Flood Risk and Drainage
Site Appraisal
February 2020

EAS

Land off Oakington Road

Cottenham, Cambridgeshire

Christ's College Cambridge

EAS

Document History

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A	Client Draft	ML	SA	SA	14/02/2020
B	Final	ML	SA	SA	24/02/2020
C					
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E					

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Contents

1 Introduction

1.1 EAS has been commissioned by Christ's College Cambridge to prepare a Site Appraisal for land north of Oakington Road, Cottenham, Cambridgeshire. This document has been prepared to inform site representations to the Greater Cambridge Local Plan Regulation 18 Issues and Options consultation.

1.2 The contents of this report form a preliminary assessment of the site in terms of flood risk and drainage.

1.3 The site is located to the south of Oakington Road, in Cottenham to the south west of the main settlement. The site is surrounded by agricultural land to the west with residential areas to the north, east and south.

1.4 The 4.22ha site is currently greenfield and a location plan is contained within Appendix A. For the purposes of this report it is proposed that the site be developed with around 70 residential dwellings with associated infrastructure and open space.

1.5 The site falls wholly within Flood Zone 1 of the Environment Agency (EA) Flood Zone maps. It is also shown to be at very low risk of surface water flooding with some very minor areas at low risk of surface water flooding. This document will review the above risks further and provide advice to support the site representation and future masterplanning of the site.

1.6 This report is based on EA Flood Maps, South Cambs Strategic Flood Risk Assessment (SFRA), Cambridgeshire County Council Surface Water Management Plan (SWMP), BGS geological information and Anglian Water sewer records.

1.7 The report is set out as follows:

- Section 2 – sets out the relevant flood risk and drainage policy background.
- Section 3 – reviews and discusses the flood risk to the development and the future development drainage.
- Section 4 – provides a review of surface water drainage solutions
- Section 5 – provides a brief review of foul drainage solutions.
- Section 6 – summarises the findings of the report.

2 Policy Background

Introduction

2.1 This section sets out the current local policy and examines the local strategic documents for flood risk and drainage matters.

Adopted South Cambridgeshire Local Plan (2018)

Policy CC/9: Managing Flood Risk

2.2 The policy states that:

1. "In order to minimise flood risk, development will only be permitted where:

    a. The sequential test and exception tests established by the National Planning Policy Framework demonstrate the development is acceptable (where required).

    b. Floor levels are 300mm above the 1 in 100 year flood level plus an allowance for climate change where appropriate and practicable also 300mm above adjacent highway levels.

    c. Suitable flood protection/mitigation measures are incorporated as appropriate to the level and nature of flood risk, which can be satisfactorily implemented to ensure safe occupation, access and egress. Management and maintenance plans will be required, including arrangements for adoption by any public authority of statutory undertaker and any other arrangements to secure the operation of the scheme throughout its lifetime;

    d. There would be no increase to flood risk elsewhere, and opportunities to reduce flood risk elsewhere have been explored and taken (where appropriate), including limiting discharge of surface water (post development volume and peak rate) to natural greenfield rates or low, and

    e. The destination of the discharge obeys the following priority order:

        I. Firstly, to the ground via infiltration;

        II. Then, to a water body;

        III. Then, to a surface water sewer

        IV. Discharge to a foul water or combined sewer is unacceptable.

2. Site specific Flood Risk Assessments (FRAs) appropriate to the scale and nature of the development and the risks involved, and which takes account of future climate change, will be required for the following:

    f. Development proposals over 1ha in size;

    g. Any other development proposals in flood zones 2 and 3;

    h. Any other development proposals in flood zone 1 where evidence, in particular the Strategic Flood Risk Assessment or Surface Water Management Plans, indicates there

are records of historic flooding or other sources of flooding, and/or a need for more detailed analysis.

3. FRAs will need to meet national standards and local guidance (including recommendations of the South Cambridgeshire and Cambridge City Strategic Flood Risk Assessment (2010) and the Phase 1 and 2 Water Cycle Strategy or successor documents)."

Policy CC/8: Sustainable Drainage Systems

2.3 The policy is as follows:

"Development proposals must incorporate appropriate sustainable surface water drainage systems (SuDS) appropriate to the nature of the site. Development proposals will be required to demonstrate that:

a. Surface water drainage schemes comply with the Sustainable Drainage Systems: Non-statutory technical standards for sustainable drainage systems and the Cambridgeshire Flood and Water Supplementary Planning Document or successor documents;

b. Opportunities have been taken to integrate sustainable drainage with the development, create amenity, enhance biodiversity, and contribute to a network of green (and blue) open space;

c. Surface water is managed close to its source and on the surface where it practicable to do so;

d. Maximum use has been made of low land take drainage measures, such as rain water recycling, green roofs, permeable surfaces and water butts;

e. Appropriate pollution control measures have been incorporated, including multiple component treatment trains; and

f. Arrangements have been established for the whole life management and maintenance of surface water drainage systems."

Policy CC/7: Water Quality

2.4 The policy states:

1. "In order to protect and enhance water quality, all development proposals must demonstrate that:

a. There are adequate water supply sewerage and land drainage systems (including water sources, water and waste water infrastructure) to serve the whole development, or an agreement with the relevant service provide to ensure the proivision of the necessary infrastructure prior to the occupation of the development. Where development is being phased, each phase must demonstrate sufficient water supply and waste water conveyance, treatment and discharge capacity;

b. The quality of ground, surface or water bodies will not be harmed and opportunities have been explored and taken for improvements to water quality, including renaturalisation of river morphology, and ecology;

c. Appropriate consideration is given to sources of pollution, and appropriate Sustainable Drainage Systems (SuDS) measures incorporated to protect water quality from polluted surface water runoff.

2. Foul drainage to a public sewer should be provided wherever possible, but where it is demonstrated that it is not feasible, alternative facilities must not pose unacceptable risk to water quality or quantity."

South Cambridgeshire and Cambridge City Level 1 Strategic Flood Risk Assessment (SFRA) September 2010

2.5 The SFRA objectives are to:

- Assess the risks from all forms of flooding affecting the SCDS and CCC area;
- Provide a reference and policy document to inform the preparation of future LDF documents;
- Ensure that SCDC and CCC meet their obligations under the current PPS25 and Local Development Framework Policy guidelines and standards;
- Inform the Sustainability Appraisal so that flood risk is taken into account when considering options and in the preparation of land use policies;
- Provide a sufficient level of detail to allow SCDC and CCC to undertake the Sequential Test;
- Advise and inform private and commercial developers of their obligations under PPS25 in relation to sustainable development and flood risk.

2.6 Appendix C2 and C2.2 illustrate that there is high potential for infiltration at this site.

2.7 Appendix C3 confirms that the site is not within a Source Protection Zone.

2.8 Appendix D1.2 shows that the site is not at risk of fluvial flooding.

2.9 Tables 4a and 4b from the SFRA contain historic flood records from sources including rivers, highway drainage and sewers and there are no records of historic flooding within the site and one record of sewer flooding within Cottenham but Appendix B3.2 shows that this is occurred approximately 1km east of the site.

2.10 In summary no evidence is presented within the SFRA which indicates that the development site is at a risk of flooding from any source. The local geology has been identified to have high potential for infiltration.

Cambridgeshire County Council Surface Water Management Plan (SWMP) August 2011 and County Wide Update (2014)

2.11 The SWMP was originally published in 2011 and was updated in 2014.

2.12 The objectives of the SWMP are to:

- Engage with partners and stakeholders

- Map historical flood incident data
- Map surface water influenced flooding locations
- Identify areas at risk of surface water flooding referred to as “wetspots”
- Identify measures, assess options and confirm preferred options to mitigate against surface water flooding in the prioritised “wetspots”
- Make recommendations for next steps

2.13 The update was to ensure that flooding incidents between 2011 and 2014 were taken in to consideration due to instances of surface water flooding across the County.

3. Flood Risk Assessment

3.1 A copy of the Environment Agency's current Flood Map included in Appendix B shows the development site to be located wholly within Flood Zone 1, and therefore deemed to be at a low risk of fluvial flooding.

3.2 The NPPF requires that for a development site located within Flood Zone 1 which is larger than one hectare, an FRA must accompany the planning application which demonstrates that the proposals would not be exposed to an unsatisfactory level of flood risk, and would not result in an increase in the existing level of flood risk to the surrounding area.

3.3 In addition to the requirements of the NPPF and as a result of changes to the roles of Lead Flood Authorities, from 15 April 2015 all major applications (over 10 dwellings) submitted to the Lead Local Flood Authority (LLFA) which for this site is Cambridgeshire County Council and must include a 'Surface Water Drainage Strategy' which will set out the appropriateness of SuDS to manage surface water run-off, including the provision of the maintenance for the lifetime of the development which they serve. Major applications which do not meet this requirement will not be made valid.

3.4 The site is not within an area managed by an Internal Drainage Board (IDB).

Local Policy

3.5 From a review of the South Cambridgeshire and Cambridge City Council SFRA undertaken in Section 2 of this report, there were no sources of flooding identified which would impact on the development site nor historic flooding incidents associated with the site.

Sources of Flooding

3.6 **Fluvial Watercourses:** A copy of the Environment Agency's Flood Map for the area is included in Appendix B. The mapping shows that the site is located within Flood Zone 1 and therefore deemed to be at a low risk of fluvial flooding; less than a 0.1% annual probability of flooding from fluvial sources.

3.7 There are no known ordinary watercourses within or adjacent to the site.

3.8 **Groundwater:** The site has a bedrock of Woburn Sands formation - Sandstone and no superficial deposits. The area is shown to have a high groundwater vulnerability in DEFRA's Magic Map.

3.9 Appendix C2 and C2.2 of the SFRA show that there is high potential for infiltration whilst appendix B3 confirms that there are no recorded incidents of groundwater flooding at this location. The Flood Incidents Register contained within the 2015 Cambridgeshire County Council Surface Water Management Plan also shows include any records of groundwater flooding.

3.10 BGS borehole data show three records within close proximity to the site. Of the three records only 1 borehole which is located approximately 300m east of the site's southern boundary, struck ground water at 1.2m below ground, although no resting water level or any other supporting information was supplied. Therefore it is strongly recommended that on site testing is carried out to determine the risk of seasonal variations in groundwater. As such, the risk of groundwater flooding at the site is considered to be medium as

groundwater is relatively high in the area and seasonal fluctuations are unknown however, there are no recorded incidents of groundwater flooding within the SFRA.

3.11 **Sewer Flooding:** Anglian Water sewer records do not show any sewers within the site however there is a 150mm diameter foul sewer which runs along the northern boundary of the site. Table 4b of the SFRA shows one incident of sewer flooding within Cottenham but this is located approximately 1km to the east of the site. Due to the lack of sewers within the vicinity and the absence of any recorded incidents of sewer flooding within close proximity to the site, sewer flooding is not considered to be a significant flood risk to the development site.

3.12 **Surface Water/Overland Flow:** The EA surface water flood map shows the site to be at very low risk of flooding from surface water with some minor isolated areas of low risk low depth flood risk. These are likely to be very minor topographic low points within the site which would mitigated against by incorporating sustainable drainage systems (SuDS) into the design of the development. The surface water flood map has been included in Appendix C.

3.13 It is important that an effective surface water drainage system is included in the proposed development to ensure surface water runoff does not pose a significant flood risk to the development. This has been discussed further in the next section.

4 Surface Water Drainage Assessment

4.1 The NPPF states within Flood Zone 1, “developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques (SuDS)”.

4.2 SuDS mimic the natural drainage system and provide a method of surface water drainage which can decrease the quantity of water discharged, and hence reduce the risk of flooding. In addition to reducing flood risk, these features can improve water quality and provide biodiversity and amenity benefits.

4.3 The SuDS management train incorporates a hierarchy of techniques and considers all three SUDS criteria of flood reduction, pollution reduction, and landscape and wildlife benefit. In decreasing order of preference, the preferred means of disposal of surface water runoff is:

- Discharge to ground.
- Discharge to a surface water body.
- Discharge to a surface water sewer.
- Discharge to a combined sewer.

4.4 The philosophy of SUDS is to replicate as closely as possible the natural drainage from a site pre-development and to treat runoff to remove pollutants, resulting in a reduced impact on the receiving watercourses. The benefits of this approach are as follows:

- Reducing runoff rates, thus reducing the flood risk downstream.
- Reducing pollutant concentrations, thus protecting the quality of the receiving water body.
- Groundwater recharge.
- Contributing to the enhanced amenity and aesthetic value of development areas.
- Providing habitats for wildlife in developed areas, and opportunity for biodiversity enhancement.

Site-Specific SuDS

4.5 The various SuDS methods need to be considered in relation to site-specific constraints. Several SuDS options are available to reduce or temporarily hold back the discharge of surface water runoff. Table 1 outlines the constraints and opportunities to each of the SuDS devices in accordance with the hierarchical approach outlined in The SuDS Manual CIRIA C753 It also indicates what could and could not be incorporated within the development, based upon site-specific criteria.

Device	Description	Constraints / Comments	Appropriate
Rainwater harvesting (source control)	Reduces the annual average rate of runoff from the site by reusing water for non-potable uses e.g. toilet flushing, recycling processes.	There is potential for use within the site. If community or domestic rain water harvesting is not suitable, simple systems such as water butts can be included to reduce mains water consumption for irrigation.	Yes
Living roofs (source control)	Provide soft landscaping at roof level which reduces surface water runoff.	May be suitable depending on design of buildings.	Potentially
Infiltration devices & Soakaways (source control)	Store runoff and allow water to percolate into the ground via natural infiltration.	Highly likely to be suitable subject to infiltration testing in accordance with BRE365.	Yes
Pervious surfaces (source control)	Storm water is allowed to infiltrate through the surface into a storage layer, from which it can either infiltrate and/or slowly release to sewers.	Permeable paving can be utilised across the site for parking and road surfaces.	Yes
Swales (permeable conveyance)	Broad shallow channels that convey / store runoff, and allow infiltration (ground conditions permitting).	Swales can be utilised within the site for conveyance and infiltration.	Yes
Filter drains & perforated pipes (permeable conveyance)	Trenches filled with granular materials (which are designed to take flows from adjacent impermeable areas) that convey runoff while allowing infiltration.	Highly likely to be suitable subject to infiltration testing in accordance with BRE365.	Yes
Infiltration basins (end of pipe treatment)	Depressions in the surface designed to store runoff and allow infiltration.	Highly likely to be suitable subject to infiltration testing in accordance with BRE365.	Yes
Wet ponds & constructed wetlands (end of pipe treatment)	Provide water quality treatment & temporary storage above the permanent water level.	An infiltration based design will be utilised for the site.	No
Attenuation Underground (end of pipe treatment)	Oversized pipes or geo-cellular tanks designed to store water below ground level.	An infiltration based design will be utilised for the site.	No

Table 1: Sustainable Drainage Methods

4.6 Priority must be given to features that provide multiple benefits such as multi-functional spaces, biodiversity, amenity, water quality and reducing water consumption.

4.7 Features such as infiltration basins can provide areas that are dry for most of the year and can be used for recreational activities.

4.8 The site geology is a bedrock of Woburn Sands formation with no superficial deposits (taken from BGS geology mapping) and is therefore likely to be conducive to infiltration methods. Both developments which have been approved to the north of Oakington Road have utilised infiltration drainage based on successful infiltration testing. Site specific infiltration testing will need to be carried out on the site for the purposes of detailed drainage design.

4.9 Unlined permeable paving can be used for private driveways, car parking areas and private access roads. This will provide water quality benefits in addition to providing attenuation.

4.10 All SuDS features will need to remain shallow to avoid seasonal variations of the water table. All features should be designed so that there is at least 1 metre from the bottom of the infiltration device and the maximum likely groundwater level. Site specific testing as discussed in 3.10 will be required to inform the detailed design.

4.11 Cambridgeshire County Council will also consider the adoption of permeable surfaces therefore the main access road could also be permeable if required subject to agreement with the Highway Authority. This should be considered when the stewardship model has been decided upon for the site.

4.12 Previous experience working with Cambridgeshire County Council (CCC) has identified the requirement for source control measures to be included across the site. The use of permeable paving, bioretention areas, green roofs and water butts are all considered to be source control measures and therefore would need to be included in any drainage strategy to satisfy CCC when submitting a planning application.

4.13 An assessment of the volume of storage has been based on the lowest acceptable rate for infiltration of 1×10^{-6} m/s. The specific infiltration rate will need to be determined by site specific infiltration testing in accordance with BRE365 but this assessment provides a worst case scenario for the volume of infiltration testing.

4.14 A MicroDrainage Quick Storage Estimate was carried out to determine the likely storage volume required for a 1 in 100 year (+40% climate change) based on the above infiltration rate. It was assumed that 60% of the site would be impermeable (roofs and hardstanding) for the purpose of this storage estimate, i.e. an impermeable area of 2.53 hectares. This results in a required attenuation volume of 2728m^3. The Quick Storage Estimate parameters and results are included in Appendix D.

5 Foul Water Drainage Assessment

5.1 The Anglian Water records show that there are no public foul water sewers located within the site however there is a 150mm turned 225mm diameter sewer along the northern boundary of the site which flows in an easterly direction. The Anglian Water sewer records have been included in Appendix E.

5.2 Due to the proposed number of units within the site, it would not be suitable to connect to non-mains drainage given the proximity of the public foul sewer.

5.3 Given the approved developments to the north of Oakington Road, it is recommended that consultation with Anglian Water is carried out to determine if it is feasible to connect to the sewer and the level of upgrades required.

6 Summary and Conclusions

6.1 This report has dealt with a proposed residential development of around 70 dwellings with associated facilities and open space. This land is currently greenfield.

6.2 The site falls wholly within Flood Zone 1 of the Environment Agency (EA) Flood Zone maps. There are some very minor isolated areas of low risk-low depth flooding shown within the site but the vast majority is shown to be at very low risk of surface water flooding.

6.3 The following recommendations are made as a result of this assessment in order to demonstrate the feasibility of the proposals at a planning application stage:

A) All sources of flooding have been considered by means of a desktop assessment and the site is wholly within Flood Zone 1 and with some very minor areas of low flood risk which will be mitigated against by installing an effective drainage system across the site.

B) The Strategic Flood Risk Assessment shows that there is high potential for infiltration drainage at the site as the geology is sandstone and recently approved neighbouring developments have been based on infiltration drainage. Therefore, an infiltration strategy will be implemented on site subject to site specific infiltration testing.

C) The SuDS should be integrated in to the development and utilise drainage features that provide multiple benefits and functions including above ground features such as infiltration basins that can be used as recreational space when dry.

D) The surface water drainage strategy should also include features that improve water quality, biodiversity, amenity and habitat creation.

E) Further ground investigation is required to determine seasonal variations in ground water levels as one historic borehole doesn't provide enough information to determine the risk of groundwater flooding fully.

F) Surface water drainage features on the site should are likely to be shallow to ensure that they remain 1 metre above the maximum likely groundwater level.

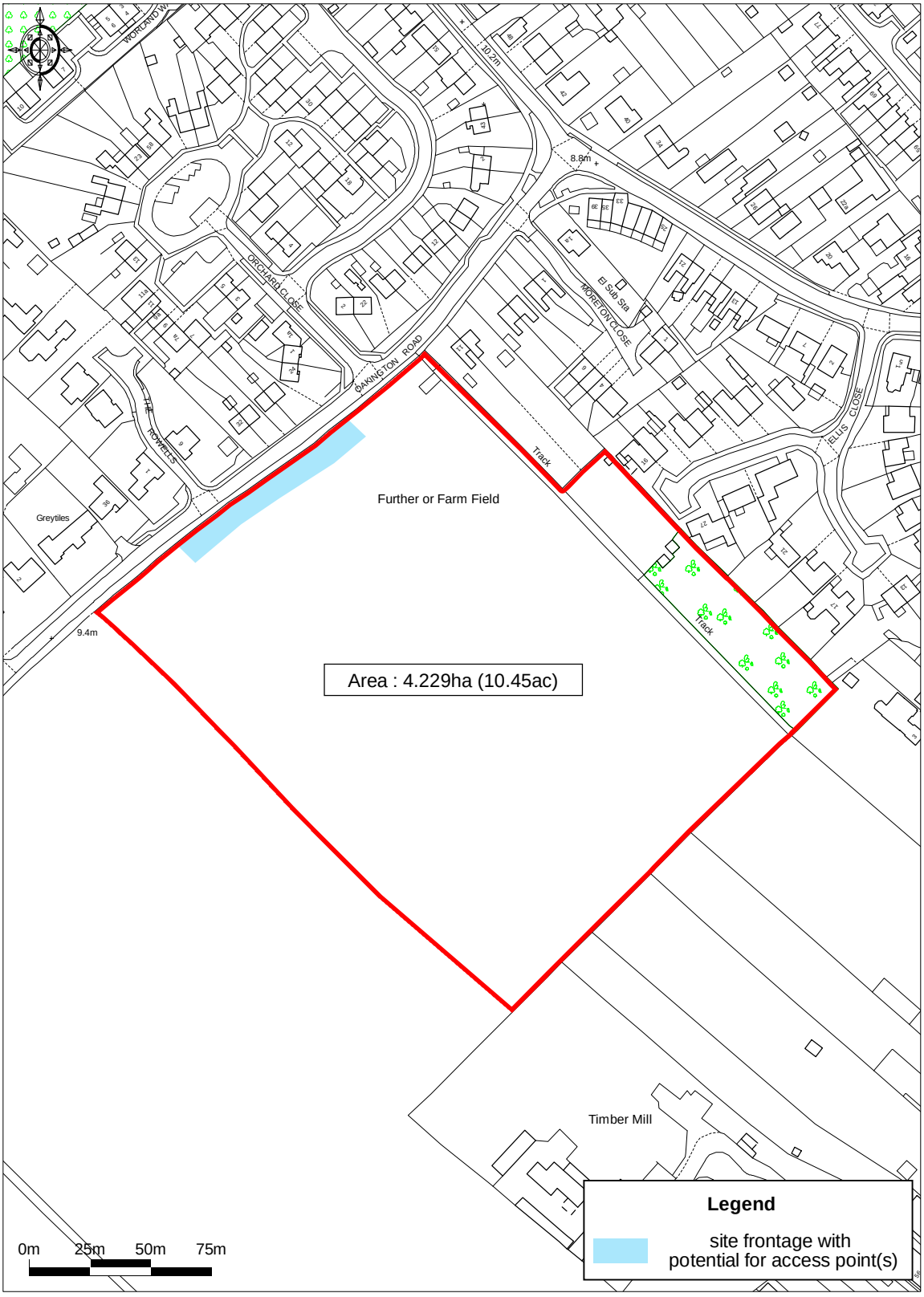
G) The public foul sewer runs to the north of the site in an easterly direction. It is strongly recommended that consultation with Anglian Water is undertaken to determine if the sewer is suitable for connection and the level of upgrades that are required, where necessary.

6.4 In conclusion, this site is suitable for residential development from a flood risk and drainage perspective as the site falls wholly within Flood Zone 1 and mostly at very low risk of surface water flooding. It is recommended that ground investigations are carried out to determine seasonal variations in ground water levels. The overall risk of flooding to the site is low with practical and sustainable solutions for both foul and surface water drainage.

Appendices

Appendix: A - Location Plan

Land off Oakington Road, Cottenham



Promap®
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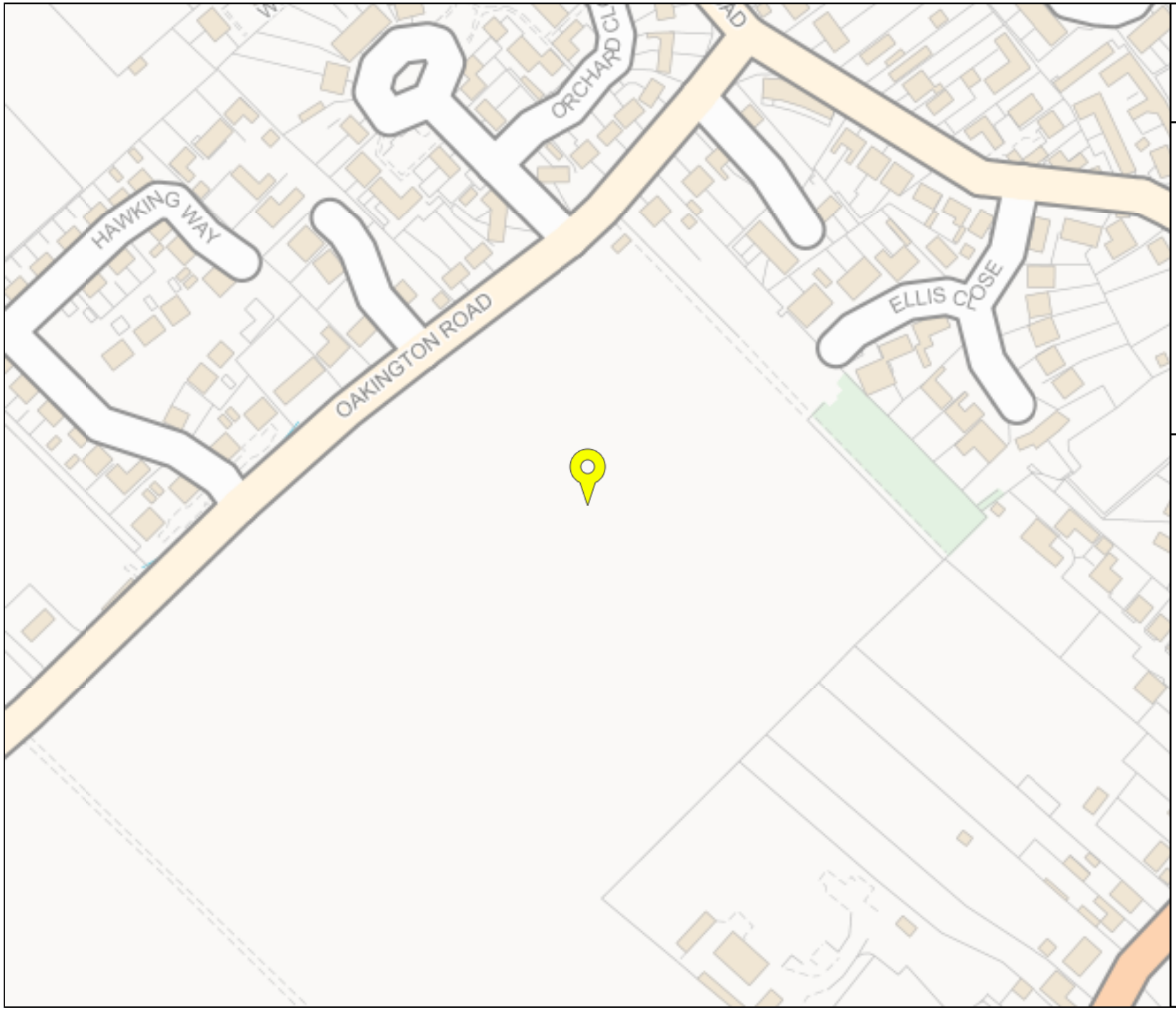
Drawing Number : A.42,745a
OS Ref : TL 4466 NW
Date : 25/03/2019

Appendix: B – EA Flood Map for Planning



Environment Agency

Flood map for planning

Your reference
Oakington Rd

Location (easting/northing)
544481/266959

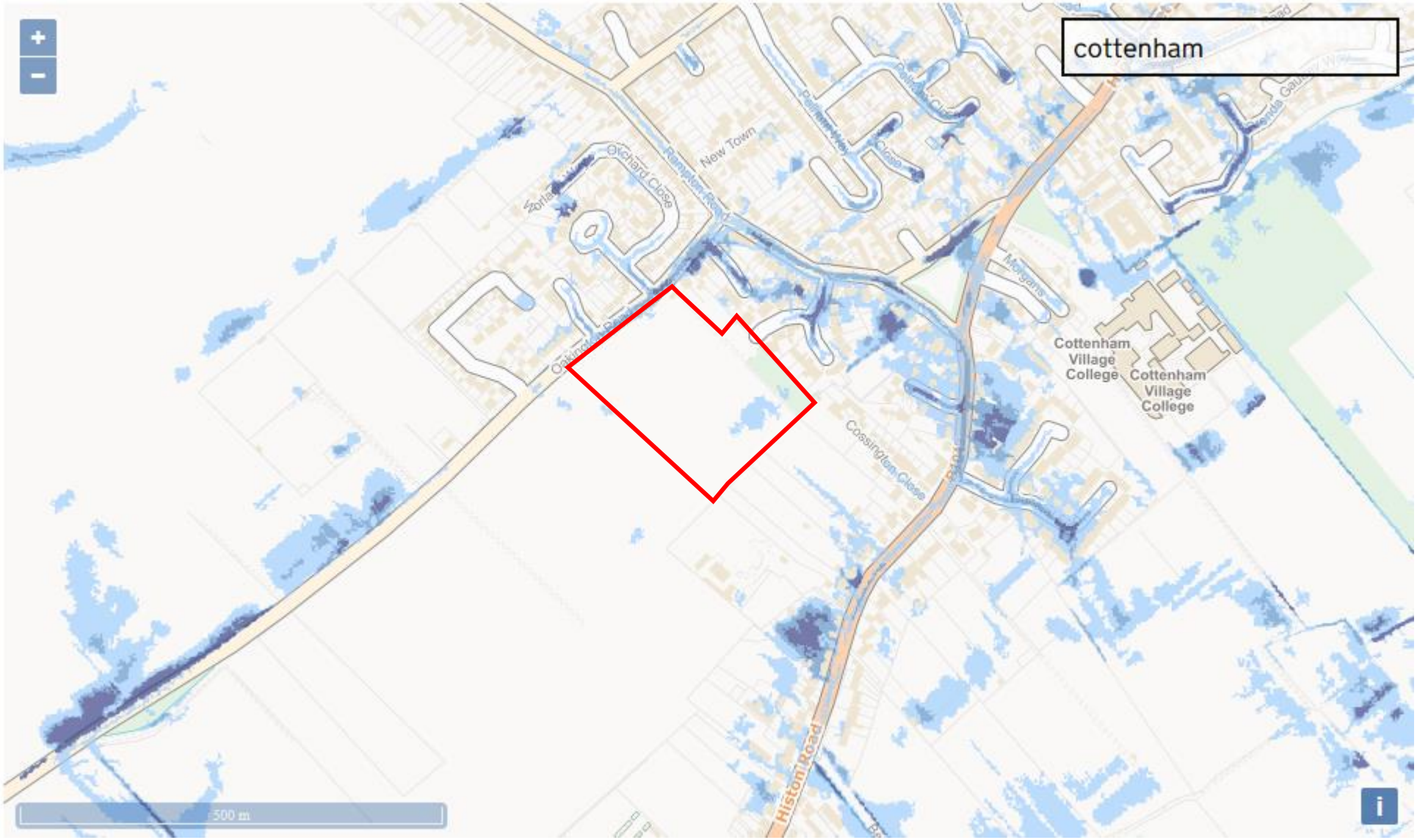
Scale
1:2500

Created
13 Feb 2020 10:05

- Selected point
- Flood zone 3
- Flood zone 3: areas benefitting from flood defences
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Flood storage area

0 20 40 60m

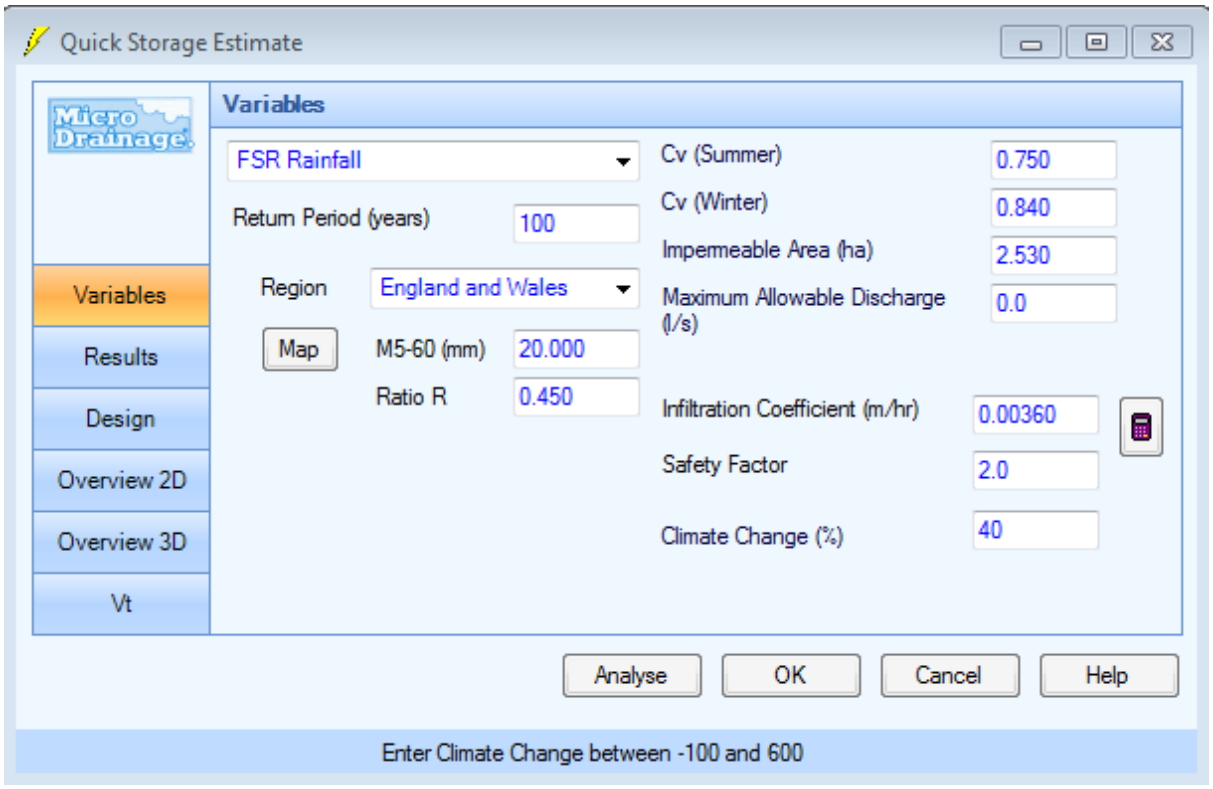
Appendix: C – EA Surface Water Flood Map

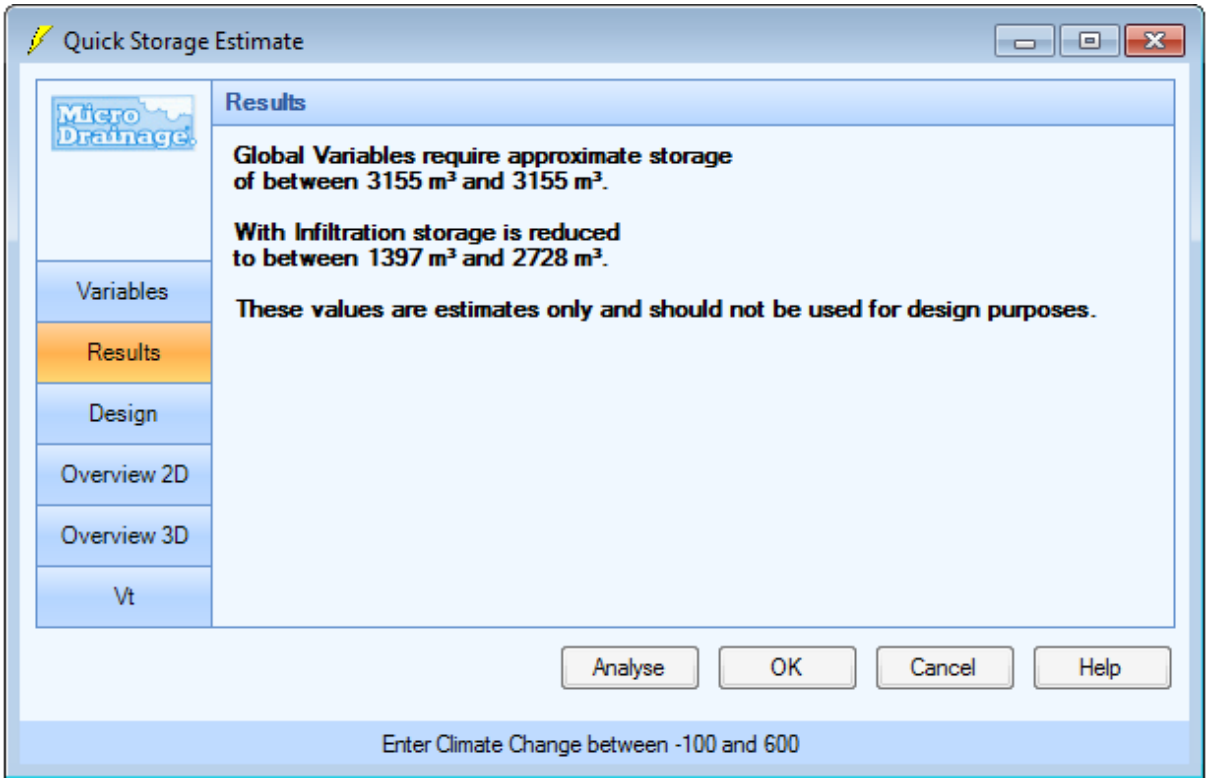


Source: Long Term Flood Risk Map (https://flood-warning-information.service.gov.uk/long-term-flood-risk/map)

Appendix: D – MicroDrainage Quick Storage Estimate

Storage requirements for the 1 in 100 year + 40% climate change event based on the lowest acceptable infiltration rate





Appendix: E – Anglian Water Sewer Records

(c) Crown copyright and database rights 2020 Ordnance Survey 100022432 | Date: 14/02/20 | Scale: 1:1250 | Map Centre: 544537,267030 | Data updated: 03/01/20 | Our Ref: 370027 - 1 | Wastewater Plan A2

- Foul Sewer
- Surface Sewer
- Combined Sewer
- Final Effluent
- Rising Main*
- Private Sewer*
- Decommissioned Sewer*
- Outfall*
- Inlet*
- Manhole*
- Sewage Treatment Works
- Public Pumping Station
- Decommissioned Pumping Station

*(Colour denotes effluent type)

Oakington

love every drop anglianwater

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
2000	F	-	-	-
2001	F	-	-	-
2002	F	-	-	-
2900	F	-	-	-
2901	F	-	-	-
2902	F	-	-	-
3000	F	-	-	-
3001	F	-	-	-
3101	F	9.833	8.047	1.786
3900	F	-	-	-
3901	F	-	-	-
3902	F	-	-	-
4001	F	8.785	7.154	1.631
4002	F	-	-	-
4003	F	-	-	-
4004	F	-	-	-
4101	F	10.034	8.534	1.5
4102	F	-	-	-
4103	F	-	-	-
5101	F	8.275	6.544	1.731
5102	F	8.885	6.721	2.164
5103	F	8.79	6.998	1.792
5104	F	-	-	2.1
5201	F	-	-	2.91
6101	F	8.074	6.239	1.835
6102	F	8.217	6.361	1.856
6104	F	-	-	-
6202	F	-	-	-
6203	F	-	-	-
6205	F	-	-	-
6206	F	-	-	-
7001	F	7.711	5.977	1.734
7002	F	7.812	6.096	1.716
7100	F	9.59	7.64	1.95
7101	F	-	-	-
7102	F	-	-	-
7103	F	-	-	-
7104	F	-	-	-
7200	F	9.54	8.122	1.418
7201	F	9.51	8.046	1.464
7202	F	9.65	7.976	1.674
7203	F	9.66	7.736	1.924
7204	F	9.61	7.982	1.628
7206	F	9.51	7.914	1.596
7800	F	7.41	6.38	1.03
7801	F	-	-	-
7802	F	-	-	-
7901	F	-	-	-
8001	F	7.111	1.6	5.511
8002	F	7.114	1.628	5.486
8003	F	7.541	5.761	1.78
8004	F	7.721	5.697	2.024
8101	F	7.955	6.166	1.789
8102	F	8.766	6.986	1.78
8103	F	7.644	6.394	1.25
8104	F	8.671	7.001	1.67
8105	F	7.866	6.556	1.31
8801	F	-	-	-
8802	F	6.974	4.511	2.463
8803	F	6.806	4.679	2.127
8805	F	-	-	-
8806	F	7.1	4.442	2.658
8807	F	7.34	4.762	2.578
8901	F	-	-	-
8902	F	6.965	5.331	1.634
8903	F	-	-	2.05