspended solids (TSS)	Metals	Hydro-carbons
Permeable Pavement	0.7	0.6	0.7
Total	0.7	0.6	0.7

Total Pollution Hazard Indices – Proposed SuDS Features

It can be seen that the total mitigation index for the proposed SuDS features is greater than the required pollution hazard index for the proposed land use. A silt trap has also been included immediately upstream of the Raintaina unit. Therefore, the proposed system meets the water quality requirements.

It has therefore been demonstrated that a SuDS solution that meets with the requirements of current legislation is deliverable within the constraints of the site.

Foul Drainage

It is the developer's intention to connect foul drainage into the same combined sewer. Foul and surface water sewers on site will be kept separate, combined immediately prior to leaving the site into the UU sewer. The final combined connection from the site will saddle onto the large diameter UU sewer, subject to S106 approval. It is proposed that the final inspection chamber includes for non-return flap valves on both inlets.

Subject to United Utilities formal approval, it is clear that there is a means of dealing with foul and surface water from the proposed development.

Maintenance of drainage system

It is important during any development process to consider the long-term maintenance of the proposed drainage system. As with all residential plot drainage, the proposed drainage will be maintained by the homeowner. A typical management and maintenance regime for the various SuDS elements is included for reference as **Appendix D**.

Summary

- Network Rail guidance rules out the use of soakaways on the site due to proximity with their infrastructure. Providing a building regulations compliant solution (i.e. minimum 5m from building, structure and house) would also rule out soakaways given the constraints of the small development plot.
- There are no accessible watercourses within or adjoining the site.
- Surface water run-off will be restricted to a maximum 1l/s up to and including the 1 in 100yr event.
- Climatic change will be accounted for by applying a 45% increase in rainfall with a further 10% to allow for Urban Creep.
- It is proposed to utilise a porous paved solution for all external hardstanding.
- The proposed drainage will be delivered using a separate foul and surface water system.
- Future maintenance of the system will be managed by the homeowner.
- Subject to UU S106 approval, surface and foul drainage will be discharged via a saddle connection onto the 525mm combined sewer running along Lancaster Avenue.

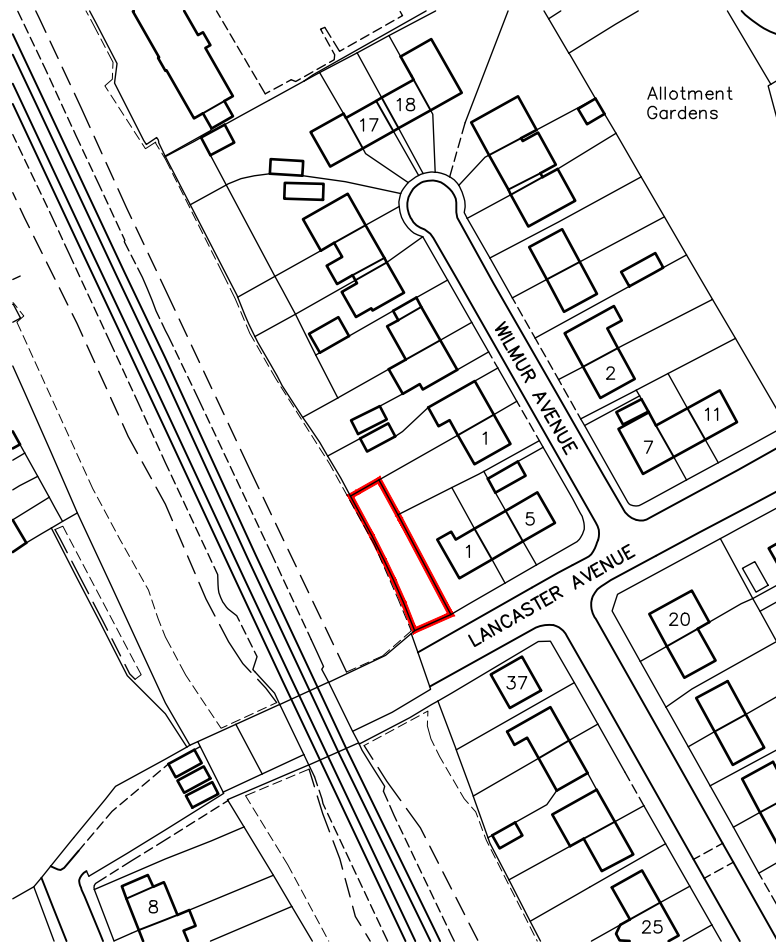
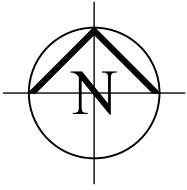
Yours sincerely,



Graham Sanderson
PSA Design Ltd.

Appendix A

Architects Drawings



Lancaster Avenue, Whitefield Location Plan

0 20m 40m 60m



1:1250@A4 1392-PL01



ARCHITECTURE

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Tel 01772 467404 E Mail info@pwlarchitecture.com

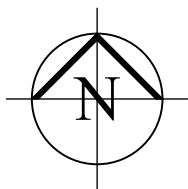


Lancaster Avenue, Whitefield

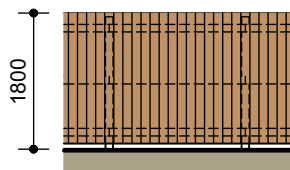
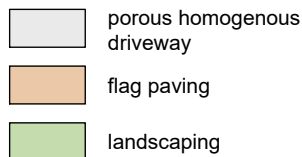
Existing Site Layout



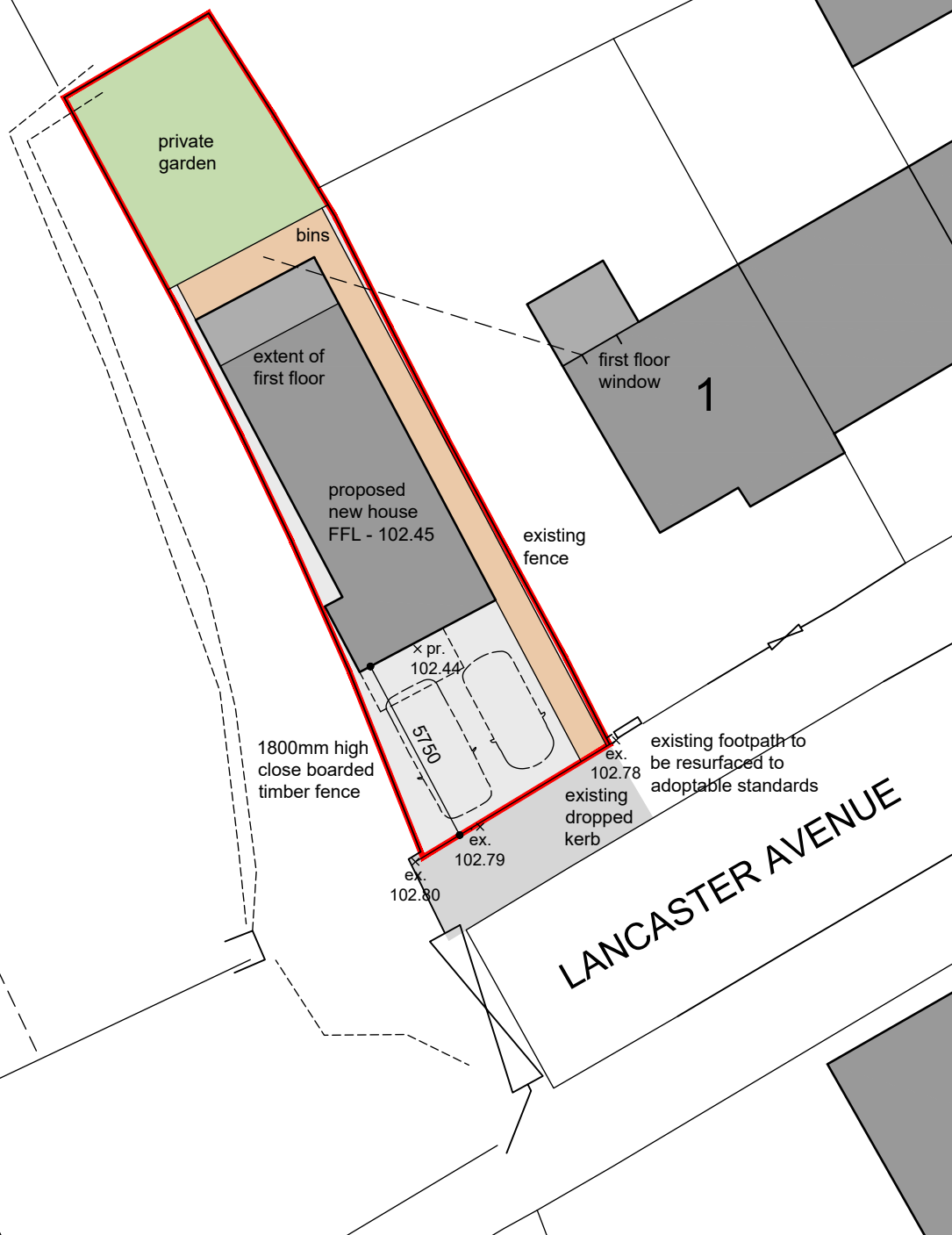
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key:



1800mm high close boarded timber fence



Lancaster Avenue, Whitefield Proposed Site Layout

0 4m 8m 12m

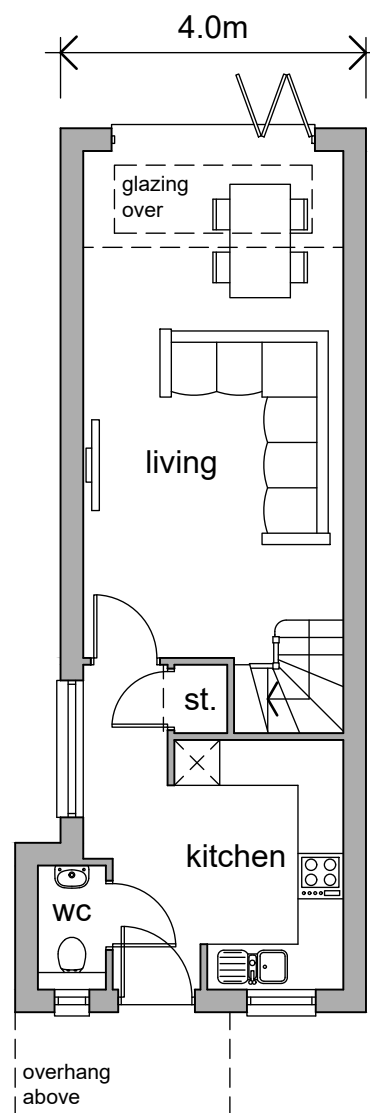
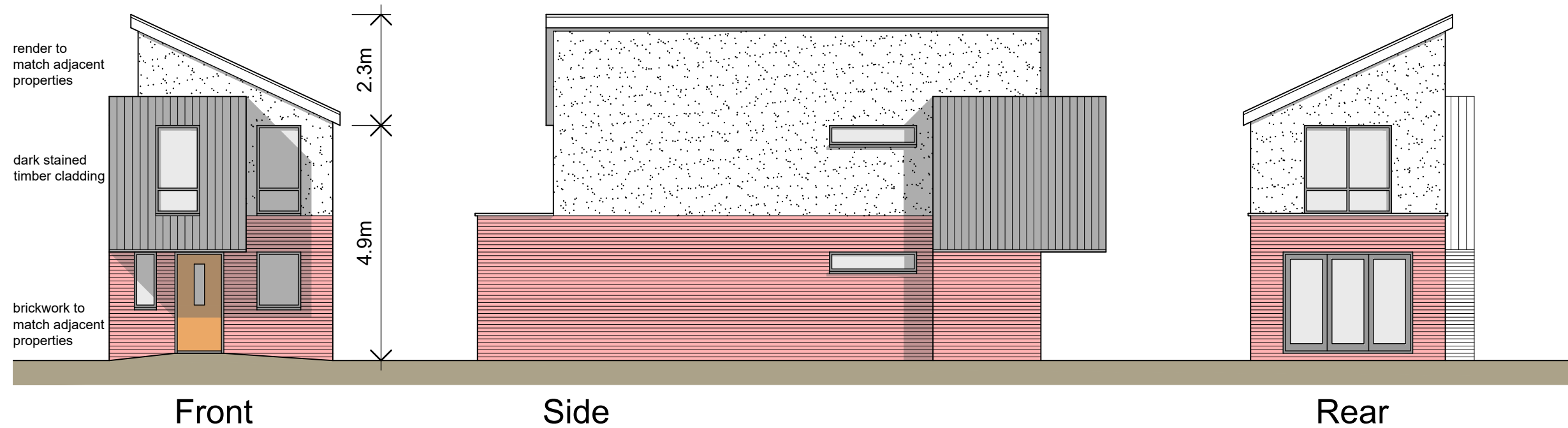
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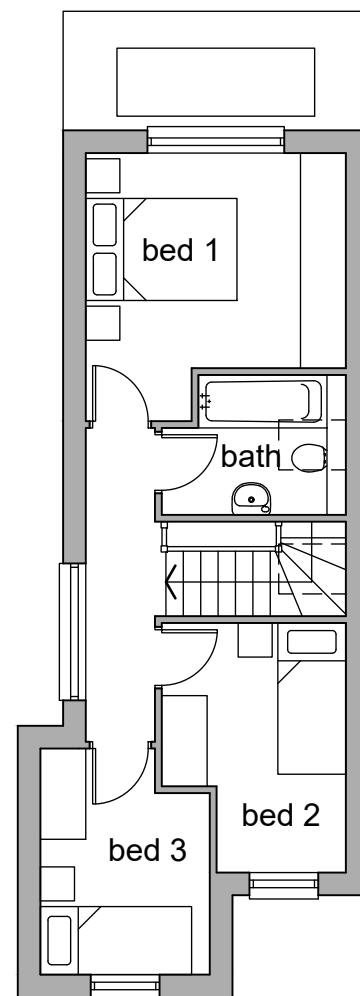
PWL

ARCHITECTURE

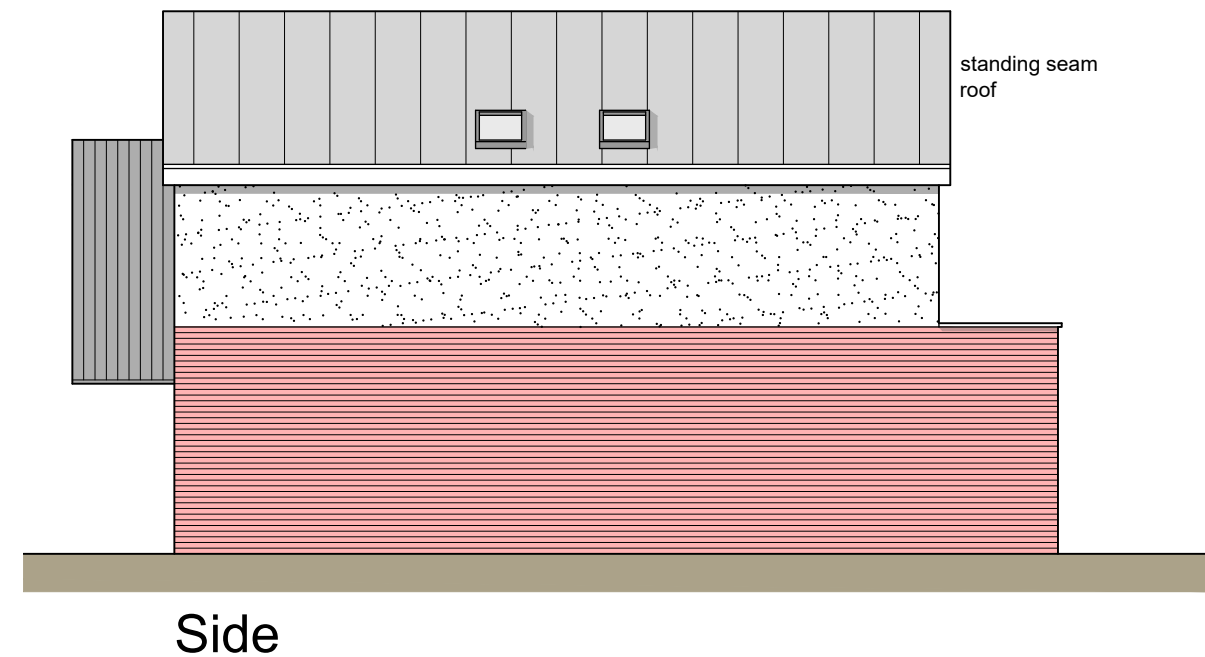
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Ground (39.1 sqm)



First (36.7 sqm)



Lancaster Avenue, Whitefield - Proposed House



Appendix B

PSA Design Drawing

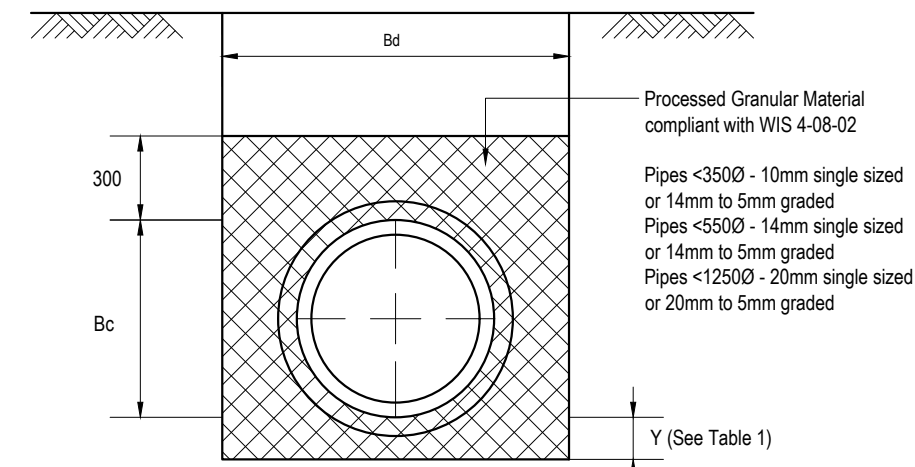
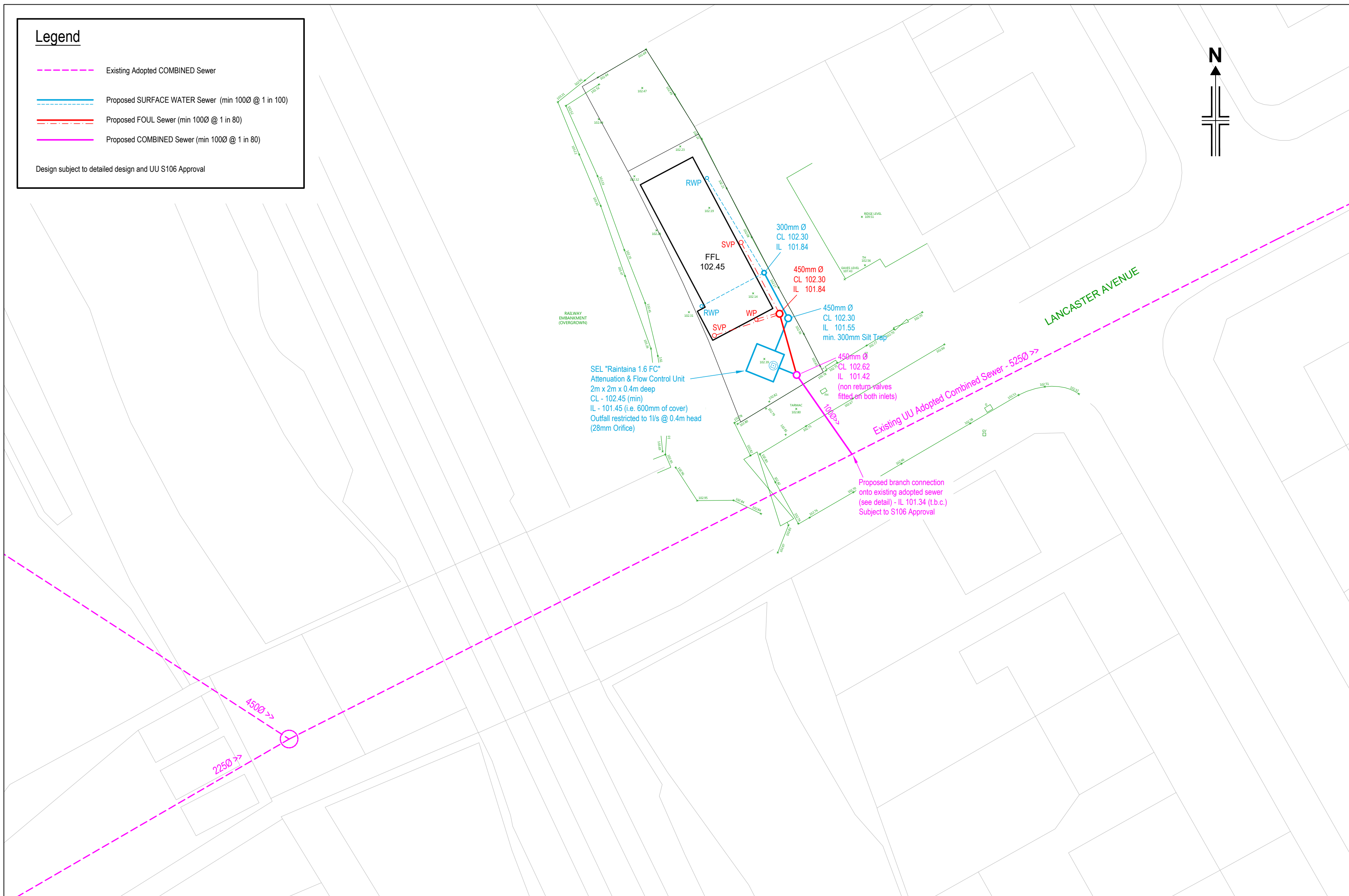
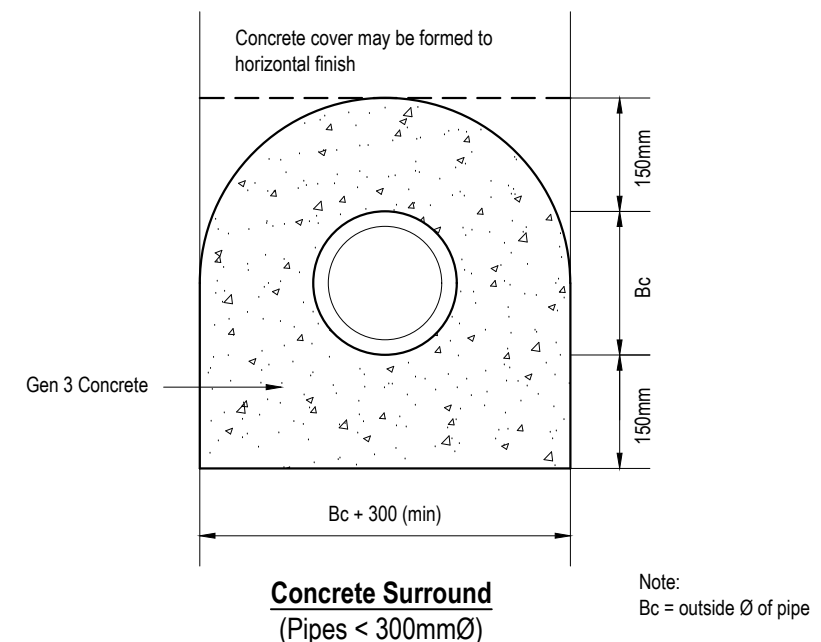


Table 1 - Dimension Y Minimum Effective Embedment Dimensions for Flexible and Semi Rigid Pipes			
Nominal Int Pipe Dia	Even trench bottom	Rock or uneven trench bottom	Minimum Effective Trench Width Bd
<400	100	200	Bc=300
400-700	150	250	Bc=450
725-900	225	300	Bc=600
1200	250	350	Bc=800

*Note:
The minimum depth of processed granular material under pipe sockets shall be 50mm for even trench bottom and 150mm for uneven trench bottom.



*Note:
Min. 18mm thick Compressible filler joint to be installed at each socket / joint

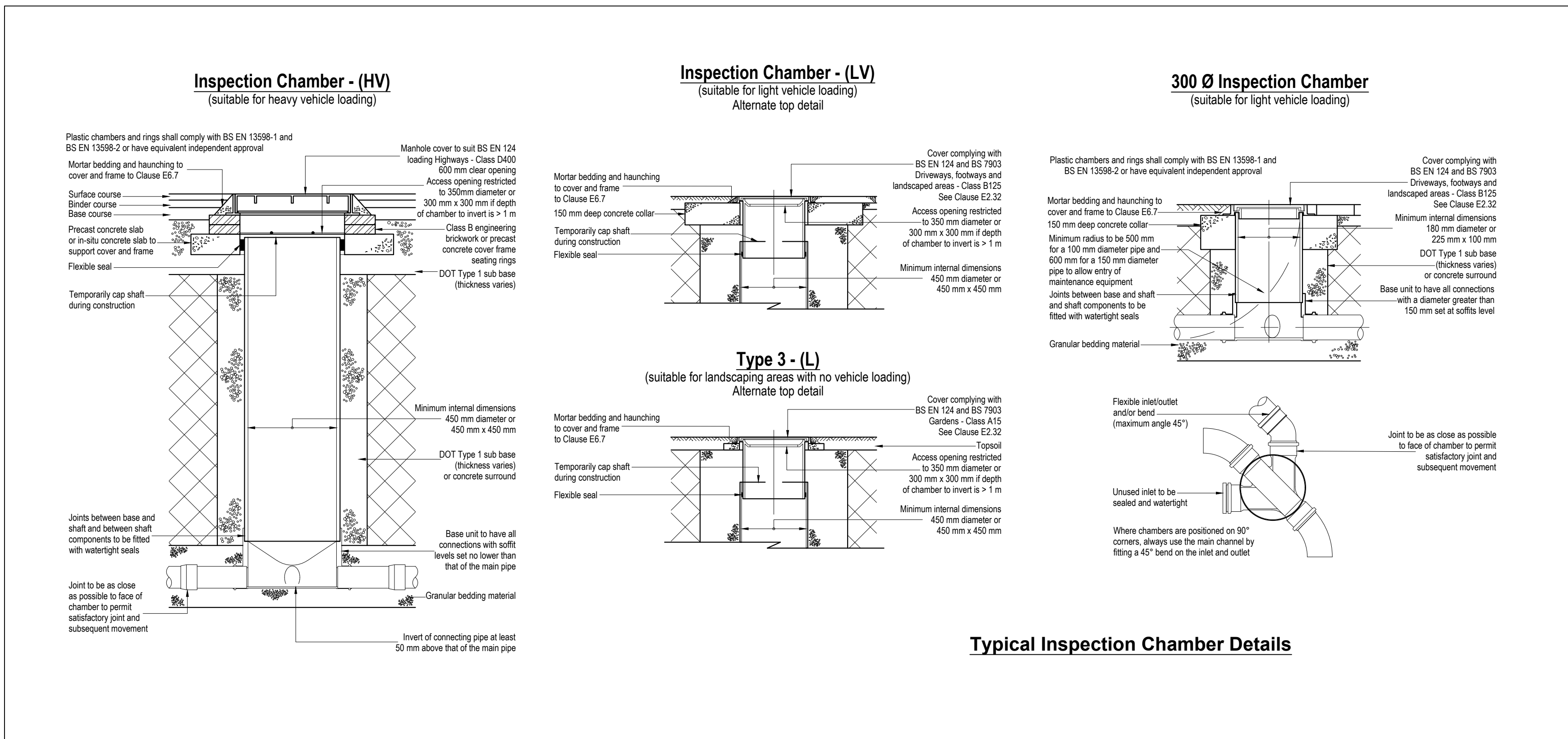
Drainage Pipe Embedment Details

Notes

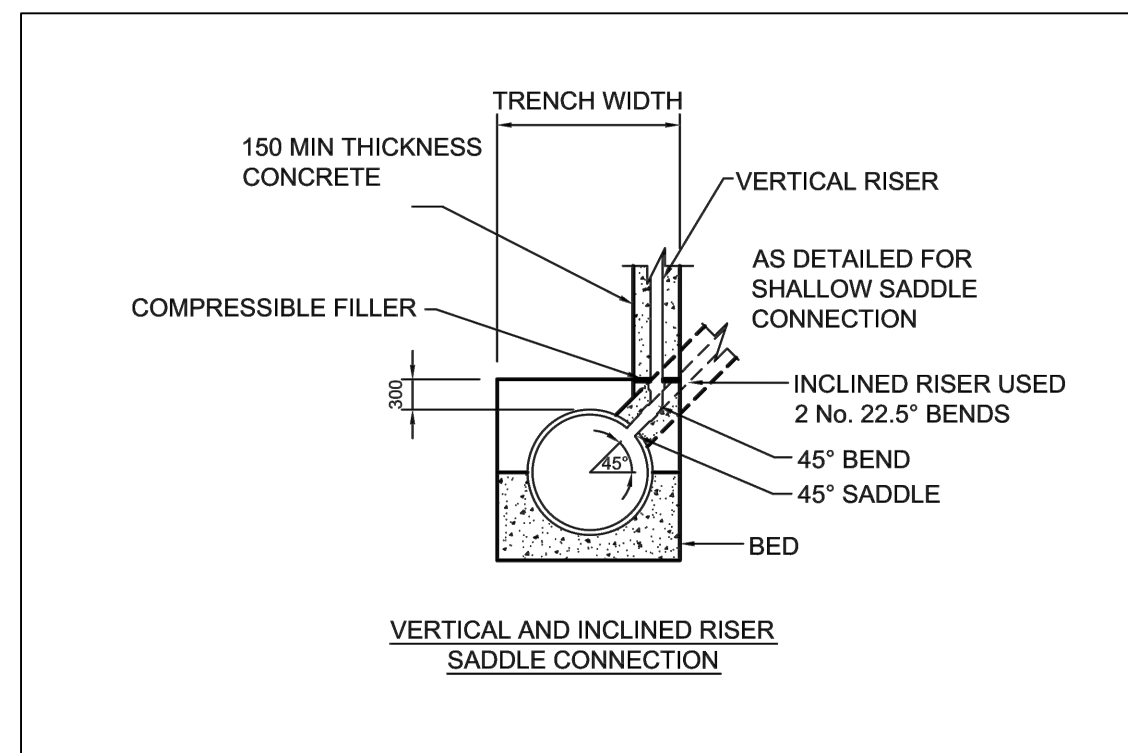
- Do not scale from this drawing, work to levels and dimensions shown, if not available refer to notes, if in doubt, refer to Engineer.
- The Engineer shall be notified immediately, in writing, should any errors or discrepancies be found prior to to be commencement or continuation of any works.
- Drawing to be read in conjunction with all other scheme drawings and relevant specifications.
- Contractor to be responsible for the location and protection of all existing services.
- Work to be undertaken in accordance with Design and Construction Guidance for foul and surface water sewers (App Ver 2.0) and Building Regulations - Document H.
- All existing land drains encountered on site during construction are to be re-connected/diverted as necessary (not connected into the new system without prior approval).
- All drains to be laid soffit to soffit unless otherwise indicated.
- Steeper gradients may be used instead of backdrops.
- Cover levels shown are approximate only and should be altered to suit finished surface levels.
- Minimum depth of cover to crown of pipe without protection should be as follows:
 - 0.35m - Gardens and Pathways with no vehicular loading
 - 0.50m - Driveways, Parking Areas and Narrow Accesses with height restrictions to prevent entry by vehicles with a gross weight in excess of 7.5 tonnes
 - 0.9m - Driveways, Parking Areas and Narrow Accesses with limited access to vehicles with a gross weight in excess of 7.5 tonnes. Agricultural land and public open space.
 - 1.2m - Other Highways and Parking Areas with unrestricted access to vehicles with a gross weight in excess of 7.5 tonnes
- All rainwater pipes (RWP) to be terminated at roddable gullies connected to a minimum 100mm dia. drain.
- Unless stipulated otherwise or invert levels are provided, all surface water pipes to be minimum 100mm dia. laid at 1 in 100. Foul sewers to be minimum 100mm dia laid at 1 in 80 (1 in 40 if no WC connected).
- Proposed PCC Manholes & Inspection Chambers and access points are to be as those defined in Design and Construction Guidance for foul and surface water sewers (App Ver 2.1). MH & IC diameters specified are minimum diameters and if necessary should be increased to accommodate minimum benching widths.
- 4500 diameter IC's > 1.2m deep to include reducing ring to reduce opening to max 350mm Ø
- Drainage under carriageways - Pipes up to 300mmØ to be structured walled PVCu or Clay. Pipes greater than 300Ø to be Concrete in accordance with BS 5911-1 and BS EN 1916. All pipes to be in accordance with Design and Construction Guidance for foul and surface water sewers (App Ver 2.1).
- All plot drainage to be in accordance with Building Regulations - Document H.
- All drains in the vicinity of existing or proposed trees to be constructed in accordance with the requirements of NHBC.
- Any drains passing through brick footings are to have r.c. lintels over and flexible joints either side. All drainage passing through external walls to have cement fibre sheet collars provided either side of wall to prevent vermin entry. All drains running under building to be encased in 100mm granular fill.
- Where drain is within 1m of a building, the trench is filled with concrete up to the underside of the foundations and where the trench is further away than 1m from the building, the trench is filled with concrete to a level below the lowest level for the building equal to the distance from the building, less 150mm.
- Installation of threshold drains to be the responsibility of the contractor in consultation with the scheme Architect. Threshold drainage should be installed where appropriate to ensure no surface water migration into properties. Where possible the contractor should ensure that all private driveways are laid to disperse surface water to adjoining landscaped areas.
- Drainage indicated on drawing around buildings spaced out for illustrative purposes, exact positions of drains may be altered to suit and determined on site prior to commencement of work (subject to maintaining minimum gradients and cover). Any revisions are to be subject to the approval of the Local Building Inspector and Structural Engineer.
- Any additional connections to be approved with Engineer, subject to minimum gradients and diameters.
- All outfall levels and existing pipe levels should be checked prior to construction to ensure the design is deliverable and no clashes occur. Contractor to report any discrepancies to Engineer immediately.
- Condition of any existing drainage to be used as part of proposed system to be checked prior to construction and any defects remedied.
- All building drainage up to connection into chambers shown to be as per Architects Building Regulations drawings.

Attenuation and Flow Control

- Rainaina Modular Attenuation tank.
Model Reference : RTNA01001 Rainaina 1.6FC
- Built in flow control unit to be restricted to 1l/s at 0.4m head.
- System to be fitted with all necessary vents and constructed strictly in accordance with manufacturers guidelines. Upstream IC include a silt trap (min 500mm). Minimum cover levels should be checked with manufacturer.



Typical Inspection Chamber Details



Please read all notes carefully.
Depth & location of outfall to be confirmed prior to commencement.
Outfall connection subject to S106 Part 1 and 2 Approval.

P1	23/06/03	For Approval	GS	DLW	GS
REV	DATE	AMENDMENT DETAILS	DRAWN	CHECKED	APPROVED
Mr Power					
Lancaster Ave, Whitefield. Proposed Residential Development			Drwg No. D3985-D-01	Rev. P1	
Proposed Foul & Surface Water Drainage			Scale As Shown	Sheet Size A1	
PSA Design Ltd The Old Bank House, 6 Berry Lane, Longridge, Preston, PR3 3JA Tel. 01772 786066 www.psaesign.co.uk mail@psaesign.co.uk			Date 23 June 2023	Drawn GS	
			Checked	Approved	

Appendix C

FLOW Surface Water Drainage Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	18.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.350	Preferred Cover Depth (m)	0.350
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
IC1	0.005	4.00	102.300	300	381043.198	405336.974	0.460
IC2			102.300	300	381044.805	405333.940	0.750
Raintaina	0.003	4.00	102.350	1200	381043.860	405330.624	0.900
Combined			102.650	450	381045.420	405329.996	1.230

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	IC1	IC2	3.433	0.600	101.840	101.550	0.290	11.8	100	4.03	50.0
1.001	IC2	Raintaina	3.448	0.600	101.550	101.450	0.100	34.5	100	4.07	50.0
1.002	Raintaina	Combined	1.682	0.600	101.450	101.420	0.030	56.1	100	4.10	49.9

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	2.258	17.7	0.7	0.360	0.650	0.005	0.0	14	1.091
1.001	1.318	10.3	0.7	0.650	0.800	0.005	0.0	18	0.745
1.002	1.031	8.1	1.1	0.800	1.130	0.008	0.0	25	0.714

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	3.433	11.8	100	Circular	102.300	101.840	0.360	102.300	101.550	0.650
1.001	3.448	34.5	100	Circular	102.300	101.550	0.650	102.350	101.450	0.800
1.002	1.682	56.1	100	Circular	102.350	101.450	0.800	102.650	101.420	1.130

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	IC1	300	Manhole	PCC	IC2	300	Manhole	PCC
1.001	IC2	300	Manhole	PCC	Raintaina	1200	Manhole	PCC
1.002	Raintaina	1200	Manhole	PCC	Combined	450	Manhole	PCC

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
IC1	381043.198	405336.974	102.300	0.460	300		0	1.000	101.840	100
IC2	381044.805	405333.940	102.300	0.750	300		1	1.000	101.550	100
							0	1.001	101.550	100
Raintaina	381043.860	405330.624	102.350	0.900	1200		1	1.001	101.450	100
							0	1.002	101.450	100
Combined	381045.420	405329.996	102.650	1.230	450		1	1.002	101.420	100

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	18.000	Drain Down Time (mins)	240
Ratio-R	0.350	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
30	40	10	0
100	45	10	0

Node Raintaina Online Orifice Control

Flap Valve	x	Design Depth (m)	0.400	Discharge Coefficient	0.660
Replaces Downstream Link	✓	Design Flow (l/s)	1.0		
Invert Level (m)	101.450	Diameter (m)	0.028		

Node Raintaina Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	101.450
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	26

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	4.0	0.0	0.400	4.0	0.0	0.401	0.0	0.0

Results for 30 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	IC1	10	101.865	0.025	2.4	0.0078	0.0000	OK
30 minute winter	IC2	25	101.684	0.134	1.9	0.0095	0.0000	SURCHARGED
30 minute winter	Raintaina	25	101.684	0.234	2.8	1.2164	0.0000	SURCHARGED
15 minute summer	Combined	1	101.420	0.000	0.7	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	IC1	1.000	IC2	2.4	1.279	0.135	0.0129	
30 minute winter	IC2	1.001	Raintaina	1.7	0.684	0.167	0.0270	
30 minute winter	Raintaina	Orifice	Combined	0.8				2.2

Results for 100 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	IC1	9	101.869	0.029	3.2	0.0091	0.0000	OK
60 minute winter	IC2	44	101.781	0.231	1.7	0.0164	0.0000	SURCHARGED
60 minute winter	Raintaina	44	101.780	0.330	2.4	1.7179	0.0000	SURCHARGED
15 minute summer	Combined	1	101.420	0.000	0.9	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	IC1	1.000	IC2	3.2	1.375	0.180	0.0163	
60 minute winter	IC2	1.001	Raintaina	1.4	0.663	0.133	0.0270	
60 minute winter	Raintaina	Orifice	Combined	1.0				3.9

Appendix D

Management and maintenance regime

SuDS Maintenance

This section is intended to give an overview of the operation and maintenance for the drainage features included with the drainage strategy. Where proprietary products are specified, the manufacturer's instructions and recommendations should be followed in priority to this document unless specifically noted otherwise due to project constraints.

The recommended operations and frequencies are typical and should be more frequent initially to ensure that there are no unforeseen issues with the operation. They should then be adjusted to suit the site requirements.

The surface water network has been designed to accommodate the 1 in 100-year storm rainfall event plus an allowance for climate change particular to the requirements of the site. It may be that the exceedance flows above the 1 in 30-year storm rainfall event are stored within the site partially above ground, on non-habitable external landscaping, parking or other space. As the flows are generally being attenuated on site and within SuDS features, there will be a period after storm events where the network is still partially or fully surcharged and is draining down. Where this surcharging is still present after 48hrs, appropriate action should be taken as noted in this section.

Components

The typical SuDS components are highlighted below. This is not an exhaustive list and reference should be made to the SuDS Manual (Ciria C753) for any items not listed.

- Pipes
- Drainage Channels and Gullies
- Permeable Pavements
- Soakaways & Infiltration Trenches
- Attenuation / Infiltration Basins
- Attenuation Storage Tanks
- Oil Separators

A suitable maintenance strategy should be adopted to ensure the drainage network is cleaned regularly and the routine maintenance and cleansing regime should be documented.

It is assumed that the maintenance of the drainage network will be the responsibility of an on-site facilities management team.

A copy of the final construction drainage layout should be provided in the final Operations and Maintenance Manual.

It is recommended that the drainage system is inspected as a minimum twice a year, with the system also being inspected after any major storm event.

Significant sediment deposition is likely in areas used for storage, so a post clean-up operation may be required including the removal of litter, vegetation, sewerage debris and larger objects.

Long-term management practices include monthly sweeping of external paved areas. The sweeping program will remove sand and contaminants directly from paved surfaces before they become mobilised during storm events and transported to the drainage system.

During the winter months, drainage features such as gullies and channels should be cleared of ice, snow, debris or litter

Sediment/material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols; especially where run-off is taken from potentially contaminated areas such as the filter drains and the upstream/downstream chambers.

Pipes

Pipes are proprietary products and the materials can vary across the site and as such where used the manufacture's recommendations should be followed.

Pipes are intended to be the main conveyance across the development and where oversized they form the attenuation volume required by the limitation of the discharge rate. They are intended to be dry except during rainfall events. These have been designed to be self-cleaning where possible for smaller diameter pipes, and for larger diameters the risk is reduced due to the overall pipe size.

Access for maintenance is provided through access chambers and manholes.

Regular inspection and maintenance is important to identify areas which may have been obstructed and may not be draining correctly thus exposing the development to a greater level of flood risk.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Initial Inspection should be provided as post construction CCTV survey.	N/A
Regular maintenance\ inspection	Inspect for evidence of poor operation via water level in chambers. If required, take remedial action.	3-monthly, 48 hours after large storms.
	Check and remove large vegetation growth near pipe runs.	Monthly or as required
Remedial Action	Rod through poorly performing runs as initial remediation.	As required.
	If continued poor performance jet and CCTV survey poorly performing runs.	As required.
	Seek advice as to remediation techniques suitable for the type of performance issue and location.	As required If above does not improve performance.

Drainage Channels and Gullies

Channels and gullies should be inspected and cleaned in accordance with the manufacturer's details. Channel units can be cleaned through the use of a high-pressure hose; this can be fed into the channel system through access units strategically placed along the channel run. The throat section of channel units should be kept clear at all times to ensure uninterrupted flow of surface water into the drainage channel and any debris within the throat should be removed.

Locking bolts should be replaced and sufficiently tightened, taking care that the bolt heads do not stand above the top surface of the cover or grate. If covers are allowed to move within their frame, this may cause damage to the frame or seating.

Sediment\material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols; especially where run-off is taken from potentially contaminated areas such as the car park channels.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Initial Inspection including channel outlet boxes.	Half yearly and after large storms.
Regular maintenance\ inspection	Litter and debris removal	Monthly or as required.
	Check and remove large vegetation growth near channel runs.	Monthly or as required
	Inspect for evidence of poor operation and/or weed growth. If required take remedial action. Inspect silt accumulation rates and establish appropriate brushing frequencies. Silt can also be caused by adjacent landscaping areas which should be reprofiled to provide a flat area or berm adjacent to the paving.	3-monthly, 48 hours after large storms.
Remedial Action	Inspect access/outlet boxes and rod through poorly performing channels and outlets as initial remediation.	As required.

Permeable Pavements

Permeable pavements contain proprietary products and as such where used the manufacturer's recommendations should be followed.

The permeable pavements are intended to be water quality and attenuation storage features. These features are intended to be dry except during rainfall events.

The surface has been designed to contain gaps where rain can flow through the upper construction layers in to the voided stone which makes up the subbase. Where these features are intended to be used as infiltration devices or soakaways any capping also needs to be permeable to permit the flows to the formation.

Access for maintenance is provided by inspection/access pipes, although access will be limited as this is a surface feature only.

Regular inspection and maintenance is important for the effective operation of the pervious pavement.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Initial Inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth. If required, take remedial action. Inspect silt accumulation rates and establish appropriate brushing frequencies. Silt can also be caused by adjacent landscaping areas which should be reprofiled to provide a flat area or berm adjacent to the paving.	3-monthly, 48 hours after large storms.
Regular maintenance\ inspection	Brushing and Vacuuming	Three times/year at end of winter, mid-summer, after autumn leaf fall, or as required based on site specific observations of clogging or manufacturers' recommendations.
Occasional maintenance	Stabilise and mow contributing and adjacent areas.	As required and as per landscape architect's specification.
	Removal of weeds	As required.
Remedial Action	Remediate any landscaping which, through vegetation maintenance or soil	As required.

Maintenance Schedule	Required Action	Frequency
	slip, has been raised to within 50 mm of the level of the paving.	
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users.	As required.
	Rehabilitation of surface and upper sub-structure. This could include replacement of the jointing and bedding material. The upper geotextiles layer may also need replacing if clogged and Terram 1000 has a life span of 25 years.	As required (if infiltration performance is reduced as a result of significant clogging).

Soakaways & Infiltration Trenches

Infiltration systems will require regular maintenance to ensure continuing operation to design performance standard. Different designs will have different operation and maintenance requirements.

Soakaways and infiltration trenches should include monitoring points where water level can be observed and measured. This can either be via an inspection well or inspection cover (where attenuation storage is a void). For larger installations the access should provide a clear view of the infiltration surface, for small filled soakaways a 500mm perforated pipe would be appropriate.

Silt traps should be installed immediately upstream of every inlet into a soakaway / infiltration system.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect inspection pipes for blockages, and clear if required. If faults persist rodding may be required.	Monthly for three months after installation
	Inspect silt traps and note rate of sediment accumulation	Monthly for 3 months and then annually or as required.
Regular maintenance\ inspection	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly.
	Debris removal from catchment surface (where may cause risks to performance).	Monthly
	Remove sediment from pre-treatment structures and filter chambers.	Annually (or as required after heavy rainfall events)
Remedial Actions	Repair/rehabilitation of inlets/outlets.	As required.
	Rehabilitation of surface and upper sub-structure. This could include replacement of the bedding material. The upper geotextiles layer may also need replacing if clogged and Terram 1000 has a life span of 25 years.	As required (if infiltration performance is reduced as a result of significant clogging).

Attenuation / Infiltration Basins

Regular inspection and maintenance is important for the effective operation of infiltration and attenuation basins.

Adequate access should be provided to allow appropriate equipment & vehicles to maintain the basin.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect inlets, outlets and overflows for blockages and clear if required. If faults persist rodding may be required.	Monthly for three months after installation
	Inspect silt traps and note rate of sediment accumulation	Monthly for 3 months and then annually or as required.
	Inspect infiltration surfaces for compaction and ponding	Monthly for 3 months and then annually
	Debris removal from catchment surface (where may cause risks to performance).	Monthly
	Remove sediment from pre-treatment structures and filter chambers.	Annually (or as required after heavy rainfall events)
	Cut grass for landscaped areas and access routes	Monthly during growing season or as required
	Cut grass (meadow grass in and around the basin)	Half yearly : spring (before nesting season) and autumn
	Reseed areas of poor growth, prune and trim trees and remove cuttings	As required
Remedial Actions	Repair/rehabilitation of inlets/outlets.	As required.
	Rehabilitate infiltration surface using scarifying and spiking techniques if performance deteriorates	As required

Attenuation Tanks

Regular inspection and maintenance is important for the effective operation of infiltration and attenuation basins. Attenuation tanks contain proprietary products and as such where used the manufacturer's recommendations should be followed

Access points should be established to allow for visual inspection and jetting as appropriate.

Silt traps must be installed prior to all inlets.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect inlets, outlets and overflows for blockages and clear if required. If faults persist rodding may be required.	Monthly for three months after installation then annually
	Survey inside of tank for sediment build up and remove if necessary	After 1 year and then every 5 years or as required
Remedial Actions	Repair/rehabilitation of inlets/outlets.	As required.
Regular Maintenance	Inspect and identify any areas that are not operation correctly and if necessary take remedial action	Monthly for three months after installation then annually
	Remove debris from catchment surface (where it may cause risk to performance)	As required
	Remove sediment from pre-treatment structures & silt traps	Annually or as required

Oil Separators

Proprietary treatment systems will require routine maintenance to ensure continuing operation to design performance standards. Because of the wide range of different designs and performance, all manufacturers should provide detailed specifications and frequencies for the required maintenance activities.

During the first few months after installation, units should be visually inspected after rainfall events and the amount of deposition measured to give the operator an idea of the expected rate of sediment and oil deposition. After this initial period, systems should be inspected every 6 months to verify the appropriate level of maintenance. During these inspections, the floating debris and floating oils should normally be removed. This may be done using a van mounted system without the need for a large tanker. Silt should be removed if it reached 75% of the capacity of the sump. In most situations, the units should be fully cleaned out at least

annually. Should there be a significant spill of oil then the system should be cleaned immediately.

Removal of oil, silt and other pollutants must be in accordance with the appropriate waste management legislation.

A typical operation and maintenance regime is set out in the table below for a proprietary system.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	6 monthly
	Change the filter media	As recommended by manufacturer
	Remove sediment, oil, grease and floatables	As necessary – indicated by system inspections or immediately following a significant spill
Remedial Actions	Replace malfunctioning parts or structures	As required.
Monitoring	Inspect for evidence of poor operation	6 monthly
	Inspect filter media and establish appropriate replacement frequencies	6 monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first 6 months of operation and then every 6 months