Infrastruct CS Ltd
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FLOOD RISK ASSESSMENT AND DRAINAGE STATEMENT

Scheme name: Land at Orchard Way, Chigwell Row. IG7 6EE

Document reference: **3563-ORCH-ICS-XX-RP-C-07.001**

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June 2019
Project Number: **ICS-3563**

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Date:	19 June 2019
Project Number:	ICS-3563
Project Name:	Orchard Way, Chigwell Row. IG7 6EE
Prepared By:	Adam Griffiths
Prepared For:	Mr & Mrs Healy
Client Contact:	Mrs Pat Healy

Document Revision Record

Issue	Checked By	Date	Description
-	MBD	04/06/19	Issue
A	MBD	19/06/19	Sections 6.2, 7.7 & Appendix D revised

Foreword

This document has been prepared solely as a Flood Risk Assessment & Drainage Strategy for the Clients, Mr & Mrs Healy. No responsibility or liability will be accepted for any use that is made of this document other than by the Client for the purpose it was written. The conclusions resulting from this study and contained within this report are not necessarily indicative of future conditions or operating practices at or adjacent to the site.

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Some of the information presented within this report is based on third party information which is believed to be correct; no liability will be accepted for any discrepancies in accuracy, mistakes or omissions in such information. The report also assesses the flood risk in relation to the requirements of the Environment Agency and as such assesses the site for a specific flood event and not all flood events. The contents of this document must not be copied or reproduced in whole or in part without the written consent of Infrastruct CS Ltd

Table of Contents

1.0 Summary

A Flood Risk Assessment (FRA) and drainage strategy has been undertaken to accompany the planning application for the proposed redevelopment at Orchard Way, Chigwell Row, IG7 6EE. This report has been prepared by Infrastruct CS Ltd on behalf of Mr & Mrs Healy in accordance with the guidelines set out in the National Planning Policy Framework.

The following table is an overview of the flood risk and drainage strategy for the proposed development of the site, based upon currently available information and finds the following –

ITEM	RESPONSE
Site Location	The site is located in Chigwell Row, Chigwell, Essex, bound by Orchard Way to the south, with open aggricultural land to the north. The approximate grid reference 546394 E, 193506 N.
Size and Current Land Usage	The current site is approximately 0.043ha in plan and is currently vacant open land.
Flood Zone	The development site falls entirely within Flood Zone 1, which is classified as low probability of flooding.
Fluvial Flood Risk	**Low** – Refer to Section 6.1
Overland Flood Risk	**Low** – Refer to Section 6.2
Groundwater Flood Risk	**Low** – Refer to Section 6.3
Sewerage Flood Risk	**Low** – Refer to Section 6.4
Artificial Flood Risk	**Low** – Refer to Section 6.5
Proposed Development	The proposals are for the development of land are **c**onstruction of 1x 3 bed house, plus 2x 1 bed flats, plus landscaped gardens and associated hardstanding/parking with cycle and refuse storage.

Based on this assessment, it is concluded that in accordance with the Flood risk vulnerability and flood zone compatibility table in Section 5.6 from the Planning Practice Guidance document, the report considers the proposed development appropriate.

2.0 Introduction

2.1 Commission

Mr. & Mrs. Healy have commissioned Infrastruct CS Ltd, to prepare a Flood Risk Assessment (FRA) and drainage statement to support a planning application for the re-development at Orchard Way, Chigwell Row, IG7 6EE**.** The proposed planning layout drawings are contained in Appendix B.

2.2 Guidance

This flood risk assessment has been compiled in accordance with the recommendations of the National Planning Policy Framework (NPPF) and the Planning Practice Guidance (PPG).

2.3 Aims and Objectives

The purpose of this flood risk assessment is to assess the potential flood risks by and to the proposed development. It will identify the flood risk zone, potential sources of flood risk, consider the proposed drainage and will be used to support the planning application.

3.0 Site Details

3.1 Location

The site is in Orchard Way, Chigwell Row in Chigwell, Essex. The site is bound by residental gardens with Orchard Way to the south and open land to the north.

Figure 3.1.1 - Site Context

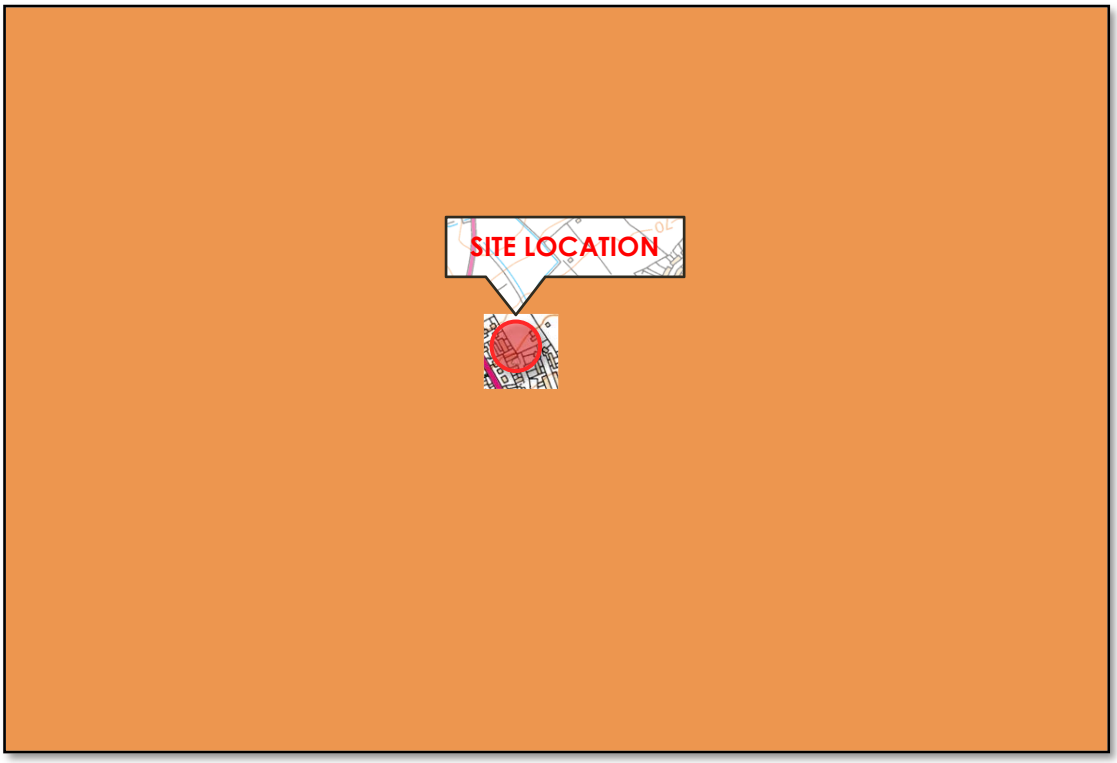


Figure 3.1.2 - Site location

3.2 Grid Reference

The Ordnance Survey National grid reference for the centre of the site is:

546394 E, 193506 N (Nat Grid TQ 46394 93506)

3.3 Topography and Site Description

The site covers an approximate greenfield area of 0.043ha, and is located on open land, at the end of a row of houses on Orchard Way, Chigwell Row in Essex. The site is approximately rectangular on plan with its long axis running in a North-South direction.

Levels vary within the site between 76.53mAOD to the southern corner and 73.93mAOD to the northern corner. The maximum fall across the site is 2.6m over 42.5m, giving a gradient of 6.1%. See Appendix A a topographic survey of the site.

3.4 Ground Conditions

Reference to the Geological Survey of Great Britain indicates the following strata:

> **Superficial deposits:** Lowestoft Formation - Diamicton. Sedimentary superficial deposit formed between 480 and 423 thousand years ago during the Quaternary period.
>
> **Bedrock geology:** Claygate Member - Clay, silt and sand. Sedimentary bedrock formed between 56 and 47.8 million years ago during the Palaeogene period.

Intrusive site investigations carried out near the development and shown on the British Geological Survey database (BGS ID: 698978, BGS Ref: TQ49SE109, British NGR (27700): 545630,193910) found Made Ground (sands and gravels)to depths of 6.0mbgl, with London Clay to 108mbgl with Sands and Chalk below.

3.5 Ground Water

Boreholes carried out in the vicinity (see above for BGS Ref) of the site, found resting water at 88.7mbgl. Further in-situ testing is required to confirm the depth of groundwater within the site.

3.6 Existing Site Drainage

Currently the site is undeveloped land without any formal drainage associated with it. Thames Waters records do show foul and surface water manholes within the site, however the records are incomplete (See Appendix C). It is presumed that the sewers within the site connect to the manholes between No.s 13 & 14 Whitehall Close to the east.

3.7 Existing Watercourses

The nearest main river watercourse to the site is the Lower Roding, a tributary of the River Thames, which is located 3.0 km to the north-west of the site adjacent to the M11 motorway.

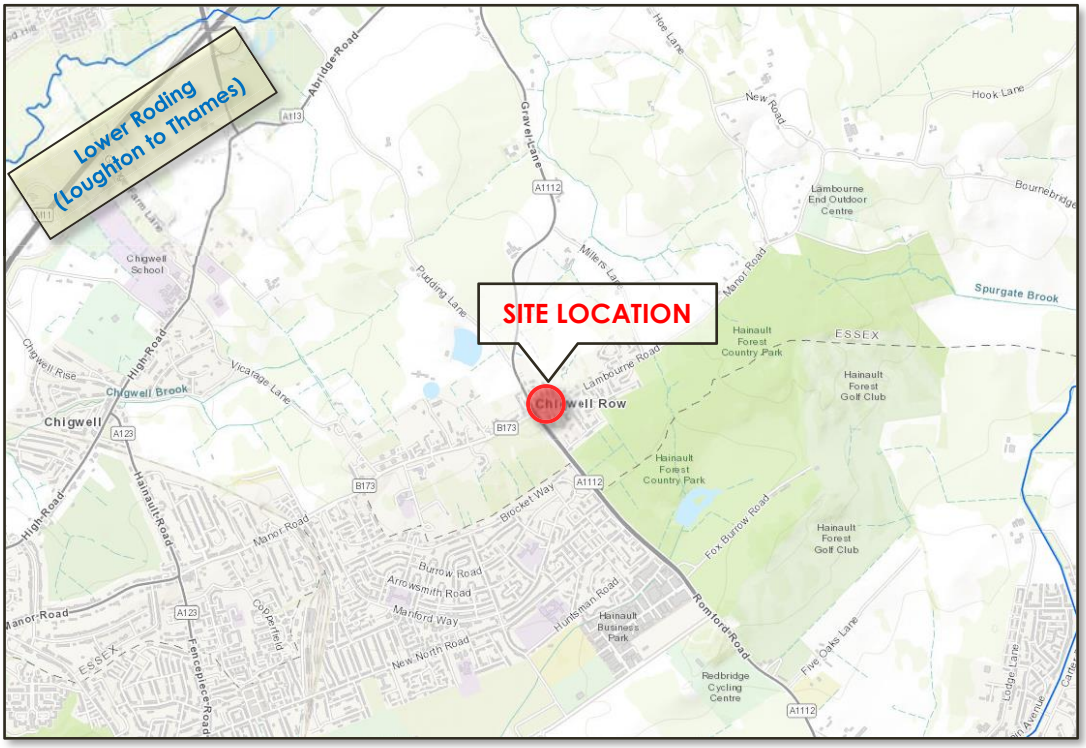


Figure 3.7.1 – Local Rivers

4.0 Proposed Development

The current architectural proposals involve the construction of 1x 3 bed house, plus 2x 1 bed flats, with landscaped gardens and associated hardstanding/parking with cycle and refuse storage. The proposed development plans can be found in Appendix B.

5.0 Flood Risk Policy

5.1 Environment Agency Flood Map

The flood map for the development site shown below suggests that the site wholly falls within flood zone 1, which is defined as land assessed as having a less than 1 in 1000 annual probability of river flooding in any one year.

Figure 5.1 - Environment Agency Flood Zone map

5.2 The National Planning Policy Framework

The National Planning Policy Framework (NPPF) and the accompanying Planning Practice Guidance (PPG) gives direction for development with respect to flooding. These documents promote a sequential approach to encourage development away from areas that may be or are susceptible to flooding. In doing so it categorizes flood zones in the context of their probability of flooding, as shown in the table within Section 5.3 below.

5.3 Flood Zone Definition

The National Planning Policy Framework Definition of Flood Zones

Flood zone	Fluvial	Tidal	Probability of flooding
1	< 1 in 1000 year	<1 in 1000 year	Low probability
2	Between < 1 in 1000 year and 1 in 100 year	Between <1 in 1000 year and 1 in 200 year	Medium Probability
3a	> 1 in 100 year	> 1 in 200 year	High probability
3b	Either > 1 in 20 or as agreed between the EA and the LPA	Either > 1 in 20 or as agreed between the EA and the LPA	Functional flood plain

5.4 Flood Zones – Table 1 – Planning Practice Guidance

(Note: These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences)

Zone 1 - Low Probability
Definition
This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
Appropriate uses
All uses of land are appropriate in this zone.
FRA requirements
For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the development on surface water run-off, should be incorporated in a FRA. This need only be brief unless the factors above or other local considerations require particular attention. See Annex E for minimum requirements.
Policy aims
In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

5.5 Flood Risk Vulnerability Classification - Extract from Table 2 - Planning Practice Guidance (PPG)

More Vulnerable

- Hospitals.
- Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
- Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels.
- Non–residential uses for health services, nurseries, and educational establishments.
- Landfill and sites used for waste management facilities for hazardous waste.
- Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.

5.6 Flood Risk Vulnerability & Flood Zone Compatibility Table

Vulnerability classification flood zone	Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
1	√	√	√	√	√
2	√	√	Exception test required	√	√
3a	Exception test required	√	x	Exception test required	√
3b	Exception test required	√	x	x	x

√ Development is appropriate x development is not appropriate

The above table, taken from PPG (table 3), confirms that residential properties within flood zones 1 is appropriate development.

5.7 Other Flooding Mechanisms

In addition to the potential for assessing flooding from fluvial and tidal sources NPPF also requires that consideration is given to other mechanisms for flooding:

- Flooding from land – intense rainfall, often in short duration, that is unable to soak into the ground or enter drainage systems, can run rapidly off land and result in local flooding.
- Flooding from groundwater – occurs when water levels in the ground rise above the surface elevations.
- Flooding from sewers – In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and waste water sewers known as combined sewers. Flooding can result causing surcharging when the sewer is overwhelmed by heavy rainfall.
- Flooding from reservoirs, canals and other artificial sources – Non-natural or artificial sources of flooding can result from sources such as reservoirs, canals lakes etc, where water is held above natural ground levels.

6.0 Flood Risk to The Development

6.1 Flooding from Fluvial Sources

The proposed development site lies entirely within flood zone 1 which is classified as land assessed as having a less than 1 in 1000 annual probability of river flooding.

Fig 6.1 – Environment Agency Flood Risk from Fluvial Flows map

It is, therefore, the consideration of this FRA that the site has a low risk of flooding from fluvial sources.

6.2 Flooding from Overland Flows

The surface water flood data for the site, shown below, indicates that there is medium to high flood risk immediately to the west of the site, to the frontage of the properties within Orchard Way, but low risk within the site itself.

Fig 6.2 – Environment Agency Flood Risk from Surface Water map

The topography of the site is such that any surface water flooding from the frontages to the existing properties in Orchard Way would be routed along the western boundary of the site towards the lower open ground to the north of the site.

The public highway immediately to the front of the site is shown to have a low risk of flooding and the flood routing is shown to be to the east of the site. Should, however, any surface water flows enter the site they will be intercepted by the proposed drainage system and either conveyed to the public sewer or to the open ground to the rear of the site in the case of system failure or exceedance.

It is, therefore, the consideration of this FRA that the site has a low risk of flooding from overland flow.

6.3 Flooding from Rising Groundwater

Section 3.5 of this report confirms that boreholes carried out in the vicinity of the site, found ground water at approximate depths of 88.7mbgl.

A review of the maps within the Epping Forrest District Council SFRA also indicate the site has a low risk of flooding from Groundwater.

It is, therefore, the consideration of this FRA that the site has a low risk of flooding from rising groundwater levels.

6.4 Flooding from the Local Sewerage Network

Sewer flooding generally results in localised short-term flooding caused by intense rainfall events overloading the capacity of sewers. Flooding from sewers can also occur as a result of blockage, poor maintenance or structural failure. Review of the extract form Thames Water's Flood Register in the Epping Forrest District Council SFRA show the site is in an area with a low history of sewer flooding incidents.

It is, therefore, the consideration of this FRA that the site has a low risk of flooding by surcharging of the local sewer network.

6.5 Flooding from Reservoirs, Canals & Other Artificial Sources

Reservoirs in the UK have an extremely good safety record. The EA is the enforcement authority for the Reservoirs Act 1975 in England and Wales. All large reservoirs must be inspected and supervised by reservoir panel engineers. These reservoirs therefore present a minimal risk. Review of the Environment Agency Flood Risk from Reservoirs map shows the site to lie outside the maximum extent of potential reservoir flooding.

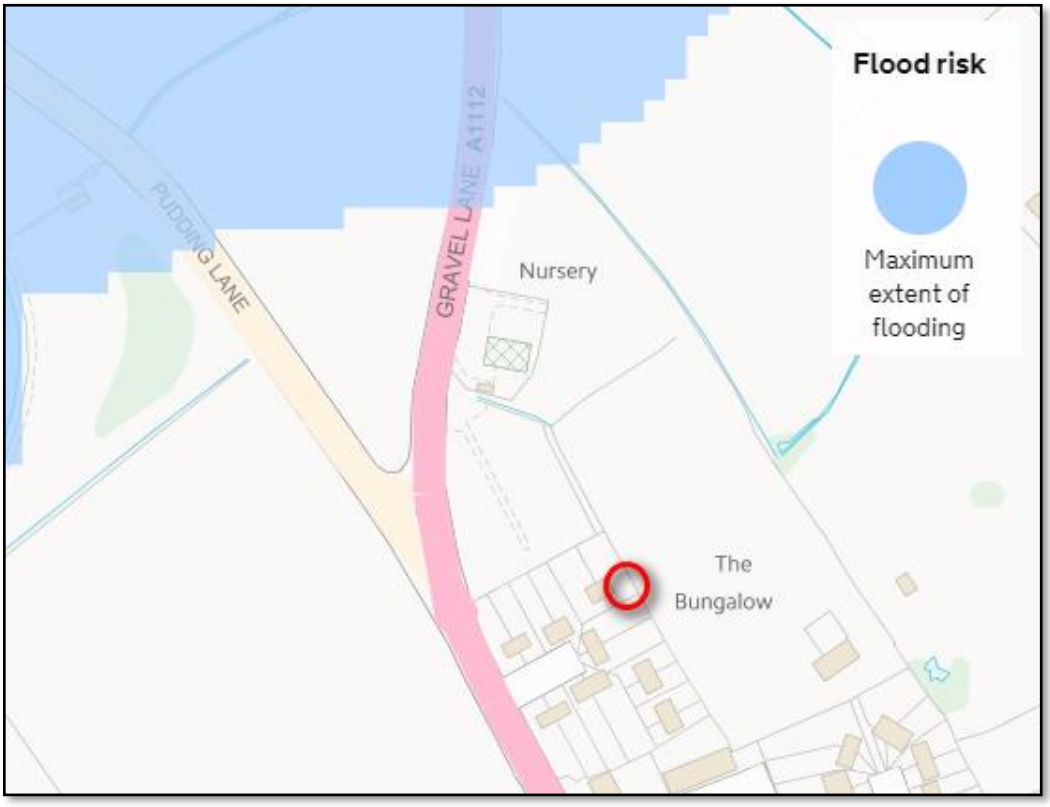


Fig 6.5 – Environment Agency Flood Risk from Reservoirs map

There are no known canals or other artificial sources in the vicinity of the site.

It is, therefore, the consideration of this FRA that the site has a low risk of flooding by reservoirs, canals or other artificial sources.

7.0 Flood Risk As A Result Of The Development

7.1 Effect of The Development Generally

Development by its nature usually has the potential to increase the impermeable area with a resultant increased risk of causing rapid surface water runoff to watercourses and sewers, thereby causing surcharging and potential flooding. There is also the potential for pollutants to be mobilised and consequently flushed into the receiving surface water system.

Increases in both the peak runoff rate (usually measured in litres per second l/s) and runoff volume (cubic metres m^3) can result.

7.2 Surface Water Drainage & Sustainable Drainage Systems

Sustainable Drainage techniques (SuDS) covers a range of approaches to manage surface water runoff so that-

'Surface water arising from a developed site should, as far as is practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account. This should be demonstrated as part of the flood risk assessment.'

7.3 Peak Storm Design Criteria

The proposed sustainable drainage techniques for the development should accommodate the peak rainfall event for a 1 in 100 year storm event with an additional allowance for climate change. Table 5 of NPPG recommends for developments that have a life expectancy beyond 2085 that an additional factor of 40% is applied to the peak volume of runoff.

7.4 Existing Surface Water Runoff Rates

The development site area is approximately 0.043ha, mostly impermeable. The site currently drains via soakaways into the ground. The existing runoff rates calculated for site are highlighted below:

Return Period	Greenfield Runoff Rate l/s
1 in 1 year	0.1
Qbar	0.2
1 in 30 year	0.4
1 in 100 year	0.5

Table 7.4 Existing Runoff rates

Greenfield runoff rates were calculated using the ICP SUDS Method within Microdrainage Software. Calculations can be found in Appendix E.

7.5 Sustainable Drainage Hierarchy

A hierarchical approach has been undertaken in consideration of the application of SuDS in relation to the development. This is in order to meet the design philosophy of ensuring that surface water run-off is managed as close to its source as possible and the existing situation is replicated as closely as possible.

The following drainage hierarchy has been undertaken with reference to the procedures set out in the SuDS Manual (CIRIA C753, 2015) to assess the viability of the application of SuDS techniques to this scheme:

- store rainwater for later use
- use infiltration techniques, such as porous surfaces in permeable strata areas
- Attenuate rainwater in ponds or open water features for gradual release to a watercourse.
- attenuate rainwater by storing in tanks or sealed water features for gradual release to a watercourse,
- discharge rainwater direct to a watercourse
- discharge rainwater to a surface water drain
- discharge rainwater to the combined sewer.

The sustainable drainage hierarchy shown above is intended to ensure that all practical and reasonable measures are taken to manage surface water higher up the hierarchy (1 being the highest) and that the amount of surface water managed at the bottom of the hierarchy is minimised.

Storing rainwater for later use might be an option but it is not sufficient to accommodate the runoff from the whole development.

The site-specific drainage hierarchy checklist considered for the drainage design for this development is detailed in Table 7.6.

SUDS OPTIONS	Comments	Potential for flow rate control	Volume reduction	Maintenance requirement	Space requirement	Cost	Included in final detailed design
Rainwater harvesting	Rainwater from roof runoff collected for re-use. Cost-benefit considerations	L	M	H	L	H	Pos
Water butts	Rainwater collection from roof runoff.	L	L	L	L	L	Pos
Living roofs	Vegetated roofs that reduce runoff volume and rate	M	L	M	L	H	N
Bio-retention	Shallow vegetated areas to retain and treat runoff.	L	L	M	M	L	N
Constructed wetlands	Waterlogged areas that can support aquatic vegetation. Replicates existing conditions and provides ecological benefit.	M	L	H	H/M	M	N
Swales	Shallow grassed drainage channels. Replicates existing conditions	H	M	L	M/H	L	N
Soakaways	Subsurface structures that dispose of water via infiltration.	H	H	L	L	M	N
Permeable pavements	Surface that infiltrate through surface. Retains pollutants.	H	H	M	L	M	N
Tanked storage systems	Oversized pipes or cellular storage.	H	L	L	M	M/H	Y
Infiltration basins	Depressions in the ground to store and release water through infiltration	H	H	H/M	H	M/L	N
Detention basins	Temporary retention of runoff with controlled discharge	H	L	M	H	M/L	N

Table 7.6 Drainage design hierarchy (SuDS techniques considered for use in this scheme)

It should be noted that where the SuDS techniques are noted as feasible or possible it does not necessarily follow that they will all be used. Reference should be made to the drainage strategy drawing in Appendix D which indicates the drainage proposals.

7.6 SUDS Techniques Employed

Owing to the sloping nature of the site the use of permeable paving is not feasible. It is therefore proposed to construct the parking bays in a non-permable material that drains via a proprietary drainage channel functioning as a combined run-off collection, silt/oil interceptor and treatment component. This will be connected to a cellular storage tank. Runoff from roofs will be collected and conveyed via a pipe network into the cellular storage. Potential sediments will be trapped using catchpits. Flows from the cellular storage tank into the public surface water sewer within site will be controlled by an orifice plate. An orifice diameter of 20mm is proposed being the minimum recommend within Ciria 753.

Urban creep has been considered when sizing the system. Catchment areas for each SuDS feature are highlighted below & calculations can be found in Appendix E.

SuDS Technique	Catchment Area (m^2)	Area with 10 % Urban Creep (m^2)
Tanked Storage System	200	220

Table 7.7.A Catchment Areas

Return Period	Existing Runoff Rate l/s	Proposed Runoff Rate l/s
1 in 1 year	0.1	0.3
1 in 30 year	0.4	0.4
1 in 100 year	0.5	0.5

Table 7.7.B Existing and proposed runoff rates

7.7 Residual Flood Risk & Exceedance

The proposed surface water drainage measures will be designed to contain the peak storm event that can be expected for a 1 in 100 year situation. A 40% allowance has already been applied to the site to account for future climate change.

A secondary drainage channel at the building entrances will mitigate against the risk of any surface water flooding entering the properties. In the event of system failure or exceedance, a trapped gully to the rear of the properties will act as a high-level overflow (set 150mm below the finished floor level). Exceedance flows will then be conveyed through the site to the open ground at the rear.

7.8 Flood Risk Management

Unlike conventional drainage systems, SuDS features are visible, and their function should be easily understood by those responsible for maintenance. When problems occur, they are generally obvious and can be remedied simply, using standard landscaping practice. During the first year of operation of all types of SuDS, inspections should usually be carried out at least monthly (and after significant storm events) to ensure that the system is functioning as designed and that no damage is evident.

7.9 Water Quality

The SuDS techniques outlined above will improve the quality of the water discharged from site as required by Policy DM16 of the Epping Forest District Local Plan.

8.0 Proposed Foul Water Drainage System

The development proposals will seek to discharge foul water from the development site into the existing foul drainage network running within the site. This will be subject to a Section 106 consents from Local Water Authority, Thames Water. Flows into this system will be via a gravity connection.

9.0 Recommendations and Conclusion

The development proposals together with the site layout have been assessed in relation to the provision of SuDS drainage associated with the works.

The report has assessed the feasibility of implementing the SuDS hierarchal approach and has confirmed that this development is likely to be able to install suitable drainage measures into the design proposals.

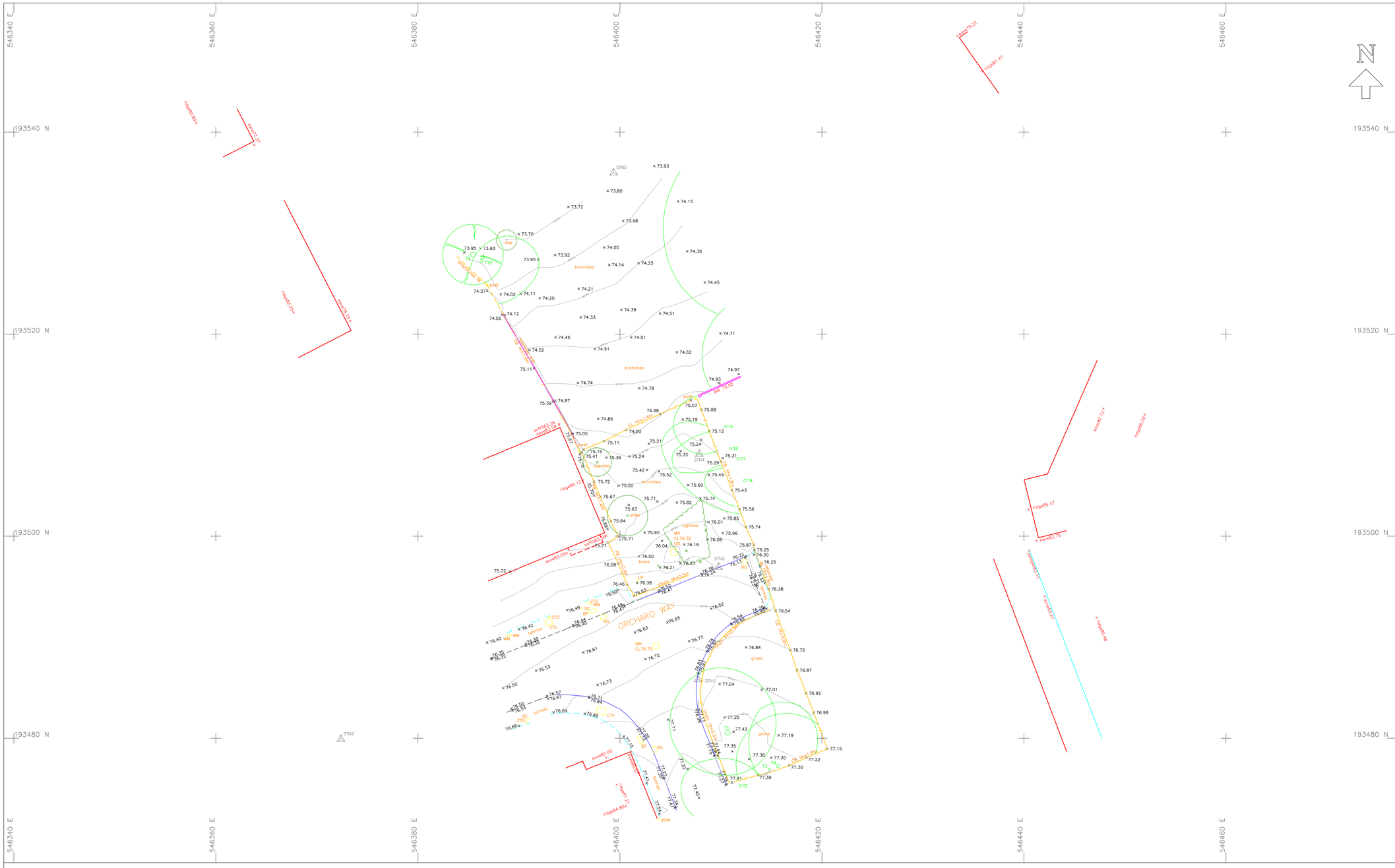
Flood risk to the site has been assessed and have been deemed low.

Therefore, in line with the recommendations of the National Planning Policy Framework, the development site lies within land classified as flood zone 1, which is considered at a low risk of flooding, and therefore appropriate for a development of this nature. Having assessed the other forms of flood risk to and from the development site, this report finds that the site is not considered at high risk from any other sources of flooding.

10.0 References & Bibliography

- The National Planning Policy Framework July 2018
- Planning Practice Guidance.
- Environment Agency - Rainfall-Runoff Management for Developments
- Environment Agency indicative flood maps https://flood-map-for-planning.service.gov.uk/
- Environment Agency indicative groundwater source protection zone maps http://www.natureonthemap.naturalengland.org.uk/MagicMap.aspx
- Environment Agency indicative Aquifer designation maps http://www.natureonthemap.naturalengland.org.uk/MagicMap.aspx
- CIRIA 2007, The Sustainable Drainage Systems (SUDS) Manual C753
- Sewers for adoption 7th edition
- Epping Forest District Council SFRA
- Epping Forest District Local Plan
- Flood Estimation Handbook
- Environment Agency - Adapting to Climate Change: Advice for the Flood and Coastal Erosion Management Authorities March 2016

Appendix A - Topographic Survey



LEGEND

FEATURE STYLES

SURVEY CONTROL
FENCE
HEDGE
FWS
SWS
WATER
POWER LINE (OVERHEAD)
TELECOM LINE (OVERHEAD)
ELECTRIC MAIN
GAS MAIN
EMBANKMENT

FENCE TYPES

BWR	Barbed Wire
CB	Close Board
CI	Corrugated Iron
CL	Chain Link
CPL	Conc Panel
CP	Chestnut Paling
CW	Chicken Wire
IW	Interwoven
IR	Iron Railing
OB	Openboard
PR	Post and rail
PW	Post and Wire

FEATURE ABREVIATIONS

AV	Air Valve
BS	Bus Stop
BT	British Telecom
BW	Brick Wall
CB	Conc Bollard
CL	Cover Level
CTO	cable TV outlet
EB	Electric Box
EC	Electric Cover
EP	Electricity Pole
FH	Fire Hydrant
FL	Floor level
G	Gully
GM	Gas Meter
GV	Gas Valve
IL	Invert Level
IC	Inspection Chamber
KLS	Keep Left Sign
KO	Kerb Offlet
LB	Letter Box
LP	Lamp Post
MKR	Marker
MP	Metal Post
MH	Manhole
MB	Metal Bollard
P	Post
PI	Petrol Interceptor
RG	Road Gully
RNB	Road Name Board
RS	Road Sign
RW	Retaining Wall
SA	Soakaway
SC	Stopcock
SV	Sluice Valve
TP	Telegraph Pole
TCB	Telephone Box
TJB	Tel.Junc.Box
TL	Traffic Light
V	Valve
VP	Vent Pipe
WL	Water Level
WM	Water Meter
WO	Water Outlet
WV	Water Valve

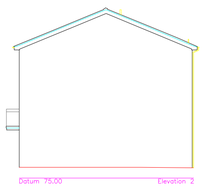
DATUM
GRID – ORDNANCE SURVEY NATIONAL GRID (OSTN15)
LEVELS – ORDNANCE SURVEY (OSGM15)
SCALE FACTOR REMOVED

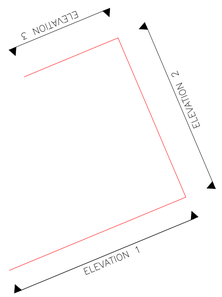
SURVEY CONTROL			
STN	–E–	–N–	–Z–
1	546407.727	193485.834	76.987
2	546372.377	193479.926	76.254
3	546409.771	193496.963	76.306
4	546407.856	193508.131	75.394
5	546399.380	193535.984	73.809

NOTES

Drainage and service covers that were buried, obscured or not visible at the time of the survey cannot be shown. Sewer connections between manholes are assumed to be straight and only pipes visible from the cover are shown.

Tree canopy measured values are written as maximium spreads.





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CLIENT

MR & MRS HEALY

SITE

land at
ORCHARD WAY
CHIGWELL ROW
IG7 6EF

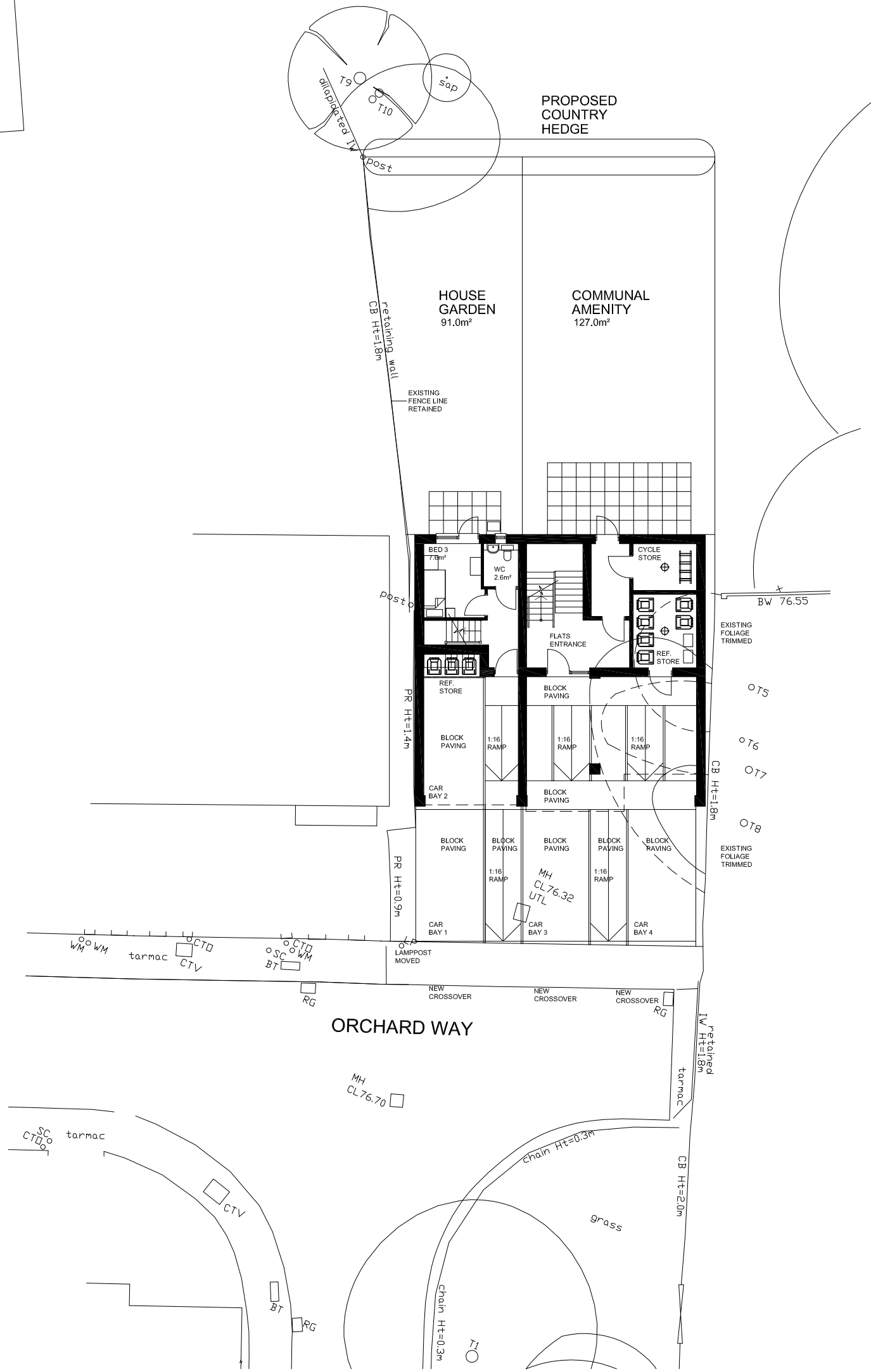
TITLE

SITE SURVEY & ELEVATIONS

AS EXISTING

SCALE 1/200 (A1)	DATE MARCH 2019
DRAWING No. 01	JOB No. 19032774

Appendix B - Development Proposals



Do not scale from this drawing.

Contractors must confirm site dimensions before starting work on shop drawings.

Rev.	Description	Date	Aut.
P1	Planning Issue	19.03.2019	NMG

0m 5m 10m

SCALE IN METRES 1:200

Purpose of Issue:	TFP Job No.
PLANNING	5216

Mrs P and Mr J Healy

Residential Development

Land at Orchard Way, Chigwell Row, IG7 6EE

Residential Development

Proposed Site Plan

Drawing Number:	Suit.	Rev.
5216-TFP-ZZ-ZZ-DR-A-2006	S1	P1

Drawn:	Approved:	Scale:	Date:
NMG	KDE	1:200 @A3	Mar.2019

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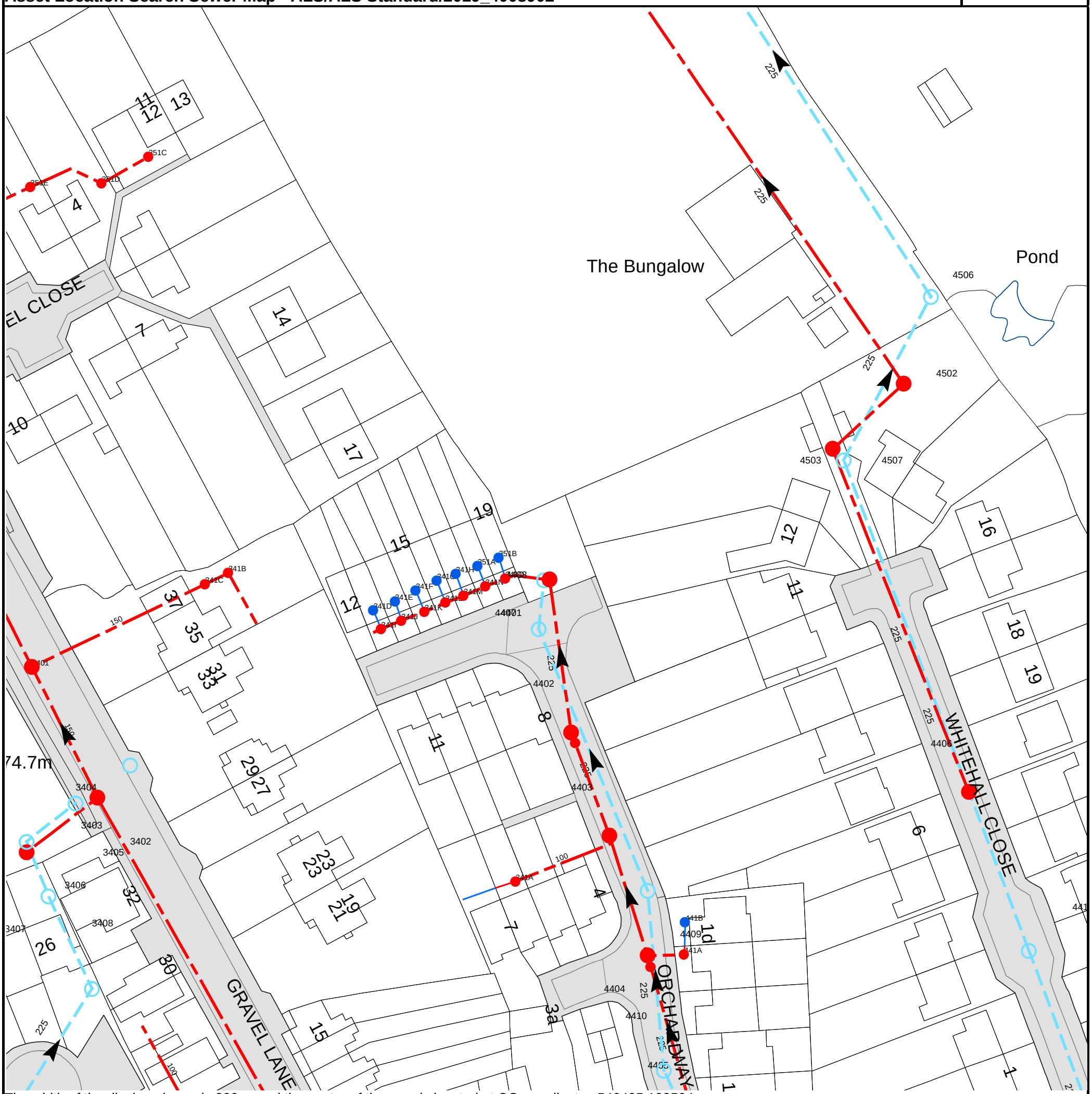
Appendix C - Thames Water Sewer Records

Asset Location Search Sewer Map - ALS/ALS Standard/2019_4008902



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 546405,193504

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
341D	n/a	n/a
341I	n/a	n/a
341E	n/a	n/a
341J	n/a	n/a
341F	n/a	n/a
341K	n/a	n/a
341G	n/a	n/a
341L	n/a	n/a
341H	n/a	n/a
341M	n/a	n/a
341N	n/a	n/a
341O	n/a	n/a
341A	n/a	n/a
4408	76.72	75.08
4407	76.31	74.57
4401	76.33	74.1
4402	77.58	74.77
4403	78.3	76.56
4404	79.16	77.03
4409	78.7	77.28
4410	79.89	78.48
441A	n/a	n/a
441B	n/a	n/a
4506	76.09	75.11
4406	79.24	77.66
4411	80.02	78.6
351A	n/a	n/a
351B	n/a	n/a
4507	n/a	n/a
4503	n/a	n/a
4502	n/a	n/a
351E	n/a	n/a
351D	n/a	n/a
351C	n/a	n/a
3406	76	74.71
3403	76.12	n/a
3401	73.31	71.76
3407	77.17	75.28
3405	75.58	n/a
3408	n/a	n/a
3402	75	73.49
3404	74.98	n/a
341C	n/a	n/a
341B	n/a	n/a

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

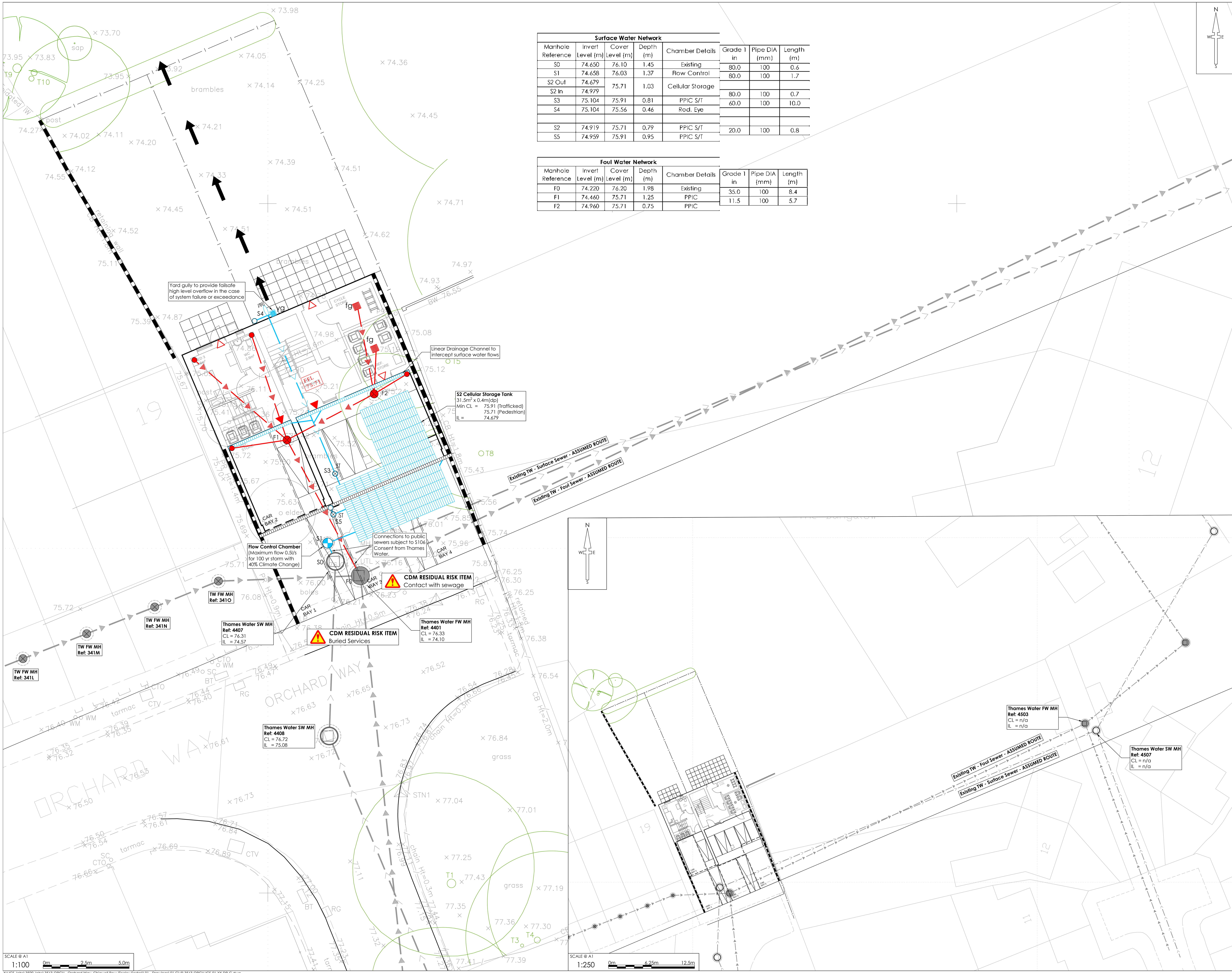
Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plans are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole level indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Appendix D - Drainage Strategy



Surface Water Network

Manhole Reference	Invert Level (m)	Cover Level (m)	Depth (m)	Chamber Details
S0	74.650	76.10	1.45	Existing
S1	74.658	76.03	1.37	Flow Control
S2 Out	74.679	75.71	1.03	Cellular Storage
S2 In	74.979			
S3	75.104	75.91	0.81	PPIC S/T
S4	75.104	75.56	0.46	Rod. Eye
S2	74.919	75.71	0.79	PPIC S/T
S5	74.959	75.91	0.95	PPIC S/T

Grade 1 in	Pipe DIA (mm)	Length (m)
80.0	100	0.6
80.0	100	1.7
80.0	100	0.7
60.0	100	10.0
20.0	100	0.8

Foul Water Network

Manhole Reference	Invert Level (m)	Cover Level (m)	Depth (m)	Chamber Details
F0	74.220	76.20	1.98	Existing
F1	74.460	75.71	1.25	PPIC
F2	74.960	75.71	0.75	PPIC

Grade 1 in	Pipe DIA (mm)	Length (m)
35.0	100	8.4
11.5	100	5.7

NOTES

1. All dimensions and levels are in metres unless otherwise noted
2. This drawing is to be read in conjunction with the relevant Architect's/Engineer's drawings, specifications and CDM documentation
3. This drawings has been produced electronically and may have been photo reduced or enlarged when copied. Work to figured dimensions only (DO NOT SCALE). All dimensions to be checked on site. Any errors or omissions to be reported to the engineer immediately.
4. This drawing contains coloured lines / information that may not be clear if reproduced in black and white.
5. Digital copies of this plan can only be considered accurate if supplied directly by Infrastruct CS Ltd.

Construction Note
It is essential that new drainage associated with the development is laid from the outfall(s) into the site. This is essential to avoid unforeseen obstructions where encountered (such as services). If the drainage is laid from the site out to the outfall it can result in significant abortive works to relay and overcome such obstructions.

Location of Public Sewers have been taken from record drawings which should be fully substantiated by the contractor prior to commencing works on site

All manholes covers located within carriageways shall have no slip covers to prevent motorcycles/cycles losing control

DESIGNERS CDM NOTE - RESIDUAL RISKS IDENTIFIED

The design Engineer(s) have analysed this design as the scheme has been developed, in order to identify if there are any significant residual risk hazards (i.e. unusual, unexpected, abnormal or difficult).

Residual risks **HAVE** been identified and are therefore shown on this drawing. These risks have not been possible to remove by design.

This statement assumes that a competent Contractor with the appropriate qualified staff will be employed for the works, and that they will be familiar with site wide construction risks and hazards that they can reasonably be expected to encounter as part of their work.

BURIED UTILITIES RISK NOTE

- Buried utilities are present on and in the vicinity of the site.
- The Contractor must satisfy themselves that they have seen utility returns for the area and that appropriate Risk Assessment Method Statement (RAMS) are in place and implemented to ensure that buried and/or overhead services are located prior to any works taking place.
- Any RAMS shall address safe procedures for protection and working in the proximity of services.

FW	SW	
mac	mac	Mini access chamber (mac) - 300mmØ *
		PPIC - 475mmØ *
RE		Surface water rodding eye
		Rain water down pipe (roddable access)
ST		Silt Trap (ST) with removable silt bucket
yg		Yard gully (150m - 200mmØ trapped)
		Soil vent pipe/soil stack
fg		Floor gully (trapped)
		Proprietary combined treatment drainage channel
		Linear drainage channel
		Cellular storage (refer to drawing for sizes)
		Retaining wall
FFL XX.XX		Finished Floor Level (FFL)
		Building Access - Primary
		Building Access - Secondary
		Flow routing in the event of system failure or exceedance

REV	DRAWN	CHECK	REVISION COMMENTS	ISSUE DATE
P02	SNN	AJG	High level overflow, exceedance routing and additional linear drainage added.	19/06/19
P01	SNN	MBD	Initial issue	04/06/19

DRAWING TITLE: Drainage Strategy

SHEET NO.: 1/1

PROJECT: Land at Orchard Way, Chigwell Row, Chigwell, Essex, IG7 6EE

S2 - INFORMATION

CLIENT: Mr & Mrs Healy

Infrastruct CS Ltd

The Stables, High Cogges Farm, High Cogges, Witney, OX29 6UN - Tel: 01993 709709: info@infrastructcs.co.uk

SCALE @ A1: Various

ENGINEER: AJG
DRAFT: SNN
APPROVED: TST

PROJECT NUMBER	STATUS	DATE
3563	S2	June 19

PROJECT	ORIGIN	PHASE	LEVEL	TYPE	ROLE	NO.	REVISION
ORCH	ICS	01	XX	DR	C	0001	P02

Appendix E - MicroDrainage Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years)	1	Soil	0.450
Area (ha)	0.043	Urban	0.000
SAAR (mm)	600	Region Number	Region 6

Results l/s

QBAR Rural	0.2
QBAR Urban	0.2
Q1 year	0.1
Q1 year	0.1
Q30 years	0.4
Q100 years	0.5

Summary of Results for 1 year Return Period (+40%)

Half Drain Time : 97 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	74.816	0.056	0.0	0.2	0.2	1.7	O K
30 min Summer	74.829	0.069	0.0	0.2	0.2	2.1	O K
60 min Summer	74.838	0.078	0.0	0.3	0.3	2.3	O K
120 min Summer	74.839	0.079	0.0	0.3	0.3	2.4	O K
180 min Summer	74.837	0.077	0.0	0.3	0.3	2.3	O K
240 min Summer	74.835	0.075	0.0	0.3	0.3	2.2	O K
360 min Summer	74.829	0.069	0.0	0.2	0.2	2.1	O K
480 min Summer	74.824	0.064	0.0	0.2	0.2	1.9	O K
600 min Summer	74.819	0.059	0.0	0.2	0.2	1.8	O K
720 min Summer	74.814	0.054	0.0	0.2	0.2	1.6	O K
960 min Summer	74.806	0.046	0.0	0.2	0.2	1.4	O K
1440 min Summer	74.793	0.033	0.0	0.2	0.2	1.0	O K
2160 min Summer	74.780	0.020	0.0	0.2	0.2	0.6	O K
2880 min Summer	74.772	0.012	0.0	0.1	0.1	0.3	O K
4320 min Summer	74.762	0.002	0.0	0.1	0.1	0.1	O K
5760 min Summer	74.760	0.000	0.0	0.1	0.1	0.0	O K
7200 min Summer	74.760	0.000	0.0	0.1	0.1	0.0	O K
8640 min Summer	74.760	0.000	0.0	0.1	0.1	0.0	O K
10080 min Summer	74.760	0.000	0.0	0.1	0.1	0.0	O K
15 min Winter	74.824	0.064	0.0	0.2	0.2	1.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	46.531	0.0	1.9	22
30 min Summer	29.881	0.0	2.4	35
60 min Summer	18.527	0.0	3.0	62
120 min Summer	11.236	0.0	3.7	96
180 min Summer	8.340	0.0	4.1	130
240 min Summer	6.741	0.0	4.4	166
360 min Summer	4.971	0.0	4.9	234
480 min Summer	3.991	0.0	5.3	302
600 min Summer	3.365	0.0	5.5	368
720 min Summer	2.927	0.0	5.8	434
960 min Summer	2.349	0.0	6.2	562
1440 min Summer	1.723	0.0	6.8	810
2160 min Summer	1.264	0.0	7.5	1172
2880 min Summer	1.015	0.0	8.0	1528
4320 min Summer	0.744	0.0	8.8	2212
5760 min Summer	0.597	0.0	9.5	0
7200 min Summer	0.503	0.0	10.0	0
8640 min Summer	0.438	0.0	10.4	0
10080 min Summer	0.389	0.0	10.8	0
15 min Winter	46.531	0.0	2.1	22

Summary of Results for 1 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	74.839	0.079	0.0	0.3	0.3	2.4	O K
60 min Winter	74.849	0.089	0.0	0.3	0.3	2.7	O K
120 min Winter	74.852	0.092	0.0	0.3	0.3	2.7	O K
180 min Winter	74.849	0.089	0.0	0.3	0.3	2.7	O K
240 min Winter	74.846	0.086	0.0	0.3	0.3	2.6	O K
360 min Winter	74.837	0.077	0.0	0.3	0.3	2.3	O K
480 min Winter	74.828	0.068	0.0	0.2	0.2	2.0	O K
600 min Winter	74.821	0.061	0.0	0.2	0.2	1.8	O K
720 min Winter	74.814	0.054	0.0	0.2	0.2	1.6	O K
960 min Winter	74.803	0.043	0.0	0.2	0.2	1.3	O K
1440 min Winter	74.786	0.026	0.0	0.2	0.2	0.8	O K
2160 min Winter	74.771	0.011	0.0	0.1	0.1	0.3	O K
2880 min Winter	74.763	0.003	0.0	0.1	0.1	0.1	O K
4320 min Winter	74.760	0.000	0.0	0.1	0.1	0.0	O K
5760 min Winter	74.760	0.000	0.0	0.1	0.1	0.0	O K
7200 min Winter	74.760	0.000	0.0	0.1	0.1	0.0	O K
8640 min Winter	74.760	0.000	0.0	0.1	0.1	0.0	O K
10080 min Winter	74.760	0.000	0.0	0.1	0.1	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	29.881	0.0	2.7	35
60 min Winter	18.527	0.0	3.4	62
120 min Winter	11.236	0.0	4.1	102
180 min Winter	8.340	0.0	4.6	140
240 min Winter	6.741	0.0	5.0	178
360 min Winter	4.971	0.0	5.5	252
480 min Winter	3.991	0.0	5.9	324
600 min Winter	3.365	0.0	6.2	392
720 min Winter	2.927	0.0	6.5	460
960 min Winter	2.349	0.0	6.9	590
1440 min Winter	1.723	0.0	7.6	840
2160 min Winter	1.264	0.0	8.4	1192
2880 min Winter	1.015	0.0	9.0	1532
4320 min Winter	0.744	0.0	9.9	0
5760 min Winter	0.597	0.0	10.6	0
7200 min Winter	0.503	0.0	11.2	0
8640 min Winter	0.438	0.0	11.7	0
10080 min Winter	0.389	0.0	12.1	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.600	Shortest Storm (mins)	15
Ratio R	0.450	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.022

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.006	4	8	0.014	8	12	0.002

Model Details

Storage is Online Cover Level (m) 75.910

Cellular Storage Structure

Invert Level (m) 74.760 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	31.5	30.0	0.500	0.1	40.4
0.400	31.5	40.4			

Orifice Outflow Control

Diameter (m) 0.020 Discharge Coefficient 0.600 Invert Level (m) 74.730

Summary of Results for 30 year Return Period (+40%)

Half Drain Time : 178 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	74.906	0.146	0.0	0.3	0.3	4.4	O K
30 min Summer	74.942	0.182	0.0	0.4	0.4	5.4	O K
60 min Summer	74.969	0.209	0.0	0.4	0.4	6.3	O K
120 min Summer	74.980	0.220	0.0	0.4	0.4	6.6	O K
180 min Summer	74.978	0.218	0.0	0.4	0.4	6.5	O K
240 min Summer	74.973	0.213	0.0	0.4	0.4	6.4	O K
360 min Summer	74.962	0.202	0.0	0.4	0.4	6.1	O K
480 min Summer	74.951	0.191	0.0	0.4	0.4	5.7	O K
600 min Summer	74.940	0.180	0.0	0.4	0.4	5.4	O K
720 min Summer	74.929	0.169	0.0	0.4	0.4	5.1	O K
960 min Summer	74.912	0.152	0.0	0.3	0.3	4.5	O K
1440 min Summer	74.883	0.123	0.0	0.3	0.3	3.7	O K
2160 min Summer	74.853	0.093	0.0	0.3	0.3	2.8	O K
2880 min Summer	74.831	0.071	0.0	0.3	0.3	2.1	O K
4320 min Summer	74.803	0.043	0.0	0.2	0.2	1.3	O K
5760 min Summer	74.786	0.026	0.0	0.2	0.2	0.8	O K
7200 min Summer	74.775	0.015	0.0	0.2	0.2	0.5	O K
8640 min Summer	74.768	0.008	0.0	0.1	0.1	0.2	O K
10080 min Summer	74.763	0.003	0.0	0.1	0.1	0.1	O K
15 min Winter	74.925	0.165	0.0	0.4	0.4	4.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	114.281	0.0	4.7	23
30 min Summer	72.943	0.0	6.0	37
60 min Summer	44.449	0.0	7.3	64
120 min Summer	26.291	0.0	8.7	120
180 min Summer	19.146	0.0	9.5	148
240 min Summer	15.230	0.0	10.0	180
360 min Summer	11.002	0.0	10.9	248
480 min Summer	8.733	0.0	11.5	318
600 min Summer	7.297	0.0	12.0	386
720 min Summer	6.299	0.0	12.5	454
960 min Summer	4.991	0.0	13.2	586
1440 min Summer	3.593	0.0	14.2	842
2160 min Summer	2.583	0.0	15.3	1216
2880 min Summer	2.043	0.0	16.2	1588
4320 min Summer	1.467	0.0	17.4	2296
5760 min Summer	1.159	0.0	18.3	3000
7200 min Summer	0.966	0.0	19.1	3744
8640 min Summer	0.831	0.0	19.7	4416
10080 min Summer	0.732	0.0	20.3	5144
15 min Winter	114.281	0.0	5.3	23

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	74.966	0.206	0.0	0.4	0.4	6.2	O K
60 min Winter	74.998	0.238	0.0	0.4	0.4	7.1	O K
120 min Winter	75.013	0.253	0.0	0.4	0.4	7.6	O K
180 min Winter	75.010	0.250	0.0	0.4	0.4	7.5	O K
240 min Winter	75.004	0.244	0.0	0.4	0.4	7.3	O K
360 min Winter	74.990	0.230	0.0	0.4	0.4	6.9	O K
480 min Winter	74.974	0.214	0.0	0.4	0.4	6.4	O K
600 min Winter	74.958	0.198	0.0	0.4	0.4	5.9	O K
720 min Winter	74.944	0.184	0.0	0.4	0.4	5.5	O K
960 min Winter	74.918	0.158	0.0	0.4	0.4	4.7	O K
1440 min Winter	74.879	0.119	0.0	0.3	0.3	3.6	O K
2160 min Winter	74.840	0.080	0.0	0.3	0.3	2.4	O K
2880 min Winter	74.814	0.054	0.0	0.2	0.2	1.6	O K
4320 min Winter	74.785	0.025	0.0	0.2	0.2	0.8	O K
5760 min Winter	74.770	0.010	0.0	0.1	0.1	0.3	O K
7200 min Winter	74.762	0.002	0.0	0.1	0.1	0.1	O K
8640 min Winter	74.760	0.000	0.0	0.1	0.1	0.0	O K
10080 min Winter	74.760	0.000	0.0	0.1	0.1	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	72.943	0.0	6.7	36
60 min Winter	44.449	0.0	8.2	64
120 min Winter	26.291	0.0	9.7	120
180 min Winter	19.146	0.0	10.6	166
240 min Winter	15.230	0.0	11.2	190
360 min Winter	11.002	0.0	12.2	268
480 min Winter	8.733	0.0	12.9	342
600 min Winter	7.297	0.0	13.5	416
720 min Winter	6.299	0.0	14.0	488
960 min Winter	4.991	0.0	14.7	626
1440 min Winter	3.593	0.0	15.9	888
2160 min Winter	2.583	0.0	17.2	1260
2880 min Winter	2.043	0.0	18.1	1620
4320 min Winter	1.467	0.0	19.5	2336
5760 min Winter	1.159	0.0	20.6	3048
7200 min Winter	0.966	0.0	21.4	3744
8640 min Winter	0.831	0.0	22.1	0
10080 min Winter	0.732	0.0	22.7	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.600	Shortest Storm (mins)	15
Ratio R	0.450	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.022

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.006	4	8	0.014	8	12	0.002

Model Details

Storage is Online Cover Level (m) 75.910

Cellular Storage Structure

Invert Level (m) 74.760 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	31.5	30.0	0.500	0.1	40.4
0.400	31.5	40.4			

Orifice Outflow Control

Diameter (m) 0.020 Discharge Coefficient 0.600 Invert Level (m) 74.730

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 213 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	74.953	0.193	0.0	0.4	0.4	5.8	O K
30 min Summer	75.002	0.242	0.0	0.4	0.4	7.2	O K
60 min Summer	75.042	0.282	0.0	0.5	0.5	8.4	O K
120 min Summer	75.061	0.301	0.0	0.5	0.5	9.0	O K
180 min Summer	75.059	0.299	0.0	0.5	0.5	9.0	O K
240 min Summer	75.054	0.294	0.0	0.5	0.5	8.8	O K
360 min Summer	75.040	0.280	0.0	0.5	0.5	8.4	O K
480 min Summer	75.026	0.266	0.0	0.4	0.4	8.0	O K
600 min Summer	75.013	0.253	0.0	0.4	0.4	7.6	O K
720 min Summer	75.000	0.240	0.0	0.4	0.4	7.2	O K
960 min Summer	74.976	0.216	0.0	0.4	0.4	6.5	O K
1440 min Summer	74.939	0.179	0.0	0.4	0.4	5.4	O K
2160 min Summer	74.898	0.138	0.0	0.3	0.3	4.1	O K
2880 min Summer	74.869	0.109	0.0	0.3	0.3	3.3	O K
4320 min Summer	74.830	0.070	0.0	0.3	0.3	2.1	O K
5760 min Summer	74.807	0.047	0.0	0.2	0.2	1.4	O K
7200 min Summer	74.791	0.031	0.0	0.2	0.2	0.9	O K
8640 min Summer	74.781	0.021	0.0	0.2	0.2	0.6	O K
10080 min Summer	74.773	0.013	0.0	0.2	0.2	0.4	O K
15 min Winter	74.977	0.217	0.0	0.4	0.4	6.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.682	0.0	6.1	23
30 min Summer	95.604	0.0	7.9	37
60 min Summer	58.456	0.0	9.6	66
120 min Summer	34.543	0.0	11.4	122
180 min Summer	25.080	0.0	12.4	158
240 min Summer	19.882	0.0	13.1	188
360 min Summer	14.284	0.0	14.1	254
480 min Summer	11.300	0.0	14.9	322
600 min Summer	9.416	0.0	15.5	392
720 min Summer	8.109	0.0	16.0	460
960 min Summer	6.401	0.0	16.9	594
1440 min Summer	4.581	0.0	18.1	856
2160 min Summer	3.275	0.0	19.4	1236
2880 min Summer	2.578	0.0	20.4	1592
4320 min Summer	1.839	0.0	21.8	2332
5760 min Summer	1.446	0.0	22.9	3048
7200 min Summer	1.199	0.0	23.7	3752
8640 min Summer	1.029	0.0	24.4	4488
10080 min Summer	0.904	0.0	25.0	5152
15 min Winter	148.682	0.0	6.9	23

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	75.033	0.273	0.0	0.5	0.5	8.2	O K
60 min Winter	75.079	0.319	0.0	0.5	0.5	9.5	O K
120 min Winter	75.105	0.345	0.0	0.5	0.5	10.3	O K
180 min Winter	75.104	0.344	0.0	0.5	0.5	10.3	O K
240 min Winter	75.096	0.336	0.0	0.5	0.5	10.0	O K
360 min Winter	75.079	0.319	0.0	0.5	0.5	9.5	O K
480 min Winter	75.060	0.300	0.0	0.5	0.5	9.0	O K
600 min Winter	75.041	0.281	0.0	0.5	0.5	8.4	O K
720 min Winter	75.023	0.263	0.0	0.4	0.4	7.9	O K
960 min Winter	74.990	0.230	0.0	0.4	0.4	6.9	O K
1440 min Winter	74.938	0.178	0.0	0.4	0.4	5.3	O K
2160 min Winter	74.885	0.125	0.0	0.3	0.3	3.7	O K
2880 min Winter	74.850	0.090	0.0	0.3	0.3	2.7	O K
4320 min Winter	74.808	0.048	0.0	0.2	0.2	1.4	O K
5760 min Winter	74.786	0.026	0.0	0.2	0.2	0.8	O K
7200 min Winter	74.773	0.013	0.0	0.2	0.2	0.4	O K
8640 min Winter	74.765	0.005	0.0	0.1	0.1	0.1	O K
10080 min Winter	74.760	0.000	0.0	0.1	0.1	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	95.604	0.0	8.8	36
60 min Winter	58.456	0.0	10.8	64
120 min Winter	34.543	0.0	12.8	120
180 min Winter	25.080	0.0	13.9	172
240 min Winter	19.882	0.0	14.7	196
360 min Winter	14.284	0.0	15.8	272
480 min Winter	11.300	0.0	16.7	348
600 min Winter	9.416	0.0	17.4	422
720 min Winter	8.109	0.0	18.0	496
960 min Winter	6.401	0.0	18.9	636
1440 min Winter	4.581	0.0	20.3	906
2160 min Winter	3.275	0.0	21.8	1284
2880 min Winter	2.578	0.0	22.9	1648
4320 min Winter	1.839	0.0	24.4	2380
5760 min Winter	1.446	0.0	25.6	3064
7200 min Winter	1.199	0.0	26.6	3752
8640 min Winter	1.029	0.0	27.4	4488
10080 min Winter	0.904	0.0	28.1	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.600	Shortest Storm (mins)	15
Ratio R	0.450	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.022

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.006	4	8	0.014	8	12	0.002

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Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
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