FLOOD RISK ASSESSMENTS &
DRAINAGE STRATEGIES

Land Rear Damson Close, Watford, WD24 5JY

Reference: 480 -Rev - V1

Feb-23

www.rida-reports.co.uk

Drainage Design - Planning Condition

Rev 1 Produced by: ARD 079 721 44579 arge@rida-reports.co.uk

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England and Wales number 10590566

Introduction 1

Purpose of this report

1.1 The purpose of this statement is to accompany the technical drawings and details showing the proposed Surface Water drainage system which addresses each point relating to relevant planning conditions.

Site Characteristics

2.1 The site background is clearly identified through answers to the questions in table 1 below.

Table 1: Site Characteristics . See appendix B for support documentation

TOPIC	QUESTION	ANSWER
Protected species or habitat	Is the site near to designated sites and priority habitats?	No
Flood Plain	Is the site located in the flood plain?	No
Soils and Geology	Soil permeability? - See appendix B for results	Yes
Space constraints	Space for SuDS components?	Yes
Topography	Sited on a flat site?	Yes
	Sited on a steep slope (5-15%)	No
	Sited on a very steep slope (>15%)	No
Groundwater	Is the site at groundwater flood risk?	No
Contaminated land	Are there contaminated soils on site?	No
Source Protection Zone	Is the site within a SPZ 3?	Yes
Runoff characteristics	Is the development in a high risk flooding area?	No

Existing and Proposed Site

2.2 The distribution of catchment areas for existing and proposed site is as per table 2 below. See appendix A for details

Table 2 : Existing and Proposed catchment areas in hectares

Description		Existing Site	Proposed Site
Impermeable Areas		0.000	0.010
Permeable Areas	Connected to Drainage	0.000	0.000
	Self Draining Areas	0.000	0.016
Areas Draining Away from drainage System		0.047	0.021
	Total Development Area	0.047	0.047

2.3 It has been assumed that the positively drained areas will have different runoff coefficients depending on the type of surface as follow:

Impermeable Surface	1.0
Permeable Surfaces	0.5
Grass Areas	0.3

Evaluation of Discharge Point

3.1 The SuDS design takes into account Building Regulations Section H3 and the National Planning Practice Guidance. The aim is to discharge surface water run-off as high up the drainage hierarchy, as reasonably practicable:

1. into the ground (infiltration);
2. to a surface water body;
3. to a surface water sewer, highway drain, or another drainage system;
4. to a combined sewer.

3.2 The discharge point has been evaluated following the NPPG and Building regulations. The findings are in table 3 below.

Table 3: Drainage Hierarchy evaluation

Superficial geology classification	The British Geological Society records show that the superficial deposits are Gerrards Cross Gravel - Sand and Gravel.
Bedrock geology classification	The British Geological Society records of the site show that it is located within the Seaford Chalk Formation and Newhaven Chalk Formation (Undifferentiated) - Chalk.
Landis Top Soil Infiltration	The SOILSCAPE's records of the site show that it is located within an area of freely draining soils.
Groundwater	The British Geological Survey's flood risk susceptibility maps show that the development has limited susceptibility to ground water flooding. The risk from groundwater flood to the site is considered very low.
Is infiltration feasible?	The site has potential for infiltration. The assumed infiltration rate for the site is 0.00001m/s or 0.036m/hr. This rate has been assumed from the site investigation report. See appendix B for details.
Is a discharge to a watercourse possible?	There are no watercourses in the proximity to the site.
Is a discharge to a surface water sewer possible?	There is no surface water sewer in the proximity to the site.
Is a discharge to a combined sewer possible?	There is no combined water sewers in the proximity to the site.

Existing and Proposed Peak Run-off Calculations

4.1 The current site is a Greenfield. The peak runoff rate for the existing site was calculated as per table 4 and discharge rates as per table 5.

Table 4: Peak run-off rate calculation method for existing site

Method Used	Calculation Method
X	Report 124 Flood Estimation for Small Catchments method has been used to estimate the site peak flow rates
	This is a brownfield site, runoff rates are calculated in accordance with best practice simulation modelling and using the modified rational method
	This is a brownfield site where the pre-development drainage isn't known. The runoff rates are calculated using the Greenfield model with soil type 5

4.2 The runoff flow produced by the development will be controlled as per table 5.

Table 5: Runoff discharge rate control

Control Used	Description of runoff discharge
X	Water will be discharged into the ground via a SuDS as described in table 6 below
	The peak discharge rate has been reduced to Greenfield Qbar flow
	The peak discharge rate has been taken as 0.7 l/s as it is not possible to reduce it to the Greenfield Qbar rate
	The peak discharge rate has been reduced to Brownfield pre-development 1 in 1 flow
	The peak discharge rate has been reduced by 60% from the existing Brownfield pre-development 1 in 2 flow rate

Run-off flows

4.3 The size of the SuDS has been calculated for all events up to the 1 in 100 including an allowance for climate change of 40%. As per tables above, it is proposed to infiltrate all the flows. See table 6 for values and appendix C for calculations.

Table 6: Peak discharge rates for SuDS

Return Period Event	Discharge Rate (l/s)			Infiltration Rate (m/hr)
	Existing Greenfield	Existing Brownfield	Proposed	
Qbar	0.10	N/A	N/A	0.0360
1 in 1	0.10	N/A	0.0	0.0360
1 in 2	0.10	N/A	0.0	0.0360
1 in 30	0.20	N/A	0.0	0.0360
1 in 30 + CC	N/A	N/A	0.0	0.0360
1 in 100	0.30	N/A	0.0	0.0360
1 in 100 + CC	N/A	N/A	0.0	0.0360

Proposed Sustainable Drainage System

5.1 The following sustainable drainage systems have been used for this site. The drainage design uses these drainage system through out the site. See table 7 for details.

Table 7: Proposed Drainage System

SuDS Proposed	Feasible	Proposed
Use of green roofs	No	No
Store rainwater for later use	No	No
Use infiltration techniques, for instance soakaways, permeable surfaces	Yes	Yes
Attenuate rainwater in ponds or open water features for gradual release	No	No
Attenuate rainwater by storing in tanks or sealed water features for gradual release	No	No
Discharge Point Proposed		
Discharge rainwater direct to a watercourse	No	No
Discharge rainwater to a surface water sewer/drain	No	No
Discharge rainwater to the combined sewer	No	No

5.2 The location and details of the SuDS can be seen drainage layouts in appendix D. Calculations are in appendix C.

5.3 The drainage calculations demonstrate:
- No flooding occurs for the 1 in 30 storm events.
- Any flooding for the 1 in 100 year + 40% climate change event can be safely contained on site

5.4 The proposed drainage design demonstrates that the development can be sustainably drained to comply with the requirements of the NPPF.

Management of Exceedance Flows

5.5 The drainage network has been designed to attenuate surface runoff for all events up to and including the 1% AEP + CC(1 in 100 years). However consideration has been given to what may happen when the design capacity of the surface water drainage network is exceeded. Surface water will flow to the lowest points within the site. The flood risk to the buildings would therefore remain low. See appendix D.

Water Quality Assessment

5.6 The pollution hazard indices for this development has been taken from the CIRIA C753 publication 'The SuDS Manual' – Table 26.2. The tables below shows the mitigation measure for the highest pollution hazard indices presented in the development.

Table 8: Pollution Hazard Indices

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. <300 traffic movements/day	Low	0.5	0.4	0.4
	TOTAL	0.7	0.6	0.45

Table 9: SuDS Mitigation Indices for worst case**

Type of SuDS	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Permeable paving	0.7	0.6	0.7
Crate Storage/ Soakaway	0.2	0.15	0.15
TOTAL	0.9	0.75	0.85

** Values already reduced as per CIRIA C753

5.7 It is demonstrated that the proposed sustainable systems exceeds the required pollution indices and provides sufficient treatment as part of the surface water management train in accordance with the 2015 SuDS Manual (CIRIA C753)

Maintenance and Management plan responsibility

6.1 The SuDS will be maintained by The Owner the property

Maintenance and Management plan for proposed SuDS

6.2 The maintenance and Management Plan Guidance from the SuDS Manual, CIRIA C753 (CIRIA, 2015) is to be followed for the effective maintenance of the proposed SuDS techniques outlined above. The maintenance for SuDS structures are as follow:

INLETS, OUTLETS, CONTROLS AND INSPECTION CHAMBERS	
Regular Maintenance	**Frequency**
Inlets, outlets and surface control structures	
Inspect surface structures removing obstructions and silt as necessary. Check there is no physical damage.	Monthly
Strim vegetation 1m min. surround to structures and keep hard aprons free from silt and debris	Monthly
Inspection chambers and below ground control chambers	
Remove cover and inspect ensuring water is flowing freely and that the exit route for water is unobstructed. Remove debris and silt.	Annually
Undertake inspection after leaf fall in autumn	
Occasional Maintenance	
Check topsoil levels are 20mm above edges of baskets and chambers to avoid mower damage	As necessary
Remedial work	**Frequency**
Unpack stone in basket features and unblock or repair and repack stone as design detail as necessary.	As required
Repair physical damage if necessary.	As required

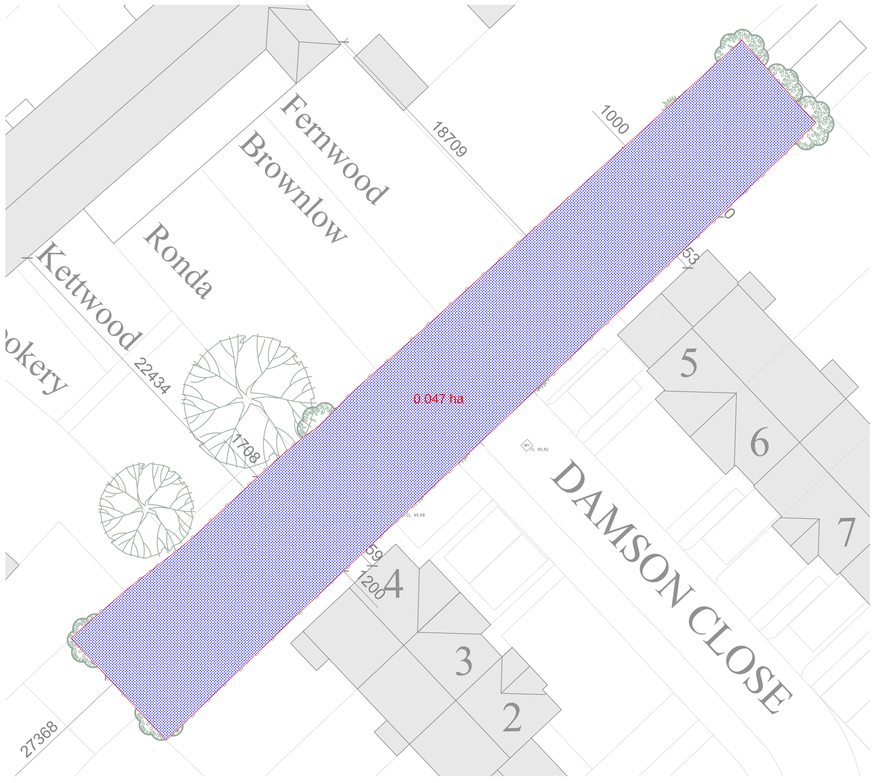
Operation and maintenance requirements for soakaways

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional maintenance	Remove sediment and debris from pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	As required, based on inspections
Remedial actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually
	Check soakaway to ensure emptying is occurring	Annually

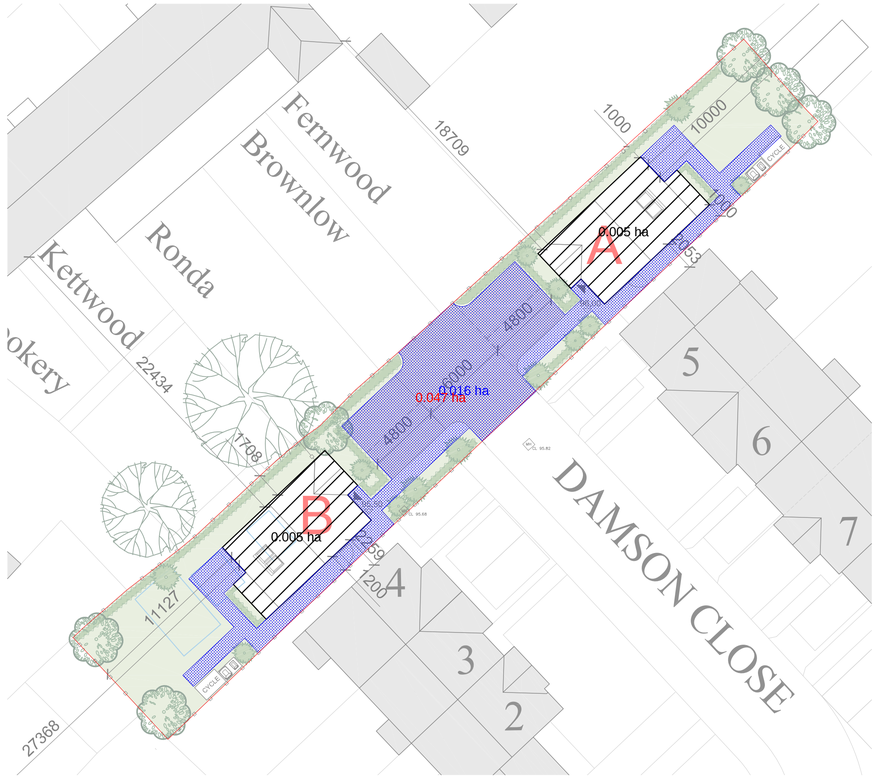
Operation and maintenance requirements for pervious pavements

Maintenance schedule	Required action	Typical frequency
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 glyphospate 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

Appendix A



EXISTING SITE
1:200



PROPOSED SITE
1:200

Drawing Scale Bar

Drawing scale	Line length	Drawing scale	Line length
1:5 =	0.25 metres	1:200 =	10.0 metres
1:10 =	0.5 metres	1:250 =	12.5 metres
1:20 =	1.0 metres	1:500 =	25.0 metres
1:25 =	1.25 metres	1:1000 =	50.0 metres
1:50 =	2.5 metres	1:1250 =	62.5 metres
1:100 =	5.0 metres	1:2500 =	125 metres

Measure length of line above for checking of scale

GENERAL NOTES

KEY

PERMEABLE AREAS

IMPERMEABLE AREAS

STUDY AREA

Rev	Details	Date	By	Chk'd

Drawing Status:
PRELIMINARY

FLOOD RISK ASSESSMENT & DRAINAGE STRATEGIES

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www.rida-reports.co.uk

Client:

Project:
Land Rear Damson Close, Watford, WD24 5JY

Drawing:
Existing and Proposed Areas
Permeable and Impermeable

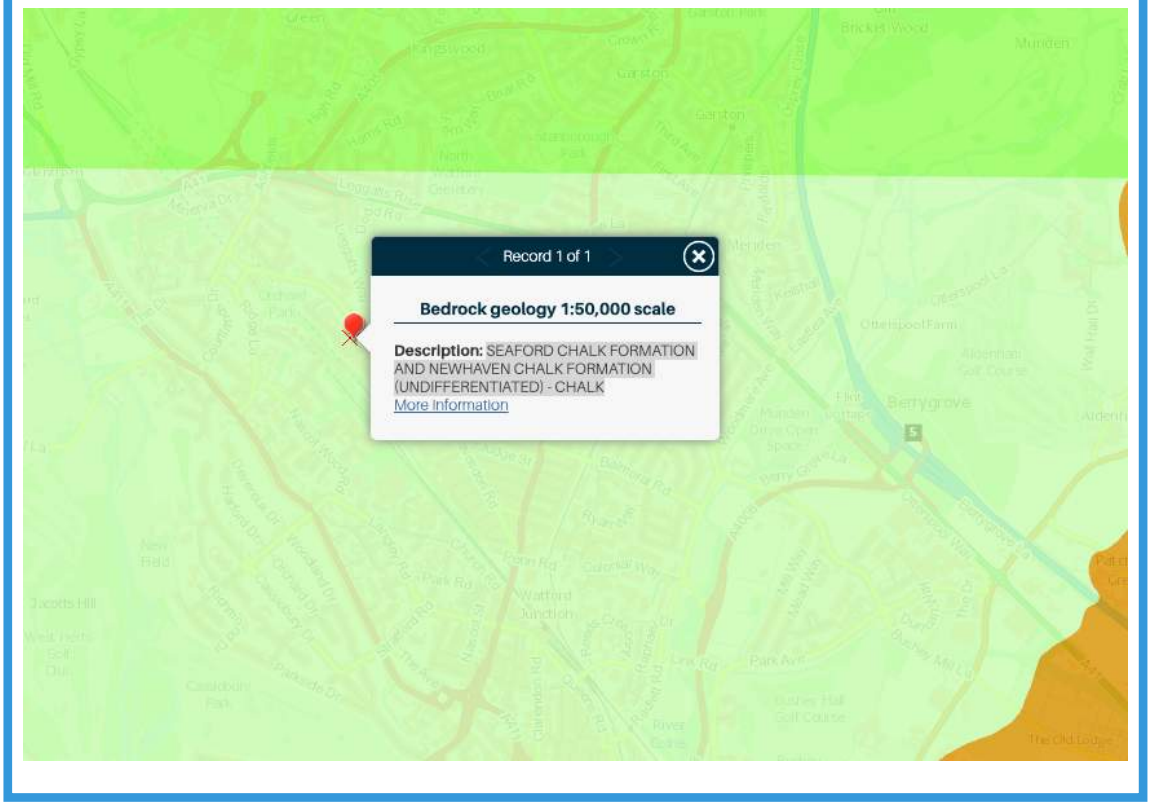
Print Size:	Project No:	Drawing No:	Revision:
A1	0480	002	P1

Appendix B

SITE GEOLOGY

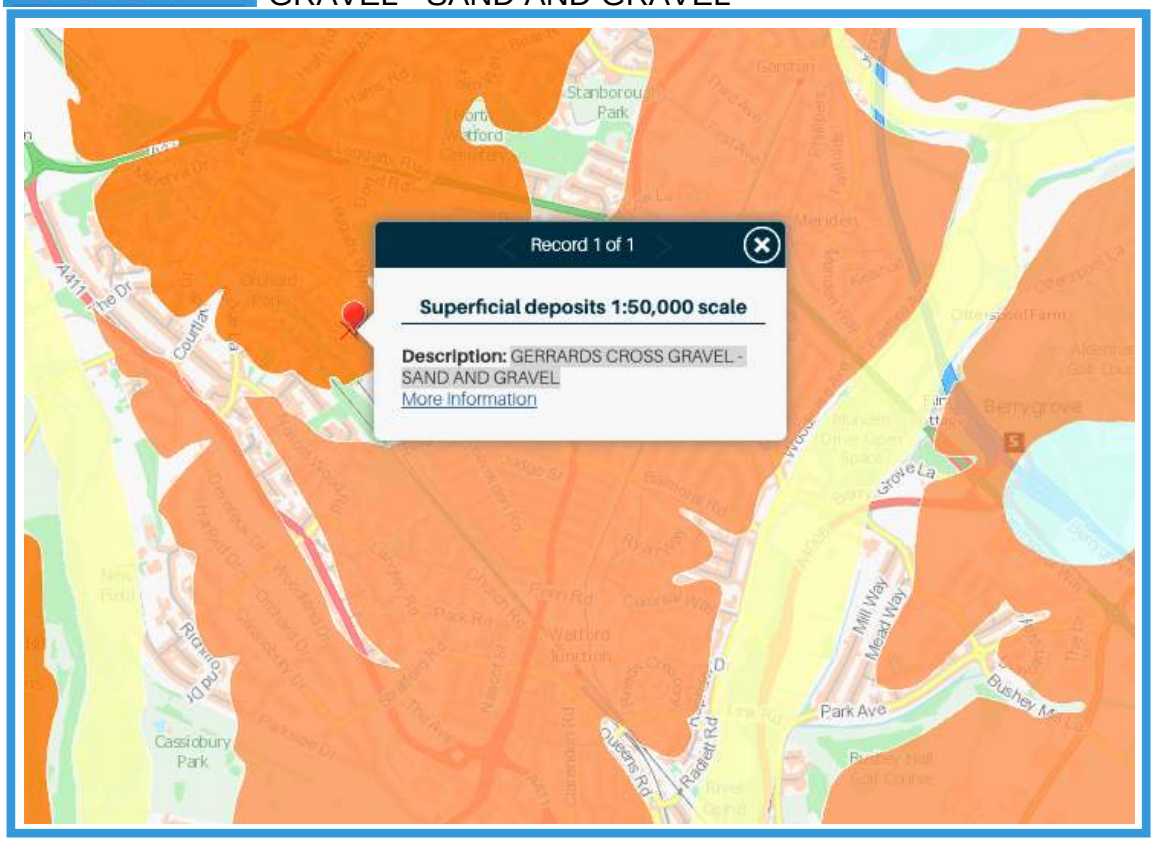
GEOINDEX ONSHORE

GEOLOGY - BEDROCK - SEAFORD CHALK FORMATION AND NEWHAVEN CHALK FORMATION (UNDIFFERENTIATED) - CHALK



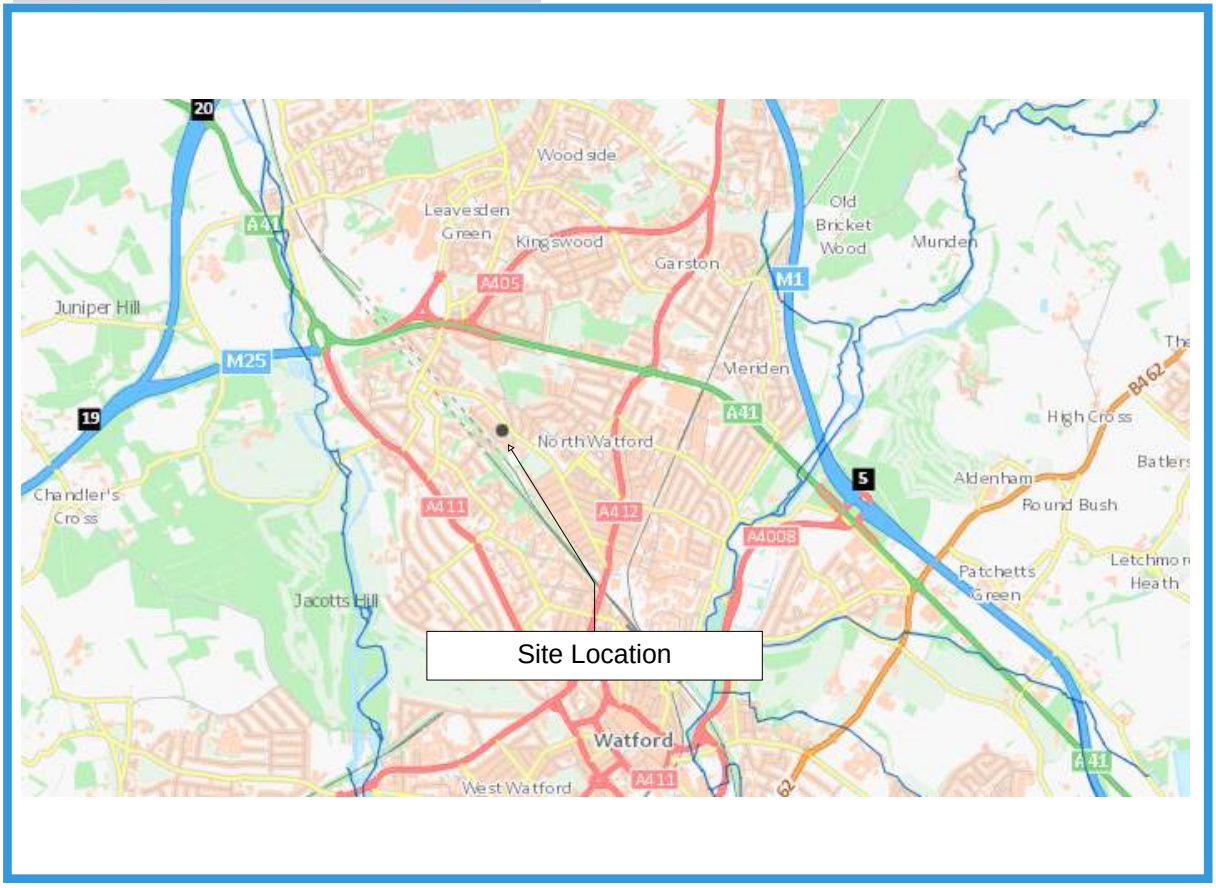
GEOINDEX ONSHORE

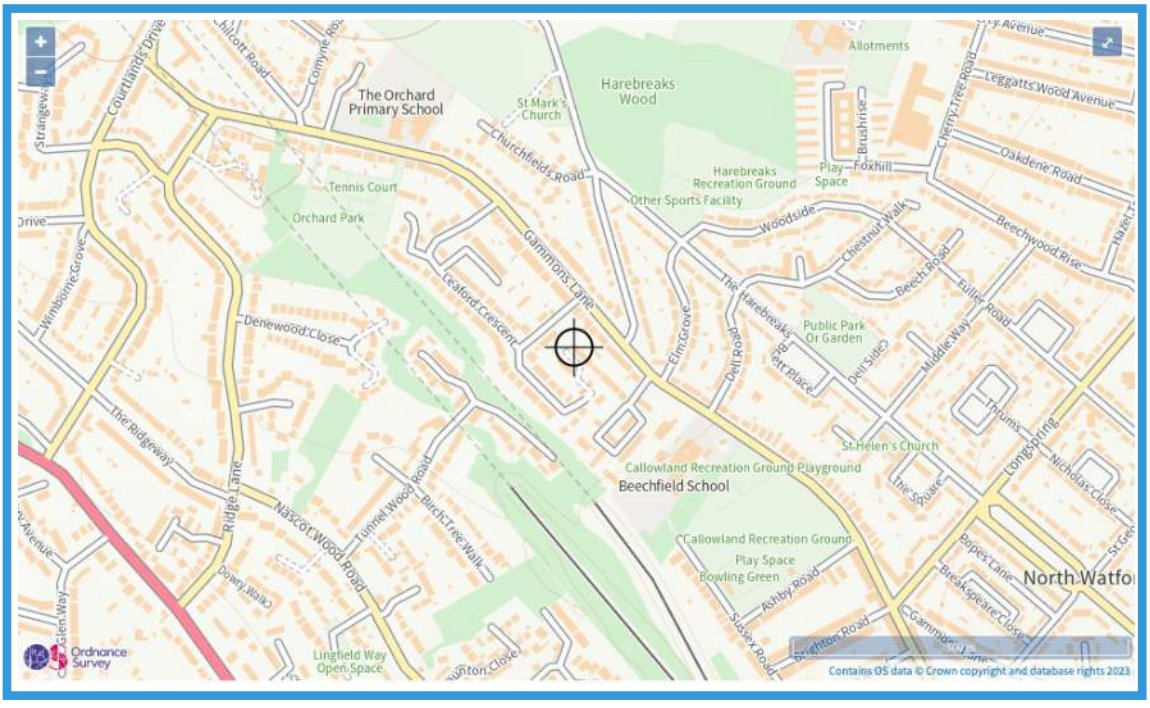
GEOLOGY - SUPERFICIAL DEPOSITS - GERRARDS CROSS GRAVEL - SAND AND GRAVEL



SITE HYDROGEOLOGY

Environment Agency Main River Map





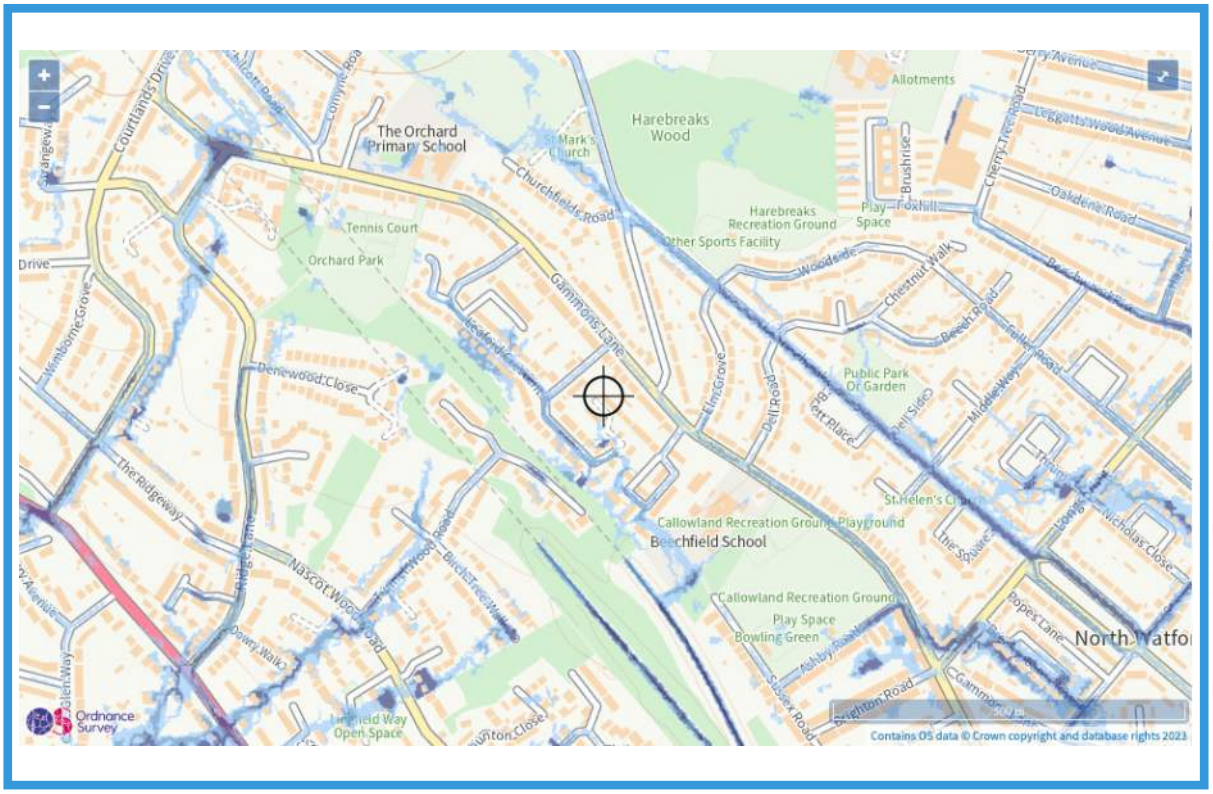
when river levels are normal when there is also flooding from rivers

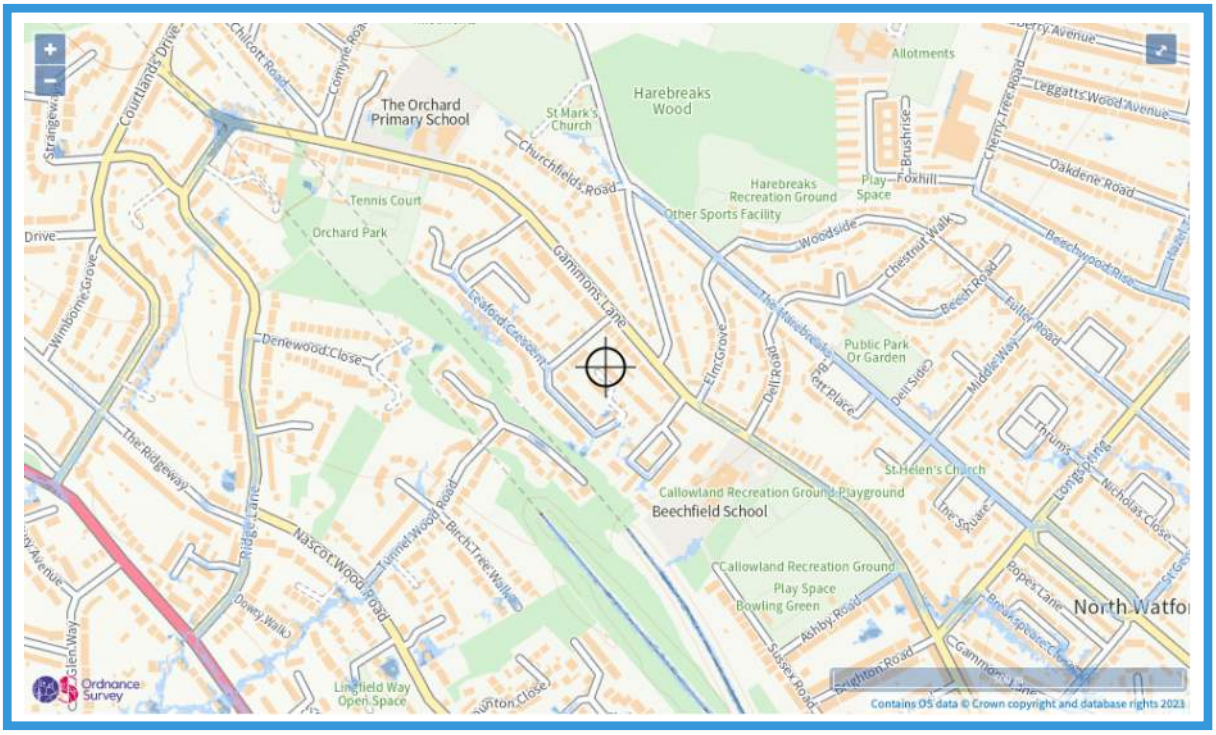
SITE FLOOD RISK

Flood risk from surface water

Extent of flooding

High risk means a chance of flooding greater than 3.3% (1:30)
Medium risk means a chance of flooding of btw 1% (1:100) and 3.3%
Low risk means a chance of flooding of btw 0.1% (1:1000) and 1%
Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding





Over 900mm | 300 to 900mm | Below 300mm

MAGIC RESULTS

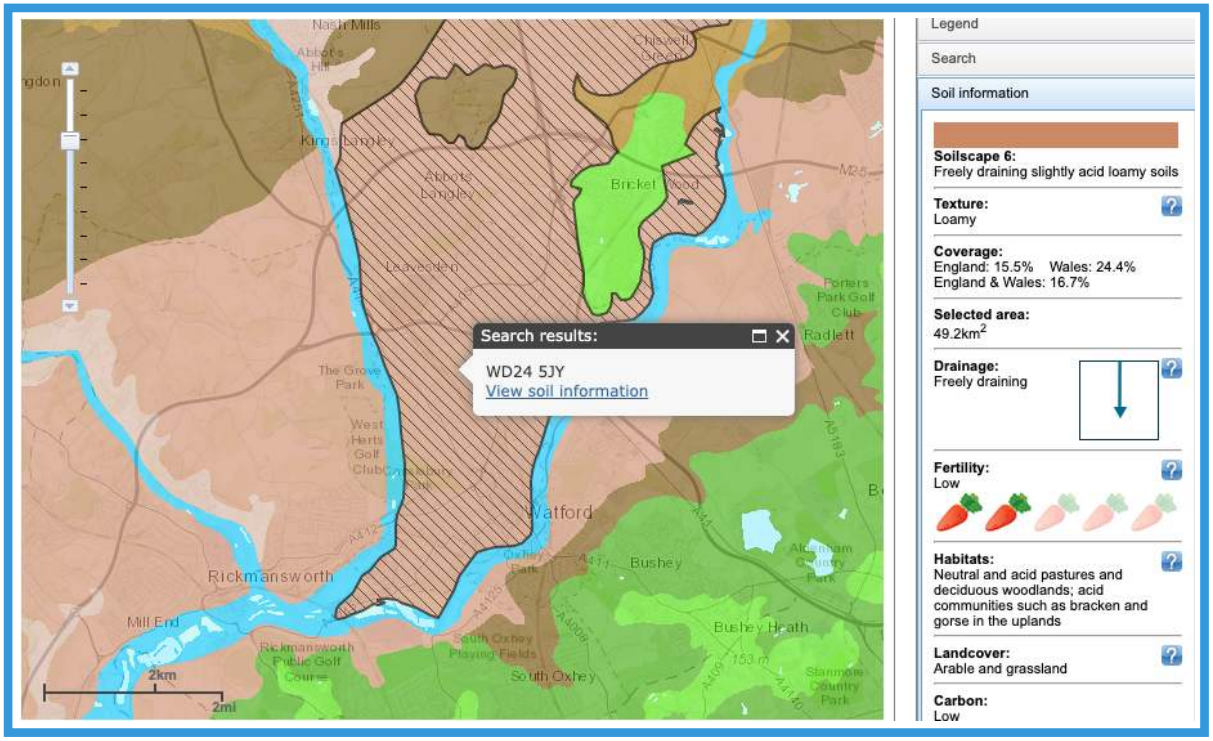
Site Check Results

Site Check Report Report generated on Thu Jan 26 2023
You selected the location: Centroid Grid Ref: TQ10029882
The following features have been found in your search area:

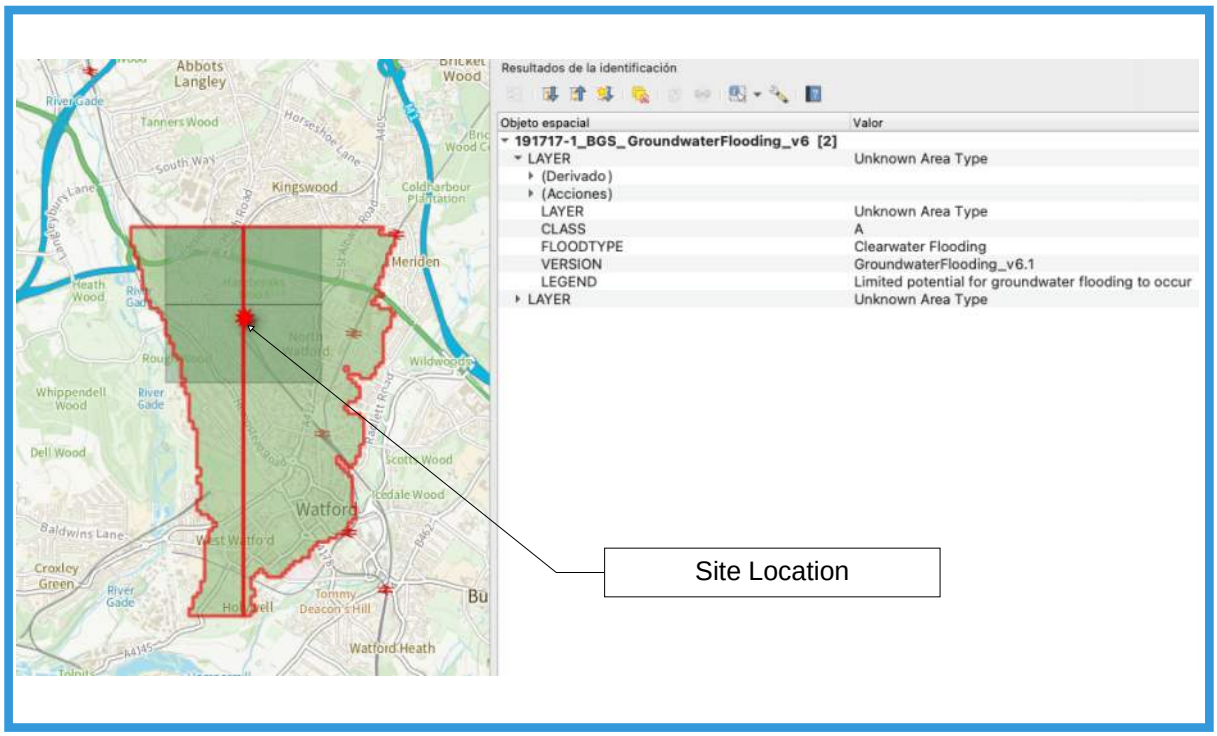
Source Protection Zones merged (England)	
Zone	3
Aquifer Designation Map (Bedrock) (England)	
Typology	Principal
Aquifer Designation Map (Superficial Drift) (England)	
Typology	Secondary A

OK Cancel Export to CSV Print

SOILSCAPES MAP



GROUND WATER FLOOD RISK



Flood map for planning

Your reference	Location (easting/northing)	Created
WD24 5JY	**510021/198825**	**26 Jan 2023 21:36**

Your selected location is in flood zone 1, an area with a low probability of flooding.

You will need to do a flood risk assessment if your site is **any of the following:**

- bigger that 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Environment Agency

Flood map for planning

Your reference
WD24 5JY

Location (easting/northing)
510021/198825

Scale
1:2500

Created
26 Jan 2023 21:36

- Selected area
- Flood zone 3
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area

0 20 40 60m

Site Check Report Report generated on Thu Jan 26 2023
You selected the location: Centroid Grid Ref: TQ10029882
The following features have been found in your search area:

SSSI Impact Risk Zones - to assess planning applications for likely impacts on SSSIs/SACs/SPAs & Ramsar sites (England)

1. DOES PLANNING PROPOSAL FALL INTO ONE OR MORE OF THE CATEGORIES BELOW?	2. IF YES, CHECK THE CORRESPONDING DESCRIPTION(S) BELOW. LPA SHOULD CONSULT NATURAL ENGLAND ON LIKELY RISKS FROM THE FOLLOWING:
All Planning Applications	
Infrastructure	Airports, helipads and other aviation proposals.
Wind & Solar Energy	
Minerals, Oil & Gas	
Rural Non Residential	
Residential	
Rural Residential	
Air Pollution	Livestock & poultry units with floorspace > 500m², slurry lagoons & digestate stores > 750m², manure stores > 3500t.
Combustion	
Waste	
Composting	
Discharges	Any discharge of water or liquid waste of more than 20m³/day to ground (ie to seep away) or to surface water, such as a beck or stream.
Water Supply	
Notes 1	
Notes 2	
GUIDANCE - How to use the Impact Risk Zones	/Metadata_for_magic/SSSI IRZ User Guidance MAGIC.pdf

Source Protection Zones merged (England)

Zone	3

Aquifer Designation Map (Bedrock) (England)

Typology	Principal

Aquifer Designation Map (Superficial Drift) (England)

Typology	Secondary A

Soilscape (England)

Reference	6
Name	FREELY DRAINING SLIGHTLY ACID LOAMY SOILS
Main Surface Texture Class	LOAMY
Natural Drainage Type	FREELY DRAINING
Natural Fertility	LOW
Characteristic Semi-natural Habitats	NEUTRAL AND ACID PASTURES AND DECIDUOUS WOODLANDS; ACID COMMUNITIES SUCH AS BRACKEN AND GORSE IN THE UPLANDS
Main Land Cover	ARABLE AND GRASSLAND
Hyperlink	/Metadata_for_magic/soilscape_summary.pdf

Areas of Outstanding Natural Beauty (England)
No Features found

Limestone Pavement Orders (England)
No Features found

Local Nature Reserves (England) - points
No Features found

Local Nature Reserves (England)
No Features found

Moorland Line (England)
No Features found

National Nature Reserves (England) - points
No Features found

National Nature Reserves (England)
No Features found

National Parks (England)
No Features found

Ramsar Sites (England) - points
No Features found

Ramsar Sites (England)
No Features found

Proposed Ramsar Sites (England) - points
No Features found

Proposed Ramsar Sites (England)
No Features found

Sites of Special Scientific Interest Units (England) - points
No Features found

Sites of Special Scientific Interest Units (England)
No Features found

Sites of Special Scientific Interest (England) - points
No Features found

Sites of Special Scientific Interest (England)
No Features found

Special Areas of Conservation (England) - points
No Features found

Special Areas of Conservation (England)
No Features found

Possible Special Areas of Conservation (England) - points
No Features found

Possible Special Areas of Conservation (England)
No Features found

Special Protection Areas (England) - points
No Features found

Special Protection Areas (England)
No Features found

Potential Special Protection Areas (England) - points
No Features found

Potential Special Protection Areas (England)
No Features found

Biosphere Reserves (England) - points
No Features found

Biosphere Reserves (England)
No Features found

Less Favoured Areas (England)
No Features found

Wild Bird General Licence Protected Sites Condition Zone (England)
No Features found

Simon Quarrell
Eur Ing, BSc, MSc(Soils), CEng, MICE, FGS

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GROUND INVESTIGATION REPORT

for two houses adjacent to

No 4 and No 5, DAMSON CLOSE,

NORTH WATFORD, WD24 5JY

Developer :

INSPIRE

4th January 2023

Tel: +44 (0) 1494 718121
Mobile: +44 (0) 7831 403046 Email: seq@inkermanfarm.co.uk

1.0 Introduction

Two houses are to be built on the vacant land at the northwest end of Damson Close. This Report presents the information from ground exploratory boreholes and Laboratory soil tests, Recommendations for the design of foundations are then given

2.0 Site Description

The site is within an established residential area in North Watford. The estate centred around Leaford Crescent incorporated the rear gardens of houses fronting Gammons Lane. The houses in Damson Close were built about 10 years ago.

The plot is an 8m wide strip of land adjacent to House No 4 and House No 5. The ground is reasonably level and was formerly garden with two sheds and a glass house. There were two small conifer trees in the central area. In the gardens of the houses on the northwest boundary is an old Cherry and several Conifer trees.

3.0 Exploratory Work

The Geological Survey map shows that Glacial Gravel (Gerrards Cross Gravel) is present resting on Chalk. Following the site inspection, nine boreholes were constructed to provide a full cover of the footprint of the houses. Four boreholes were located at the corners of the northeast house and designated 5A, 5B, 5C, 5D For the southwest house, the four boreholes were numbers 4A, 4B, 4C, 4D and a further borehole 4E was positioned opposite a tall spindly conifer in the neighbour's garden.

The boreholes generally encountered "Claybound Gravel" that contains lenses or pockets of Sand in a few places. However, at the western end of the site, Clay was met and extended to a depth of over 4m. Groundwater was not met.

Claybound Gravel = the amount of flint gravel is dominant with the clay providing a binding that results in a compact stratum. In some places, the clay is minimal, or absent. The plasticity of the Clay part of this soil was measured to be 22% and 31%, but 70% to 80% of the soil mass is gravel. Consequently, the Claybound Gravel is considered to be of very Low plasticity.

Sand = lenses or pockets of orange-brown Sand were met at random levels

Clay = in the two western boreholes, No 4D and No 4C, firm to stiff orange-brown and pale grey mottled clay containing some scattered gravel is present. This clay has a measured Plasticity Index of around 20%, slightly reduced by the presence of scattered gravel. This clay is classified as being of Low shrinkage/swelling potential. The clay does not appear to have been affected by the nearby Conifer and Cherry tree some 6m distant.

4.0 Design of Foundations.

Traditional strip footings are suitable for both houses, but the foundations for the southwest house require particular consideration. A directly bearing floor slab could be used for the northeast house. The ground floor slab of the southeast house should be supported on the footings and not in contact with the soil.

Northeast house – adjacent to house No 5 :

Normal strip footings should be placed at a depth of about 0.9m, and bearing on Claybound Gravel and/or Gravel & Sand. For design purposes, a safe bearing pressure of 150 kN/sq.m may be used on the Claybound Gravel.

The Cypress tree to the west and in the garden of a neighbouring house (Fernwood) is about 6m distant. The roots of this tree are not likely to have an influence on the footings

Southwest house – adjacent to House No 4 :

Along the northwest boundary trees are present –

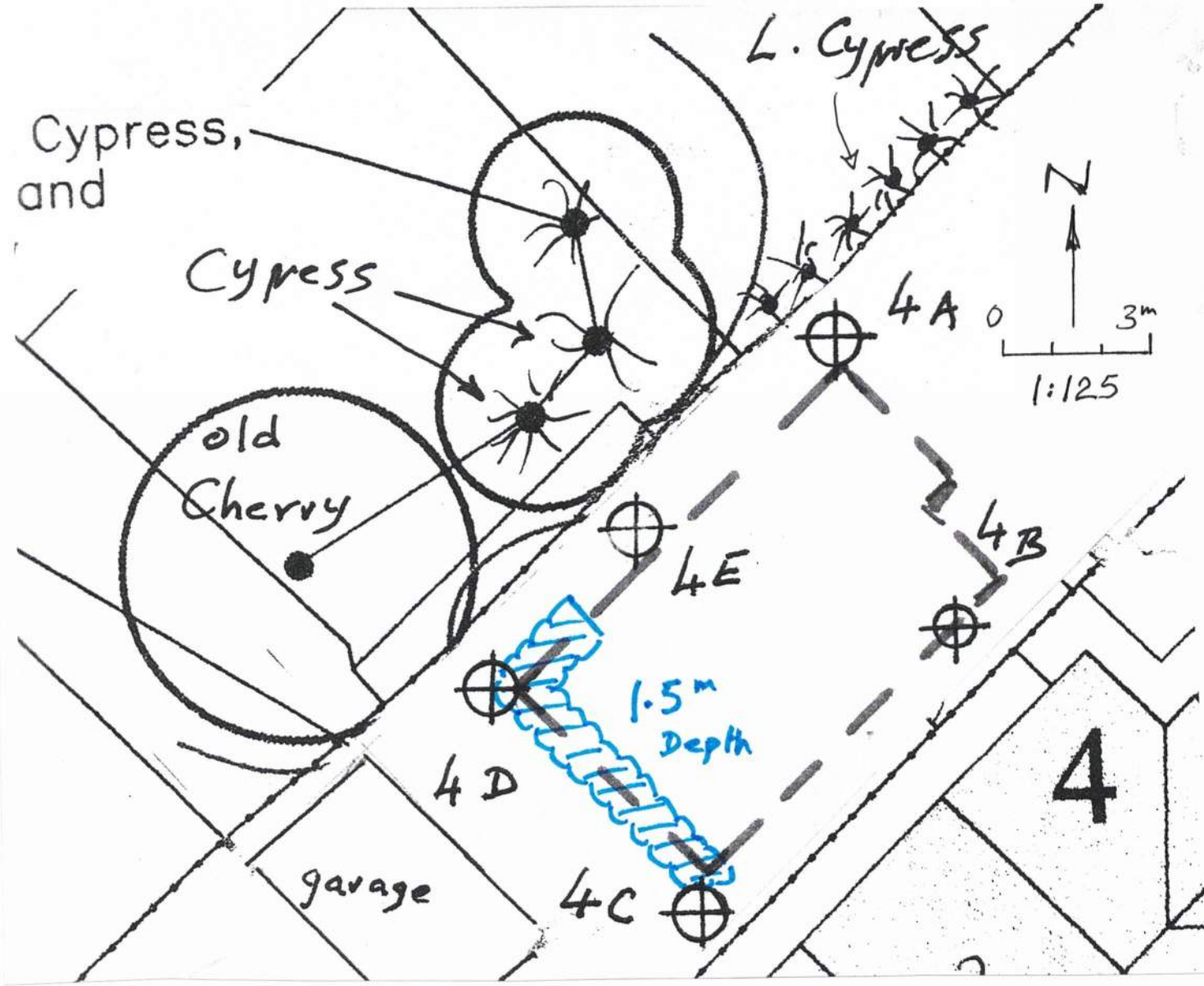
- there were two small Conifer trees near the northeastern area of the proposed house
- there is a row of young Cypress trees on the neighbour's side of the boundary (Ronda)
- there are three Cypress trees in the neighbour's garden

Borehole Nos 4A and 4E were positioned opposite these conifer trees. Claybound Gravel was met and this soil is not susceptible to shrinkage caused by tree roots. The presence of these coniferous trees is not likely to affect new footings along this particular section.

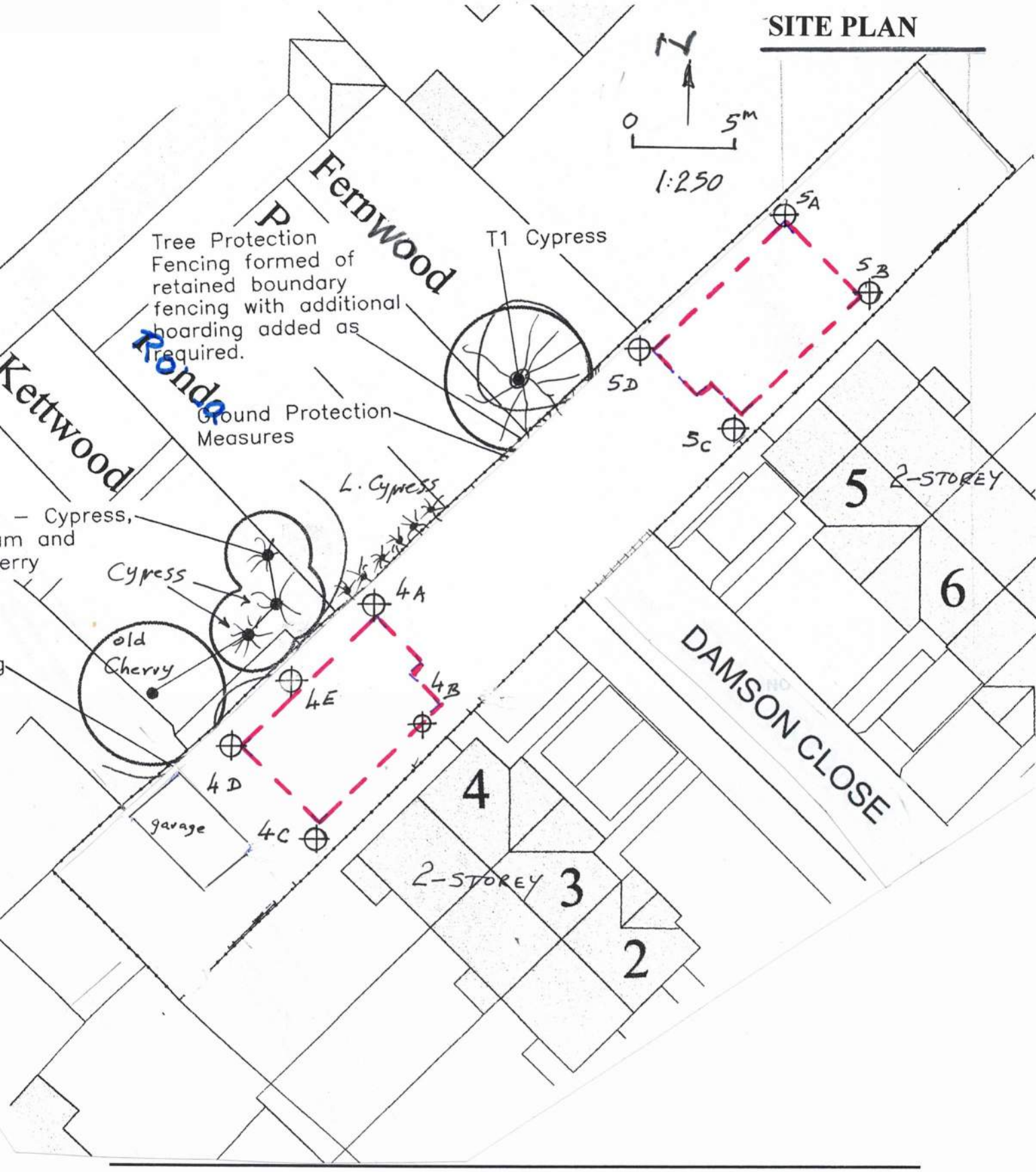
However, the remaining 4m length of this wall will be partly resting on Clay, as revealed by Borehole 4E in the corner. The roots of the nearest Conifer tree, and the old Cherry tree, could extend to this corner although it is considered unlikely since both trees are poor specimens.

It is also appreciated that the bearing capacity and the compressibility of the Claybound Gravel and the Clay are different.

In order to minimise the effect of differential settlement, and also as a precaution to tree roots, it is recommended that the design bearing pressure is limited to about 100 kN/sq.m and the founding level is increased to 1.5m where clay is present at this corner of the proposed house. The anticipated deeper level footings are indicated on the drawing :



GROUND INVESTIGATION REPORT for two dwellings on land adjacent to No 4 and No 5, DAMSON CLOSE, off LEAFORD CRESCENT, WATFORD, WD24 5JY



Simon Quarrell Geotechnical Engineer **4th January 2023**

RECORD of EXPLORATORY BOREHOLES

Constructed on 4th January 2023 using a track-mounted Percussive Sampler incorporating a 1m long barrel with plastic lining tube. Borehole advanced in 1m length increments using successively smaller diameter sampler tubes. Core sample examined on site by geotechnical engineer.

Borehole No 4 A

GL to 0.3m grey-brown clayey topsoil with gravel and many roots

0.3 to 0.6m firm pale grey-brown clay with much gravel

0.6 to 4.0m Claybound Gravel – flint gravel in a variable binding of stiff pale brown, becoming orange-brown clay

Soil sample at 1.2m : wc=13, LL=41, PL=19, PI=22 (mod PI=4)

Borehole No 4 B

GL to 0.3m grey-brown clayey topsoil with gravel

0.3 to 1.0m gravel in a sparse binding of firm pale brown clay

1.0 to 3.0m Claybound Gravel - flint gravel in a binding of stiff orange-brown clay, only a little clay from 2.5m to 3.0m

Borehole No 4 C

GL to 0.2m grey-brown clayey topsoil with gravel

0.2 to 1.1m Claybound Gravel – flint gravel in a binding of stiff brown clay

1.1 to 1.7m stiff orange-brown clay containing abundant gravel

1.7 to 2.0m firm to stiff orange-brown clay

2.0 to 4.0m firm to stiff pale orange-brown slightly silty clay

Borehole No 4 D

GL to 0.3m grey-brown clayey topsoil with gravel and roots

0.3 to 0.6m firm pale grey-brown clay with much gravel

0.6 to 1.1m firm to stiff orange-brown clay with fine roots to 1m.

1.1 to 1.9m firm to stiff orange-brown and pale grey mottled clay Containing a little scattered gravel

Soil sample at 1.2m : wc=20, LL=41, PL=18, PI=23 (mod PI=18)

Soil sample at 1.8m : wc=21, LL=37, PL=21, PI=16 (mod PI=15)

1.9 to 2.2m stiff orange-brown clay with some gravel

2.2 to 4.0m firm to stiff pale orange-brown slightly silty clay, occasional pocket of gravel

Soil sample at 2.3m : wc=20, LL=45, PL=19, PI=26 (mod PI=24)

Depth	wc
1.0	29
1.2	20
1.4	20
1.6	21
1.8	21
2.3	20
2.5	18
3.0	18

Borehole No 4 E

GL to 0.2m grey-brown clayey topsoil with gravel

0.2 to 2.5m Claybound Gravel – flint gravel in a binding of stiff orange-brown clay

Soil too dense for further penetration.

Borehole No 5 A

GL to 0.3m grey-brown clayey topsoil with gravel

0.3 to 1.0m orange-brown medium grain-sized Sand

1.0 to 2.3m Claybound Gravel – flint gravel with brown sand in a sparse binding of clay, and some lenses of Sand

Soil too dense for further penetration

Borehole No 5 B

GL to 0.3m grey-brown clayey topsoil with gravel

0.3 to 4.0m Claybound Gravel – flint gravel in a binding of stiff pale brown and orange-brown clay

Borehole No 5 C

GL to 0.2m grey-brown clayey topsoil with gravel

0.3 to 4.0m Claybound Gravel – flint gravel in a binding stiff orange-brown clay, occasional lens or pocket of orange-brown Sand

Borehole No 5 D

GL to 0.3m grey-brown clayey topsoil with gravel

0.3 to 2.7m Claybound Gravel – flint gravel in a binding of stiff orange-brown clay

Soil sample at 1.2m : wc=13, LL=55, PL=24, PI=31 (mod PI =7)

2.7 to 3.2m orange-brown clayey Sand, some scattered gravel

3.2 to 4.0m Claybound Gravel – flint gravel in a binding of stiff orange-brown clay

NOTE : Groundwater was not encountered.

Summary of Natural Moisture Content, Liquid Limit and Plastic Limit Results

Job No.	Project Name	Programme	
32817	Damson Close, Watford	Samples received	04/01/2023
		Schedule received	04/01/2023
Project No.	Client	Project started	05/01/2023
	Simon Quarrell	Testing Started	06/01/2023

Hole No.	Sample				Soil Description	NMC	Passing 425µm	LL	PL	PI	Remarks
	Ref	Top m	Base m	Type		%	%	%	%	%	Mod. PI
BH4A	-	1.20	-	D	Brown gravelly silty CLAY (gravel is fmc and sub-angular)	13	19	41	19	22	Sample washed to obtain test fraction 4
BH4D	-	1.20	-	D	Reddish brown and bluish grey mottled slightly gravelly silty CLAY (gravel is fmc and angular)	20	78	41	18	23	18
BH4D	-	1.80	-	D	Reddish brown and bluish grey mottled slightly sandy slightly gravellly silty CLAY (gravel is fm and sub-angular)	21	94	37	21	16	15
BH4D	-	2.30	-	D	Brown slightly sandy slightly gravelly silty CLAY (gravel is fm and sub-angular)	20	92	45	19	26	24
BH5D	-	1.20	-	D	Brown gravelly silty CLAY (gravel is fmc and sub-angular)	13	24	55	24	31	Sample washed to obtain test fraction 7

Test Methods: BS1377: Part 2: 1990:
Natural Moisture Content : clause 3.2
Atterberg Limits: clause 4.3 and 5.0
These results only apply to the items tested

NOTE: The report shall not be reproduced except in full without authority of the laboratory

Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU

Tel: 01923 711 288
Email: James@k4soils.com

Checked and Approved
Initials J.P
Date: 11/01/2023

UKAS TESTING
2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

Ground Investigation Report for two houses at northern end of DAMSON CLOSE, off LEAFORD CRESCENT, WATFORD, WD24 5JY

LOCATION PLAN

Project:
Land to rear of 131 Gammons Lane, Watford

Content:
EXISTING SITE PLAN

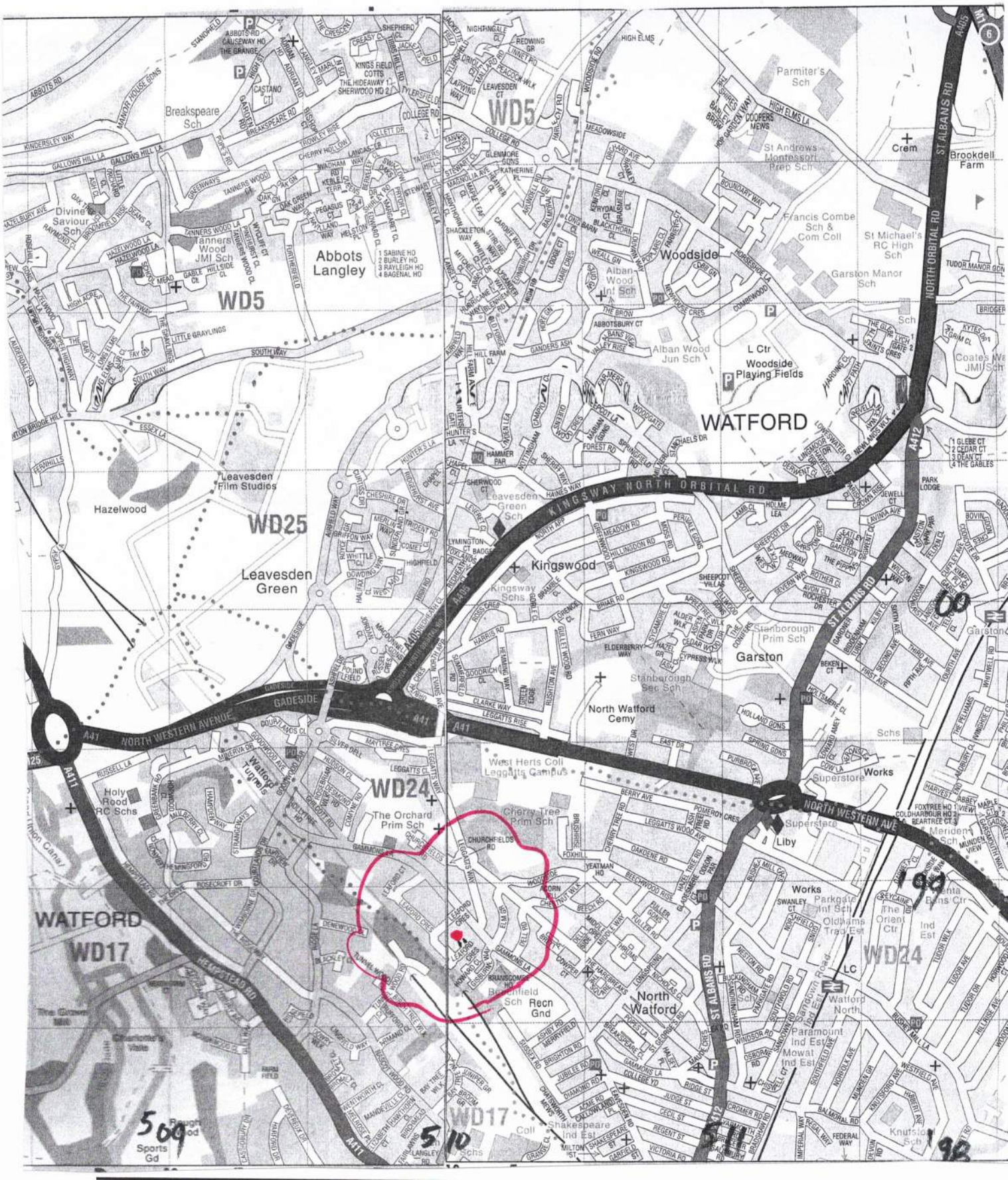
Scale:	Date:
1:500@A3	MAY 22
Drawn: AH	Rev:

Dwg No: DC/22/EX01 Rev No:

Wakelin Associates Architects
The Old School House Bridge Road Hunton Bridge
Kings Langley Hertfordshire WD4 8RQ
T: 01923 267488 E: info@wakelin.co.uk

Ground Investigation Report for two houses at northern end of DAMSON CLOSE, off LEAFORD CRESCENT, WATFORD, WD24 5JY

National Grid Reference TQ 510020 198825



Appendix C

CAUSEWAY	Rida Projects Limited	File: Land Rear Damson Close.p Network: Storm Network Mario Mora 28/01/2023	Page 1

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	240
FSR Region	England and Wales	Additional Storage (m³/ha)	20.0
M5-60 (mm)	20.000	Check Discharge Rate(s)	✓
Ratio-R	0.400	1 year (l/s)	0.1
Summer CV	0.750	2 year (l/s)	0.1
Winter CV	0.840	30 year (l/s)	0.2
Analysis Speed	Normal	100 year (l/s)	0.3
Skip Steady State	x	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 %)
1	0	0	0
2	0	0	0
30	0	0	0
30	40	0	0
100	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	2.40
Greenfield Method	IH124	Growth Factor 100 year	3.19
Positively Drained Area (ha)	0.047	Betterment (%)	0
SAAR (mm)	677	QBar	0.1
Soil Index	2	Q 1 year (l/s)	0.1
SPR	0.30	Q 2 year (l/s)	0.1
Region	6	Q 30 year (l/s)	0.2
Growth Factor 1 year	0.85	Q 100 year (l/s)	0.3
Growth Factor 2 year	0.88		

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Inverts
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	6.00	Enforce best practice design rules	✓

Circular Link Type

Shape	Circular	Auto Increment (mm)	75
Barrels	1	Follow Ground	x

Available Diameters (mm)

100 | 150

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
RE4	0.003	6.00	96.080	450	0.266	40.087	0.737
S03			96.230	450	9.883	40.002	0.986
S04			96.210	450	9.868	44.904	1.045
Soakaway A			96.220		15.081	45.089	1.500
RE3	0.003	6.00	96.140	450	-0.006	44.976	0.880
Dummy			95.970	450	19.939	44.978	1.300

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)
3.000	RE4	S03	9.930	0.600	95.343	95.244	0.099	100.0	150	6.16	50.0
3.001	S03	S04	6.370	0.600	95.244	95.180	0.064	100.0	150	6.27	50.0
3.002	S04	Soakaway A	4.500	0.600	95.165	94.720	0.445	10.1	150	6.29	50.0
4.000	RE3	S04	10.760	0.600	95.260	95.165	0.095	113.3	150	6.19	50.0
1.003	Soakaway A	Dummy	5.000	0.600	94.720	94.670	0.050	100.0	150	6.38	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)
3.000	1.005	17.8	0.4	0.587	0.836	0.003	0.0	16	0.407
3.001	1.005	17.8	0.4	0.836	0.880	0.003	0.0	16	0.407
3.002	3.186	56.3	0.8	0.895	1.350	0.006	0.0	13	1.137
4.000	0.943	16.7	0.4	0.730	0.895	0.003	0.0	16	0.391
1.003	1.005	17.8	0.8	1.350	1.150	0.006	0.0	22	0.510

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)
3.000	9.930	100.0	150	Circular	96.080	95.343	0.587	96.230	95.244	0.836
3.001	6.370	100.0	150	Circular	96.230	95.244	0.836	96.210	95.180	0.880
3.002	4.500	10.1	150	Circular	96.210	95.165	0.895	96.220	94.720	1.350
4.000	10.760	113.3	150	Circular	96.140	95.260	0.730	96.210	95.165	0.895
1.003	5.000	100.0	150	Circular	96.220	94.720	1.350	95.970	94.670	1.150

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
3.000	RE4	450	Manhole	Adoptable	S03	450	Manhole	Adoptable
3.001	S03	450	Manhole	Adoptable	S04	450	Manhole	Adoptable
3.002	S04	450	Manhole	Adoptable	Soakaway A		Junction	
4.000	RE3	450	Manhole	Adoptable	S04	450	Manhole	Adoptable
1.003	Soakaway A		Junction		Dummy	450	Manhole	Adoptable

Node Soakaway A Online Pump Control

Flap Valve	x	Invert Level (m)	94.720	Switch on depth (m)	1.500
Downstream Link	1.003	Design Depth (m)	1.500	Switch off depth (m)	0.010
Replaces Downstream Link	✓	Design Flow (l/s)	0.1		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	0.000	1.500	0.000

Node Soakaway A Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	94.720
Side Inf Coefficient (m/hr)	0.03600	Porosity	0.96	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	7.0	0.0	0.800	7.0	0.0	0.801	0.0	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	109.521	30.991	1 year 240 minute winter	12.274	4.882
1 year 15 minute winter	76.857	30.991	1 year 360 minute summer	14.169	3.646
1 year 30 minute summer	71.439	20.215	1 year 360 minute winter	9.210	3.646
1 year 30 minute winter	50.133	20.215	1 year 480 minute summer	11.185	2.956
1 year 60 minute summer	48.435	12.800	1 year 480 minute winter	7.431	2.956
1 year 60 minute winter	32.179	12.800	1 year 600 minute summer	9.182	2.511
1 year 120 minute summer	30.053	7.942	1 year 600 minute winter	6.274	2.511
1 year 120 minute winter	19.966	7.942	1 year 720 minute summer	8.203	2.199
1 year 180 minute summer	23.233	5.979	1 year 720 minute winter	5.513	2.199
1 year 180 minute winter	15.102	5.979	1 year 960 minute summer	6.768	1.782
1 year 240 minute summer	18.475	4.882	1 year 960 minute winter	4.483	1.782

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 1440 minute summer	4.949	1.326
1 year 1440 minute winter	3.326	1.326
2 year 15 minute summer	141.566	40.058
2 year 15 minute winter	99.345	40.058
2 year 30 minute summer	91.753	25.963
2 year 30 minute winter	64.388	25.963
2 year 60 minute summer	61.301	16.200
2 year 60 minute winter	40.727	16.200
2 year 120 minute summer	37.449	9.897
2 year 120 minute winter	24.880	9.897
2 year 180 minute summer	28.672	7.378
2 year 180 minute winter	18.637	7.378
2 year 240 minute summer	22.636	5.982
2 year 240 minute winter	15.039	5.982
2 year 360 minute summer	17.235	4.435
2 year 360 minute winter	11.203	4.435
2 year 480 minute summer	13.550	3.581
2 year 480 minute winter	9.003	3.581
2 year 600 minute summer	11.088	3.033
2 year 600 minute winter	7.576	3.033
2 year 720 minute summer	9.878	2.647
2 year 720 minute winter	6.639	2.647
2 year 960 minute summer	8.113	2.136
2 year 960 minute winter	5.374	2.136
2 year 1440 minute summer	5.891	1.579
2 year 1440 minute winter	3.959	1.579
30 year 15 minute summer	268.706	76.035
30 year 15 minute winter	188.566	76.035
30 year 30 minute summer	174.929	49.499
30 year 30 minute winter	122.757	49.499
30 year 60 minute summer	116.589	30.811
30 year 60 minute winter	77.459	30.811
30 year 120 minute summer	70.438	18.615
30 year 120 minute winter	46.797	18.615
30 year 180 minute summer	53.298	13.715
30 year 180 minute winter	34.645	13.715
30 year 240 minute summer	41.604	10.995
30 year 240 minute winter	27.641	10.995
30 year 360 minute summer	31.221	8.034
30 year 360 minute winter	20.295	8.034
30 year 480 minute summer	24.324	6.428
30 year 480 minute winter	16.160	6.428
30 year 600 minute summer	19.756	5.404
30 year 600 minute winter	13.498	5.404
30 year 720 minute summer	17.490	4.687
30 year 720 minute winter	11.754	4.687
30 year 960 minute summer	14.215	3.743
30 year 960 minute winter	9.416	3.743
30 year 1440 minute summer	10.161	2.723
30 year 1440 minute winter	6.829	2.723
30 year +40% CC 15 minute summer	376.189	106.449
30 year +40% CC 15 minute winter	263.992	106.449
30 year +40% CC 30 minute summer	244.900	69.298
30 year +40% CC 30 minute winter	171.860	69.298
30 year +40% CC 60 minute summer	163.225	43.136
30 year +40% CC 60 minute winter	108.443	43.136
30 year +40% CC 120 minute summer	98.613	26.061
30 year +40% CC 120 minute winter	65.516	26.061
30 year +40% CC 180 minute summer	74.617	19.202
30 year +40% CC 180 minute winter	48.503	19.202
30 year +40% CC 240 minute summer	58.245	15.393
30 year +40% CC 240 minute winter	38.697	15.393
30 year +40% CC 360 minute summer	43.710	11.248
30 year +40% CC 360 minute winter	28.413	11.248
30 year +40% CC 480 minute summer	34.053	8.999
30 year +40% CC 480 minute winter	22.624	8.999
30 year +40% CC 600 minute summer	27.658	7.565
30 year +40% CC 600 minute winter	18.898	7.565
30 year +40% CC 720 minute summer	24.485	6.562
30 year +40% CC 720 minute winter	16.456	6.562
30 year +40% CC 960 minute summer	19.901	5.240
30 year +40% CC 960 minute winter	13.183	5.240
30 year +40% CC 1440 minute summer	14.225	3.812
30 year +40% CC 1440 minute winter	9.560	3.812
100 year 15 minute summer	348.738	98.681
100 year 15 minute winter	244.728	98.681
100 year 30 minute summer	228.965	64.789
100 year 30 minute winter	160.677	64.789
100 year 60 minute summer	153.288	40.510
100 year 60 minute winter	101.841	40.510
100 year 120 minute summer	92.562	24.461
100 year 120 minute winter	61.496	24.461
100 year 180 minute summer	69.806	17.964
100 year 180 minute winter	45.376	17.964
100 year 240 minute summer	54.269	14.342
100 year 240 minute winter	36.055	14.342
100 year 360 minute summer	40.484	10.418
100 year 360 minute winter	26.315	10.418
100 year 480 minute summer	31.414	8.302
100 year 480 minute winter	20.871	8.302
100 year 600 minute summer	25.431	6.956
100 year 600 minute winter	17.376	6.956
100 year 720 minute summer	22.452	6.017
100 year 720 minute winter	15.089	6.017
100 year 960 minute summer	18.166	4.784
100 year 960 minute winter	12.033	4.784
100 year 1440 minute summer	12.896	3.456
100 year 1440 minute winter	8.667	3.456
100 year +40% CC 15 minute summer	488.233	138.153
100 year +40% CC 15 minute winter	342.620	138.153
100 year +40% CC 30 minute summer	320.551	90.705
100 year +40% CC 30 minute winter	224.948	90.705
100 year +40% CC 60 minute summer	214.603	56.713
100 year +40% CC 60 minute winter	142.577	56.713

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 120 minute summer	129.587	34.246	100 year +40% CC 480 minute winter	29.219	11.622
100 year +40% CC 120 minute winter	86.094	34.246	100 year +40% CC 600 minute summer	35.604	9.738
100 year +40% CC 180 minute summer	97.729	25.149	100 year +40% CC 600 minute winter	24.327	9.738
100 year +40% CC 180 minute winter	63.526	25.149	100 year +40% CC 720 minute summer	31.433	8.424
100 year +40% CC 240 minute summer	75.977	20.078	100 year +40% CC 720 minute winter	21.125	8.424
100 year +40% CC 240 minute winter	50.477	20.078	100 year +40% CC 960 minute summer	25.432	6.697
100 year +40% CC 360 minute summer	56.677	14.585	100 year +40% CC 960 minute winter	16.847	6.697
100 year +40% CC 360 minute winter	36.841	14.585	100 year +40% CC 1440 minute summer	18.055	4.839
100 year +40% CC 480 minute summer	43.979	11.622	100 year +40% CC 1440 minute winter	12.134	4.839

Results for 1 year Critical Storm Duration. Lowest mass balance: 92.40%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	RE4	10	95.359	0.016	0.4	0.0038	0.0000	OK
15 minute winter	S03	12	95.260	0.016	0.4	0.0025	0.0000	OK
15 minute winter	S04	12	95.178	0.013	0.8	0.0020	0.0000	OK
240 minute winter	Soakaway A	412	94.837	0.117	0.2	0.7835	0.0000	OK
15 minute winter	RE3	11	95.277	0.017	0.4	0.0038	0.0000	OK
15 minute summer	Dummy	1	94.670	0.000	0.0	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)
15 minute winter	RE4	3.000	S03	0.4	0.423	0.023	0.0098	
15 minute winter	S03	3.001	S04	0.4	0.410	0.023	0.0062	
15 minute winter	S04	3.002	Soakaway A	0.8	1.337	0.014	0.0132	
240 minute winter	Soakaway A	Pump	Dummy	0.0				0.0
240 minute winter	Soakaway A	Infiltration		0.0				
15 minute winter	RE3	4.000	S04	0.4	0.452	0.024	0.0096	

Results for 2 year Critical Storm Duration. Lowest mass balance: 92.40%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	RE4	10	95.361	0.018	0.5	0.0042	0.0000	OK
15 minute winter	S03	12	95.262	0.018	0.5	0.0028	0.0000	OK
15 minute winter	S04	12	95.179	0.014	1.0	0.0022	0.0000	OK
360 minute winter	Soakaway A	480	94.871	0.151	0.2	1.0145	0.0000	SURCHARGED
15 minute winter	RE3	11	95.279	0.019	0.5	0.0043	0.0000	OK
15 minute summer	Dummy	1	94.670	0.000	0.0	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)
15 minute winter	RE4	3.000	S03	0.5	0.443	0.028	0.0115	
15 minute winter	S03	3.001	S04	0.5	0.437	0.028	0.0073	
15 minute winter	S04	3.002	Soakaway A	1.0	1.337	0.018	0.0200	
360 minute winter	Soakaway A	Pump	Dummy	0.0				0.0
360 minute winter	Soakaway A	Infiltration		0.0				
15 minute winter	RE3	4.000	S04	0.5	0.487	0.030	0.0112	

Results for 30 year Critical Storm Duration. Lowest mass balance: 92.40%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	RE4	10	95.366	0.023	0.9	0.0056	0.0000	OK
15 minute winter	S03	12	95.268	0.024	0.9	0.0038	0.0000	OK
15 minute winter	S04	12	95.183	0.018	1.8	0.0029	0.0000	OK
600 minute winter	Soakaway A	660	95.031	0.311	0.2	2.0918	0.0000	SURCHARGED
15 minute winter	RE3	10	95.285	0.025	0.9	0.0057	0.0000	OK
15 minute summer	Dummy	1	94.670	0.000	0.0	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)
15 minute winter	RE4	3.000	S03	0.9	0.519	0.051	0.0174	
15 minute winter	S03	3.001	S04	0.9	0.520	0.051	0.0110	
15 minute winter	S04	3.002	Soakaway A	1.8	1.375	0.032	0.0380	
600 minute winter	Soakaway A	Pump	Dummy	0.0				0.0
600 minute winter	Soakaway A	Infiltration		0.0				
15 minute winter	RE3	4.000	S04	0.9	0.578	0.054	0.0169	

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 92.40%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	RE4	11	95.371	0.028	1.3	0.0067	0.0000	OK
15 minute winter	S03	11	95.272	0.028	1.3	0.0045	0.0000	OK
1440 minute winter	S04	1590	95.224	0.059	0.2	0.0093	0.0000	OK
1440 minute winter	Soakaway A	1410	95.224	0.504	0.2	3.3848	0.0000	SURCHARGED
15 minute winter	RE3	11	95.290	0.030	1.3	0.0068	0.0000	OK
15 minute summer	Dummy	1	94.670	0.000	0.0	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)
15 minute winter	RE4	3.000	S03	1.3	0.570	0.073	0.0227	
15 minute winter	S03	3.001	S04	1.3	0.575	0.073	0.0143	
1440 minute winter	S04	3.002	Soakaway A	0.2	0.244	0.004	0.0540	
1440 minute winter	Soakaway A	Pump	Dummy	0.0				0.0
1440 minute winter	Soakaway A	Infiltration		0.0				
15 minute winter	RE3	4.000	S04	1.3	0.643	0.078	0.0219	

Results for 100 year Critical Storm Duration. Lowest mass balance: 92.40%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	RE4	11	95.370	0.027	1.2	0.0065	0.0000	OK
15 minute winter	S03	11	95.271	0.027	1.2	0.0043	0.0000	OK
15 minute winter	S04	11	95.186	0.021	2.4	0.0034	0.0000	OK
960 minute winter	Soakaway A	1200	95.184	0.464	0.2	3.1182	0.0000	SURCHARGED
15 minute winter	RE3	11	95.289	0.029	1.2	0.0065	0.0000	OK
15 minute summer	Dummy	1	94.670	0.000	0.0	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)
15 minute winter	RE4	3.000	S03	1.2	0.558	0.068	0.0215	
15 minute winter	S03	3.001	S04	1.2	0.562	0.067	0.0135	
15 minute winter	S04	3.002	Soakaway A	2.4	1.488	0.042	0.0414	
960 minute winter	Soakaway A	Pump	Dummy	0.0				0.0
960 minute winter	Soakaway A	Infiltration		0.0				
15 minute winter	RE3	4.000	S04	1.2	0.628	0.072	0.0207	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 92.40%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	RE4	11	95.375	0.032	1.7	0.0077	0.0000	OK
1440 minute winter	S03	1380	95.346	0.102	0.1	0.0162	0.0000	OK
1440 minute winter	S04	1590	95.346	0.181	0.2	0.0287	0.0000	SURCHARGED
1440 minute winter	Soakaway A	1500	95.346	0.626	0.2	4.2040	0.0000	SURCHARGED
1440 minute winter	RE3	1680	95.346	0.086	0.1	0.0195	0.0000	OK
15 minute summer	Dummy	1	94.670	0.000	0.0	0.0000	0.0000	OK

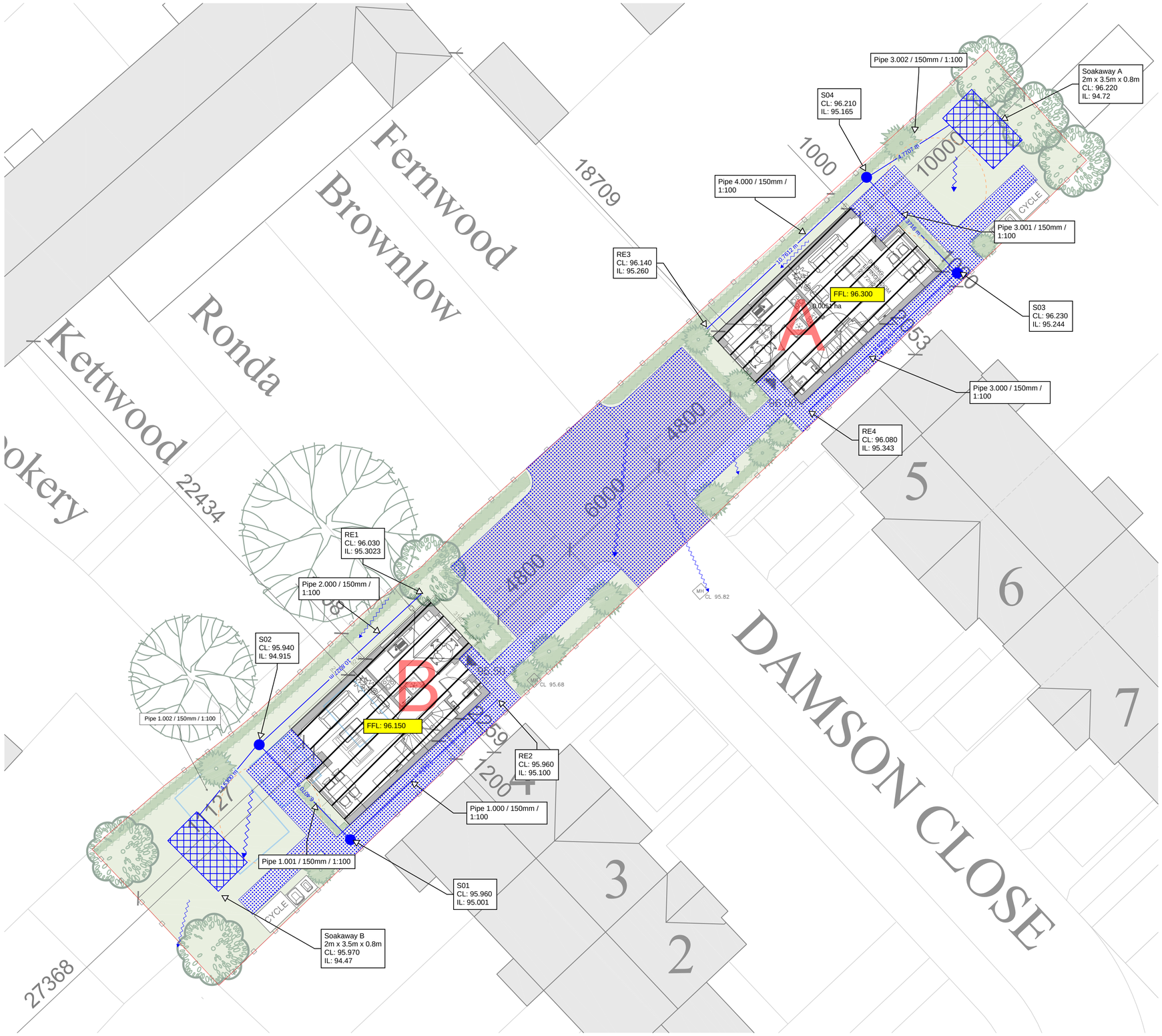
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	RE4	3.000	S03	1.7	0.612	0.096	0.0276	
1440 minute winter	S03	3.001	S04	0.1	0.270	0.006	0.0965	
1440 minute winter	S04	3.002	Soakaway A	0.2	0.244	0.004	0.0792	
1440 minute winter	Soakaway A	Pump	Dummy	0.0				0.0
1440 minute winter	Soakaway A	Infiltration		0.0				
1440 minute winter	RE3	4.000	S04	0.1	0.294	0.006	0.1507	

Appendix D

Drawing Scale Bar

Drawing scale	Line length	Drawing scale	Line length
1:5 =	0.25 metres	1:200 =	10.0 metres
1:10 =	0.5 metres	1:250 =	12.5 metres
1:20 =	1.0 metres	1:500 =	25.0 metres
1:25 =	1.25 metres	1:1000 =	50.0 metres
1:50 =	2.5 metres	1:1250 =	62.5 metres
1:100 =	5.0 metres	1:2500 =	125 metres

Measure length of line above for checking of scale



GENERAL NOTES

1. All dimensions are in millimetres and levels in m AOD unless stated otherwise.

2. Do not scale. If in any doubt, consult Engineer.

3. Read in conjunction with the architects and engineers schedule drawings.

4. Check inverts and sizes of existing pipes prior to the commencement of any work. Report any discrepancies to the engineer and await instructions.

5. The location of services is shown as indicative. This drawing should be read in conjunction with the utilities drawings. No warranty to their accuracy can be given. The contractor shall take all necessary measures to satisfy himself as to the location of the existing services and connection points. Excavation should be undertaken in compliance with HSG47.

6. Concrete structures design sulphate class and ACEC concrete class unknown.

7. Pipework to be 110mm Thermoplastics U-PVC (Polypipe or similar) installed at levels marked on this drawing UNO. Pipe bedding should be class Z in pipes within 1.5m of the building or shallower than 700mm below ground level. For all other areas the pipe bedding should be class S.

8. Joints and fittings for gravity sewers shall comply with the relevant provisions of BS EN 1401-1, BS EN 1852 and BS EN 12666-1. Pipes shall have a limit of 6% deformation. Pipes shall be SN8 ring stiffness and stamped accordingly. Pipe sections shall not be longer than 3m.

9. Plastic chambers and rings, including demarcation chambers,shall comply with BS EN 3598-1 or BS EN 13598-2 as appropriate.

10. Inspection chamber covers and frames shall comply with the relevant provisions of BS EN 124 and should be double sealed.

11. All inspection chamber covers shall be the non-ventilating type and shall have closed keyways.

12. Testing of pipelines should be as follow:

Gravity Pipework: Air pipe testing. Pipework should withstand a pressure of 100mm water gauge and this should not fall by more than 25mm in a 5minute period. However where traps or gullies are connected they should withstand a pressure of 50mm water gauge and this should not fall by more than 12mm in a 5minute period. It is recommended that pipework installations are tested in sections rather than waiting to complete in one operation.

13. Manhole covers to be set square to the building. Covers of existing manholes to be adjusted to match final ground levels.

14. Granular Bedding for pipes shall be constructed by spreading and compacting granular bedding material over the full width of the pipe trench. After the pipes have been laid, additional granular material shall, if required, be placed and compacted equally on each side of the pipes and, where practicable, this shall be done in sequence with the removal of the trench supports.

KEY

- Proposed Surface Water Sewer Pipe
- Exceedance Flows
- Permeable Surface as per architect's details Sub-base 350mm Type 3
- Silt Trap
- Proposed Foul Sewer Pipe
- Type 3 Manhole
- FW — FW — Existing Foul Sewer Pipe

Rev	Details	Date	By	Ch'd

Drawing Status:

PRELIMINARY

RIDA
FLOOD RISK ASSESSMENT & DRAINAGE STRATEGIES

4 Bean Acre Road, Hook Norton, Banbury, Oxfordshire
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t: 01608 510 121
www.rida-reports.co.uk

Client:

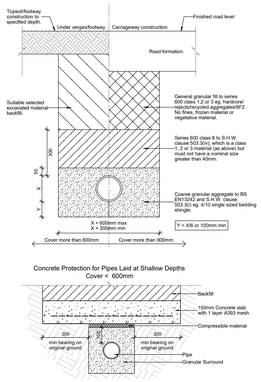
Project:

Land Rear Damson Close, Watford, WD24 5JY

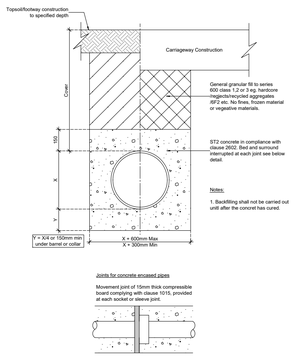
Drawing:

Proposed Drainage Strategy

Print Size:	Scale:	Project No:	Drawing No:	Revision:
A1	**1:100**	**0480**	**003**	P1

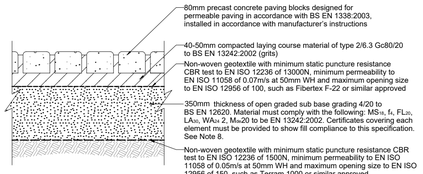


Pipe Bedding Detail Type S

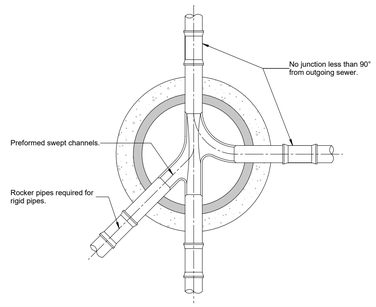


Pipe Bedding Detail Type Z

Concrete Protection for Pipes Laid at Shallow Depths
Cover < 600mm

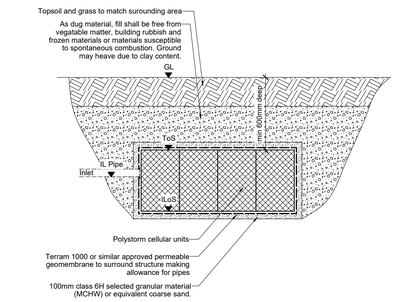


Permeable Paving - Infiltration



Rigid pipes built into manholes should have a flexible joint as close as feasible to the external face of the structure and the length of the next rocker pipe should be as per table below.

Pipe Junction within Manhole



NOTES:

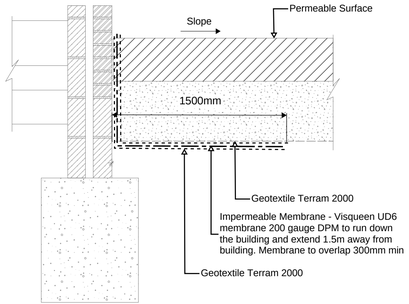
1. Permeable modular storage cell with 95% minimum void ratio. Maximum load 20 tonnes/m².

2. Installation of units as per supplier recommendations.

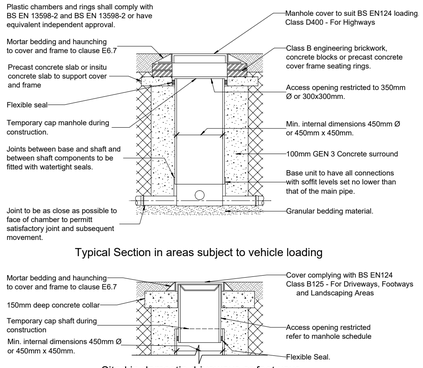
3. Ground may heave due to clay content in the as dug material. Contractor to level ground where required.

4. The area of the infiltration unit and the minimum total storage volume should be as per approved by the local planning authority documents.

Cellular Infiltration System - Landscape Area



Permeable Surface Against Building



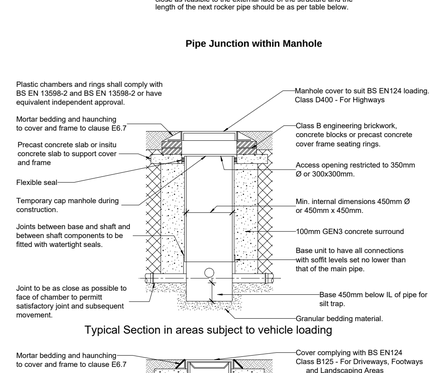
Typical Section in areas subject to vehicle loading

Sited in domestic driveways or footways

Sited in private garden - No loading

Notes:
1. Refer to drawing 8193 for base layouts.

- Chamber Type 3 - Flexible Material



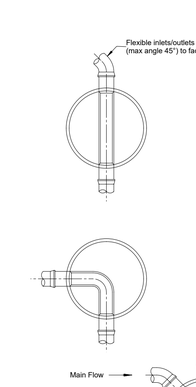
Typical Section in areas subject to vehicle loading

Sited in domestic driveways or footways

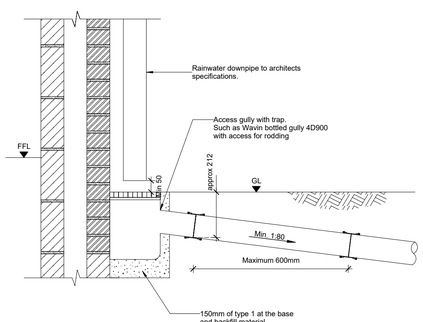
Sited in private garden - No loading

Notes:
1. Refer to drawing 8193 for base layouts.

Silt Trap Plastic



Chamber Type 3 Base Layouts

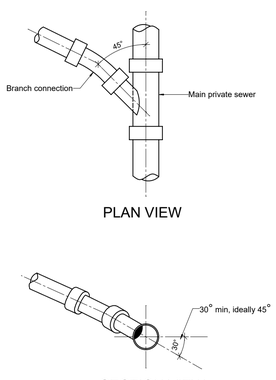


NOTES:

1. This details shows the standard generic arrangement.

2. The pipe and connector details will be different for each manufacturer of the components. They are to be in installed in accordance with the manufacturers recommendations.

8250 - External Rainwater (High Level)



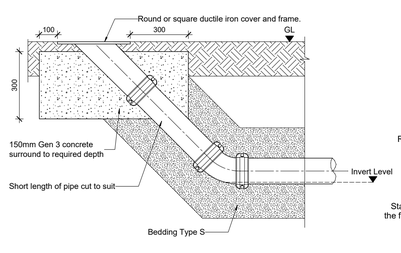
NOTES:

1. The vertical angle between the connecting pipe and the horizontal should be greater than 0° and not more than 60°.

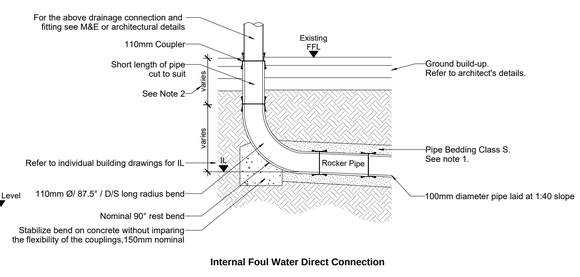
2. Where the connection is being made to a sewer with a nominal internal diameter of 300 mm or less, connections should be made using 45° angle, or 90° angle, curved square junctions.

3. Connections made with junction fittings should be made by cutting the existing pipe, inserting the junction fitting and jointing with flexible repair couplings or slip couplers.

Lateral Connection to private sewer



External Rodding Eye Detail



Internal Foul Water Direct Connection

Drawing Scale Bar

Drawing scale	Line length	Drawing scale	Line length
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1:50 =	2.5 metres	1:1250 =	62.5 metres
1:100 =	5.0 metres	1:2500 =	125 metres

Measure length of line above for checking of scale

GENERAL NOTES

Rev	Details	Date	By	Ch'd

Drawing Status:

PRELIMINARY

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FLOOD RISK ASSESSMENT & DRAINAGE STRATEGIES
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Client:

Project:

Land Rear Damson Close, Watford, WD24 5JY

Drawing:

Standard Details

Print Size:	Scale:	Project No:	Drawing No:	Revision:
A1	NTS	0480	006	P1