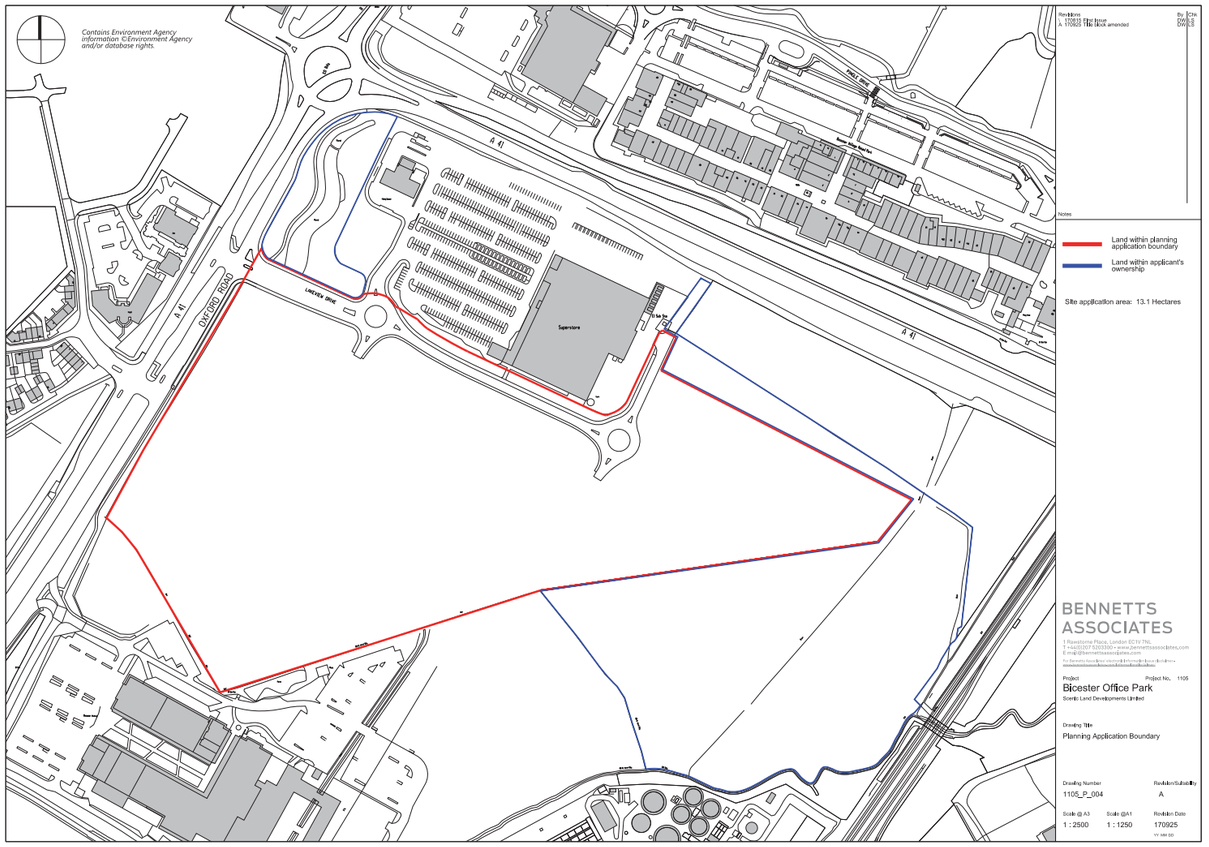
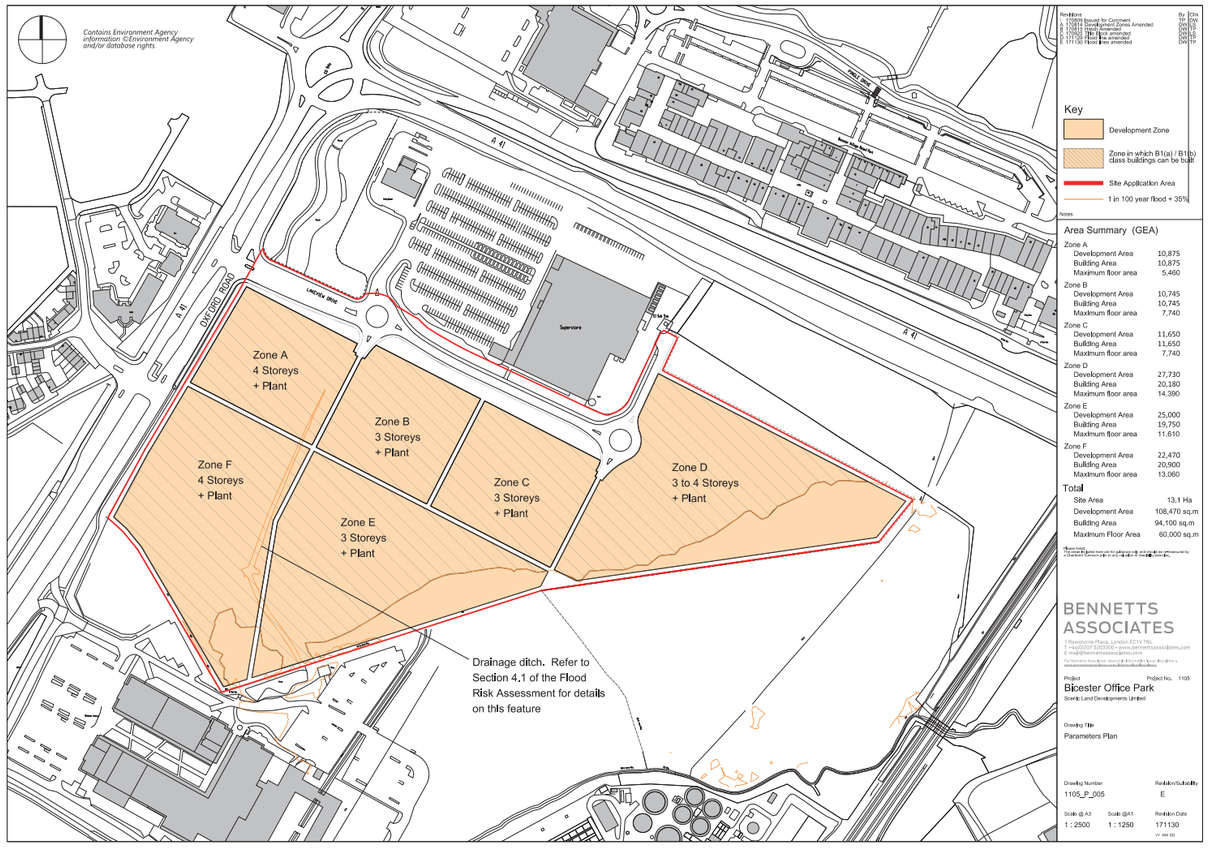
Appendix B Proposed Development



Appendix C Environment Agency Consultation



Appendix C Environment Agency Consultation

Product 4 (Detailed Flood Risk) for Bicester Office Park, Oxfordshire,OX26 1DE
Our Ref: THM48041

Product 4 is designed for developers where Flood Risk Standing Advice FRA (Flood Risk Assessment) Guidance Note 3 Applies. This is:

i) "all applications in Flood Zone 3, other than non-domestic extensions less than 250 sq metres; and all domestic extensions", and
ii) "all applications with a site area greater than 1 ha" in Flood Zone 2.

Product 4 includes the following information:

Ordnance Survey 1:25k colour raster base mapping;
Flood Zone 2 and Flood Zone 3;
Relevant model node locations and unique identifiers (for cross referencing to the water levels, depths and flows table);
Model extents showing *defended* scenarios;
FRA site boundary (where a suitable GIS layer is supplied);
Flood defence locations (where available/relevant) and unique identifiers; (supplied separately)
Flood Map areas benefiting from defences (where available/relevant);
Flood Map flood storage areas (where available/relevant);
Historic flood events outlines (where available/relevant, not the Historic Flood Map) and unique identifiers;
Statutory (Sealed) Main River (where available within map extents);

A table showing:

i) Model node X/Y coordinate locations, unique identifiers, and levels and flows for *defended* scenarios.
ii) Flood defence locations unique identifiers and attributes; (supplied seperately)
iii) Historic flood events outlines unique identifiers and attributes; and
iv) Local flood history data (where available/relevant).

Please note:

If you will be carrying out computer modelling as part of your Flood Risk Assessment, please request our guidance which sets out the requirements and best practice for computer river modelling.

This information is based on that currently available as of the date of this letter. You may feel it is appropriate to contact our office at regular intervals, to check whether any amendments/ improvements have been made. Should you re-contact us after a period of time, please quote the above reference in order to help us deal with your query.

This information is provided subject to the enclosed notice which you should read.
This letter is not a Flood Risk Assessment. The information supplied can be used to form part of your Flood Risk Assessment. Further advice and guidance regarding Flood Risk Assessments can be found on our website at:

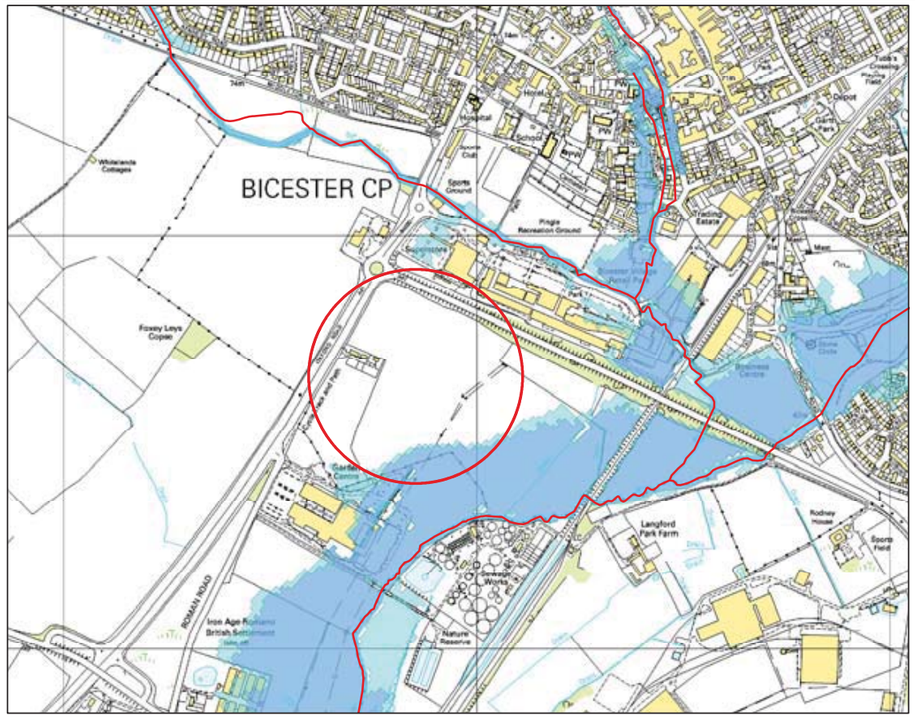
https://www.gov.uk/guidance/flood-risk-assessment-local-planning-authorities

If you would like advice from us regarding your development proposals you can complete our pre application enquiry form which can be found at:

https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion

Red Kite House, Howbery Park, Wallingford, Oxon OX10 8BD
Customer services line: 08708 506 506
Email: WTenquiries@environment-agency.gov.uk

Flood Map for Planning centred on Lakeview Drive Bicester OX26 1DE
Created on 23/05/17 REF: THM48041



Environment Agency

Kilometres

0 0.25 0.5

Legend

- Main River
- Flood defences
- Areas benefiting from flood defences
- Flooding from rivers or sea (FZ3)
- Extent of extreme flood (FZ2)
- Flood Map - flood storage areas

Flooding from rivers or sea without 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.

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

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Environment Agency

Defence information

THM48041

Defence Location:	No defences on Main River
Description:	This location is not currently protected by any formal defences and we do not currently have any flood alleviation works planned for the area. However we continue to maintain certain watercourses and the schedule of these can be found on our internet pages.

Model information

THM48041

Model: Langford Brook (Bicester) & Pingle-Back-Bure 2010

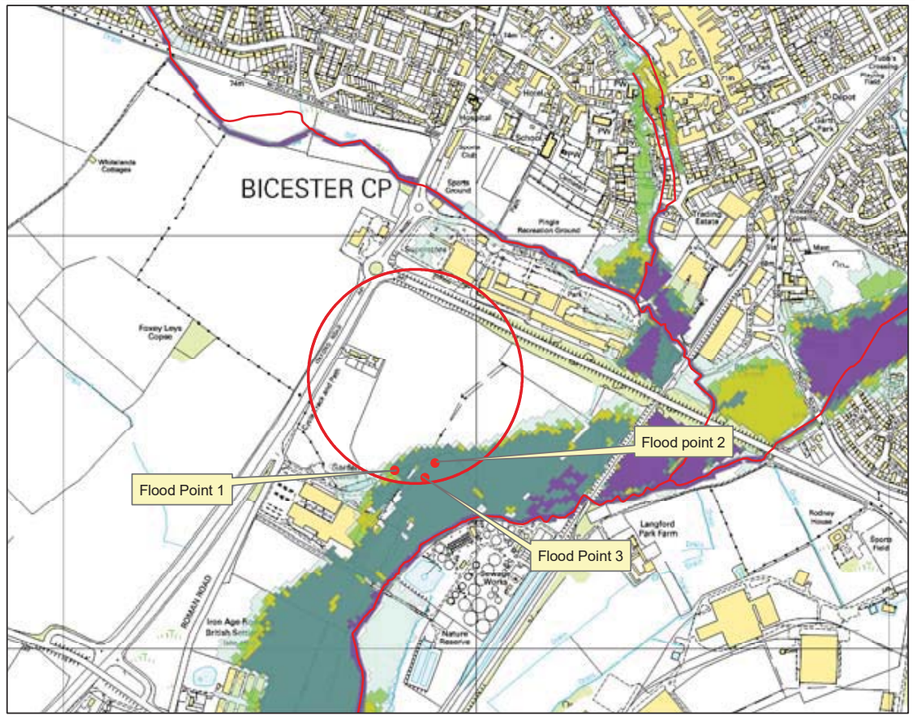
Description: The information provided is from the Langford Brook (Bicester) & Pingle-Back-Bure 2010 detailed mapping project. The study was carried out using 2D modelling software (ISIS-Tuflow).

Model design runs:
1 in 5 / 20% Annual Exceedance Probability (AEP); 1 in 20 / 5% AEP; 1 in 50 / 2% AEP; 1 in 100 / 1% AEP; 1 in 100+20% / 1% AEP plus 20% increase in flows and 1 in 1000 / 0.1% AEP

Mapped Outputs:
1 in 5 / 20% AEP; 1 in 20 / 5% AEP; 1 in 50 / 2% AEP; 1 in 100 / 1% AEP and 1 in 1000 / 0.1% AEP

Model accuracy:
Levels ± 250mm

Detailed FRA centred on Lakeview Drive Bicester OX26 1DE
Created on 23/05/17 REF: THM48041



Environment Agency

Kilometres
0 0.25 0.5

Legend

- Main River
- 20% AEP
- 5% AEP
- 2% AEP
- 1% AEP
- 0.1% AEP

AEP = Annual Exceedance Probability
The probability of a flood of a particular magnitude, or greater, occuring in any given year

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Modelled floodplain flood levels

THM48041

The modelled flood levels for the closest most appropriate model grid cells for your site are provided below:

2D grid cell reference	Model	Easting	Northing	flood levels (mAOD)								
				20% AEP	5% AEP	2% AEP	1% AEP	1% AEP (+20% increase in flows)	1% AEP (+25% increase in flows)	1% AEP (+35% increase in flows)	1% AEP (+70% increase in flows)	0.1% AEP
Flood Point 1	Langford Brook (Bicester) & Pingle-Back-Bure 2010	457,806	221,434		64.66	64.70	64.74	64.78				64.85
Flood Point 2	Langford Brook (Bicester) & Pingle-Back-Bure 2010	457,904	457,904		64.67	64.72	64.76	64.80				64.90
Flood Point 3	Langford Brook (Bicester) & Pingle-Back-Bure 2010	457,876	221,413		64.64	64.70	64.73	64.78				64.86

This flood model has represented the floodplain as a grid.
The flood water levels have been calculated for each grid cell.

Note:
Due to changes in guidance on the allowances for climate change, the 20% increase in river flows should no longer to be used for development design purposes. The data included in this Product can be used for interpolation of levels as part of an intermediate level assessment.

For further advice on the new allowances please visit
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Historic flood data

THM48041

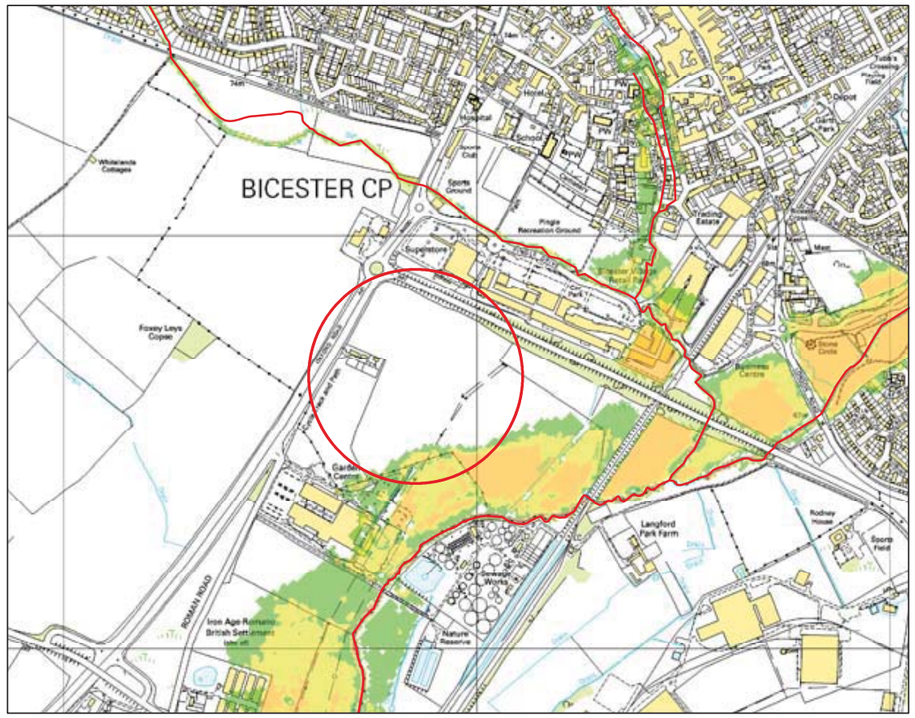
Our records show that the area of your site has been affected by flooding.
Information on the floods that have affected your site is provided in the table below:

Flood Event Code	Flood Event Name	Start Date	End Date	Source of Flooding	Cause of Flooding
We hold no records of historic flooding for this location					

Please note the Environment Agency maps flooding to land not individual properties. Floodplain extents are an indication of the geographical extent of a historic flood. They do not provide information regarding levels of individual properties, nor do they imply that a property has flooded internally.

Start and End Dates shown above may represent a wider range where the exact dates are not available.

Hazzard Map centred on Lakeview Drive Bicester OX26 1DE
Created on 23/05/17 REF: THM48041



Environment Agency

Kilometres

0 0.25 0.5

Legend

- Main River
- Very low hazard
- Danger for some
- Danger for most
- Danger for all

For hazard and debris factor we used HR Wallingford and Environment Agency (May 2008) supplementary note on flood hazard ratings and thresholds for development planning and control purpose. The following calculation is used:

HR = d x (v+0.5) + DF

HR = flood hazard rating
d = depth of flooding (m)
v = velocity of floodwaters (m/sec)
DF = debris factor calculated (0, 0.5, 1 depending on probability that debris will lead to a hazard)

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Environment Agency

Hazard Mapping

THM48041

Hazard Mapping methodology:

To calculate flood hazard with the debris factor we have used the supplementary note to Flood Risk to People Methodology (see below).
The following calculation is used:

HR = d x (v+0.5) + DF

Where HR = flood hazard rating
d = depth of flooding (m)
v = velocity of floodwaters (m/sec)
DF = debris factor calculated (0, 0.5, 1 depending on probability that debris will lead to a hazard)

The resultant hazard rating is then classified according to:

Flood Hazard	Colour	Hazard to People Classification	
Less than 0.75		Very low hazard	- Caution
0.75 to 1.25		Danger for some	- includes children, the elderly and the infirm
1.25 to 2.0		Danger for most	- includes the general public
More than 2.0		Danger for all	- includes the emergency services

REF: HR Wallingford and Environment Agency (May 2008) Supplementary note of flood hazard ratings and thresholds for development planning and control purpose – Clarification of the Table 113.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1

Red Kite House, Howbery Park, Wallingford, Oxon OX10 8BD
Customer services line: 08708 506 506
Email: WTenquiries@environment-agency.gov.uk

Thames Area Climate Change Allowances

Guidance for their use in flood risk assessments

Jan 2017

We recently updated our national guidance on climate change allowances for Flood Risk Assessments. The following information provides additional local guidance which applies to developments within our Thames area boundary.

Climate change allowances - overview

The National Planning Practice Guidance refers planners, developers and advisors to the Environment Agency to our guidance on considering climate change in Flood Risk Assessments. We updated this guidance in February 2016 and it should be read in conjunction with this document to inform planning applications, local plans, neighbourhood plans and other projects. It provides:

- Climate change allowances for peak river flow, peak rainfall, sea level rise, wind speed and wave height
- A range of allowances to assess fluvial flooding, rather than a single national allowance
- Advice on which allowances to use for assessments based on vulnerability classification, flood zone and development lifetime

Updated climate change allowances guidance:

https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

National Planning Practice Guidance:

http://planningguidance.communities.gov.uk/

Assessing climate change impacts on fluvial flooding

Table A below indicates the level of technical assessment of climate change impacts on fluvial flooding appropriate for new developments depending on their scale and location (flood zone). Please note that this should be used as a guide only. Ultimately, the agreed approach should be based on expert local knowledge of flood risk conditions, local sensitivities and other influences.

Applicants and consultants may contact the Environment Agency at the pre-planning application stage to confirm the assessment approach on a case-by-case basis. We provide standard guidance free of charge or bespoke advice for a fee for developments for which we are a statutory consultee. If your development is instead covered by Flood Risk Standing Advice, we recommend you contact the relevant Local Planning Authority for their guidance and confirmation of the assessment approach. Flood Risk Standing Advice can be found here:

https://www.gov.uk/flood-risk-assessment-local-planning-authorities

Table A defines three possible approaches to account for flood risk impacts due to climate change in new development proposals:

1. **Basic -** Developer can add an allowance to the 'design flood' (i.e. 1% annual probability) peak levels to account for potential climate change impacts. The allowance should be derived and agreed locally by Environment Agency teams.
2. **Intermediate -** Developer can use existing modelled flood and flow data to construct a stage-discharge rating curve, which can be used to interpolate a flood level based on the required peak flow allowance to apply to the 'design flood' flow.
3. **Detailed -** Perform detailed hydraulic modelling, through either re-running Environment Agency hydraulic models (if available) or construction of a new model by the developer.

Table A – Indicative guide to assessment approach

Vulnerability classification	Flood zone	Assessment by development type		
		Minor	Small-Major	Large-Major
Essential infrastructure	Zone 2	Detailed		
	Zone 3a	Detailed		
	Zone 3b	Detailed		
Highly vulnerable	Zone 2	Intermediate/Basic	Intermediate/Basic	Detailed
	Zone 3a	Not appropriate development		
	Zone 3b	Not appropriate development		
More vulnerable	Zone 2	Basic	Basic	Intermediate/Basic
	Zone 3a	Basic	Detailed	Detailed
	Zone 3b	Not appropriate development		
Less vulnerable	Zone 2	Basic	Basic	Intermediate/Basic
	Zone 3a	Basic	Basic	Detailed
	Zone 3b	Not appropriate development		
Water compatible	Zone 2	None		
	Zone 3a	Intermediate/Basic		
	Zone 3b	Detailed		

Definitions of terms in Table A

Minor

1-9 dwellings/less than 0.5 ha; office/light industrial under 1ha; general industrial under 1 ha; retail under 1 ha; travelling community site between 0 and 9 pitches.

Small-Major

10 to 30 dwellings; office/light industrial 1ha to 5ha; general industrial 1ha to 5ha; retail over 1ha to 5ha; travelling community site over 10 to 30 pitches.

Large-Major

30+ dwellings; office; light industrial 5ha+; general industrial 5ha+; retail 5ha+; gypsy/traveller site over 30+ pitches; any other development that creates a non-residential building or development over 1000 sqm.

Further info on vulnerability classifications:

http://planningguidance.communities.gov.uk/blog/guidance/flood-risk-and-coastal-change/flood-zone-and-flood-risk-tables/table-2-flood-risk-vulnerability-classification/

Further info on flood zones:

http://planningguidance.communities.gov.uk/blog/guidance/flood-risk-and-coastal-change/flood-zone-and-flood-risk-tables/table-2-flood-risk-vulnerability-classification/

Specific local considerations

Where the Environment Agency and the applicant or their consultant has agreed that a basic level of assessment is appropriate, the figures in Table B below can be used as an allowance for potential climate change impacts on peak design (i.e. 1% annual probability) fluvial flood level rather than undertaking detailed modelling.

Table B – Local allowances for potential climate change impacts

Watercourse	Central	Higher central	Upper
Thames	500mm	700mm	1000mm

Use of these allowances will only be accepted after discussion with the Environment Agency.

Fluvial food risk mitigation

Please use the national guidance to find out which allowances to use to assess the impact of climate change on flood risk.

For planning consultations where we are a statutory consultee and our Flood Risk Standing Advice does not apply, we use the following benchmarks to inform flood risk mitigation for different vulnerability classifications.

These benchmarks are a guide only. We strongly recommend you contact us at the pre-planning application stage to confirm this on a case-by-case basis. Please note you may be charged for pre-planning advice.

For planning consultations where we are not a statutory consultee or where our Flood Risk Standing Advice does apply, we recommend local planning authorities and developers use these benchmarks but we do not expect to be consulted.

Essential Infrastructure

For these developments, our benchmark for flood risk mitigation is for it to be designed to the **upper end** climate change allowance for the epoch that most closely represents the lifetime of the development, including decommissioning.

Highly Vulnerable

For these developments in flood zone 2, the **higher central** climate change allowance is our minimum benchmark for flood risk mitigation. In sensitive locations it may be necessary to use the **upper end** allowance.

More Vulnerable

For these developments in flood zone 2, the **central** climate change allowance is our minimum benchmark for flood risk mitigation. In flood zone 3 the **higher central** climate change allowance is our minimum benchmark for flood risk mitigation. In sensitive locations it may be necessary to use the **higher central** (in flood zone 2) and the **upper end** allowance (in flood zone 3).

Water Compatible or Less Vulnerable

For these developments, the **central** climate change allowance for the epoch that most closely represents the lifetime of the development is our minimum benchmark for flood risk mitigation. In sensitive locations it may be necessary to use the **higher central** to inform built in resilience, particularly in flood zone 3.

Further info on our Flood Risk Standing Advice:

https://www.gov.uk/guidance/flood-risk-assessment-local-planning-authorities

There may be circumstances where local evidence supports the use of other data or allowances. Where you think this is the case we may want to check this data and how you propose to use it.

For more information

Please contact our Thames area Customers and Engagement team:

Enquiries_THM@environment-agency.gov.uk

creating a better place

Environment Agency

Ms Clare Jones
Buro Happold Ltd.
Infrastructure Water
17 Newman Street
London
W1T 1PD

Our ref: ENVPAC/WTHAMS/00432 (WA/2017/124029/01-L01)

Date: 27 June 2017

Dear Ms Jones

The proposed development, includes the construction of a business park comprising between 55,000 and 60,000m2 office use (B1), parking for approximately 2,000 cars, associated highway, infrastructure and earthworks.

Bicester Office Park, Oxfordshire, OX26 1DE

Thank you for consulting us. We received confirmation to proceed with the work on 22 June and we are now in a position to respond.

We have reviewed the following documents:

- Emails from Clare Jones (Buro Happold), dated 02, 22, 27 June 2017
- Pre-application Enquiry Form
- Draft EIA Scoping Report produced by TRIUM Environmental, dated 15 May 2017
- Drawing 1105(SK)058 Rev A – Site Plan
- Drawing 1105(SK)065 Rev B – Parking Provision
- Drawing WSKL001 Rev 01 – Flood Extents 2017
- Drawing WSKL002 Rev 01 – 2007 and 2017 Flood Extents
- Drawing WSKL003 Rev 00 – Flood Extents Derived From Topographic Levels
- Drawing WSKL004 Rev 00 – Flood Extents Derived From 2011 LiDAR Data

We have reviewed the draft EIA Scoping report in relation to Flood Risk only as confirmed under our charging agreement. We disagree that the Flood Risk topic area should be scoped out of the EIA. Flood risk to this site is surely one of the most significant environmental impacts affecting this site and therefore should warrant assessment within the EIA. The reasoning given within the Scoping Report for scoping out this topic is frankly misinterpreting the level of risk on site. It fails to acknowledge that there are areas of this site at the highest level of flood risk (Flood Zones 3a and 3b). We would therefore be likely to object if an EIA was submitted for this site that did not include a chapter on flood risk.

We can confirm that the site is affected by the 1 in 20 year modelled flood extent and we consider this to be the functional floodplain (Flood Zone 3b). In normal circumstances we would not accept development of this type in areas at this high risk.

Cont/d..

However, this site has been allocated (Bicester 4) within the Cherwell District Council Local Plan and has been sequentially tested. We therefore have no in principle objection on flood risk grounds to this site coming forward for development.

To ensure that Policy Bicester 4 clearly states that a sequential approach should be followed and that where possible buildings should be located away from the highest risk of flooding. We are pleased to see from the drawings you have provided that no buildings are proposed within the 1 in 20 (functional floodplain) extents. We would accept car parking within this area of highest risk providing that there was no raising of ground levels.

However, we would expect that a sequential approach is taken to ensure that no built development is located in areas up to the 1 in 100 year plus climate change (plus 35%) flood level. We note that you have carried out an intermediate assessment to establish a new climate change level and then mapped it on a topographic survey. This shows buildings located in the 1 in 100 year plus climate change (plus 35%) flood extent which we feel is not in line with the principles of Bicester Policy 4.

We strongly advise that any master plan is re-orientated so that there is no built development or ground raising in areas within the 1 in 100 year plus climate change (plus 35%) flood extent. There appears to be plenty of car parking in areas at much lower risk and so we see no need to place any buildings within this area of risk.

We also have concerns that the 1 in 100 year plus climate change (plus 35%) flood level has been established by using the intermediate approach. Please find attached the Thames Climate Change Guidance which clearly states that a detailed assessment is required for 'Large-Major' development in Flood Zone 3a or 3b.

In summary, the scoping report is inadequate as it fails to represent the true level of flood risk affecting this site and makes recommendations that are flawed. The 1 in 100 year plus climate change flood level needs to be established by carrying out a detailed assessment as outlined in our guidance. The site must be developed in accordance with the principles as set out in Bicester Policy 4. This clearly stipulates that built development should be located in areas of the site at least flood risk.

Yours sincerely,

Mr Jack Moeran
Planning Specialist

Direct dial 02030259655
Direct e-mail planning-wallingford@environment-agency.gov.uk

End

Clare Jones

From: Moeran, Jack
Sent: 24 July 2017 14:20
To: Clare Jones
Subject: RE: THM48041 Product 4 Bicester Office Park, Oxfordshire,OX26 1DE

** External E-Mail **

Hi Clare,

Yes I'm happy that this is an accurate reflection of our conversation.

One point I would just like to clarify is the following:

- The EA confirmed it was acceptable to have car parking with Functional Floodplain (1 in 20 year extent), providing it wasn't increasing the level of 'use vulnerability' from what is existing and that there was no ground raising.

Thanks,

Jack Moeran
Planning Specialist

FCRM Planning Specialist - PSO - Thames Area

From: Clare Jones
Sent: 27 June 2017 17:13
To: 'Moeran, Jack'

Subject: RE: THM48041 Product 4 Bicester Office Park, Oxfordshire,OX26 1DE

Jack,

Thank you for your quick response to the pre-application enquiry. As a record of our earlier conversation today, please find below a summary of the items discussed:

EIA Water Chapter

- The EA has confirmed that they will require an EIA Water Chapter to be written for the site to accompany the Flood Risk Assessment for the Outline Planning Application. They explained that a site lying in Flood Zone 3(a and b) would be considered to be a significant environmental effect which would need to be assessed under an EIA. The EA advised that whilst an FRA was proposed, they would also expect to see the EIA Water Chapter.

Flood Extents

- The EA confirmed that the approach taken to define the flood extents for the 1 in 20, 1 in 100 and 1 in 1000 year using the flood levels against the topographic survey information was acceptable. Whilst the topographic survey information was available for most of the site, BHE explained that there was an area to the west where topo survey information was not available. The EA confirmed that it was acceptable to use LiDAR to define the flood extents in this area and to combine this with the flood extent derived from the topographic survey, provided this was explained on the drawings.
- The EA confirmed that they require hydraulic modelling to be undertaken to define the flood levels for the 1 in 100 + 25% and 1 in 100 + 35% climate change events. The same approach of deriving the flood extents based on

the topographic survey should be adopted. For the hydraulic modelling, the EA would expect to see an appendix to the FRA detailing the method adopted for the modelling and the results with a short summary in the FRA.
- The EA recommended that the flood extent plans submitted are overlaid with the parameter plan rather than the illustrative masterplan which could change in the future.

Development in the Flood Zones
- The EA confirmed it was acceptable to have car parking with Functional Floodplain (1 in 20 year extent), provided that there was no ground raising.
- The EA would seek that all buildings were located outside the 1 in 100 year + 35% extent.
- If ground raising is required between the 1 in 20 year and 1 in 100 year + climate change level (25%) then floodplain compensation would be required. BHE advised that parameter plans would be submitted for Outline planning and the need for flood compensation would not be known until detailed design. The EA agreed that this could be dealt with at a later date through a planning condition.

Finished Floor Levels
- The EA confirmed that the design flood event for the site is the 1 in 100 year +25% climate change event. The EA anticipate that the levels will be very close to the 1 in 100 year + 35% climate change event. The EA would seek that we adopt the 1 in 100 year +35% level with 300mm freeboard to define finished floor levels. The EA would review this if there was a significant difference in levels between the 1 in 100 year +25% climate change and 1 in 100 year +35% levels.

We would appreciate if you can review the above and confirm if this is an accurate record of the conversation.

Kind Regards
Clare

Clare Jones CEng MICE
Senior Engineer
BuroHappold Engineering | Water
T: +44 (0)1225 320600
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From: Moeran, Jack
Sent: 27 June 2017 12:05
To: Clare Jones
Subject: RE: THM48041 Product 4 Bicester Office Park, Oxfordshire,OX26 1DE

** External E-Mail **

Hi Clare,

Please find attached our response.

If you wish to chat any of the content through with me then please don't hesitate to give me a call.

Kind regards,

Jack Moeran
Planning Specialist

FCRM Planning Specialist - PSO - Thames Area

From: Clare Jones [mailto:Clare.Jones@BuroHappold.com]
Sent: 27 June 2017 10:04
To: Planning_THM <Planning_THM@environment-agency.gov.uk>

Subject: RE: THM48041 Product 4 Bicester Office Park, Oxfordshire,OX26 1DE

Jack,

Further to my email below, please find attached drawings showing the flood extents derived from survey data from both topographic survey information (2007) and LiDAR Data (2011, 1m resolution) with the illustrative masterplan. We would propose to refine the modelled flood extents to those defined from the topographic survey information. Unfortunately as the topo survey does not cover a section west of the site so for this section, we would propose to defer back to the LiDAR contour. The methodology for defining the flood extents is summarized below. We are intending to write this up in more detail for the FRA but before we do, we would appreciate the EA's view on this methodology. Also attached, are drawings showing the current EA extents overlaid with the illustrative masterplan and showing the flood extents from the 2007 OPA FRA for the site for information.

The flood extents have been derived by the following means:

- Flood model level information has been extracted from the Langford Brook (Bicester) & Pingle-Back- Bure 2010 ISIS-TUFLOW Model for Points A to G in the floodplain. It has been assumed that the levels within the floodplain are the same as within the corresponding point in the river channel. Using 3D modelling software, a flood level surface for each return period event has been created by interpolating between the flood level points defined in the floodplain and the channel.
- The survey information used (topographic survey or LiDAR) has been used to create a ground level surface by interpolating between the LiDAR contours/ topographic survey points.
- 3D modelling software has then been used to determine where the flood level meets the ground level surface. The model has defined a contour for each of the flood level extents which is provided on the attached drawings.

In addition to the 1 in 20, 1 in 100 and 1 in 1000 flood extents, the climate change allowance has been calculated. In accordance with February 2016 climate change guidance, for office developments (defined as Less Vulnerable) in Flood Zone 3a, the central and higher central allowances are required to be assessed. For the Thames region, this would require the 25% and 35% climate change allowances to be considered. We have defined these using the Intermediate approach as follows:

1. 1D flood levels and flows have been extracted out of the Langford Brook (Bicester) & Pingle-Back- Bure 2010 ISIS-TUFLOW Model for Points LA.0865, LA.0957 and LA.1350 for the 1 in 5, 1 in 20, 1 in 100, 1in 100+20% and 1 in 1000
2. The above flow (Q) data was plotted against flood level (H) data and a line of best fit derived.
3. For the 1 in 100 year + 25% and 1 in 100 year + 35%, the flood flows were calculated using the below relationship, with the 35% value used as an example:

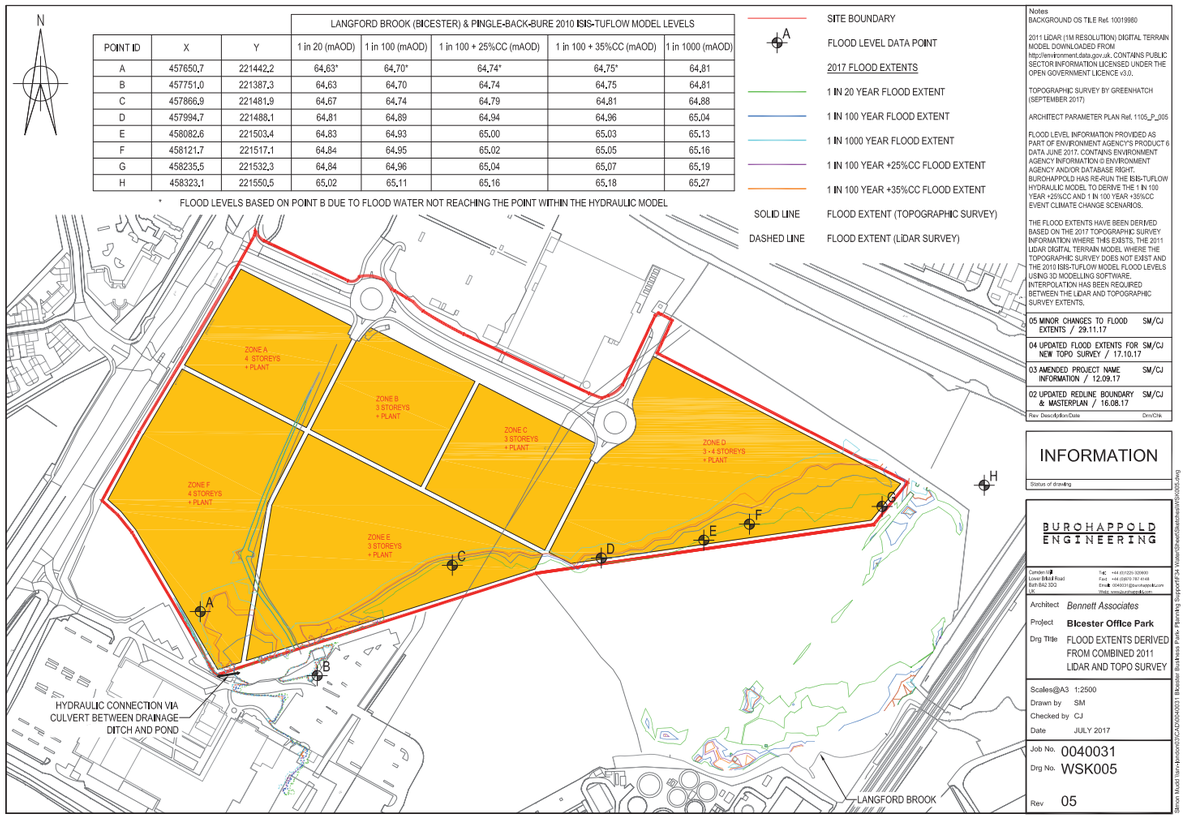
$$\left(\frac{100yr+20\%CC-100yr}{20}\times(35-20)\right)+100yr+20\%CC$$

4. Using the line of best fit HQ relationship, the flood levels for the 1D flood levels at A, B, C and G for the 1 in 100 year + 25% and 1 in 100 year + 35% have been calculated.
5. The 1 in 100 year + 25% and 1 in 100 year + 35% in the 2d domain have then been calculated based on scaling the level differences between the 1d and 2d domains from the other return periods.
6. For the remaining points (i.e. D,E and F, the levels have been interpolated)

Hopefully the above illustrates that we have taken an appropriate approach to defining the flood extents in this location. Please give me a call if you have any queries.

Kind Regards,

Appendix D Flood Extents Drawing



Appendix E Hydraulic Modelling Summary

BUROHAPPOLD ENGINEERING

Design Note

Project Bicester Office Park
Subject Hydraulic Modelling Summary
Project no 0040031
Date 17 July 2017

Revision	Description	Issued by	Date	Approved
00	Summary of hydraulic modelling to define flood extents	DKR	24/07/17	CEJ
01	Appendix B added	DKR	11/08/17	CEJ
02	Appendix A updated	CEJ	17/08/17	DKR
03	Final for Planning	CEJ	11/09/17	DKR
04	For Planning (updated survey)	CEJ	14/12/17	

1 Introduction

BuroHappold Engineering has produced the following note to summarise the work carried out to define the flood extents for the 1 in 100 year event including the effects of climate change using the latest Environment Agency (EA) guidance for climate change allowances.

Through the pre-planning application enquiry process, the EA confirmed that hydraulic modelling was required to define the flood levels for the 1 in 100 year with the new climate change allowances using the existing ISIS- TUFLOW model. This note provides a summary of the hydraulic modelling undertaken, the model output results and the derived flood extents.

The note is intended to support the flood risk assessment being carried out for the Bicester Office Park development, located to the south of Bicester.

2 Modelling Methodology

2.1 Hydraulic Model

The EA provided a hydraulic model built by Peter Brett Associates in 2009 which covers the Langford Brook, Pingle Stream, Bure Brook and Back Brook watercourses in Bicester, Oxfordshire. The model has been built using detailed topographic survey and LiDAR topographic data and the model calibrated based on five recent (at time of model construction) flood events.

The model simulations were carried out using the following software versions:

- ISIS – version 3.1
- TUFLOW – version 2008-08-AH-iSP

This version of the hydraulic model will be referred to as the EA model to distinguish it from the models re-run by BuroHappold.

2.2 Re-baselining the Model 1 – Model Version

On receipt of the EA model BuroHappold re-ran the model to attempt to replicate the results from the EA model which were provided separately by the EA.

Since the model was originally run, both ISIS and TUFLOW have updated their software. Since the versions listed above have been superseded it was not possible to re-run the models using the same software versions as the original models. To determine what the effect of changing the software versions would have on the model results a number of test simulations were carried out.

Following this investigation, it was decided to run the models using the following software versions:

- ISIS – version 3.7 using the backwards compatibility options to match the version 3.1 defaults.
- TUFLOW – version 2016-03-AE-iSP-w64

The results of these investigations showed that the flood levels predicted by the re-baselined model were lower than the flood levels provided by the Environment Agency. In the vicinity of the site the reductions in the modelled flood levels were of the order of 5mm and were therefore considered to be within modelling tolerances.

2.3 Modelling the Effects of Climate Change

The results provided by the Environment Agency included one climate change scenario, the 1 in 100 year event plus an allowance for climate change through increasing the inflow hydrographs by 20%. Following completion of the modelling process in 2009 the EA has updated its recommended allowances for how climate change should be represented.

The latest guidance for the Thames catchment recommends that climate change be considered through an uplift to the inflow hydrographs of 25%, 35% or 70%. The choice of climate change allowance depends on the land uses, and for the development site the EA has confirmed that the two scenarios to be tested are the 25% and 35% climate change scenarios.

The inflow hydrographs for the 1 in 100 year +25% and 1 in 100 year + 35% scenarios were developed by increasing the 1 in 100 year flow multiplier in ISIS by 25% or 35% in a similar manner to the way that the 1 in 100 year + 20% climate change scenario has been represented.

2.4 Other changes to the Model

No other changes to the model were made apart from those described in order to carry out the simulations using the latest software versions and to increase the flows for two new climate change scenarios.

3 Model Results

3.1 Comparison against Previous Results

The model results in the vicinity of the site were evaluated for eight locations in the 2d domain, referred to as locations A-H. These locations can be seen on the drawing provided in Appendix A along with the peak flood levels observed at these locations. A summary of the results are provided in Table 3-1below and the hydraulic model outputs.

Table 3-1 ISIS-TUFLOW Model levels at points on the site

Point ID	1 in 100 year + 20% climate change (mAOD)	1 in 100 year + 25% climate change (mAOD)	1 in 100 year + 35% climate change (mAOD)
A	64.73*	64.74*	64.75*
B	64.73	64.74	64.75
C	64.79	64.79	64.81
D	64.94	64.94	64.96
E	65.00	65.00	65.03
F	65.02	65.02	65.05

G	65.04	65.04	65.07
H	65.16	65.16	65.18

* Flood Levels based on Point B due to flood water not reaching the point within the hydraulic model.

The results showed that the peak water levels for the 1 in 100 year + 25% allowance for climate change event were overall similar to those reported for the 1 in 100 + 20% allowance for climate change event with differences of between 0-5mm.

Results from the 1 in 100 year + 35% run show increases in peak flood levels of approximately 15-35mm from the 1 in 100 year + 20% run in the floodplain to the south of the site.

3.2 Generation of Flood Extents

The peak flood levels from all of the models provided by the EA and simulated by BH were used to create 3d flood level surfaces for the section adjacent to the site.

A 3d topographic model was constructed using 12d software from the topographical survey for the site from 2017 and LiDAR information for the section of the site not covered by the topographic survey. The intersection of the flood level surface and the topographic surface was used to define the flood extent within the site for each of the flood events modelled.

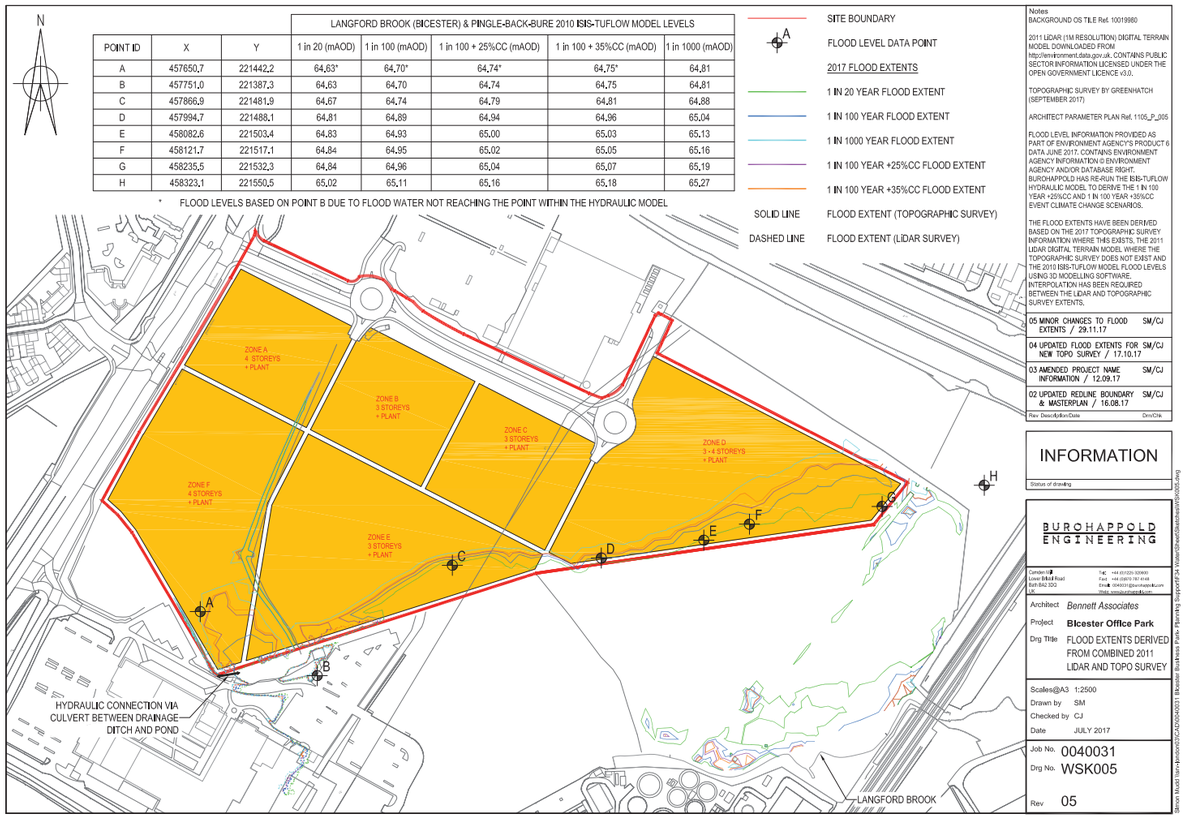
Since there are differences between the levels measured during the topographic survey and the LiDAR survey, due to the respective tolerances, there were some discontinuities between the flood extent lines at the boundary between the topographic survey and LiDAR surfaces. At these locations the flood extent line has been interpolated between the flood extents on either side of the discontinuity at the point where there is the least difference between the two surveys. A drawing showing the flood extent lines shown in Appendix A, with the locations where the flood extent line defined by the LiDAR and topographic survey clearly marked.

4 Conclusions

A hydraulic model constructed by PBA in 2009 has been rerun by BuroHappold using updated software versions to determine the peak flood levels in the 1 in 100 year event, including a 25% and 35% uplift in the hydrographs to allow for the effects of climate change based on the most recent guidance from the EA.

The peak flood levels from these simulations are shown in Appendix A and the model outputs provided in Appendix B.

Appendix A – Flood Extent Map



Appendix B – Flood Model Outputs

The table below provides the maximum flood levels from the 1d model at each of the nodes in the vicinity of the site. The levels are to ordnance datum.

Node	1 in 20	1 in 100	1 in 100 + 20%	1 in 100 + 25%	1 in 100 + 35%	1 in 1000
LA.1408	65.454	65.640	65.728	65.759	65.809	65.954
LA.1362	65.299	65.429	65.491	65.515	65.557	65.684
LA.1350	65.268	65.378	65.424	65.442	65.473	65.572
LA.1350BU	65.268	65.378	65.424	65.442	65.473	65.572
LA.1350BD	65.268	65.378	65.424	65.442	65.473	65.571
LA.1873CU	65.832	65.996	66.128	66.138	66.165	66.257
LA.1350D	65.268	65.378	65.424	65.442	65.473	65.571
LA.0957	64.548	64.623	64.660	64.666	64.680	64.714
LA.0865	64.438	64.525	64.571	64.580	64.599	64.640
LA.0767	64.302	64.382	64.466	64.479	64.501	64.550
LA.0737	64.221	64.266	64.374	64.387	64.409	64.461
LA.0726	64.217	64.258	64.364	64.376	64.397	64.445
LA.0726BU	64.217	64.258	64.364	64.376	64.397	64.445
LA.0720BD	64.215	64.255	64.272	64.280	64.295	64.332
LA.0720	64.215	64.255	64.272	64.280	64.295	64.332
LA.0711	64.208	64.251	64.269	64.278	64.296	64.337

Appendix F Drainage Strategy

BUROHAPPOLD ENGINEERING

Bicester Office Park

Drainage Strategy

040031

3 July 2017

Revision 04

Revision	Description	Issued by	Date	Checked
00	Initial Issue	JW	9/8/17	LJ
01	Client name amended	JW	10/8/17	LJ
02	Red line plan amended	JW	16/8/17	LJ
03	Minor amendments	JW	08/9/17	LJ
04	Red line plan amended	JW	26/09/17	LJ

C:\Users\jwaiting\Documents\Bicester\170911 JW 040031 Drainage Strategy 04.docx

author	**John Waiting**
date	**8/8/17**
approved	**Les Johnson**
signature	[redacted]
Date	**9/8/17**

..

Contents

1 Executive summary

1.1 This report has been prepared to set out the drainage strategy in support of an outline planning application for 60,000 m^2 B1 development at Bicester Office Park.

1.2 The majority of the site area covered by the current planning application was subject to an outline planning application submitted in 2007. It subsequently received approval.

1.3 In 2011 a detailed application was submitted for a the primary infrastructure and a retail development. To accompany this a revised drainage strategy document was prepared to show how the relevant planning conditions that were attached to the outline permission were to be discharged.

1.4 As part of the primary infrastructure contract both foul and surface water sewers have been constructed to serve the proposed development. These have capacity for the foul and surface water flow rates from the proposed 60,000 m^2 B1 development.

1.5 The surface water runoff from the development will be limited to greenfield flow rates and the primary infrastructure has been design to reflect this. The on-site surface water drainage network will incorporate the recommendations of Sustainable Drainage Systems (SuDS) good practice.

1.6 The proposed development density of the masterplan will allow the incorporation of a significant area of green infrastructure. This will facilitate the provision of a number of different SuDS components within the detailed design of the surface water network

2 Introduction

2.1 This drainage strategy has been produced in support of an outline planning application for a 13Ha site known as the Bicester Office Park. BuroHappold has been involved with the development since 2007 when the first outline planning application was submitted, and have produced both Flood Risk Assessments and Drainage Strategies in support of the initial phases of development.

2.2 The site is located on the western side of Bicester, adjacent to the Bicester Outlet Shopping Village. An aerial view of the site is shown in figure 1 below.

Figure 1

2.3 It can be seen in figure 1 that a spine road (Lakeview Drive) to serve the development has been constructed in addition to a Tesco store. As part of the primary infrastructure contract both surface water and foul water drainage networks were constructed. These were designed to provide capacity to serve the development proposals covered by the outline planning application.

3 Planning history

3.1 An outline planning application which covered most of the area of the current application was submitted in 2007. It subsequently received approval.

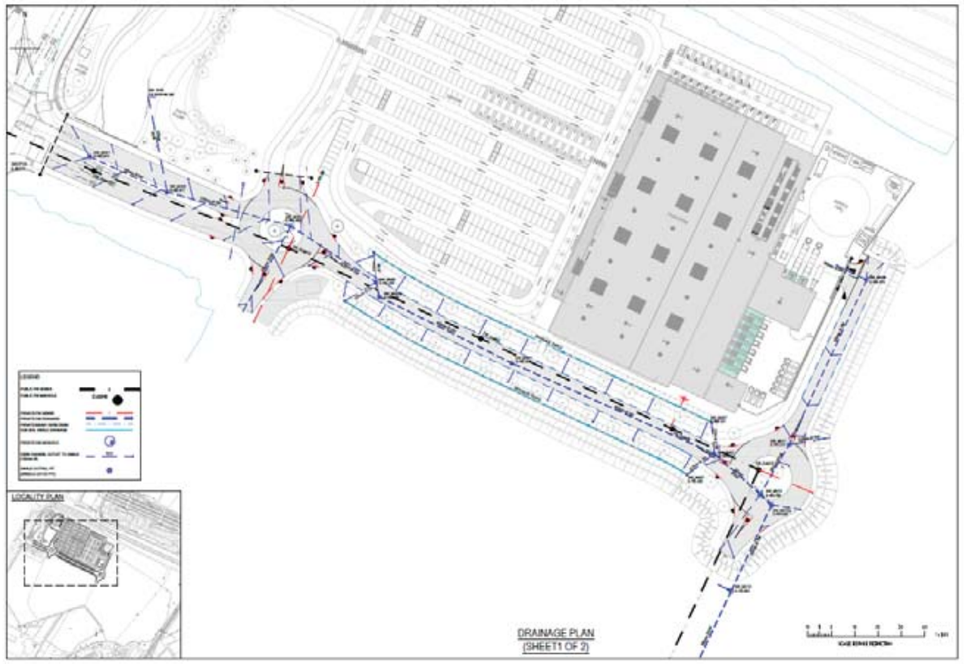
3.2 In 2011 a detailed application was submitted for a the primary infrastructure and a retail development (Tesco Store). To accompany this, a revised drainage strategy document was prepared to show how the relevant planning conditions that were attached to the outline permission were to be discharged.

3.3 As part of the current application a new Flood Risk Assessment has been prepared and this assumes that the surface water runoff from the undeveloped part of the site will be limited to 'Greenfield' run of rates i.e. the runoff will not exceed the flow rates that occur at present. In addition the associated attenuation measures for the developed site will be designed to accommodate the increased rainfall intensities in accordance with the climate change recommendations issued by the Environment Agency in February 2016.

4 Existing drainage networks

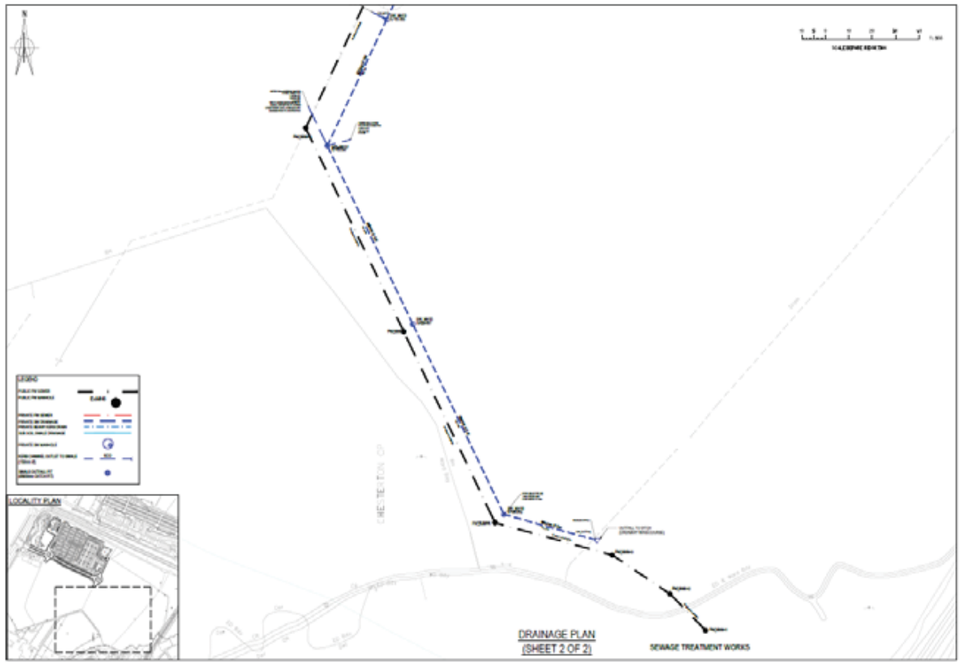
4.1 Surface Water

4.1.1 A surface water sewer network was constructed as part of the primary infrastructure works. The network associated with the access road is shown on the plan below.



The surface water infrastructure is shown by the blue dotted lines. Spurs have been left to facilitate drainage connections from the masterplan proposals.

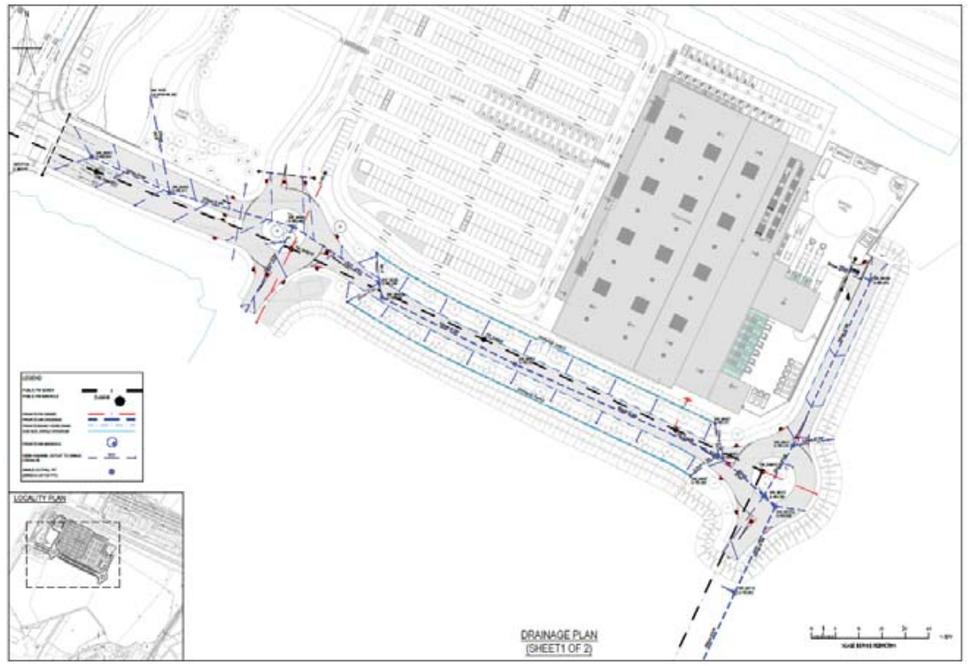
4.1.2 The plan below shows the route of the surface water sewer as it transverses the masterplan area before connecting to the ditch which then connects a stream known as the Langford Brook .



The surface water sewer is shown as a blue dotted line. As it will remain a private sewer in the ownership of the landowner there is no easement associated with it.

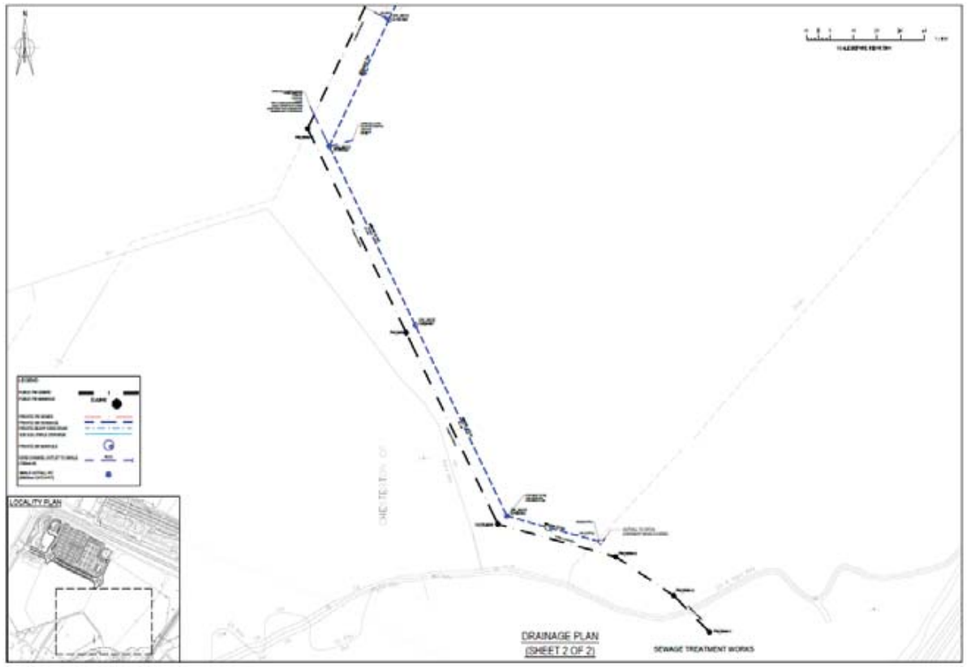
4.2 Foul Water

4.2.1 The route of the 600mm diameter public foul sewer under the access road is shown on the plan below



The foul sewer is shown by the dotted black line. The red lines show connection points that have been left to facilitate the future connection to serve the masterplan proposals.

4.2.2 The plan below shows the route of the public foul sewer as it transverses the masterplan area before connecting to the sewage treatment works.



The black dotted line shows the line of the public foul sewer it should be noted that there will be a 6 metre easement centred on the line of the sewer.

5 Drainage strategy

5.1 Surface Water

5.1.1 Design parameters to be adopted

The surface water sewer was designed with a capacity to serve the masterplan proposals. In accordance with the previously agreed drainage strategy that surface water runoff from the developed site will be limited to current 'greenfield' runoff rates and onsite storage will be required. When carrying out the detailed design, the greenfield runoff rate will be estimated using the HR Wallingford *uksuds* tool. The sewer capacity of the constructed surface water drainage has been designed on this basis.

Surface water attenuation will be required to store the runoff from 1 in 100 year storm event + 20% climate change balanced against current Greenfield runoff rate for a 1 in 100 year storm. When the drainage strategy for the Tesco store was approved a Greenfield runoff rate for the site of 9.47 l/s/ha was agreed by the Local Drainage Authority (Oxfordshire County Council). When detailed planning application is made for the area within the red line the Greenfield runoff rate will need to be reconfirmed with the local Drainage Authority. The on-site attenuation/storage will be in accordance with Sustainable Drainage System (SuDs) design requirements.

5.1.2 Sustainable Drainage Systems (SuDS)

In order to limit the runoff of the current 'Greenfield' rates the drainage system to serve the development will incorporate the recommendations within the current good practice guidance for SuDS contained in CIRIA Report C753, issued in 2015. This will be used to design the onsite drainage network unless superseded in the future.

The current guidance has been reviewed and the table in section 6 indicates which SuDS methods may be applicable for the Bicester Office Park Development.

5.1.3 Water demand management.

As part of the primary infrastructure works a 150mm water main was laid under the access road and Thames Water have confirmed that this has sufficient capacity to meet the water demand requirements of the development proposals covered by the new outline planning application. However it is anticipated that rainwater harvesting may be suitable for the development and this would allow the water demand to be reduced as well providing attenuation in accordance with BS 8515:2009+A1 2013.

5.2 Foul Water

5.2.1 General

A 600 mm public foul sewer constructed as part of the primary infrastructure works with blank connection points to serve the proposed development. The flow rates from the proposed development has been estimated based on the benchmarks for B1 uses. The total flow rate is from the completed development will be very low in comparison with the capacity of public sewer. It is not anticipated that there will be any flow restrictions placed on the connections by Thames Water.

5.2.2 Design Criteria

The foul sewer network to serve the development will be designed in accordance with Sewers for Adoption 7th Edition or subsequent revisions.

6 Sustainable Drainage Systems (SuDS)

6.1 Sustainable Drainage Systems (SUDS)

SUDS will be utilised in the surface water drainage system in line with current good practice.

SUDS take account of the quality and quantity of surface water runoff together with the amenity value of surface water in the urban environment. These systems aim to provide a more sustainable solution than conventional drainage and should:

- Manage runoff flow rate, reducing the impact of urbanisation on flooding;
- Protect enhance water quality; and
- Be sympathetic to the environment setting and the needs of the local community.

There are several advantages to using SUDS that include:

- Effective control of peak flows;
- Improved water quality;
- Reduction in surface erosion;
- Reduced sewer surcharging and flooding as discharge flow rates are reduced; and
- Water conservation through rainwater harvesting and re-use.

The pollutants of concern that have been identified to include:

- Oils and Fuels. Sourced from leaks and spills;
- Suspended Solids. Sourced from traffic wear, and landscaping features;
- Chemicals. Typically detergents from washing activities;
- Litter. Sourced from bins and bin overflows, particularly within the public domain.

The surface water approach will incorporate various SUDS controls into the drainage system. It will include both source controls and larger downstream site (catchment) controls. These controls will work in series along the drainage system and it is envisaged they could include:

- Source Controls:
  - Provision of rainwater harvesting for individual buildings.
  - Use of green roofs.

    Note Green roofs and rainwater harvesting would not be used in combination
- Catchment Controls including:
  - Trapped gullies as initial silt traps
  - End of line petrol interceptors.
  - Use of swales and ponds (see table 2)

SUDS Systems	Suitability	Remarks
Ground Infiltration	×	Existing site constraints severely limit the application to this development area. These include: • Low design infiltration rate of 2.4 x 10^{-6} m/s; and • Majority of the site is underlain by clay.
Ponds/Wetlands	✓	A ponds or water features can be incorporated into the landscape proposals. The system would provide temporary storage required during storm events and promote pollutant removal.
Swales	✓	The swales were constructed adjacent to the access road to convey highway drainage. The system helps to reduce the rate of runoff provide infiltrations to the ground, and a degree of cleansing. These may be suitable for inclusion in the proposed landscaping.
French drains/Infiltration trenches	✓	An alternative to swales. The system helps to reduce the runoff, provide some infiltration or convey the storm water in pipes, and can be sited adjacent to the highways with little land take.
Below Ground Attenuation	✓	If insufficient storage can be provided above aground below ground storage tanks can be used. Note these can be used in combination with rainwater harvesting tanks see 5.1.3
Permeable Pavement	✓	Permeable pavement is recommended for all car parking areas. It is not suitable for servicing/waste storage areas

Table 2 SuDS Components

7 Conclusions.

7.1 Primary drainage infrastructure has been constructed to serve the development proposed within the outline planning application. It has sufficient capacity to accept the proposed surface water and foul flows from the quantum and type of development proposed, without requiring any reinforcement.

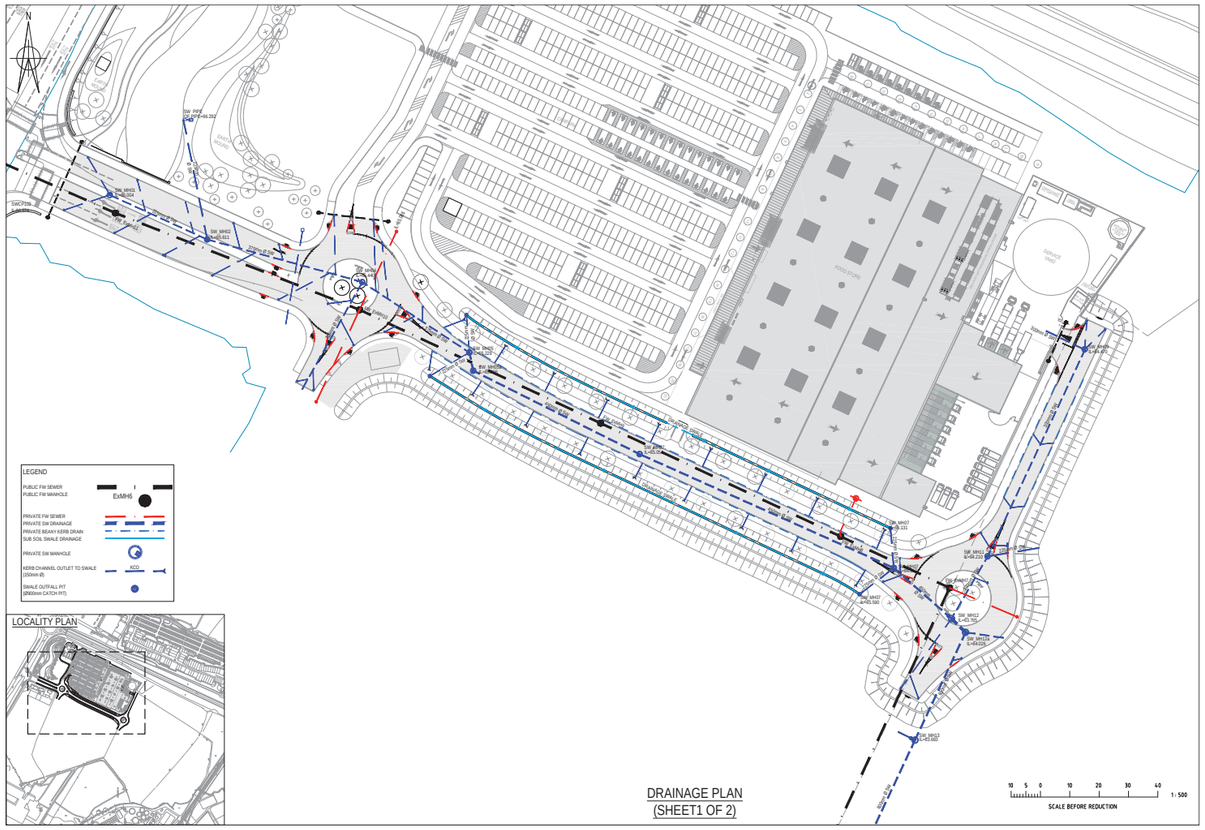
7.2 The surface water network will incorporate SuDS good practice and the runoff will be limited to the current greenfield runoff rates. The rate will need to be confirmed with the Local Drainage Authority when detailed planning application(s) are submitted. The 1 in 100 year Greenfield runoff rate agreed for the Tesco development was 9.47 l/s/ha.

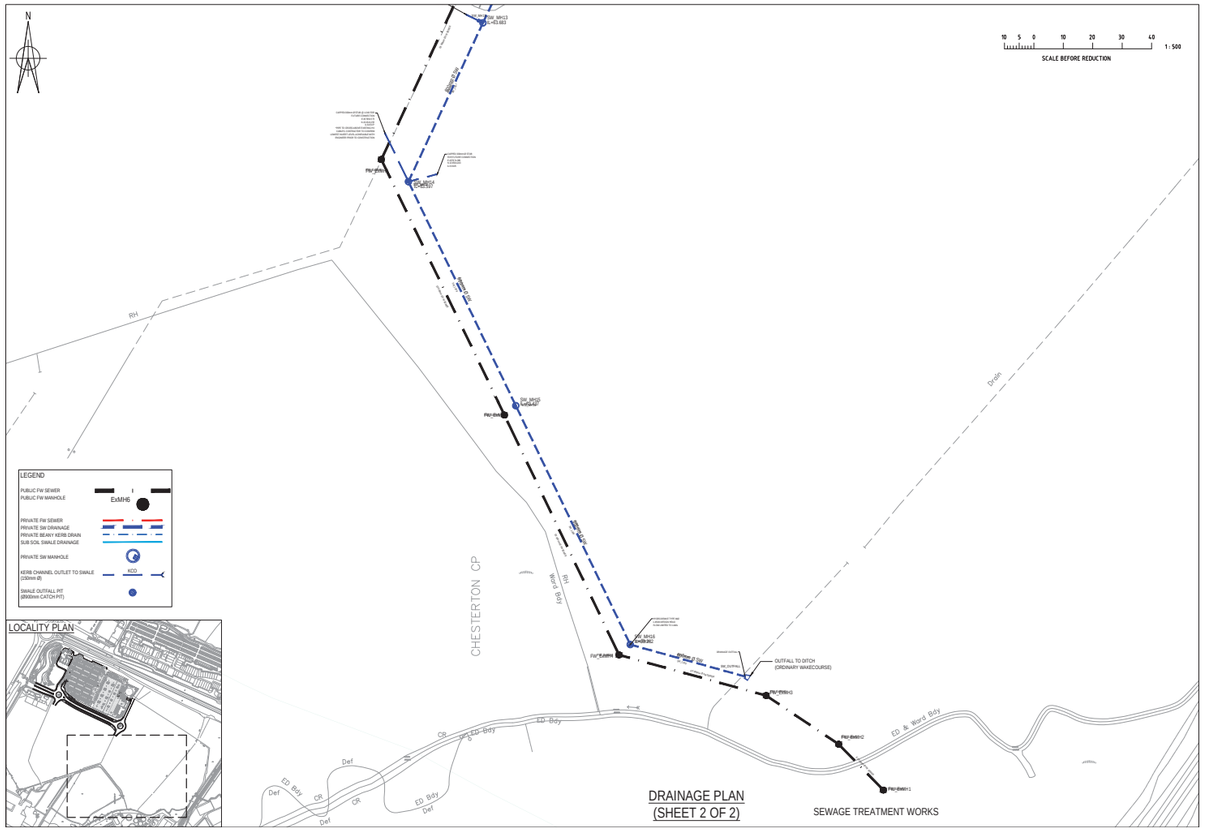
7.3 Green infrastructure will be provided which will facilitate a wide range of SuDS components and it is anticipated that providing the required onsite surface water storage will not present a significant challenge.

7.4 The public foul sewer located under the access road has sufficient capacity to serve proposed development and connections have been left to serve the development.

7.5 The development can incorporate rainwater harvesting as part of the SuDS strategy. In addition to providing surface water storage it also would contribute to a reduction in potable water demand as part of a water resource management strategy.

Appendix A As built drainage network drawings


N
LEGEND
PUBLIC FW SEWER
PUBLIC FW MANHOLE
ExMH6
PRIVATE FW SEWER
PRIVATE SW DRAINAGE
PRIVATE BEAVY KERB DRAIN
SUB SOIL SWALE DRAINAGE
PRIVATE SW MANHOLE
KERB CHANNEL OUTLET TO SWALE (150mm Ø)
KCO
SWALE OUTFALL PIT (Ø600mm CATCH PIT)
LOCALITY PLAN
DRAINAGE PLAN
(SHEET1 OF 2)
10 5 0 10 20 30 40
1 : 500
SCALE BEFORE REDUCTION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LEGEND
PUBLIC FW SEWER
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ExMH6
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PRIVATE SW DRAINAGE
PRIVATE BEAVY KERB DRAIN
SUB SOIL SWALE DRAINAGE
PRIVATE SW MANHOLE
KERB CHANNEL OUTLET TO SWALE (150mm Ø)
KCO
SWALE OUTFALL PIT (Ø600mm CATCH PIT)
LOCALITY PLAN
10 5 0 10 20 30 40
1 : 500
SCALE BEFORE REDUCTION
CHESTERTON CP
OUTFALL TO DITCH (ORDINARY WAWECOURSE)
SEWAGE TREATMENT WORKS
DRAINAGE PLAN
(SHEET 2 OF 2)

Appendix G Ground Investigation Location Plan

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