The Civil Engineering Practice
11 Tungsten Building
George Street
Fishersgate
Sussex
BN41 1RA

01273 424424
reception@civil.co.uk
www.civil.co.uk

Flood Risk Assessment

Proposed Residential Development at

Land at Cottage Farm, Lovedean Lane, Horndean, Waterlooville

On behalf of

Bargate Homes Limited

September 2020

Document History and Status

Project Number 23246

Date	Version	Prepared By	Reviewed By	Approved By
22 Jan 2020	1.0	Steve Burgess HNDipp.	Steve Doughty Director	Stuart Magowan IEng MICE
27 Jan 2020	1.1	Steve Burgess HNDipp.	Steve Doughty Director	Stuart Magowan IEng MICE
28 Jan 2020	1.2	Steve Burgess HNDipp.	Steve Doughty Director	Stuart Magowan IEng MICE
6 May 2020	2.0	Steve Burgess HNDipp.	Steve Doughty Director	Stuart Magowan IEng MICE
12 May 2020	2.1	Steve Burgess HNDipp.	Steve Doughty Director	Stuart Magowan IEng MICE
8 September 2020	2.2	Steve Burgess HNDipp.	Steve Doughty Director	Stuart Magowan IEng MICE

This document has been prepared in accordance with the scope of services for The Civil Engineering Practice's appointment with its client and is subject to the terms of the appointment. It is addressed to and for the sole use and reliance of The Civil Engineering Practice's client. The Civil Engineering Practice accepts no liability for any use of this document other than by its client and only for the purposes, stated in the document, for which it was prepared and provided. No person other than the client may copy (in whole or in part) use or rely on the contents of this document, without the prior written permission of The Civil Engineering Practice.

Any advice, opinions, or recommendations within this document should be read and relied upon only in the context of the document as a whole. In preparing this document, information and advice may have been sought from third parties. The Civil Engineering Practice cannot be held liable for the accuracy of third party information.

The information contained within this document takes precedence over that contained within any previous version.

ISO 9001 : 2008 REGISTERED
Cert No. 14127180

CONTENTS

1 Non Technical Summary 1

2 Planning Policy Context 2

2.1 National Planning Policy Framework 2
2.1 Lead Local Flood Authority 3
2.2 Local Planning Authorities 3
2.3 East Hampshire District Council 3
2.4 East Hampshire District Council Policy 3
2.5 Havant Borough Council 5
2.6 Havant Borough Council Policy 5

3 Existing Site 7

3.1 Site Location 7
3.2 Site Description 7
3.3 Existing Drainage 8
3.4 Geology and Groundwater 9

4 Flood Zone and Flood History 10

4.1 Flood Zone 10
4.2 Flood History 10

5 Flooding Potential 11

5.1 Tidal Flooding 11
5.2 Fluvial Flooding 11
5.3 Groundwater Flooding 11
5.4 Overland Flow 11
5.5 Flood Routing 13

6 Development Proposals 14

6.1 Description 14
6.2 Drainage Strategy 14
6.3 Water Quality 17

7 Safe Development 18

7.1 Flood Zone Compatibility 18
7.2 Risk to Others 18

8 Conclusions 19

9 List of Appendices, Images and Tables 20

1 Non Technical Summary

1.1 This Flood Risk Assessment has been undertaken in accordance with the National Planning Policy Framework on behalf of Bargate Homes Limited in support of an Outline Planning Application for the construction of up to 56 residential properties with associated access roads, car parking and landscaping on land southwest of Lovedean Lane, Horndean, Waterlooville, Hampshire.

1.2 This Assessment is to be read in conjunction with all planning, architectural and other reports that accompany the Planning Application for the proposed development.

1.3 The site is located in Flood Zone 1.

1.4 The proposed development will incorporate a sustainable drainage system which will discharge surface water at a restricted rate into the surrounding public surface water sewers and provide storage for all storm return periods up to and including the 1:100 year rainfall event with an allowance for climate change.

1.5 Foul drainage for the development will drain via gravity into the existing Southern Water public foul sewer.

1.6 This report concludes that the site is not at risk of flooding from tidal or fluvial sources, overland flows or groundwater.

1.7 In terms of flood risk the proposed development is suitable at this location.

2 Planning Policy Context

2.1 National Planning Policy Framework

2.1.1 The National Planning Policy Framework was updated in February 2019.

2.1.2 With regard to planning and flood risk the policy framework states that *'when determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment.*

Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;

b) the development is appropriately flood resistant and resilient;

c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;

d) any residual risk can be safely managed; and

e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.'

2.1.3 With regard to major developments the NPPF states that *'major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:*

a) take account of advice from the lead local flood authority;

b) have appropriate proposed minimum operational standards;

c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and

d) where possible, provide multifunctional benefits'

2.1.4 Major development is defined as follows:

'For housing, development where 10 or more homes will be provided, or the site has an area of 0.5 hectares or more. For non-residential development it means additional floorspace of 1,000m^2 or more, or a site of 1 hectare or more, or as otherwise provided in the Town and Country Planning (Development Management Procedure) (England) Order 2015.'

2.1 Lead Local Flood Authority

2.1.1 Hampshire County Council became a Lead Local Flood Authority under the Flood and Water Management Act 2010 and was given a series of new responsibilities to coordinate the management of local flood risk.

2.1.2 As part of its role Hampshire County Council has commissioned and produced the following documents:

- Preliminary Flood Risk Assessment – January 2016
- Local Flood Risk Management Strategy – July 2013

2.1.3 The above documents have been reviewed in the preparation of this report.

2.2 Local Planning Authorities

2.2.1 The majority of the site is located within the East Hampshire District Council local authority with a small section along the eastern site boundary located within the Havant Borough Council local authority.

2.3 East Hampshire District Council

2.3.1 East Hampshire District Council has commissioned and produced the East Hampshire Level 1 SFRA – October 2018 which has been reviewed in the preparation of this report.

2.4 East Hampshire District Council Policy

2.4.1 The East Hampshire District Local Plan: Joint Core Strategy was adopted on 8 May 2014.

2.4.2 The following policies are of specific relevance to this Flood Risk Assessment.

2.4.3 **CP25** Flood Risk states that *'development in areas at risk of flooding, now and in the future, as identified on the latest Environment Agency flood risk maps and the Council's Strategic Flood Risk Assessment will be permitted provided that:*

a) it meets the sequential and exception test (where required) as outlined in Government guidance;

b) a site–specific flood risk assessment demonstrates that the development, including the access, will be safe without increasing flooding elsewhere, and where possible, will reduce flood risk overall;

c) the scheme incorporates flood protection, flood resilience and resistance measures appropriate to the character and biodiversity of the area and the

specific requirements of the site;

d) *appropriate flood warning and evacuation plans are in place; and*

e) *new site drainage systems are designed taking account of events which exceed the normal design standard.*

All development will be required to ensure that there is no net increase in surface water run off. Priority will be given to incorporating SUDs (Sustainable Drainage Systems) to manage surface water drainage, unless it can be demonstrated that SUDs are not appropriate. Where SUDs are provided, arrangements must be put in place for their whole life management and maintenance.

Specific areas in the District, which overlay the Chalk geology, can be prone to groundwater flooding as shown on the Council's Strategic Flood Risk Assessment maps. Rivers in East Hampshire which are sourced in the chalk area are the River Meon, River Wey and Lavant Stream, and thus groundwater fed. Development should be avoided in areas at risk from, susceptible to, or have a history of groundwater flooding. If this is not possible then the development should be designed to incorporate flood resistance and resilience measures.'

2.4.4 **CP26** Water Resources/Water Quality states that *'development will be required to protect the quality and quantity of water, and make efficient use of water. Development will be permitted provided that:*

a) *it protects and enhances the quality and quantity of groundwater, surface water features and controls aquatic pollution to help to achieve the requirements of the European Water Framework Directive;*

b) *it has an adequate means of water supply (even in a drought), sufficient foul and surface water drainage and adequate sewage treatment capacity. Development must be phased to take into account the timing of any water and/or wastewater infrastructure required which must be in place prior to the occupation of development. The developer must show that additional provision or improvement of local infrastructure is required and demonstrate that adequate funding is available for that infrastructure in advance of development taking place;*

c) *demand management technologies are incorporated to meet the appropriate levels of the Code for Sustainable Homes as set out in Policy CP24.*

Development within Groundwater Source Protection Zones will only be permitted provided that it has no adverse impact on the quality of the groundwater source or a risk to its ability to maintain a public water supply.

Proposals by service providers for the delivery of wastewater services to meet the needs generated by new development and by existing communities will be encouraged and/or permitted, subject to other relevant policies.

The Council and National Park Authority have a duty to take account of the Water Framework Directive (WFD) objectives. Any development which will impact on a known water body will be required to seek out opportunities to introduce mitigation and enhancement measures to help ensure the objectives of the WFD are met. The site identified for the Havant Thicket reservoir will be safeguarded from development (see Map 3).'

2.5 Havant Borough Council

2.5.1 Havant Borough Council has commissioned and produced the Strategic Flood Risk Assessment (Local Plan Sites) – November 2018 which has been reviewed in the preparation of this report.

2.5.2 Havant Borough Council belongs to the Partnership for Urban South Hampshire who commissioned a Strategic Flood Risk Assessment (SFRA) Update – February 2016 which was produced by the Eastern Solent Coastal Partnership and which has been reviewed in the preparation of this report.

2.6 Havant Borough Council Policy

2.6.1 The Havant Borough Council Local Plan: Core Strategy was adopted in March 2011.

2.6.2 The following policies are of specific relevance to this Flood Risk Assessment.

2.6.3 **CS15** Flood and Costal Erosion Risk states that *'development in areas at risk of flooding now and in the future as identified on the latest Environment Agency flood risk maps and Strategic Flood Risk Assessment climate change maps will only be permitted where:*

1) It meets the sequential and exception test (where required) in relation to PPS25.

2) The site is located in a low hazard area as defined in the Strategic Flood Risk Assessment.

3) A site-specific flood risk assessment demonstrates that the development will be safe, including the access, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

4) *The scheme incorporates flood protection, flood resilience and resistance measures appropriate to the character and biodiversity of the area and the specific requirements of the site.*

5) *Appropriate flood warning and evacuation plans are in place.*

6) *New site drainage systems are designed taking account of events which exceed the normal design standard.*

All development will be required to ensure that there is no net increase in surface water run off. Priority should be given to incorporating Sustainable Drainage Systems (SuDS) to manage surface water drainage, unless it is proven that SuDS are not appropriate. Where SuDs are provided arrangements must be put in place for their whole life management and maintenance.

The council will work with partners to implement the Coastal Policy Zones in the North Solent Shoreline Management Plan to ensure that development avoids areas at risk from coastal erosion and coastal flooding and that areas required to offset coastal squeeze and prevent habitat fragmentation, to allow species to adapt to climate change, are identified and protected from development.'

2.6.4 **DM10** Pollution states that '*development that may cause pollution of water, air or soil or pollution through noise, smell, smoke, fumes, gases, steam, dust, vibration, light, heat, electromagnetic radiation and other pollutants will only be permitted where all of the following relevant criteria can be met:*

1) *The health and safety of existing and future users of the site, or nearby occupiers and residents is not put at risk.*

2) *National air quality standards or objectives would not be breached.*

3) *The water environment would not be detrimentally affected.*

4) *It would not lead to an unacceptable deterioration in the quality or potential yield of coastal, surface and ground water resources.*

5) *External lighting is of the minimum level of illumination and duration required for security and operational purposes.*

6) *External lighting would not interfere with safe navigation in either Chichester or Langstone Harbours and other coastal locations.*

3 Existing Site

3.1 Site Location

3.1.1 The development site is located on land southwest of Lovedean Lane, Horndean, Waterlooville at Ordnance Survey Reference SU 685 125. The nearest postcode is PO8 9RP.

Image 1: Site Location

3.1.2 The site is bounded to the north by the Phase 1 Norton Heights residential development, to the east by existing residential dwellings along Lovedean Lane, to the west by agricultural farmland and to the south by the existing residential Ashley Close and James Copse Road.

3.1.3 A copy of the site location plan is located in Appendix 1 at the rear of this report.

3.2 Site Description

3.2.1 The site is approximately 2.6ha in area and currently comprises undeveloped agricultural land and fields.

3.2.2 Existing ground levels are highest at the northwest corner of the site with levels at approximately 71m AOD. The site falls eastward to a low point of approximately 58m AOD.

3.2.3 A copy of the existing site layout plan is located in Appendix 2 at the rear of this report.

3.3 Existing Drainage

3.3.1 The site currently has no positive surface water or foul water drainage infrastructure.

3.3.2 Rainfall on the site currently discharges in part to ground and in part as overland greenfield runoff to the east of the site.

3.3.3 The existing greenfield runoff rate has been established using the HR Wallingford tool for Greenfield runoff estimation.

3.3.4 Q_{bar} has been established at 0.53l/s and the 1:100 year peak runoff at 1.68l/s

3.3.5 The equivalent greenfield runoff rates are 0.20l/s/ha and 0.65l/s/ha respectively.

HR Wallingford
Working with water

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Steve Burgess
Site name:	Norton Heights
Site location:	Lovedean Lane

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	50.90855° N
Longitude:	1.02651° W
Reference:	850652819
Date:	Jan 09 2020 12:52

Runoff estimation approach	IH124

Site characteristics

Total site area (ha):	2.6

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	1	1
HOST class:	N/A	N/A
SPR/SPRHOST:	0.1	0.1

Hydrological characteristics

	Default	Edited
SAAR (mm):	820	820
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flowrates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flowrates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	0.53	0.53
1 in 1 year (l/s):	0.45	0.45
1 in 30 years (l/s):	1.21	1.21
1 in 100 year (l/s):	1.68	1.68
1 in 200 years (l/s):	1.97	1.97

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UKSuDS terms and conditions and licence agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Image 2: Greenfield Runoff Calculation

3.3.6 To the east of the site, beneath Lovedean Lane, there is a 300mm diameter Southern Water public surface water sewer flowing north to south.

3.3.7 To the south of the site, beneath Ashley Close and James Copse Road, there is a 225mm diameter Southern Water public surface water sewer flowing north to south.

3.3.8 Along the eastern boundary of the site there is a 300mm Southern Water public foul sewer flowing north to south which continues along the eastern side of James Copse Road.

3.3.9 A copy of the sewer records is located in Appendix 3 at the rear of this report.

3.4 Geology and Groundwater

3.4.1 A Desk Study Report was undertaken by Wilson Bailey Geotechnical & Environmental in January 2020.

3.4.2 The report identifies that the site is underlain by a junction between clay and sand soils of the Lambeth Group overlying the chalk soils of the Tarrant Chalk.

3.4.3 The site's geological characteristics present a risk of chalk solution and database searches undertaken within the report have also indicated numerous chalk solution features within the site and surrounding area.

3.4.4 Preliminary discussions regarding surface water and geology and the risk of solution features have been held with Hampshire County Council as Lead Local Flood Authority, the Environment Agency and Portsmouth Water.

3.4.5 These discussions concluded that due to the risk of solution features within the chalk substrata infiltration to ground will not be a suitable form of surface water disposal.

3.4.6 The online "Magic Map" available from Defra confirms that the site is located above a principal aquifer.

3.4.7 The Environment Agency indicates that the site is located within a Groundwater Source Protection Zone Class 1 associated with a public drinking water abstraction owned and operated by Portsmouth Water.

3.4.8 Extracts from the Wilson Bailey Geotechnical & Environmental Desk Study Report are located in Appendix 4 at the rear of this report.

3.4.9 A copy of correspondence and minutes of the meetings held with Hampshire County Council as Local Lead Flood Authority, the Environment Agency and Portsmouth Water are located in Appendix 5 at the rear of this report

4 Flood Zone and Flood History

4.1 Flood Zone

4.1.1 The Environment Agency's online mapping confirms that the site is located in Flood Zone 1 and is not at risk of flooding from rivers or the sea from anything less extreme than a 1:1,000 year flood event.

4.2 Flood History

4.2.1 Environment Agency

4.2.1.1 The Environment Agency maps of historic flood incidents do not identify any incidents of flooding in the locality of the site.

4.2.2 Hampshire County Council

4.2.2.1 Neither the Local Flood Risk Management Strategy dated July 2013 nor the Preliminary Flood Risk Assessment dated January 2016 identify any specific flood incidents in the immediate vicinity of the site.

4.2.3 East Hampshire District Council

4.2.3.1 The East Hampshire Level 1 SFRA dated October 2018 identifies a single instance of flooding along Lovedean Lane in January 2013. The document identifies the cause of the flood as being blocked highway drainage.

4.2.4 Havant Borough Council

4.2.4.1 Neither the Havant Borough Council Strategic Flood Risk Assessment (Local Plan Sites) dated November 2018 nor the Partnership for Urban South Hampshire Strategic Flood Risk Assessment (SFRA) Update dated February 2016 identify any specific flood incidents in the immediate vicinity of the site.

4.2.5 Copies of the available flood maps and correspondence are located in Appendix 6 at the rear of this report.

5 Flooding Potential

5.1 Tidal Flooding

5.1.1 The site is located approximately 13.5km from the coast at an elevation of 70m AOD and is not at risk of tidal flooding.

5.2 Fluvial Flooding

5.2.1 The area of the proposed site is within Flood Zone 1 and is not at risk of fluvial flooding from anything less extreme than a 1:1,000 year flood event.

5.3 Groundwater Flooding

5.3.1 The East Hampshire Level 1 SFRA dated October 2018 identifies the site as having a 'Limited potential for groundwater flooding to occur'.

5.3.2 There are no records identified within Hampshire County Council's Preliminary Flood Risk Assessment or Local Flood Risk Management Strategy of groundwater flooding affecting the site.

5.4 Overland Flow

5.4.1 The Environment Agency has undertaken modelling of surface water flood risk at a national scale and produced mapping identifying and classifying those areas at risk of surface water flooding as:

- 3.33% annual probability (1 in 30 year), 'high'
- 1% annual probability (1 in 100 year), 'medium'
- 0.1% annual probability (1 in 1,000 year) 'low'

5.4.2 The flood mapping contained within the various flood documents produced by Hampshire County Council do not identify any flood risk associated with overland flow routes.

5.4.3 The East Hampshire Level 1 SFRA dated October 2018 identifies small, isolated areas of the site, which have no apparent flow route to or from each location, at high risk of surface water flooding.

5.4.4 The Environment Agency maps identify the site access located on the northeast site boundary as being at high surface water flood risk with potential depths of up to 900mm.

5.4.5 There is no corroboration between the area noted at risk of flooding on the Environment Agency's surface water flood map and the actual surveyed site and carriageway levels of Lovedean Lane. We note that the Environment Agency Surface Water flood maps are not based on site specific data and in this instance

the area noted as having a surface water flood risk is at a higher ground level than the site and carriageway levels to the south with direct flow paths to the lower levels available. The site and carriageway to the south are not indicated to be at surface water flood risk on the Environment Agency mapping.

5.4.6 The existing carriageway of Lovedean Lane falls north to south at this location from a level of approximately 59.540m AOD adjacent to the site entrance. At the extent of the site survey to the south the carriageway has fallen to a level of 57.320m AOD and continues to fall to the south along Lovedean Lane.

5.4.7 With reference to the existing topography within the site, it is anticipated that there is potential for 130mm depth of surface water ponding approximately 20m into the site access road at the existing low point. However this would not prevent vehicular access or egress to the site or be an area that could support up to 900mm of surface water as suggested by the Environment Agency mapping.

5.4.8 As part of the design proposals the site access road will be raised and constructed with a straight gradient to eliminate the existing low point and any surface water flow path into the site.

5.4.9 There is also no evidence from Lead Local Flood Authority, Local Authority drainage records or Environment Agency records other than the disputed Environment Agency mapping to suggest flooding form surface water will occur at the proposed site entrance.

5.4.10 We have noted the existing ground levels at the proposed site entrance and along Lovedean Lane together with an indication of the flood routing on drawing 50 located in Appendix 7 at the rear of this report.

5.5 Flood Routing

5.5.1 The existing natural route for flood waters to dissipate, should any event occur on the site, is towards the eastern site boundary.

5.5.2 The proposed route for any exceedance flows to dissipate will mimic the existing situation.

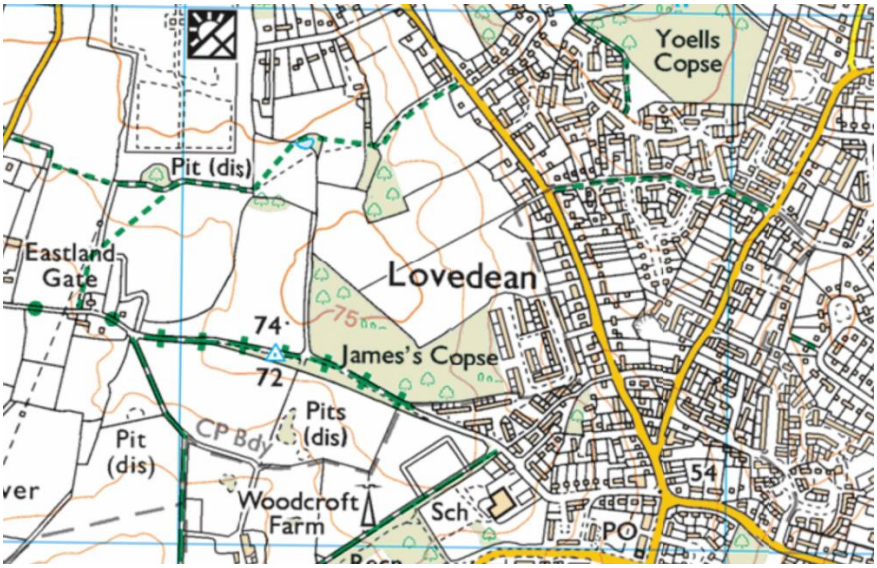


Image 3: Local Topography

5.5.3 Copies of plans identifying the existing and proposed flood routing are located in Appendix 7 at the rear of this report.

6 Development Proposals

6.1 Description

6.1.1 The development proposals are for the construction of up to 56 residential dwellings with associated access roads, car parking and landscaping.

6.1.2 An indicative site layout plan is located in Appendix 8 at the rear of this report.

6.2 Drainage Strategy

6.2.1 A preliminary surface water drainage system has been designed in accordance with the National Planning Policy Framework (NPPF) and the accompanying Guidance and Technical Standards for SuDS. The design also complies with the requirements under Building Regulations Part H.

6.2.2 For surface water discharge, the drainage hierarchy notes the following list of drainage options in order of preference:

1. Infiltration to ground
2. Discharge to a watercourse
3. Discharge to a surface water sewer
4. Discharge to a foul water sewer

6.2.3 Due to the site's geological characteristics presenting a risk of chalk solution features, infiltration of surface water to ground has been ruled out as an option in agreement with Hampshire County Council, the Environment Agency and Portsmouth Water.

6.2.4 There are no watercourses within the vicinity of the site and therefore the proposed surface water drainage strategy is to discharge surface water at a restricted rate to the existing Southern Water surface water sewers in the vicinity of the site and provide storage to accommodate a 1:100 year storm event including an additional 40% to account for the predicted effects of future climate change.

6.2.5 The estimated impermeable areas for various elements of the development are as follows:

- Residential Dwellings
  - 2,790m^2 Roof Area
  - 2,800m^2 Parking / Driveways
- Onsite Access Roads / Footways
  - 4,555m^2 Total

6.2.6 As previously noted, infiltration is not a suitable means of discharging surface water at this location and given the concern about potential solution features surface water from paths and patios will be intercepted and positively drained rather than allowed to run off into gardens and verges. An additional 20m^2 of impermeable per dwelling has been included within the calculations to allow for this.

6.2.7 The total impermeable area of the development is anticipated to be approximately 11,085m^2. An additional 10 percent impermeable area has been included within the design calculations a 12,575 m^2.

6.2.8 Surface water drainage for the development will be divided into three main systems. System 1 will serve the northern area of the development. System two will serve the low level section of site access road at the entrance to the development. System 3 will serve the southern area of the development.

6.2.9 As previously noted the greenfield Q_{bar} runoff rate is 0.2l/s/ha which equates to an equivalent greenfield runoff rate for the proposed impermeable area of 0.25l/s

6.2.10 The 1:00 year runoff rate is 0.65l/s/ha which equates to an equivalent greenfield runoff rate of 0.82l/s

6.2.11 Such low levels of runoff are indicative of the chalk subsoil however they are impractical and in accordance with HR Wallingford guidance a minimum restriction of 2l/s is recommended for the 1:1 year rainfall event.

6.2.12 System 1

6.2.12.1 Surface water runoff from the northern area of the development will be discharged into a crate storage system, located beneath the private driveway/car parking area at the north of the site.

6.2.12.2 Surface water will then be discharged, via a lined water treatment swale, into the existing public surface water sewer to the east of the site beneath Lovedean Lane.

6.2.12.3 In order to achieve a half drain time of less than 24 hours for a 1 in 100 year plus 40% storm event a restriction of 3.8l/s is proposed.

6.2.12.4 Preliminary calculations confirm a storage volume of 493m^3 will be required.

6.2.12.5 This system will have an estimated half drain time of 1,221 minutes (approximately 20.4 hours).

6.2.13 System 2

6.2.13.1 Due to the steep gradient of the site a separate system is proposed to drain approximately the first 55m long section of the access road.

6.2.13.2 Surface water runoff from this area will drain through a permeable paving system incorporating a lined 30% voided subbase system and discharged into the existing public surface water sewer to the east of the site beneath Lovedean Lane at a restricted rate of 2.0l/s

6.2.13.3 A minimum of 425mm deep subbase will be required providing 22.0m^3 of storage with an estimated half drain time of 100 minutes (approximately 1.7 hours).

6.2.14 System 3

6.2.14.1 Surface water runoff from the southern area of the development will be discharged into a crate storage system, located beneath the private driveway and the public open space area at the southeast corner of the site, via a lined water treatment swale.

6.2.14.2 Surface water will then be discharged into the existing public surface water sewer to the south of the site beneath James Copse Road.

6.2.14.3 In order to achieve a half drain time of less than 24 hours for a 1 in 100 year plus 40% storm event a restriction of 3.1l/s is proposed.

6.2.14.4 Preliminary calculations confirm a storage volume of 453m^3 will be required.

6.2.14.5 This system with have an estimated half drain time of 1,417 minutes (approximately 23.6 hours).

6.2.15 Further information on the surface water drainage proposals will be confirmed at detailed design stage subject to further site investigations and testing.

6.2.16 Foul drainage from the development will discharge via gravity into the existing Southern Water public foul sewer which flows along the eastern boundary of the site.

6.2.17 A plan of the proposed impermeable areas is located in Appendix 9 at the rear of this report.

6.2.18 A copy of the preliminary drainage strategy plan together with copies of the preliminary storage calculations is located in Appendix 10 at the rear of this report.

6.3 Water Quality

6.3.1 The proposed development is for residential use. In accordance with CIRIA SuDS Manual 2015 (Report C753), the pollution hazard level for this type of development is between very low and low depending on the use/area of the site.

6.3.2 The surface water scheme will include mitigation to ensure that surface water is suitably treated, and any pollution risk adequately managed prior to discharge.

6.3.3 Table 26.2 in Chapter 26 of CIRIA report C753 The SuDS Manual provides Pollution Hazard Indices for varying land types. Those of relevance to the development proposals are as follows:

Land Use	**Pollution hazard level**	**Total suspended solids (TSS)**	**Metals**	**Hydro-carbons**
Residential roofs	Very Low	0.2	0.2	0.05
Individual property driveways, residential car park, low-traffic roads	Low	0.5	0.4	0.4

Table 1: Pollution Hazard Indices

6.3.4 Where multiple drainage components are used in series the individual mitigation index of secondary and tertiary components is lowered by 50% due to reduced performance associated with primary treatment.

SuDS Type	**Total suspended solids (TSS)**	**Metals**	**Hydro-carbons**
Swale	0.5	0.6	0.6
Permeable pavement	0.7	0.6	0.7

Table 2: Pollution Mitigation Indices

6.3.5 The proposed use of a lined water quality swale and permeable paving will meet the target treatment level required for runoff with very low to low risk of pollution hazard thus demonstrating that the surface water drainage system for the site can be designed to adequately mitigate against the risk of pollution.

6.3.6 An outline drainage maintenance schedule is located in Appendix 11 at the rear of this report.

7 Safe Development

7.1 Flood Zone Compatibility

7.1.1 The site and its wider area are in Flood Zone 1 and will remain so for the foreseeable future.

7.1.2 With reference to the Technical Guidance to the National Planning Policy Framework:

- Table 2: Flood Risk Vulnerability Classification

  The type of development proposed is residential and therefore classified as More Vulnerable

- Table 3: Flood Risk Vulnerability and Flood Zone Compatibility

  More Vulnerable development is appropriate in Flood Zones 1 and 2

7.2 Risk to Others

7.2.1 The proposed surface water drainage system will be designed to current standards incorporating SuDS elements providing treatment, attenuation and storage which will minimise runoff leaving the site during times of heavy rain.

7.2.2 Allowance has been made for a 40% increase in rainfall intensities which accords with the latest figures published by the Environment Agency and in accordance with the requirements under the National Planning Policy Framework.

7.2.3 The proposed drainage system will incorporate sufficient treatment prior to final discharge destination thus mitigating the risk of pollution from the site.

7.2.4 The risk of surface water flooding to others due to the development proposals is negligible.

7.2.5 Sewerage undertakers have an obligation to upgrade the existing networks if a connection to an equivalent or larger sized public sewer is technically achievable.

7.2.6 The residual risk of sewer flooding from this development for the foreseeable future is therefore negligible.

8 Conclusions

8.1 The site is located within Flood Zone 1 and is not at risk from any source of flooding.

8.2 The Desk Study Report undertaken by Wilson Bailey Geotechnical & Environmental in January 2020 identifies that the site is underlain by a junction between clay and sand soils of the Lambeth Group overlying the chalk soils of the Tarrant Chalk.

8.3 The proposed drainage strategy is to discharge surface water at a restricted rate into the surrounding public surface water sewers beneath Lovedean Lane and James Copse Road.

8.4 Sufficient storage will be provided to accommodate a 1:100 year storm event including an additional 40% to account for the predicted effects of future climate change.

8.5 Water quality improvement will be provided to mitigate against any risk to any receiving waterbody.

8.6 Foul drainage will discharge by gravity into the existing public foul sewer which flows along the eastern boundary of the site.

8.7 There are no historic records of flooding from any source affecting the site or its immediate area.

8.8 The site is not at risk of flooding from tidal or fluvial sources, overland flows or groundwater.

8.9 In terms of flood risk planning the proposed development is safe, will not increase flood risk elsewhere and will provide improvement to immediately adjacent sites by managing surface water from all rainfall events up to the 100 year plus climate change event.

8.10 The development proposals are suitable at this location.

9 List of Appendices, Images and Tables

Appendix 1 Site Location Plan

Appendix 2 Existing Site Layout Plan

Appendix 3 Southern Water Sewer Records

Appendix 4 Site Investigation Extracts

Appendix 5 Correspondence and Meeting Minutes

Appendix 6 Flood Maps and Correspondence

Appendix 7 Existing and Proposed Flood Routing Plans

Appendix 8 Indicative Site Layout Plan

Appendix 9 Proposed Impermeable Area Plan

Appendix 10 Preliminary Drainage Strategy Plan and Calculations

Appendix 11 Drainage Maintenance Schedule

Image 1 Site Location

Image 2 Greenfield Runoff Calculation

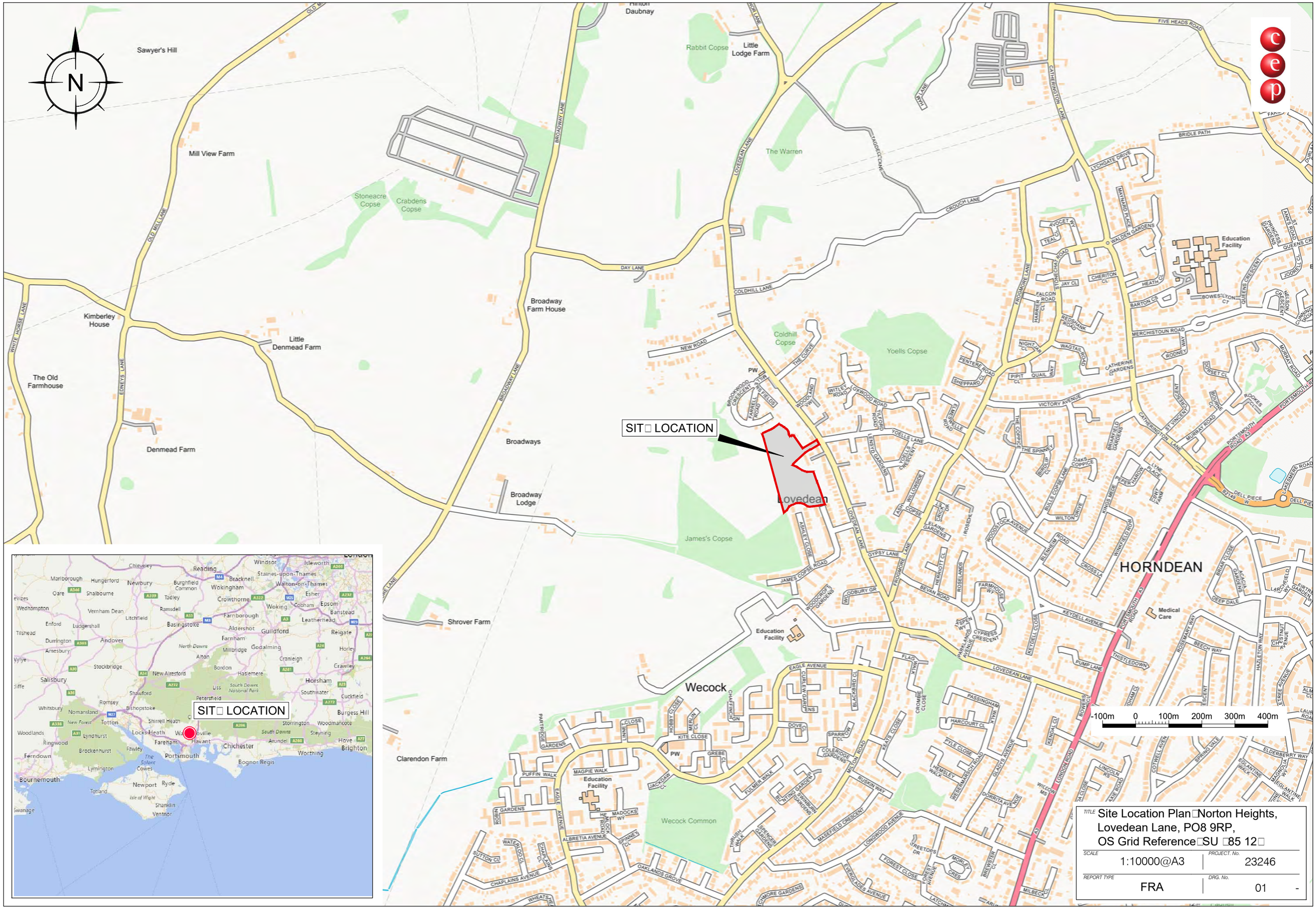
Image 3 Local Topography

Table 1 Pollution Hazard Indices

Table 2 Pollution Mitigation Indices

Appendix 1

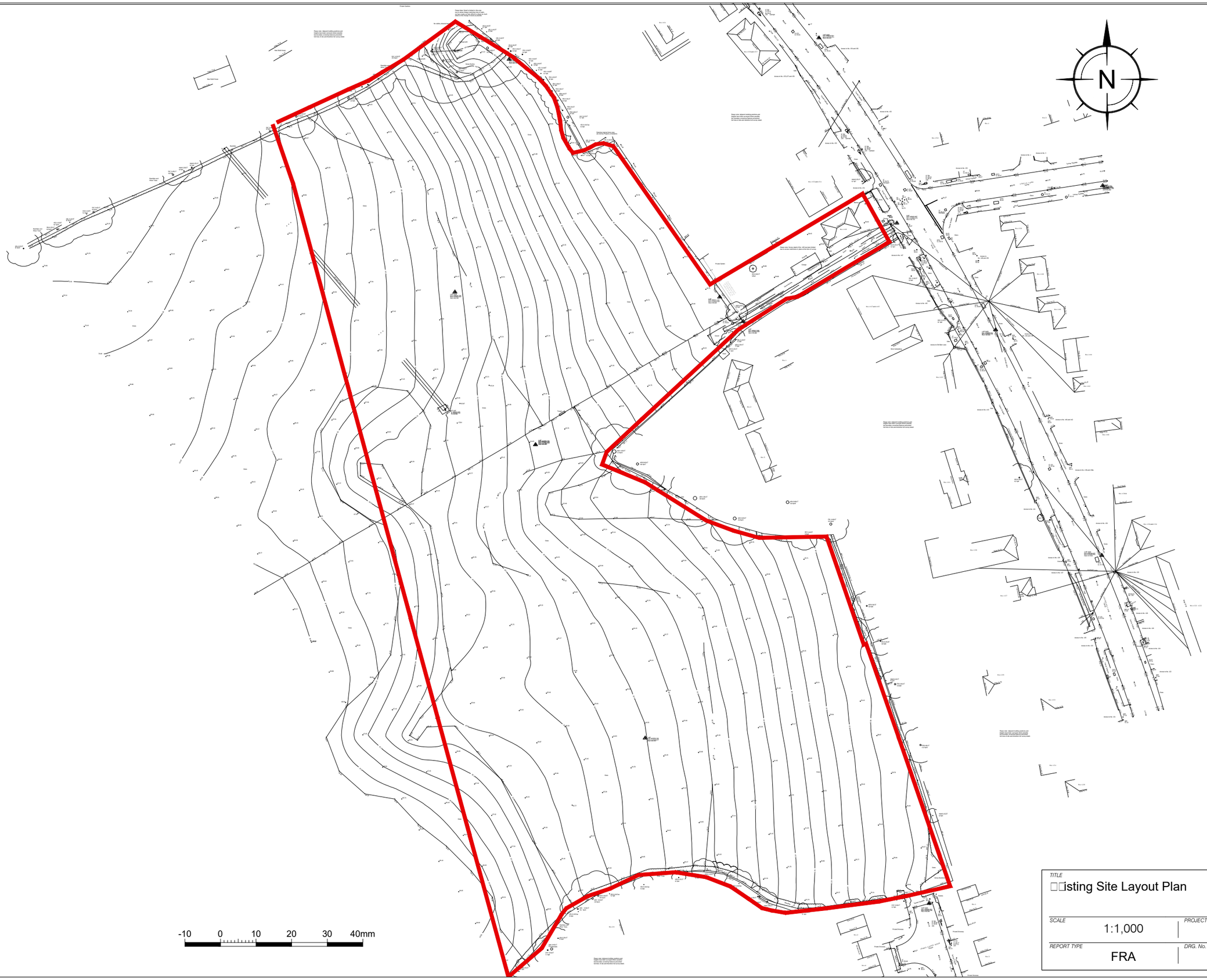
Site Location Plan



SITE LOCATION
Chichester
Portsmouth
Havant
Fareham
Waterlooville
Southampton
Bournemouth
Salisbury
Winchester
Reading
Basingstoke
Guildford
Aldershot
Farnborough
Woking
Horsham
Brighton
Worthing
Isle of Wight
Newbury
Andover
Stockbridge
Romsey
Lymington
Ringwood
Fordingbridge
Petersfield
Haslemere
Godalming
Farnham
Alton
Bognor Regis
Littlehampton
Arundel
Crawley
Reigate
Epsom
Kingston upon Thames
Windsor
Slough
Bracknell
Wokingham
Newport
Ryde
Shanklin
Ventnor
Totland
Swanage
Lyndhurst
Brockenhurst
Ferndown
Wimborne Minster
Blandford Forum
Dorchester
Weymouth
Lyme Regis
Axminster
Honiton
Exeter
Tiverton
Barnstaple
Bideford
Ilfracombe
Taunton
Bridgwater
Yeovil
Dorchester
Salisbury
Swindon
Cirencester
Gloucester
Cheltenham
Tewkesbury
Worcester
Hereford
Ross-on-Wye
Monmouth
Abergavenny
Brecon
Cardiff
Newport
Swansea
Carmarthen
Aberystwyth
Bangor
Caernarfon
Llandudno
Rhyl
Wrexham
Chester
Shrewsbury
Ludlow
Leominster
Kidderminster
Stourbridge
Birmingham
Coventry
Leicester
Nottingham
Derby
Stoke-on-Trent
Stafford
Lichfield
Tamworth
Rugby
Northampton
Milton Keynes
Bedford
Luton
Hemel Hempstead
Watford
Slough
Reading
Oxford
Banbury
Bicester
Aylesbury
Amersham
Chesham
Tring
Hitchin
Stevenage
Hertford
Ware
Bishop's Stortford
Harlow
Epping
Brentwood
Chelmsford
Colchester
Ipswich
Felixstowe
Lowestoft
Great Yarmouth
Norwich
Cromer
Sheringham
King's Lynn
Wisbech
Peterborough
Stamford
Grantham
Lincoln
Gainsborough
Scunthorpe
Grimsby
Cleethorpes
Hull
Beverley
Bridlington
Scarborough
Whitby
Middlesbrough
Darlington
Durham
Newcastle upon Tyne
Sunderland
Carlisle
Dumfries
Ayr
Glasgow
Edinburgh
Stirling
Perth
Dundee
Aberdeen
Inverness
Fort William
Oban
Lerwick
Kirkwall
Stornoway
Belfast
Dublin
Cork
Limerick
Galway
Sligo
Waterford
Wexford
Kilkenny
Cashel
Tralee
Killarney
Ennis
Athlone
Mullingar
Navan
Dundalk
Newry
Ballymena
Coleraine
Londonderry
Enniskillen
Omagh
Cavan
Monaghan
Clonmel
Dungarvan
Ballinrobe
Castlebar
Westport
Ballina
Letterkenny
Donegal
Ballyshannon
Bundoran
Carrick-on-Shannon
Longford
Tullamore
Portlaoise
Naas
Wicklow
Arklow
Gorey
Enniscorthy
Kilkenny
Thurles
Nenagh
Ennis
Tuam
Ballinasloe
Roscommon
Boyle
Sligo
Ballyshannon
Donegal
Letterkenny
Buncrana
Derry
Coleraine
Ballycastle
Larne
Belfast
Newcastle
Downpatrick
Newry
Dundalk
Drogheda
Navan
Kilkenny
Waterford
Wexford
Rosslare
Cork
Kinsale
Bantry
Killarney
Tralee
Dingle
Limerick
Ennis
Galway
Clifden
Westport
Castlebar
Ballina

Appendix 2

Existing Site Layout Plan



TITLE

□□isting Site Layout Plan

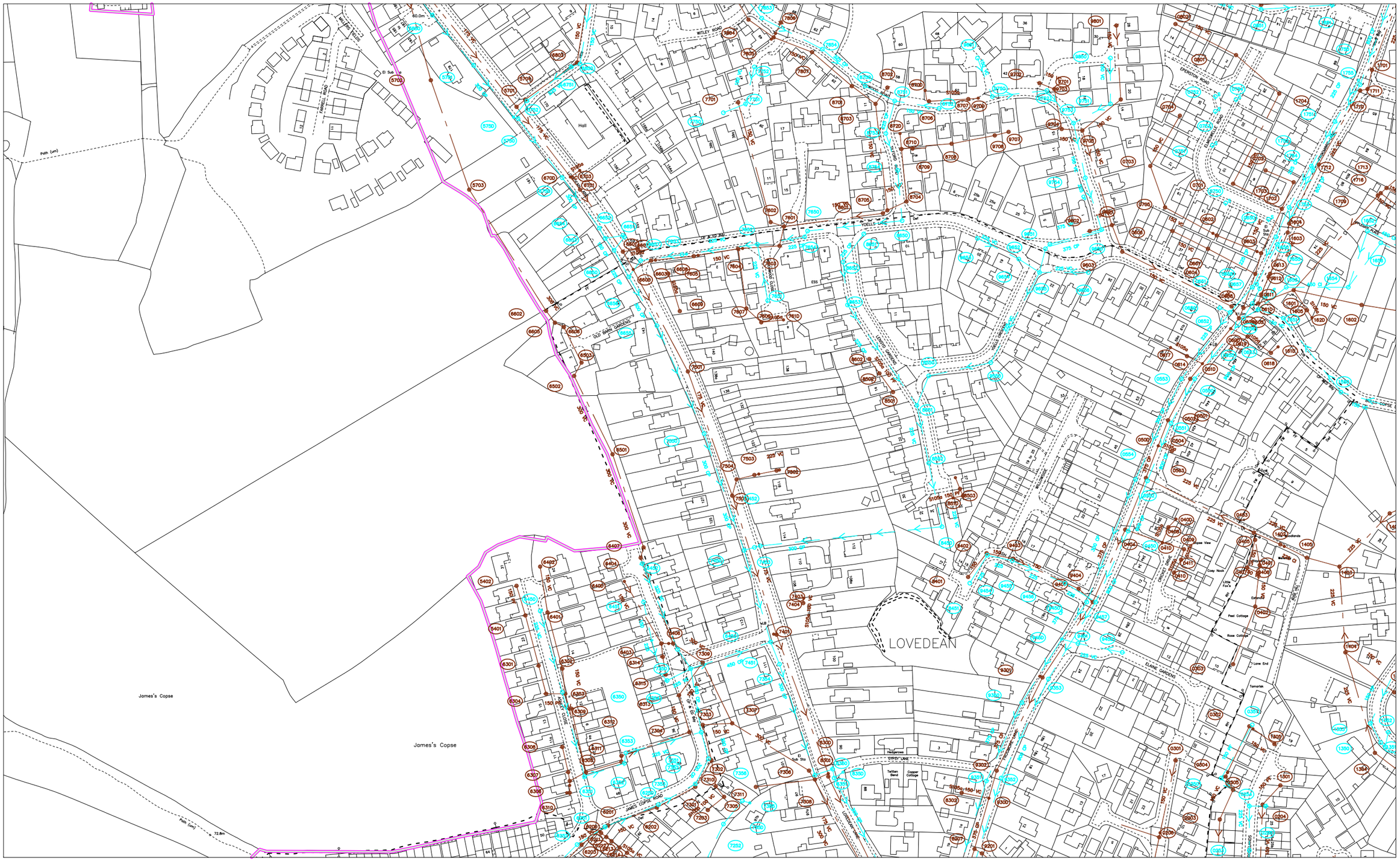
SCALE	PROJECT. No.
1:1,000	23246
REPORT TYPE	**DRG. No.**
FRA	02 -

Appendix 3

Southern Water Sewer Records

SEWER RECORDS PAGE 1 OF 2

112841



112263

468241

469185

O.S. REF. SU6812NE	Drawn by: gujskew	The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determnined on site. WARNING: BAC pipes are constructed of Bonded Asbestos Cement WARNING: Unknown (UNK) materials may Include Bonded Asbestos Cement	N
	Scale: 1:2500		
Title: 363085_Norton Heights	Date: 10/01/2020	Based upon Ordnance Survey Digital Data with the permission of the controller of H.M.S.O. Crown Copyright Reserved Licence No. WU 298530.	Southern Water

SEWER RECORDS PAGE 2 OF 2

Node	Cover	Invert	Size	Material	Shape	
0203X	63.38	61.64	150	VC	CIRC	
0204X	66.25	65.29	150	VC	CIRC	
0206X	60.68	58.54	150	VC	CIRC	
0253X	64.61	62.72	225	VC	CIRC	
0254X	65.71	63.34	225	VC	CIRC	
0255X	66.28	65.61	150	PF	CIRC	
0301X	62.16	60.47	150	VC	CIRC	
0302X	68.27		150	VC	CIRC	
0303X			UNK	UNK	CIRC	
0304X	64.87	62.43	150	VC	CIRC	
0305X			150	VC	CIRC	
0350X	64.56	63.86	150	PF	CIRC	
0351X	68.53		150	PF	CIRC	
0401X	65.93		150	VC	CIRC	
0402X			150	VC	CIRC	
0403X	64.21	63.02	225	VC	CIRC	
0404X	58.33	56.01	375	CP	CIRC	
0405X	64.57	63.425	150	VC	CIRC	
0406Y	65.31	64.69	150	VC	CIRC	
0407X	65.09	64.295	150	VC	CIRC	
0408X			UNK	UNK	CIRC	
0409X			UNK	UNK	CIRC	
040DX			UNK	UNK	CIRC	
0410X			UNK	UNK	CIRC	
0411X			UNK	UNK	CIRC	
041DX			UNK	UNK	CIRC	
0450X	58.4	54.8	900	CP	CIRC	
0501X	59.92	57.91	375	CP	CIRC	
0502X	59.3		375	CP	CIRC	
0503X	58.64	56.43	375	CP	CIRC	
0504X			UNK	UNK	CIRC	
050DX			375	CP	CIRC	
051DX			375	CP	CIRC	
0550X	59.84	56.71	900	CP	CIRC	
0551X	59.25	56.11	900	CP	CIRC	
0552X	58.69	55.25	900	CP	CIRC	
0553X	60.3	58.31	300	CP	CIRC	
0554X	58.92	57.69	300	CP	CIRC	
0601X	65.16	63.83	150	VC	CIRC	
0602X	65.57	63.41	150	VC	CIRC	
0603X	62.83	61.41	150	VC	CIRC	
0604X	62.47	60.84	150	VC	CIRC	
0605X	61.13	59.03	225	VC	CIRC	
0606X	66.42	64.98	150	VC	CIRC	
0608X	61.63	60.13	150	VC	CIRC	
0609X	61.02	58.73	375	CP	CIRC	
060DX			375	CP	CIRC	
0610X	61.23	59.14	225	VC	CIRC	
0611X	61.39	59.44	225	VC	CIRC	
0612X	61.8	59.66	225	VC	CIRC	
0613X	61.89	59.75	225	VC	CIRC	
0614X			UNK	UNK	CIRC	
0617X			UNK	UNK	CIRC	
0618X			UNK	UNK	CIRC	
0619X			UNK	UNK	CIRC	
0650X	63.69	62.34	150	VC	CIRC	
0651X	61.83	60.7	225	CP	CIRC	
0652X	61.23	59.65	225	CP	CIRC	
0653X	61.11	58.98	450	CP	CIRC	
0655X	60.96	57.53	900	CP	CIRC	
0656X	61.19	58.24	600	CP	CIRC	
0657X	61.62	58.89	600	CP	CIRC	
0658X	61.23		600	CP	CIRC	
0659X	61.97	60.8	225	VC	CIRC	
0701X			150	VC	CIRC	

Node	Cover	Invert	Size	Material	Shape	
0702X			UNK	UNK	CIRC	
0703X	69.15	67.94	150	VC	CIRC	
0704X			150	VC	CIRC	
0705X			150	VC	CIRC	
0801X	70.72		150	VC	CIRC	
0802X			150	VC	CIRC	
0851X	70.87	69.21	225	VC	CIRC	
1301X	68.57	67.71	150	PF	CIRC	
1303X	74.36	72.77	150	VC	CIRC	
1304X	73.13		225	VC	CIRC	
1305X	69.53		150	VC	CIRC	
1350X	73.63	72.76	150	CP	CIRC	
1351X	73.66	72.74	150	CP	CIRC	
1352X	73.67	72.93	150	CP	CIRC	
1353X	73.58	72.8	150	CP	CIRC	
1401X	73.52	71.16	225	VC	CIRC	
1402X	67.81	64.74	225	VC	CIRC	
1403X	72.77	70.65	225	VC	CIRC	
1404X	73.42	71.25	225	VC	CIRC	
1405X	70.9	69.06	225	CI	CIRC	
1550X	63.14	61.64	150	VC	CIRC	
1601X	61.29	59.48	225	VC	CIRC	
1602X	61.92		150	VC	CIRC	
1603X	61.23		225	VC	CIRC	
1604X	63.16		225	VC	CIRC	
161DX			UNK	UNK	CIRC	
1650X	62.94	61.78	225	CP	CIRC	
1651X	61.28	60.61	150	VC	CIRC	
1652X	61.83	60.3	450	CP	CIRC	
1653X	61.4	59.87	450	CP	CIRC	
1654X	61.62	60.09	450	CI	CIRC	
1655X	62.46		600	CP	CIRC	
1656X	61.66	60.26	225	VC	CIRC	
1701X	66.44	64.68	150	VC	CIRC	*
1701Y	66.44		225	VC	CIRC	*
1702X	64.15	62.83	150	VC	CIRC	
1703X	65.16	64	150	VC	CIRC	
1704X	68.88		150	VC	CIRC	
1709X	62.54	60.51	225	VC	CIRC	
1710X	66.3	63.16	225	VC	CIRC	
1711X	66.34	63.21	225	VC	CIRC	
1712X	65.02	62.2	225	VC	CIRC	
1713X	62.45		150	VC	CIRC	
1716X	62.45		150	VC	CIRC	
1751X	65.74	64.98	225	CP	CIRC	
1752X	64.93	63.97	225	CP	CIRC	
1753X	64.15	62.99	225	CP	CIRC	
1754X	64.92	62.49	600	CP	CIRC	
1755X	66.32	63.78	600	CP	CIRC	
175DX			225	CP	CIRC	
1851X	68.79	66.58	225	VC	CIRC	
5401X	63.72	62.96	150	PF	CIRC	
5402X	64.43	63.64	150	PF	CIRC	
5701X	59.48	57.89	175	VC	CIRC	
5702X			UNK	UNK	UNK	
5703X	59.83		UNK	UNK	UNK	
5704X	59.37	58.63	150	VC	CIRC	
5750X	59.5	58.37	300	CP	CIRC	
5751X	59.88	58.67	300	CP	CIRC	
5752X	59.37	58.62	225	VC	CIRC	
575DX			300	CP	CIRC	
5850X	60.21	58.82	300	CP	CIRC	
6201X	61.27	58.83	150	VC	CIRC	
6202X	59.32	57.24	150	VC	CIRC	
6203X	62.75	60.51	150	VC	CIRC	

Node	Cover	Invert	Size	Material	Shape	
620DX			150	VC	CIRC	
6211X			UNK	VC	CIRC	
6212X			UNK	VC	CIRC	
6213X			UNK	VC	CIRC	
6214X			UNK	VC	CIRC	
6215X			UNK	VC	CIRC	
6250X	59.27	57.32	225	VC	CIRC	
6251X	61.42	59.2	225	VC	CIRC	
6252X	62.72	60.89	225	VC	CIRC	
6301X	63.19	62.06	150	PF	CIRC	
6302X	62.35	60.66	150	VC	CIRC	
6303X	62.11	60.41	150	VC	CIRC	
6304X	62.67	61.24	150	PF	CIRC	
6305X	61.04	59.03	150	VC	CIRC	
6306X	61.34	59.65	150	VC	CIRC	
6307X	61.32	60.09	150	PF	CIRC	
6308X	61.77	60.9	150	PF	CIRC	
6309X	61.66	60.62	150	PF	CIRC	
6310X	61.81	60.99	150	VC	CIRC	
6311X	60.02	58.37	150	VC	CIRC	
6312X	60		150	VC	CIRC	
6313X	57.09	55.46	150	VC	CIRC	
6314X	57.39	56.43	150	VC	CIRC	
6315X	57.46	56.74	150	VC	CIRC	
6350X	61.08	59.55	225	VC	CIRC	
6351X	61.03	59.27	225	VC	CIRC	
6352X	60.02	58.51	225	VC	CIRC	
6353X	59.97	58.49	225	VC	CIRC	
6354X	57.55	56.06	225	VC	CIRC	
6401X	62.72		150	VC	CIRC	
6402X	62.99		150	VC	CIRC	
6403X	57.08	56.14	150	VC	CIRC	
6404X	58.27	55.62	300	VC	CIRC	
6406X	57.1	54.9	300	VC	CIRC	
6407X	57.98	55.95	300	VC	CIRC	
640DX			150	VC	CIRC	
6450X	63.25	61.51	225	VC	CIRC	
6451X	58.14		150	UNK	CIRC	
6452X	58.13	57.12	225	VC	CIRC	
6453X	57.05	56.06	225	VC	CIRC	
645ZX			225	UNK	CIRC	
6501X	58.63		300	VC	CIRC	
6502X	59.43		300	VC	CIRC	
6503X	59.22	57.01	300	VC	CIRC	
6601X	58.85	57.05	175	VC	CIRC	
6602X	59.64	57.57	300	VC	CIRC	
6603X	59.92	57.98	150	VC	CIRC	
6605X	59.63	57.51	300	VC	CIRC	
6606X	59.46	57.45	300	VC	CIRC	
6607X			UNK	UNK	CIRC	
6608X			UNK	UNK	CIRC	
660DX			175	VC	CIRC	
6650X	58.78	57.71	225	CP	CIRC	
6651X	59.17	57.78	225	CP	CIRC	
6652X	59.14	58.56	225	CP	CIRC	
6653Y	58.92	58	150	CP	CIRC	*
6653X	58.92	57.88	300	CP	CIRC	*
6654X	58.87	57.83	300	CP	CIRC	
6655X	58.31	56.98	300	CP	CIRC	
6656X	58.66	57.39	300	CP	CIRC	
6657X	59.25	58.25	225	VC	CIRC	
6701X	59.01	57.41	175	VC	CIRC	
6703X			UNK	UNK	CIRC	
670DX			175	VC	CIRC	
6750X	59.13	58.04	300	CP	CIRC	

Node	Cover	Invert	Size	Material	Shape	
6751X	61.6	59.96	225	VC	CIRC	
6802X	62.56	60.58	150	VC	CIRC	
6850X	62.49	61.03	150	VC	CIRC	
7203X			100	VC	CIRC	
7252X			225	VC	CIRC	
7301X	57.93	56.45	150	VC	CIRC	
7302X	57.44		150	VC	CIRC	
7303X	57.16		150	VC	CIRC	
7304X	57.17	56.2	150	VC	CIRC	
7305X	56.17		150	VC	CIRC	
7306X	55.8	53.37	300	VC	CIRC	
7307X	56.1		300	VC	CIRC	
7308X	55.59	54.06	150	VC	CIRC	
7309X	56.52		300	VC	CIRC	
7310X			UNK	UNK	CIRC	
7311X			100	VC	CIRC	
7350X	56.87	55.68	450	CP	CIRC	
7351X	57.09	55.83	450	CP	CIRC	
7352X	57.42	56.11	300	CP	CIRC	
7353X	57.85	56.6	300	CP	CIRC	
7354X	56.3	55.09	300	CP	CIRC	
7355X	55.61	54.54	300	CP	CIRC	
7356X			225	VC	CIRC	
7401X	56.48	54.05	175	VC	CIRC	
7403X			100	VC	CIRC	
7450X	56.97	55.7	300	CP	CIRC	
7451X	56.4	55.19	300	CP	CIRC	
7452X	56.93	56.13	300	CP	CIRC	
7453X	57.24	55.81	300	CP	CIRC	
7501X	57.94	55.95	175	VC	CIRC	
7502X	59.82	58.12	225	VC	CIRC	
7503X	58.4	56.81	225	VC	CIRC	
7504X	57.45	56.47	225	VC	CIRC	
7505X	57.27	54.86	175	VC	CIRC	
7550X	57.59	56.28	300	CP	CIRC	
7601X	68.04	66.4	150	VC	CIRC	
7602X	67.83	66.59	150	VC	CIRC	
7603X	67.45	65.74	150	VC	CIRC	
7604X	65.17	62.75	150	VC	CIRC	
7605X	62.13	60.04	150	VC	CIRC	
7606X			UNK	UNK	CIRC	
7607X			UNK	UNK	CIRC	
761DX			UNK	UNK	CIRC	
7650X	68.49	67.07	225	CP	CIRC	
7651X	65.15	64.16	225	VC	CIRC	
7652X	66.49	64.08	225	VC	CIRC	
7653X	61.5	59.25	225	VC	CIRC	
7654X	68.34	66.68	225	CP	CIRC	
7701X	70.03	67.18	150	VC	CIRC	
7751X	69.96	68.59	150	VC	CIRC	
7752X	72.31	71.31	150	VC	CIRC	
7804X	73.89		150	VC	CIRC	
7805X	73.9	70.58	150	VC	CIRC	
7806X	74.17	73.07	150	VC	CIRC	
7807X	74.24		150	VC	CIRC	
7853X	73.91	72.31	225	CP	CIRC	*
7854X	74.24	72	225	CP	CIRC	*
8207X	54.72	53.06	375	CP	CIRC	
8301X	55.55	53.31	175	VC	CIRC	
8302X			150	VC	CIRC	
830DX			175	VC	CIRC	
8350X	55.54	54.47	300	CP	CIRC	
8351X	55.47	54.29	300	CP	CIRC	
835DX			UNK	UNK	CIRC	
8401X	59.42	58.4	150	UNK	CIRC	

LEGEND - SEWERS

LINE STYLES / COLOURS

- Brown: Foul; Foul Syphon Sewer; Foul Vacuum Main; Foul Rising Main
- Red: Combined; Combined Syphon Sewer; Combined Rising Main; Lateral Drain
- Orange: Building Over Agreement Area
- Dark Blue: Treated Effluent
- Purple: Sludge; Sewer Catchment; Section 104 Area
- Light Blue: Surface Water; Surface Water Rising Main
- Yellow: Private
- Green: Access Shaft; Decommissioned

MATERIALS

AK	Alkathene
BAC	Bonded Asbestos Cement
BRC	Brick (Common)
BRE	Brick (Engineering)
CC	Concrete Box Culvert
CI	Cast Iron
CO	Concrete (In-Situ)
CP	Concrete (Pre-Cast)
CSB	Concrete Segments (bolted)
CSU	Concrete Segments (unbolted)
DI	Ductile Iron
GRC	Glass Reinforced Concrete
GRP	Glass Reinforced Plastic
MAC	Masonry in regular Courses
MAR	Masonry in random Courses
PE	Polyethylene
PF	Pitch Fibre
PP	Polypropylene
PVC	Polyvinyl Chloride
RPM	Reinforced Plastic Matrix
SI	Spun Iron
ST	Steel
VC	Vitrified Clay
XXX	Other
ZZZ	Unknown

Manhole (SW); Manhole (F&C); Lamp hole (SW); Lamp hole (F&C); Pumping Station (SW); Pumping Station (F&C); Side entry manhole (SW); Side entry Manhole (F&C); Blind shaft (SW); Blind shaft (F&C); Ejector station (SW); Ejector station (F&C); Watertight door (SW); Watertight door (F&C); Flushing ch. Mn=e (SW); Flushing ch. Mn=e (F&C); Flushing ch. No=e (SW); Flushing ch. No=e (F&C); Demarcation Chamber

Washout (SW); Washout (F&C); Rodding Eye (SW); Rodding Eye (F&C); Gauging point (SW); Gauging point (F&C); Intercept chamber (SW); Intercept chamber (F&C); Storm Tank (SW); Storm Tank (F&C); Vortex chamber (SW); Vortex chamber (F&C); Label ellipse; Dummy/S24 manhole; Outfall; Penstock chamber; Damboards; Storm Overflow; Backdrop manhole

Other (s); Other; Change in sewer (s); Change in sewer; Reflux valve; Flap valve; Cascade; Anode; Valve; Closed Valve; Air Valve; Hatch box (SW); Hatch box (F&C); Direction arrow; Emptying valve; Catchpit; Soakaway; Inlet; Balancing Pond

Wastewater treatment works; Marine treatment works; Outfall headworks; Vent; Vent column; Tidal storage tank; Blank end; Head of Public Sewer; Micro Pumping Station

SHAPES (S)

A	Arched	R	Rectangular
B	Barrel	S	Square
C	Circular	T	Trapezoidal
E	Egg	U	U Shape
H	Horseshoe	X	Other

NODE REFERENCING SYSTEM

1st digit: hundred metre easting identifier
2nd digit: hundred metre northing identifier
3rd digit: sewer type identifier
0-4 = Foul/Combined
5-9 = Surface Water
4th digit: next sequential node

Drawn by:	gujskew
Title:	363085_Norton Heights
Date:	10/01/2020

Southern Water

Appendix 4

Site Investigation Extracts

Design precautions may also need to be considered for proposed drainage infrastructure for road and any areas of private drainage.

The use of soakaways cannot be incorporated into the drainage design for this site and the normal consideration of SUDs hierarchy protocols cannot be adopted at this site.

5.2 Geotechnical Risks

The site is located within a geologically compromised setting that is prone to the risk of chalk dissolution.

The site walkover and desk study have indicated the presence of likely chalk dissolution features and man-made chalk extraction related features within the site boundary and the database searches have indicated the presence of numerous chalk dissolution features in the vicinity of the site.

The presence of any such features within the site does not necessarily preclude the potential for development, although it is important that the location of any below ground anomalies and the variation of the natural and man-made geology beneath the site is robustly and appropriately assessed. Once the ground conditions have been fully assessed, the implications with regards to geotechnical stability of the ground can be determined.

Where development can be subsequently acceptable, the design of the proposed scheme will need to be carefully considered within the geotechnical parameters of the site and below ground structures may need to incorporate measures such as reinforcement and load spreading to mitigate the risks of geotechnical instability, settlement, subsidence and collapse.

It is considered that in addition to the environmental reasons noted above, for geotechnical reasons soakaways shall not for part of any development scheme at this site and precautions will be required with regards to surface drainage and infrastructure to mitigate the risks of surface water drainage further reducing the geotechnical stability of the ground at this site.

6.0 CONCLUSIONS

It is considered that the site in its current state does not present any unacceptable environmental risks and that with careful and considered design, it should be possible to mitigate the identified potential future risks associated with the construction and completed occupation of the proposed residential development of this site.

Extensive further ground investigation works will be required to fully evaluate the site. These works should commence with a geophysical survey of the ground conditions that may be used to guide a subsequent physical investigation of the ground conditions by means of boreholes, dynamic probing and trial pits where appropriate.

Appendix 5

Correspondence and Meeting Minutes

Notes of Meeting

The Civil Engineering Practice
11 Tungsten Building
George Street
Fishersgate
Sussex
BN41 1RA
01273 424424
reception@civil.co.uk
www.civil.co.uk

Project	Norton Heights Phase 2, Lovedean
Project Number	23246
Date of Meeting	20 November 2019
Venue	Portsmouth Water, Havant

Present

Name	**Company**	Initials
Rachel Davies	Bargate Homes	RD
James Bedford	Bargate Homes	JB
Simon Deacon	Portsmouth Water	SD
James Deakin	Portsmouth Water	JBa
Tom Wickens	Environment Agency	TW
Stuart Magowan	The Civil Engineering Practice	SM

Distribution

All those present plus:

Name	**Company**	**Initials**
Dominic Brightman	Wilson Bailey	DB

1 Notes

1.1 Introductions were made, Tom Wickens dialled into the meeting and SM thanked all for attendance.

1.2 SM gave a brief overview of the project, confirming that we are at the early stages of the project, aiming for an outline application early in the new year for up to 70 dwellings.

1.3 SM confirmed that Bargate Homes developed the site immediately north of this site and during the initial works and site investigation for that site a number of historic solution features and the potential for solution features into the underlying chalk substructure were identified.

ISO 9001 : 2008 REGISTERED
Cert No. 14127180

1.4 SM noted that it was anticipated that this site would have very similar restraints as the site immediately to the north and it was expected there would be the potential for solution features in the chalk underlying the site.

1.5 SM noted that he and RD had already met Hampshire SuDS team to discuss the site given the complexity of the site to the north.

1.6 RD noted that initial desktop site investigations were taking place together with a site Geophysical Survey to identify any area of the site that may require further investigation.

1.7 The initial desktop and geophysical investigation will provide further details and will allow the site layout to be set from the constraints found.

1.8 At this initial investigation stage no soakage tests were proposed. The risk of surface water discharging to ground in concentrated areas was discussed and it was agreed that undertaking soakage tests would not be appropriate on this site.

1.9 SM noted that both surface and foul water drainage systems were constructed in plastic pipework to allow for longer 6m pipe sections to be used which minimise the number of pipe joints reducing risk of future leakage.

1.10 There was a discussion on the features undertaken for the Phase 1 scheme to minimise the risk from surface water being concentrated in one place and being allowed to drain to ground during the construction and for the completed site.

1.10.1 The items discussed included the use of raft foundations and draining the structural slabs, positive drainage of all paths and patios to prevent future discharge to ground and allowing collection using lined swales for surface water runoff from uphill of the site.

1.10.2 The phasing of construction to undertake an enabling works to provide drained roads, and structural slabs during the summer months and ensuring filtration and SuDS drainage was constructed early to allow positive drainage throughout the construction phase.

1.10.3 RD noted that most of the items worked extremely well and were aided by the early inclusion of their Groundworks Contractor in developing the plans and mitigation works.

1.10.4 Feedback during the construction phase of the site to the north was generally positive. The temporary drainage, as far as possible, used the permanent drainage features with some additional temporary filtration (double bagging of road gullies for example to remove silts and construction debris). The scheme worked well and produced a dry and usable site throughout the construction period.

1.10.5 The use of ductile iron watermains was one item that caused a number of issues during construction and the team felt that MDPE would have provided a more suitable option with less risk of future leakage.

1.10.6 The success of the Phase 1 Construction Management Plan was noted and it was agreed that using this plan as a base and adjusting items that were less successful would be beneficial. Ideally the CMP could be submitted with any Planning Application to ensure the proposals are understood by all consultees.

1.11 SM noted that initial discussions with Southern Water were being held and that it was anticipated that both foul and surface water from the site would be discharged to the public sewers. Southern Water have confirmed (subject to suitable applications and negotiation) that if the connection to the public

sewer was at the same diameter pipe or smaller they would be responsible for providing suitable capacity in the downstream network.

1.12 SM confirmed there was a foul sewer crossing the eastern part for the site and there were surface water sewers in both Lovedean Lane to the east and in both Ashley Close and James Copse Road to the south of the site.

1.13 Surface water will need to be discharged at a suitably agreed greenfield run off rate and storage provided to ensure the 100 year plus climate change rainfall event can be managed on site.

1.14 We discussed the type of storage that could be used and this will be developed as the site progresses. The use of lined swales and ponds or lined storage crates were discussed. SM noted that lined sealed crates were used on Phase 1 which worked well. The crate system also allowed for any initial overflow from exceedance events to back up into the pipe network and onto the site carriageway. Concern was expressed over the use of a pond on site as there is a risk from exceedance flows or overtop which would be more appropriate to avoid on a site with the risk of solution features.

1.15 Site access is available to Lovedean Lane via an existing access track which is due to be used as the vehicular and pedestrian access for the site.

1.16 The site layout has not yet been established and RD confirmed that once the initial site investigation is complete and the full constraints established, works to inform and develop the site layout will progress.

2 Next Steps

2.1 Complete the initial site investigation, consult on any proposed further investigation.

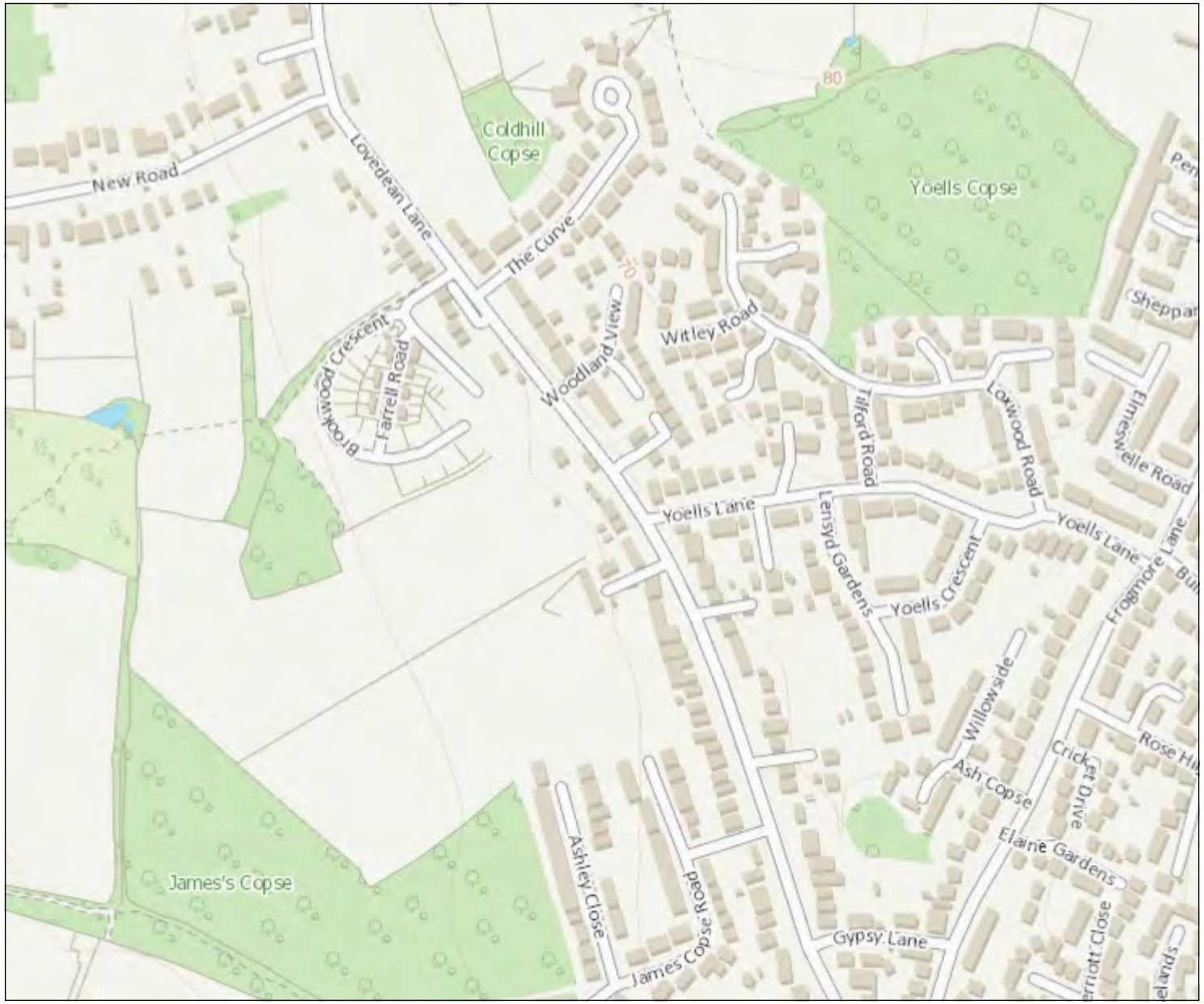
2.2 Establish constraints for the site and developable areas.

2.3 Submit Outline Planning Application to establish principle of development.

Appendix 6

Flood Maps and Correspondence

Flood Map for Planning (Rivers and Sea) - Centred on Norton Heights Phase 2 - Created 27 September 2019



Environment Agency

1: 5,000

0 Metres 125

N W E S

Flood Map for Planning (Rivers & Sea)

- Defences
- Flood Storage Areas
- Areas benefiting from flood defences
- Flood Zone 3
- Flood Zone 2

Flood Map Areas (assuming no defences)

Flood Zone 3 shows the area that could be affected by flooding:

- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occuring each year.

© Crown Copyright and database rights 2019 . Ordnance Survey 100024198

Risk of flooding from Surface Water - Centred on Norton Heights Phase 2 - Created 27 September 2019

Environment Agency

1: 5,000

0 Metres 125

N W E S

Likelihood of flooding from Surface Water

- High (>=3.3%)
- Medium (3.3% - 1%)
- Low (1% - 01%)
- Very Low

Likelihood of flooding from Surface Water

High:	Greater than or equal to 3.3% (1 in 30) chance in any given year
Medium:	Less than 3.3% (1 in 30) but greater than or equal to 1% (1 in 100) chance in any given year
Low:	Less than 1% (1 in 100) but greater than or equal to 0.1% (1 in 1,000) chance in any given year
Very Low:	Less than 0.1% (1 in 1,000) chance in any given year

This information is shown on the Risk of Flooding from Surface Water map on GOV.UK.

© Crown Copyright and database rights 2019 Ordnance Survey 100024198

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). E-mail: enquires@environment-agency.gov.uk

Extent of flooding from rivers or the sea

High Medium Low Very low

Extent of flooding from rerservoirs

Maximum extent of flooding

Extent of flooding from surface water

High Medium Low Very low

Surface water flood risk: water depth in a high risk scenario

Flood depth (millimetres)

Over 900mm 300 to 900mm Below 300mm

Surface water flood risk: water depth in a medium risk scenario

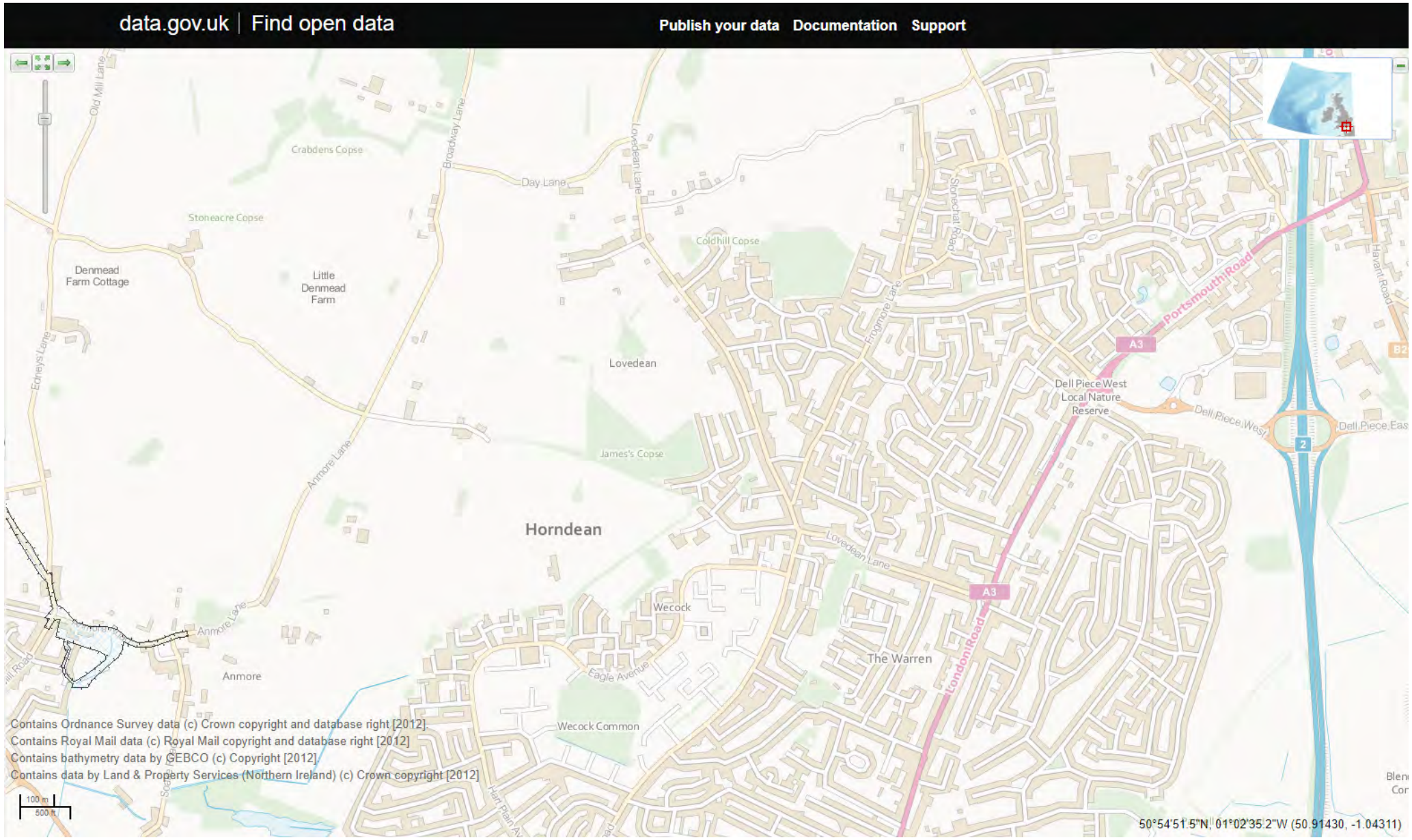
Flood depth (millimetres)

Over 900mm 300 to 900mm Below 300mm

Surface water flood risk: water depth in a low risk scenario

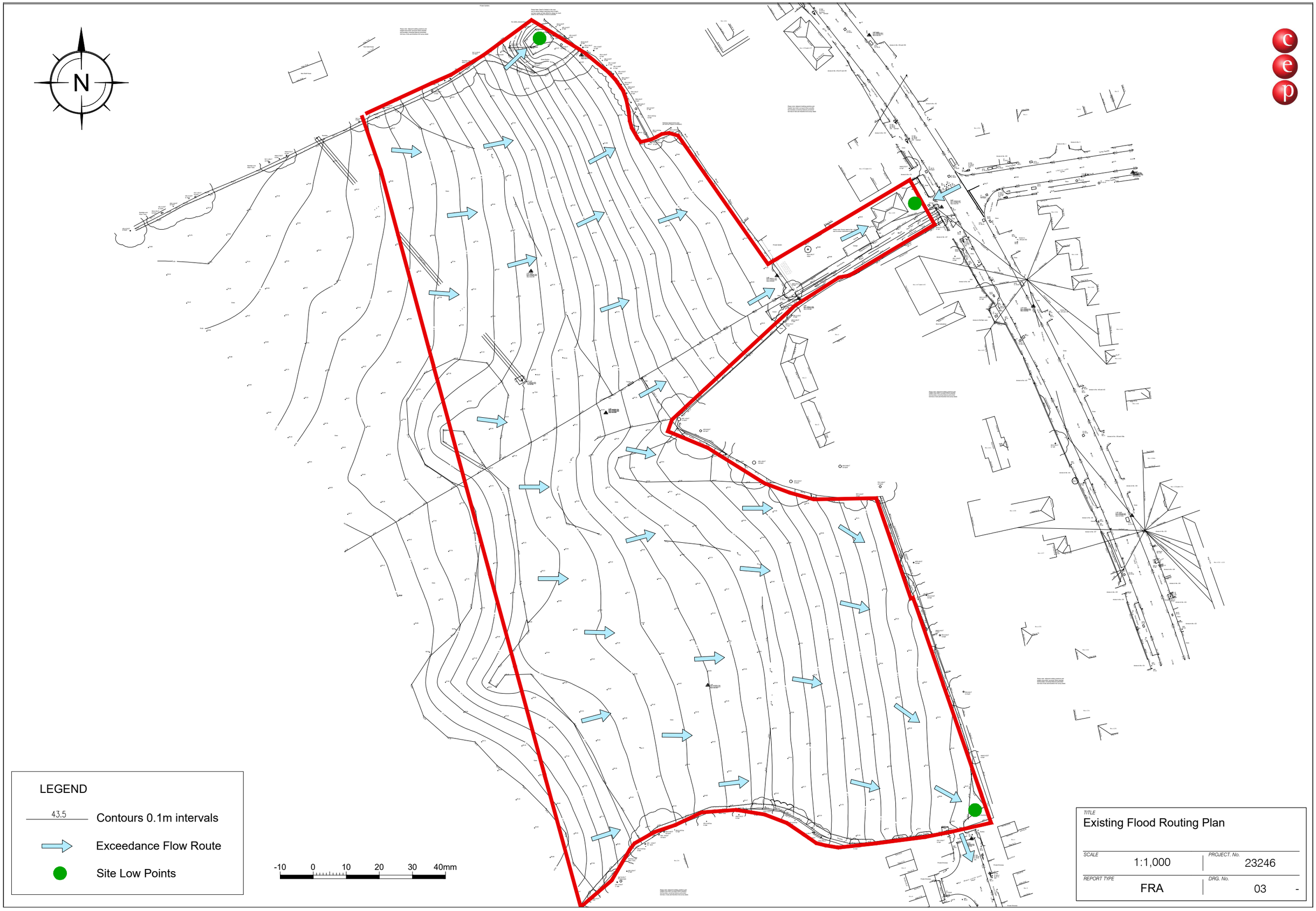
Flood depth (millimetres)

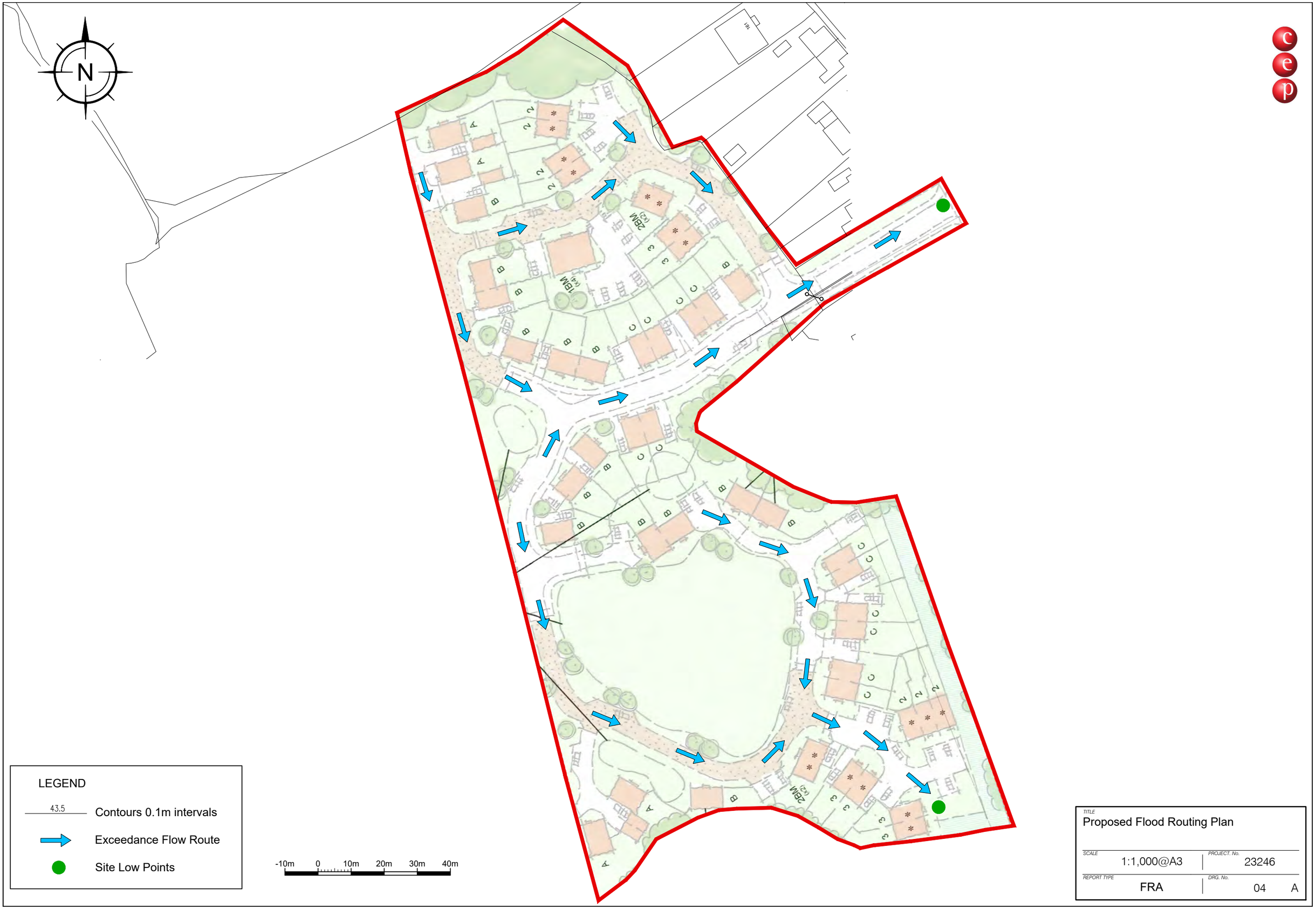
- Over 900mm
- 300 to 900mm
- Below 300mm

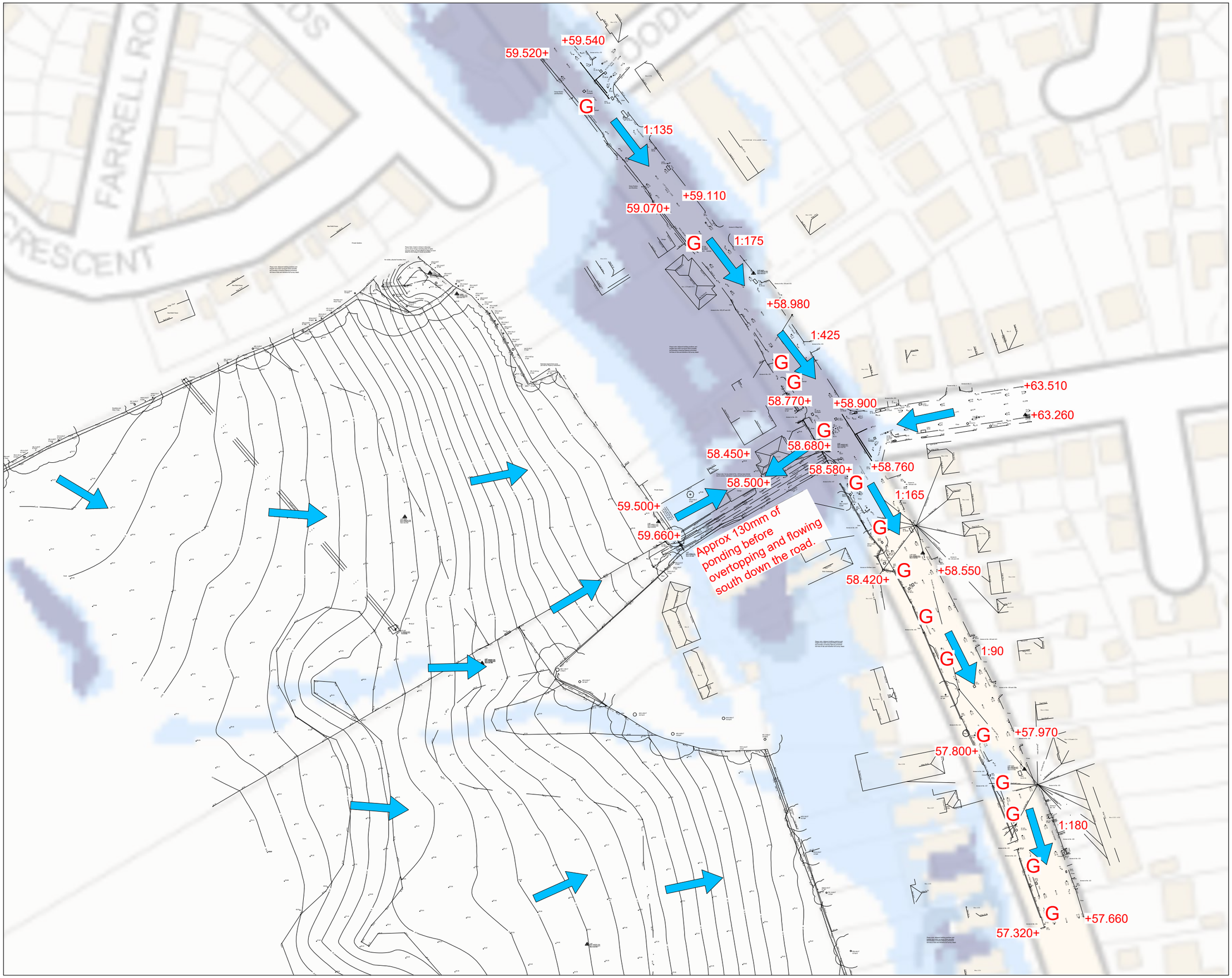

data.gov.uk | Find open data
Publish your data
Documentation
Support
Crabdens Copse
Stoneacre Copse
Denmead Farm Cottage
Little Denmead Farm
Coldhill Copse
Lovedean
James's Copse
Horndean
Wecock
The Warren
Anmore
Wecock Common
Dell Piece West Local Nature Reserve
Portsmouth Road
London Road
Lovedean Lane
Anmore Lane
Edneys Lane
Old Mill Lane
Broadway Lane
Day Lane
Stonechat Road
Frogmore Lane
Eagle Avenue
Havant Road
Dell Piece West
Dell Piece East
A3
B2
2
Contains Ordnance Survey data (c) Crown copyright and database right [2012]
Contains Royal Mail data (c) Royal Mail copyright and database right [2012]
Contains bathymetry data by GEBCO (c) Copyright [2012]
Contains data by Land & Property Services (Northern Ireland) (c) Crown copyright [2012]
100 m
500 ft
50°54'51.5"N, 01°02'35.2"W (50.91430, -1.04311)

Appendix 7

Existing and Proposed Flood Routing Plans


N
LEGEND
43.5
Contours 0.1m intervals
Exceedance Flow Route
Site Low Points
-10
0
10
20
30
40mm
TITLE
Existing Flood Routing Plan
SCALE
1:1,000
PROJECT. No.
23246
REPORT TYPE
FRA
DRG. No.
03
-


N
LEGEND
43.5
Contours 0.1m intervals
Exceedance Flow Route
Site Low Points
-10m
0
10m
20m
30m
40m
TITLE
Proposed Flood Routing Plan
SCALE
1:1,000@A3
PROJECT. No.
23246
REPORT TYPE
FRA
DRG. No.
04
A



NOTES:

1. All dimensions to be checked on site. All details and dimensions relating to sub-Contractors work must be checked and agreed between the sub-Contractor or supplier and the general Contractor.

2. This drawing is to be read in conjunction with all relevant Architect's and Engineer's drawings and specification.

3. The main Contractor is responsible for ensuring the stability of the structure whilst the works are in progress.

4. Any information given regarding existing underground services is given in good faith after consultation with the relevant authority. No liability is accepted by the Consultant and the main Contractor is responsible for obtaining and checking all information and taking due care and attention whilst undertaking the works.

5. All pipes, bends and junctions shall be vitrified clay to BS EN 295-1, with flexible joints and kitemark certified. Alternatively all pipes and fittings can be UPVC conforming to BS EN 1401-1 and shall be laid in accordance with the manufacturers specification. If UPVC pipes are to be used then the manufacturer shall be approved by the Engineer prior to construction.

6. All Adoptable sewers shall be in strict accordance with the current edition of Sewers For Adoption. Unless otherwise stated adoptable sewers shall be 150mm diameter and shall be laid in a class S bedding. Where the depth to soffit is less than 1.2m under a public highway or 0.9m elsewhere the pipe shall be laid with a class Z bedding.

7. All private building drainage shall be constructed in strict accordance with BS EN 752:1996. Unless otherwise specified building drainage shall be 100mm diameter and shall be laid at a minimum gradient of 1 in 40 for foul drains and 1 in 80 for surface water drains. All building drains shall be laid in class B bedding unless otherwise specified.

8. Where the service trench is near to the foundation of any building, refer to the guidance in Approved Document H, Building Regulations Part H1.

9. Where pipes, external to the structures, have a depth to soffit from ground level of less than 450mm they shall have a class GEN 3 concrete encasement (150mm thick). In all other cases the pipes shall be bedded and surrounded with 100mm thick granular material.

10. In any circumstances where pipes are bedded and surrounded in concrete flexible joints should be provided. Compressible boards (fibreboard or polystyrene) shall be provided at a maximum of 8m centres (coinciding with pipe joints). The boards shall be pre-cut to pipe diameter and to a height and width equal to the concrete cross section. A board thickness of 18mm for pipes up to 450mm nominal diameter and 36mm for pipes over 450mm nominal diameter.

11. All svps shall have rodding access plates fitted at their bases (ground floor level).

12. Where existing pipes are to be abandoned they shall be dug out together with any abandoned manholes.

G Existing Gully Location

+63.260 Existing Level

Existing Flow

REV	DATE	INT	DESCRIPTION	CHK

Issue Status FOR INFORMATION

The Civil Engineering Practice
11 Tungsten Building
George Street
Fishersgate
Sussex
BN41 1RA

01273 424424
reception@civil.co.uk
www.civil.co.uk

CLIENT
Bargate Homes

PROJECT
Norton Heights
Lovedean

TITLE
Surface Water Flooding Overlay
With Levels, Gradients and Gully Locations

DRAWN	DATE	PROJECT NO.
S Burgess	June 2020	23246
ENGINEER	CHECKED	DRG. No. / REV.
S Burgess		50

SCALE
1:500 @ A1

Appendix 8

Indicative Site Layout Plan

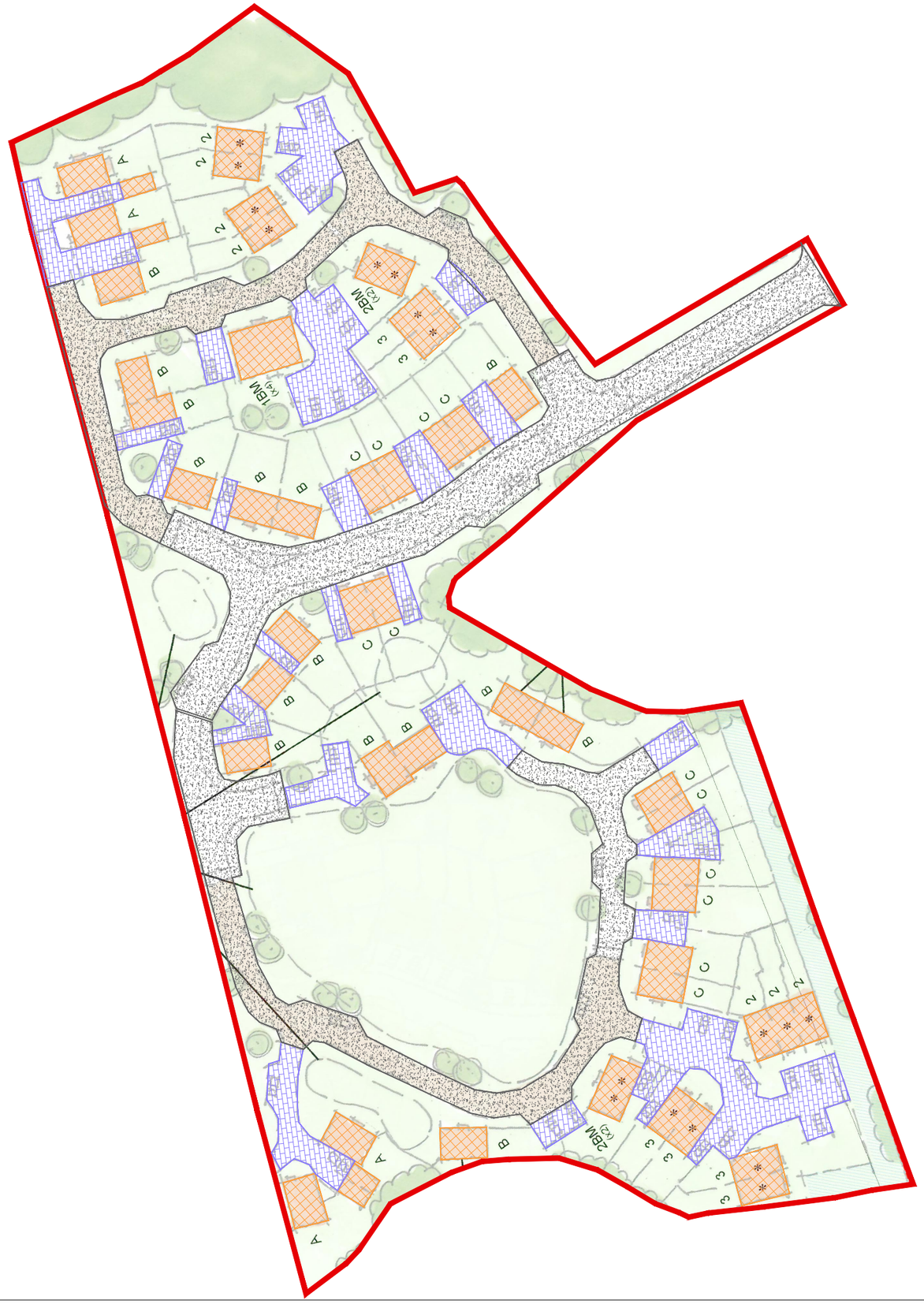
TITLE
Indicative Site Layout Plan

SCALE	PROJECT. No.
1:1000	23246
REPORT TYPE	DRG. No.
FRA	05 A

Appendix 9

Proposed Impermeable Area Plan

Total Site Area	25,501m²
Impermeable Areas	
Highway	4,555m²
Building Roofs	2,790m²
Driveways	2,800m²
Paths and Patios - (An area of 20m² has been assumed for each dwelling)	940m²
	TOTAL 11,085m²
Impermeable Areas plus 10% Urban Creep	TOTAL 12,575m²



N

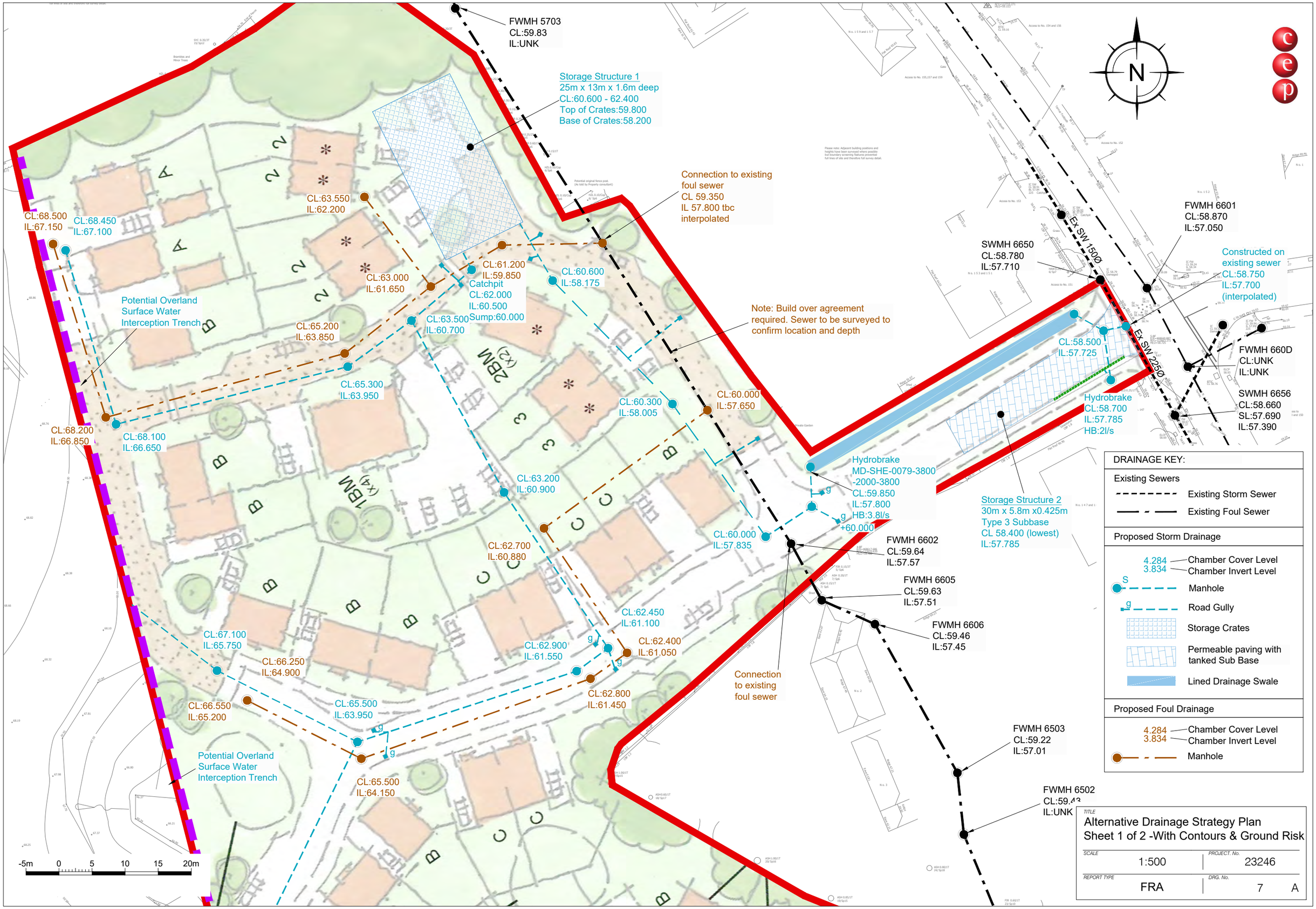
-10m 0 10m 20m 30m 40m

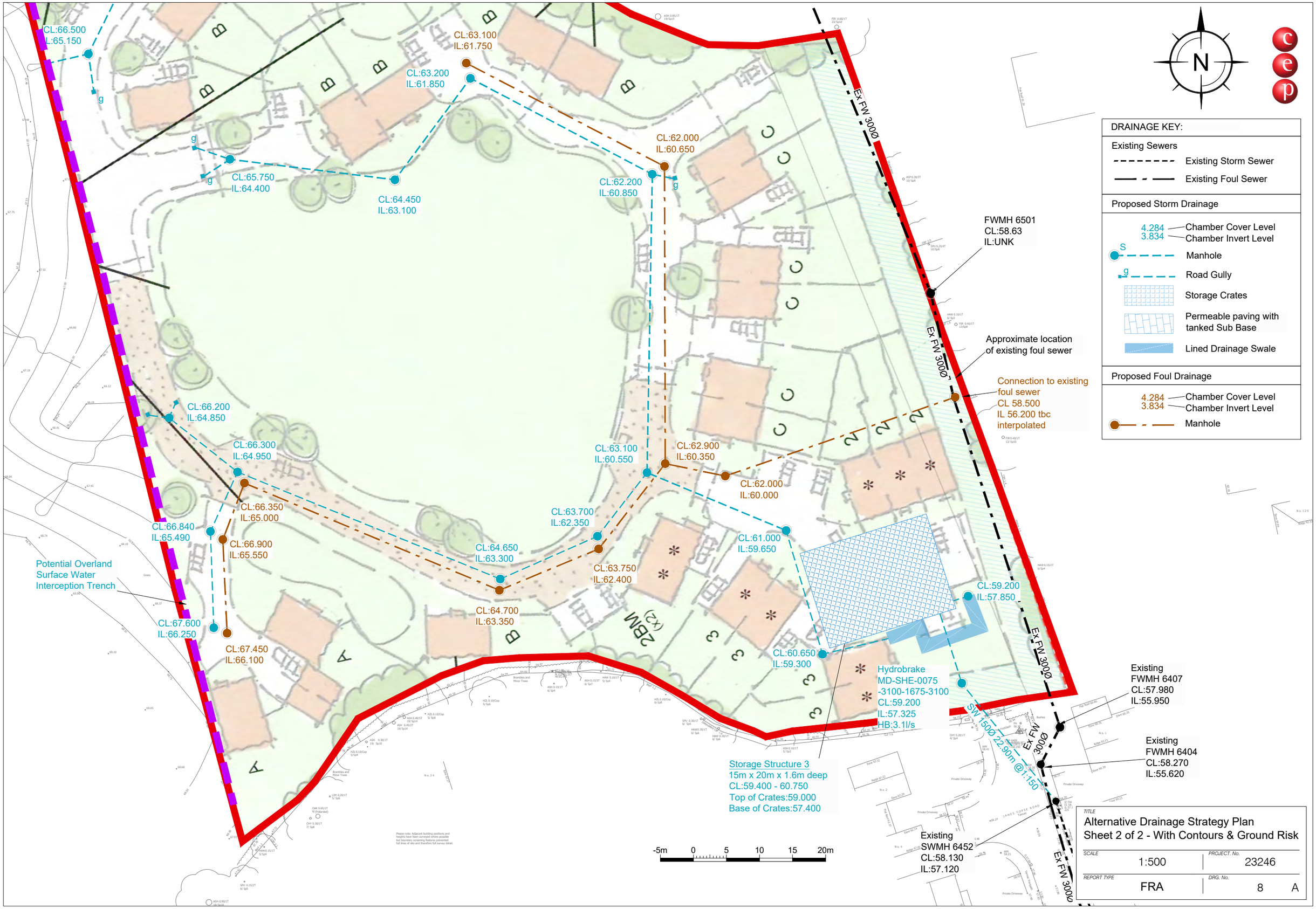
TITLE
Proposed Impermeable Area Plan
Whole Site

SCALE	PROJECT. No.
1:1,000	23246
REPORT TYPE	DRG. No.
FRA	06 A

Appendix 10

Preliminary Drainage Strategy Plan and Calculations


FWMH 5703
CL:59.83
IL:UNK
Storage Structure 1
25m x 13m x 1.6m deep
CL:60.600 - 62.400
Top of Crates:59.800
Base of Crates:58.200
Connection to existing
foul sewer
CL 59.350
IL 57.800 tbc
interpolated
CL:68.500
IL:67.150
CL:68.450
IL:67.100
CL:63.550
IL:62.200
CL:61.200
IL:59.850
Catchpit
CL:62.000
IL:60.500
Sump:60.000
CL:60.600
IL:58.175
CL:63.000
IL:61.650
Potential Overland
Surface Water
Interception Trench
CL:65.200
IL:63.850
CL:63.500
IL:60.700
Note: Build over agreement
required. Sewer to be surveyed to
confirm location and depth
CL:65.300
IL:63.950
CL:60.300
IL:58.005
CL:60.000
IL:57.650
CL:68.200
IL:66.850
CL:68.100
IL:66.650
CL:63.200
IL:60.900
CL:62.700
IL:60.880
CL:60.000
IL:57.835
CL:62.450
IL:61.100
CL:67.100
IL:65.750
CL:62.900
IL:61.550
CL:62.400
IL:61.050
CL:66.250
IL:64.900
CL:62.800
IL:61.450
CL:66.550
IL:65.200
CL:65.500
IL:63.950
Potential Overland
Surface Water
Interception Trench
CL:65.500
IL:64.150
Connection
to existing
foul sewer
Hydrobrake
MD-SHE-0079-3800
-2000-3800
CL:59.850
IL:57.800
HB:3.8l/s
+60.000
FWMH 6602
CL:59.64
IL:57.57
FWMH 6605
CL:59.63
IL:57.51
FWMH 6606
CL:59.46
IL:57.45
FWMH 6503
CL:59.22
IL:57.01
FWMH 6502
CL:59.43
IL:UNK
Storage Structure 2
30m x 5.8m x0.425m
Type 3 Subbase
CL 58.400 (lowest)
IL:57.785
Hydrobrake
CL:58.700
IL:57.785
HB:2l/s
CL:58.500
IL:57.725
Ex SW 150Ø
Ex SW 225Ø
SWMH 6650
CL:58.780
IL:57.710
FWMH 6601
CL:58.870
IL:57.050
Constructed on
existing sewer
CL:58.750
IL:57.700
(interpolated)
FWMH 660D
CL:UNK
IL:UNK
SWMH 6656
CL:58.660
SL:57.690
IL:57.390
N
-5m 0 5 10 15 20m
DRAINAGE KEY:
Existing Sewers
Existing Storm Sewer
Existing Foul Sewer
Proposed Storm Drainage
4.284 Chamber Cover Level
3.834 Chamber Invert Level
Manhole
Road Gully
Storage Crates
Permeable paving with
tanked Sub Base
Lined Drainage Swale
Proposed Foul Drainage
4.284 Chamber Cover Level
3.834 Chamber Invert Level
Manhole
TITLE
Alternative Drainage Strategy Plan
Sheet 1 of 2 -With Contours & Ground Risk
SCALE
1:500
PROJECT. No.
23246
REPORT TYPE
FRA
DRG. No.
7 A


N
DRAINAGE KEY:
Existing Sewers
Existing Storm Sewer
Existing Foul Sewer
Proposed Storm Drainage
4.284 Chamber Cover Level
3.834 Chamber Invert Level
Manhole
Road Gully
Storage Crates
Permeable paving with tanked Sub Base
Lined Drainage Swale
Proposed Foul Drainage
4.284 Chamber Cover Level
3.834 Chamber Invert Level
Manhole
CL:66.500
IL:65.150
CL:63.100
IL:61.750
CL:63.200
IL:61.850
CL:62.000
IL:60.650
CL:65.750
IL:64.400
CL:64.450
IL:63.100
CL:62.200
IL:60.850
FWMH 6501
CL:58.63
IL:UNK
Ex FW 300Ø
Approximate location of existing foul sewer
Connection to existing foul sewer
CL 58.500
IL 56.200 tbc
interpolated
CL:66.200
IL:64.850
CL:66.300
IL:64.950
CL:63.100
IL:60.550
CL:62.900
IL:60.350
CL:62.000
IL:60.000
CL:66.350
IL:65.000
CL:63.700
IL:62.350
CL:66.840
IL:65.490
CL:66.900
IL:65.550
CL:61.000
IL:59.650
CL:64.650
IL:63.300
CL:63.750
IL:62.400
Potential Overland Surface Water Interception Trench
CL:59.200
IL:57.850
CL:64.700
IL:63.350
CL:67.600
IL:66.250
CL:67.450
IL:66.100
CL:60.650
IL:59.300
Hydrobrake
MD-SHE-0075
-3100-1675-3100
CL:59.200
IL:57.325
HB:3.1l/s
Existing FWMH 6407
CL:57.980
IL:55.950
Existing FWMH 6404
CL:58.270
IL:55.620
SW 150Ø 22.90m @1:150
Storage Structure 3
15m x 20m x 1.6m deep
CL:59.400 - 60.750
Top of Crates:59.000
Base of Crates:57.400
Existing SWMH 6452
CL:58.130
IL:57.120
-5m 0 5 10 15 20m
TITLE
Alternative Drainage Strategy Plan
Sheet 2 of 2 - With Contours & Ground Risk
SCALE 1:500
PROJECT. No. 23246
REPORT TYPE FRA
DRG. No. 8 A

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

Half Drain Time : 1221 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	58.696	0.496	0.0	2.9	2.9	153.6	O K
30 min Summer	58.872	0.672	0.0	2.9	2.9	208.1	O K
60 min Summer	59.063	0.863	0.0	3.1	3.1	267.3	O K
120 min Summer	59.256	1.056	0.0	3.3	3.3	326.9	O K
180 min Summer	59.357	1.157	0.0	3.4	3.4	358.2	O K
240 min Summer	59.419	1.219	0.0	3.4	3.4	377.4	O K
360 min Summer	59.498	1.298	0.0	3.5	3.5	402.1	O K
480 min Summer	59.540	1.340	0.0	3.6	3.6	415.1	O K
600 min Summer	59.561	1.361	0.0	3.6	3.6	421.4	O K
720 min Summer	59.567	1.367	0.0	3.6	3.6	423.2	O K
960 min Summer	59.552	1.352	0.0	3.6	3.6	418.6	O K
1440 min Summer	59.500	1.300	0.0	3.5	3.5	402.7	O K
2160 min Summer	59.439	1.239	0.0	3.5	3.5	383.7	O K
2880 min Summer	59.384	1.184	0.0	3.4	3.4	366.7	O K
4320 min Summer	59.275	1.075	0.0	3.3	3.3	332.8	O K
5760 min Summer	59.172	0.972	0.0	3.2	3.2	301.0	O K
7200 min Summer	59.076	0.876	0.0	3.1	3.1	271.2	O K
8640 min Summer	58.985	0.785	0.0	3.0	3.0	243.1	O K
10080 min Summer	58.900	0.700	0.0	2.9	2.9	216.7	O K
15 min Winter	58.757	0.557	0.0	2.9	2.9	172.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	125.952	0.0	157.1	23
30 min Summer	85.839	0.0	214.2	37
60 min Summer	55.837	0.0	278.6	68
120 min Summer	34.983	0.0	349.1	126
180 min Summer	26.151	0.0	391.9	186
240 min Summer	21.135	0.0	422.3	246
360 min Summer	15.668	0.0	469.7	364
480 min Summer	12.647	0.0	505.4	482
600 min Summer	10.701	0.0	512.0	602
720 min Summer	9.329	0.0	514.7	722
960 min Summer	7.505	0.0	520.1	918
1440 min Summer	5.511	0.0	528.8	1146
2160 min Summer	4.037	0.0	725.9	1540
2880 min Summer	3.232	0.0	774.9	1960
4320 min Summer	2.357	0.0	847.9	2772
5760 min Summer	1.886	0.0	903.4	3624
7200 min Summer	1.587	0.0	951.4	4400
8640 min Summer	1.378	0.0	990.9	5192
10080 min Summer	1.224	0.0	1026.2	6048
15 min Winter	125.952	0.0	176.0	23

©1982-2020 Innovyze

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	58.955	0.755	0.0	2.9	2.9	233.9	O K
60 min Winter	59.171	0.971	0.0	3.2	3.2	300.8	O K
120 min Winter	59.392	1.192	0.0	3.4	3.4	369.1	O K
180 min Winter	59.510	1.310	0.0	3.5	3.5	405.6	O K
240 min Winter	59.584	1.384	0.0	3.6	3.6	428.5	O K
360 min Winter	59.682	1.482	0.0	3.7	3.7	458.9	O K
480 min Winter	59.738	1.538	0.0	3.7	3.7	476.4	O K
600 min Winter	59.771	1.571	0.0	3.8	3.8	486.5	O K
720 min Winter	59.788	1.588	0.0	3.8	3.8	491.7	O K
960 min Winter	59.792	1.592	0.0	3.8	3.8	493.1	O K
1440 min Winter	59.740	1.540	0.0	3.7	3.7	477.1	O K
2160 min Winter	59.650	1.450	0.0	3.7	3.7	449.2	O K
2880 min Winter	59.573	1.373	0.0	3.6	3.6	425.1	O K
4320 min Winter	59.408	1.208	0.0	3.4	3.4	374.1	O K
5760 min Winter	59.252	1.052	0.0	3.3	3.3	325.7	O K
7200 min Winter	59.107	0.907	0.0	3.1	3.1	281.0	O K
8640 min Winter	58.974	0.774	0.0	3.0	3.0	239.7	O K
10080 min Winter	58.850	0.650	0.0	2.9	2.9	201.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	85.839	0.0	232.3	37
60 min Winter	55.837	0.0	312.2	66
120 min Winter	34.983	0.0	391.3	124
180 min Winter	26.151	0.0	438.9	182
240 min Winter	21.135	0.0	472.9	240
360 min Winter	15.668	0.0	515.9	358
480 min Winter	12.647	0.0	522.2	472
600 min Winter	10.701	0.0	528.1	588
720 min Winter	9.329	0.0	534.3	700
960 min Winter	7.505	0.0	545.2	920
1440 min Winter	5.511	0.0	552.7	1312
2160 min Winter	4.037	0.0	813.4	1648
2880 min Winter	3.232	0.0	868.0	2108
4320 min Winter	2.357	0.0	929.1	3024
5760 min Winter	1.886	0.0	1013.2	3872
7200 min Winter	1.587	0.0	1064.6	4752
8640 min Winter	1.378	0.0	1110.2	5544
10080 min Winter	1.224	0.0	1149.9	6360

©1982-2020 Innovyze

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)	19.700	Shortest Storm (mins)	15
Ratio R	0.322	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.666

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.333	4	8	0.333

©1982-2020 Innovyze

Model Details

Storage is Online Cover Level (m) 60.600

Cellular Storage Structure

Invert Level (m) 58.200 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	326.0	0.0	1.300	326.0	0.0
0.100	326.0	0.0	1.400	326.0	0.0
0.200	326.0	0.0	1.500	326.0	0.0
0.300	326.0	0.0	1.600	326.0	0.0
0.400	326.0	0.0	1.601	0.0	0.0
0.500	326.0	0.0	1.800	0.0	0.0
0.600	326.0	0.0	1.900	0.0	0.0
0.700	326.0	0.0	2.000	0.0	0.0
0.800	326.0	0.0	2.100	0.0	0.0
0.900	326.0	0.0	2.200	0.0	0.0
1.000	326.0	0.0	2.300	0.0	0.0
1.100	326.0	0.0	2.400	0.0	0.0
1.200	326.0	0.0	2.500	0.0	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0079-3800-2000-3800
Design Head (m)	2.000
Design Flow (l/s)	3.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	79
Invert Level (m)	57.800
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	3.8
Flush-Flo™	0.349	2.9
Kick-Flo®	0.711	2.4
Mean Flow over Head Range	-	2.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

©1982-2020 Innovyze

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.3	1.200	3.0	3.000	4.6	7.000	6.8
0.200	2.8	1.400	3.2	3.500	4.9	7.500	7.1
0.300	2.9	1.600	3.4	4.000	5.2	8.000	7.3
0.400	2.9	1.800	3.6	4.500	5.5	8.500	7.5
0.500	2.9	2.000	3.8	5.000	5.8	9.000	7.7
0.600	2.7	2.200	4.0	5.500	6.1	9.500	7.9
0.800	2.5	2.400	4.1	6.000	6.4		
1.000	2.8	2.600	4.3	6.500	6.6		

©1982-2020 Innovyze

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

Half Drain Time : 100 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	58.009	0.224	0.0	2.0	2.0	11.7	O K
30 min Summer	58.077	0.292	0.0	2.0	2.0	15.3	O K
60 min Summer	58.133	0.348	0.0	2.0	2.0	18.2	Flood Risk
120 min Summer	58.156	0.371	0.0	2.0	2.0	19.3	Flood Risk
180 min Summer	58.153	0.368	0.0	2.0	2.0	19.2	Flood Risk
240 min Summer	58.141	0.356	0.0	2.0	2.0	18.6	Flood Risk
360 min Summer	58.114	0.329	0.0	2.0	2.0	17.2	Flood Risk
480 min Summer	58.081	0.296	0.0	2.0	2.0	15.4	O K
600 min Summer	58.046	0.261	0.0	2.0	2.0	13.6	O K
720 min Summer	58.015	0.230	0.0	2.0	2.0	12.0	O K
960 min Summer	57.963	0.178	0.0	2.0	2.0	9.3	O K
1440 min Summer	57.896	0.111	0.0	2.0	2.0	5.8	O K
2160 min Summer	57.864	0.079	0.0	1.7	1.7	4.1	O K
2880 min Summer	57.851	0.066	0.0	1.4	1.4	3.5	O K
4320 min Summer	57.838	0.053	0.0	1.0	1.0	2.8	O K
5760 min Summer	57.832	0.047	0.0	0.9	0.9	2.4	O K
7200 min Summer	57.827	0.042	0.0	0.7	0.7	2.2	O K
8640 min Summer	57.824	0.039	0.0	0.6	0.6	2.0	O K
10080 min Summer	57.821	0.036	0.0	0.6	0.6	1.9	O K
15 min Winter	58.038	0.253	0.0	2.0	2.0	13.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	125.952	0.0	12.9	17
30 min Summer	85.839	0.0	17.6	32
60 min Summer	55.837	0.0	23.0	60
120 min Summer	34.983	0.0	28.8	96
180 min Summer	26.151	0.0	32.3	130
240 min Summer	21.135	0.0	34.8	164
360 min Summer	15.668	0.0	38.7	234
480 min Summer	12.647	0.0	41.7	302
600 min Summer	10.701	0.0	44.1	364
720 min Summer	9.329	0.0	46.1	426
960 min Summer	7.505	0.0	49.5	542
1440 min Summer	5.511	0.0	54.5	766
2160 min Summer	4.037	0.0	59.9	1104
2880 min Summer	3.232	0.0	64.0	1468
4320 min Summer	2.357	0.0	70.0	2204
5760 min Summer	1.886	0.0	74.6	2936
7200 min Summer	1.587	0.0	78.5	3640
8640 min Summer	1.378	0.0	81.8	4312
10080 min Summer	1.224	0.0	84.7	5128
15 min Winter	125.952	0.0	14.5	17

©1982-2017 XP Solutions

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	58.117	0.332	0.0	2.0	2.0	17.3	Flood Risk
60 min Winter	58.182	0.397	0.0	2.0	2.0	20.7	Flood Risk
120 min Winter	58.207	0.422	0.0	2.0	2.0	22.0	Flood Risk
180 min Winter	58.201	0.416	0.0	2.0	2.0	21.7	Flood Risk
240 min Winter	58.184	0.399	0.0	2.0	2.0	20.8	Flood Risk
360 min Winter	58.141	0.356	0.0	2.0	2.0	18.6	Flood Risk
480 min Winter	58.092	0.307	0.0	2.0	2.0	16.0	O K
600 min Winter	58.035	0.250	0.0	2.0	2.0	13.0	O K
720 min Winter	57.987	0.202	0.0	2.0	2.0	10.6	O K
960 min Winter	57.915	0.130	0.0	2.0	2.0	6.8	O K
1440 min Winter	57.866	0.081	0.0	1.7	1.7	4.2	O K
2160 min Winter	57.847	0.062	0.0	1.3	1.3	3.2	O K
2880 min Winter	57.838	0.053	0.0	1.0	1.0	2.8	O K
4320 min Winter	57.829	0.044	0.0	0.8	0.8	2.3	O K
5760 min Winter	57.824	0.039	0.0	0.6	0.6	2.0	O K
7200 min Winter	57.820	0.035	0.0	0.5	0.5	1.8	O K
8640 min Winter	57.817	0.032	0.0	0.4	0.4	1.7	O K
10080 min Winter	57.815	0.030	0.0	0.4	0.4	1.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	85.839	0.0	19.8	32
60 min Winter	55.837	0.0	25.8	60
120 min Winter	34.983	0.0	32.3	108
180 min Winter	26.151	0.0	36.2	138
240 min Winter	21.135	0.0	39.0	178
360 min Winter	15.668	0.0	43.4	254
480 min Winter	12.647	0.0	46.7	328
600 min Winter	10.701	0.0	49.4	390
720 min Winter	9.329	0.0	51.7	448
960 min Winter	7.505	0.0	55.4	552
1440 min Winter	5.511	0.0	61.1	752
2160 min Winter	4.037	0.0	67.1	1108
2880 min Winter	3.232	0.0	71.6	1468
4320 min Winter	2.357	0.0	78.4	2204
5760 min Winter	1.886	0.0	83.6	2920
7200 min Winter	1.587	0.0	87.9	3672
8640 min Winter	1.378	0.0	91.7	4296
10080 min Winter	1.224	0.0	94.9	5096

©1982-2017 XP Solutions

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)	19.700	Shortest Storm (mins)	15
Ratio R	0.322	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.055

Time (mins) From:	To:	Area (ha)
0	4	0.055

©1982-2017 XP Solutions

Model Details

Storage is Online Cover Level (m) 58.400

Infiltration Blanket Structure

Infiltration Coefficient Base (m/hr)	0.00000	Diameter/Width (m)	5.8
Safety Factor	2.0	Length (m)	30.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	57.785		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0076-2000-0425-2000
Design Head (m)	0.425
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	76
Invert Level (m)	57.785
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.425	2.0
Flush-Flo™	0.130	2.0
Kick-Flo®	0.302	1.7
Mean Flow over Head Range	-	1.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	2.0	1.200	3.2	3.000	4.9	7.000	7.4
0.200	1.9	1.400	3.4	3.500	5.3	7.500	7.7
0.300	1.7	1.600	3.7	4.000	5.6	8.000	7.9
0.400	1.9	1.800	3.9	4.500	5.9	8.500	8.2
0.500	2.2	2.000	4.1	5.000	6.3	9.000	8.4
0.600	2.3	2.200	4.3	5.500	6.6	9.500	8.7
0.800	2.7	2.400	4.4	6.000	6.9		
1.000	3.0	2.600	4.6	6.500	7.1		

©1982-2017 XP Solutions

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

Half Drain Time : 1417 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	57.883	0.483	0.0	2.5	2.5	136.8	O K
30 min Summer	58.056	0.656	0.0	2.5	2.5	185.7	O K
60 min Summer	58.244	0.844	0.0	2.5	2.5	238.9	O K
120 min Summer	58.435	1.035	0.0	2.6	2.6	293.0	O K
180 min Summer	58.536	1.136	0.0	2.7	2.7	321.7	O K
240 min Summer	58.600	1.200	0.0	2.7	2.7	339.7	O K
360 min Summer	58.684	1.284	0.0	2.8	2.8	363.5	O K
480 min Summer	58.732	1.332	0.0	2.9	2.9	377.0	O K
600 min Summer	58.759	1.359	0.0	2.9	2.9	384.6	O K
720 min Summer	58.772	1.372	0.0	2.9	2.9	388.4	O K
960 min Summer	58.773	1.373	0.0	2.9	2.9	388.7	O K
1440 min Summer	58.740	1.340	0.0	2.9	2.9	379.3	O K
2160 min Summer	58.682	1.282	0.0	2.8	2.8	362.9	O K
2880 min Summer	58.628	1.228	0.0	2.8	2.8	347.7	O K
4320 min Summer	58.526	1.126	0.0	2.7	2.7	318.9	O K
5760 min Summer	58.433	1.033	0.0	2.6	2.6	292.5	O K
7200 min Summer	58.345	0.945	0.0	2.5	2.5	267.5	O K
8640 min Summer	58.261	0.861	0.0	2.5	2.5	243.8	O K
10080 min Summer	58.180	0.780	0.0	2.5	2.5	220.8	O K
15 min Winter	57.943	0.543	0.0	2.5	2.5	153.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	125.952	0.0	139.6	23
30 min Summer	85.839	0.0	190.4	38
60 min Summer	55.837	0.0	247.9	68
120 min Summer	34.983	0.0	310.4	126
180 min Summer	26.151	0.0	348.2	186
240 min Summer	21.135	0.0	375.3	246
360 min Summer	15.668	0.0	415.5	364
480 min Summer	12.647	0.0	421.8	484
600 min Summer	10.701	0.0	423.6	602
720 min Summer	9.329	0.0	424.2	722
960 min Summer	7.505	0.0	424.2	960
1440 min Summer	5.511	0.0	423.5	1202
2160 min Summer	4.037	0.0	645.1	1584
2880 min Summer	3.232	0.0	688.9	1992
4320 min Summer	2.357	0.0	735.6	2816
5760 min Summer	1.886	0.0	803.6	3640
7200 min Summer	1.587	0.0	845.5	4472
8640 min Summer	1.378	0.0	881.2	5280
10080 min Summer	1.224	0.0	912.3	6144
15 min Winter	125.952	0.0	156.5	23

©1982-2020 Innovyze

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	58.137	0.737	0.0	2.5	2.5	208.6	O K
60 min Winter	58.349	0.949	0.0	2.5	2.5	268.6	O K
120 min Winter	58.566	1.166	0.0	2.7	2.7	330.2	O K
180 min Winter	58.684	1.284	0.0	2.8	2.8	363.5	O K
240 min Winter	58.759	1.359	0.0	2.9	2.9	384.8	O K
360 min Winter	58.861	1.461	0.0	3.0	3.0	413.6	O K
480 min Winter	58.922	1.522	0.0	3.0	3.0	430.9	O K
600 min Winter	58.960	1.560	0.0	3.1	3.1	441.6	O K
720 min Winter	58.982	1.582	0.0	3.1	3.1	447.9	O K
960 min Winter	58.999	1.599	0.0	3.1	3.1	452.6	O K
1440 min Winter	58.972	1.572	0.0	3.1	3.1	444.9	O K
2160 min Winter	58.900	1.500	0.0	3.0	3.0	424.7	O K
2880 min Winter	58.825	1.425	0.0	2.9	2.9	403.3	O K
4320 min Winter	58.673	1.273	0.0	2.8	2.8	360.5	O K
5760 min Winter	58.531	1.131	0.0	2.7	2.7	320.3	O K
7200 min Winter	58.398	0.998	0.0	2.5	2.5	282.5	O K
8640 min Winter	58.270	0.870	0.0	2.5	2.5	246.3	O K
10080 min Winter	58.144	0.744	0.0	2.5	2.5	210.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	85.839	0.0	201.2	37
60 min Winter	55.837	0.0	277.5	66
120 min Winter	34.983	0.0	347.8	124
180 min Winter	26.151	0.0	390.2	182
240 min Winter	21.135	0.0	418.3	242
360 min Winter	15.668	0.0	427.8	358
480 min Winter	12.647	0.0	431.3	474
600 min Winter	10.701	0.0	433.8	588
720 min Winter	9.329	0.0	435.9	702
960 min Winter	7.505	0.0	440.4	926
1440 min Winter	5.511	0.0	447.8	1344
2160 min Winter	4.037	0.0	722.6	1672
2880 min Winter	3.232	0.0	771.6	2136
4320 min Winter	2.357	0.0	773.4	3068
5760 min Winter	1.886	0.0	900.4	3976
7200 min Winter	1.587	0.0	947.1	4832
8640 min Winter	1.378	0.0	986.6	5704
10080 min Winter	1.224	0.0	1021.9	6560

©1982-2020 Innovyze

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)	19.700	Shortest Storm (mins)	15
Ratio R	0.322	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.592

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.296	4	8	0.296

©1982-2020 Innovyze

Model Details

Storage is Online Cover Level (m) 59.400

Cellular Storage Structure

Invert Level (m) 57.400 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	298.0	0.0	1.300	298.0	0.0
0.100	298.0	0.0	1.400	298.0	0.0
0.200	298.0	0.0	1.500	298.0	0.0
0.300	298.0	0.0	1.600	298.0	0.0
0.400	298.0	0.0	1.601	0.0	0.0
0.500	298.0	0.0	1.800	0.0	0.0
0.600	298.0	0.0	1.900	0.0	0.0
0.700	298.0	0.0	2.000	0.0	0.0
0.800	298.0	0.0	2.100	0.0	0.0
0.900	298.0	0.0	2.200	0.0	0.0
1.000	298.0	0.0	2.300	0.0	0.0
1.100	298.0	0.0	2.400	0.0	0.0
1.200	298.0	0.0	2.500	0.0	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0075-3100-1675-3100
Design Head (m)	1.675
Design Flow (l/s)	3.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	57.325
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.675	3.1
Flush-Flo™	0.327	2.5
Kick-Flo®	0.667	2.0
Mean Flow over Head Range	-	2.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

©1982-2020 Innovyze

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.0	1.200	2.7	3.000	4.1	7.000	6.0
0.200	2.4	1.400	2.8	3.500	4.4	7.500	6.2
0.300	2.5	1.600	3.0	4.000	4.6	8.000	6.4
0.400	2.5	1.800	3.2	4.500	4.9	8.500	6.6
0.500	2.4	2.000	3.4	5.000	5.2	9.000	6.8
0.600	2.3	2.200	3.5	5.500	5.4	9.500	7.0
0.800	2.2	2.400	3.7	6.000	5.6		
1.000	2.4	2.600	3.8	6.500	5.8		

©1982-2020 Innovyze

Appendix 11

Drainage Maintenance Schedule

Drainage Maintenance Schedule

The Civil Engineering Practice
11 Tungsten Building
George Street
Fishersgate
Sussex
BN41 1RA
01273 424424
reception@civil.co.uk
www.civil.co.uk

Project	**Phase 2 Norton Heights, Lovedean**
Project Number	**23246**

By S Burgess

Date January 2020

1 Schedule of Maintenance

1.1 Once appointed the Contractor will prepare a site specific method statement for the control of silt and other pollutants during construction. CIRIA Report C532, Control of water pollution from construction sites, provides further guidance on this.

1.2 The Contractor will maintain the proposed drainage system during construction and until the handing over of the site.

1.3 Upon completion management of the shared drainage facilities (where not adopted) will be passed on to a Management Company appointed by the developer on behalf of the new residents.

1.4 In the event that the Management Company becomes unable to discharge its duties within two years of first appointment the developer will endeavour to appoint an alternative on behalf of the residents.

1.5 Maintenance of individual property drainage connections is the responsibility of the individual property owners.

1.6 The following maintenance schedule details the typical tasks to be undertaken at different intervals.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Remove sediment and debris from silt trap chambers, channel drains and inlet chambers	6 monthly
	Litter and debris removal – catch pits	Monthly or as required
	Surface and foul water pipework – jetting / rodding	Every 2 years or as required
	Manage other vegetation and remove nuisance plants – aesthetics	As required
	Visual inspection of permeable paving for defects and settlement	Annually
	Sweeping / brushing of permeable paving	Every 2 years

ISO 9001 : 2008 REGISTERED
Cert No. 14127180

Maintenance Schedule	Required Action	Frequency
Corrective Maintenance	Remove debris / blockages to silt traps / channel drains	As required
	Repairs to access chambers / manhole covers	As required
	Replace any broken permeable blocks / surface, remedial works to any depressions or rutting	As required
	Inspect inlet, outlet from downpipe and gullies for blockages, standing water and clear	As required

Indicative Schedule of Maintenance for the Proposed Drainage System

2 Financing

2.1 The regular maintenance of all private drainage, channels, gutters, rainwater pipes and connections will be the responsibility of the individual homeowner.

2.2 The regular and corrective maintenance of all shared elements of the drainage system will be managed and funded through the Management Company on behalf of the Residents.

Inspection / Action Required	Gullies, Channels and Gutters	Catchpits	Permeable Surface	Surface Water Pipework
After leaf fall in Autumn	✓	✓		
6 Months	✓	✓	✓	
1 Year			✓	
2 Years				✓
When alarm indicates				

Drainage System Maintenance Summary