BURO HAPPOLD

Design Note

Project	Begbroke Innovation District
Subject	Buro Happold's Response to LLFA Interim Consultation
Project no	0052188
Date	26 October 2023

Revision	Description	Issued by	Date	Approved (signature)
P01	For Issue	TW	26/10/23	John Waiting

1 Introduction

Oxfordshire County Council (OCC) has provided an interim response to consultation for the Begbroke Innovation District planning application (Ref: 23/02098/OUT). This has included detailed comments made by the Lead Local Flood Authority (LLFA) dated 29/8/23. The note provides a response to the comments made by the LLFA, which are shown in red text.

It is noted that the LLFA expectations for SuDS use on School Sites have been included under the Property – School Sites sections of the document. These are understood and will be used to guide development of the drainage strategy as it develops through detailed design.

Our response is made with reference to the following submitted documentation:

- Environmental Statement Volume III:
    - Appendix 15.1 - Desk Study Review and Ground Conditions
    - Appendix 16.1 - Begbroke Innovation District Flood Risk Assessment:
        - Appendix D Hydraulic Modelling Report
            - Appendix A Flood Estimation Report
        - Appendix E Outline Drainage Strategy
- Outline Drainage Strategy

References to figures and tables in the below are to the Outline Drainage Strategy (ODS) unless otherwise stated.

1.1 Context

The application is made in outline with all matters reserved. Should outline planning permission be granted, it will be followed by subsequent stages of more detailed planning. The outline planning permission is seeking to establish a framework that will guide the preparation of these later stages of planning. This is why the ODS does not propose detailed measures, but instead a framework strategy that will guide later stages of design and planning. The Illustrative Masterplan is shown in the ODS, but this is only to demonstrate one possible way in which the Proposed Development could be delivered within the proposed parameters of the outline permission.

2 Responses to LLFA Comments

2.1 LLFA Comment 1

LLFA Comment 1: Table 2-5 refers to existing catchments and their proposed outfalls, it's unclear where these catchments are as they are not shown on plan. Provide surface water catchment plan stating the catchments and the locations of the outfalls and discharge rates.

Buro Happold (BH) assumes this is an erroneous reference to Table 5-2 (there is no Table 2-5). Table 1 below (Table 5-2 in ODS) provides the existing greenfield run-off rates for multiple storm event scenarios as well as the QBAR rate. These are for the proposed site drainage catchments shown in Figure 2-1.

The proposed points of discharge are provided in Table 1 below (Table 5-2 in ODS). These are via infiltration and/ or watercourses. An illustrative site wide drainage layout is provided in Figure 5-4 of the ODS. The number and location of these points of discharge will be confirmed through later stages of design and planning as the masterplan is developed.

The existing catchments are provided in Figure 2-2. These are provided in more detail in Figure 5 Preliminary results of the Direct Rainfall Model, Appendix 16.1 Flood Risk Assessment And Drainage Strategy Part 7.

The proposed strategy aims to respect the existing catchments and attenuate surface water close to its source before discharging into the ground and/or to the three local watercourses. The discharge locations, discharge rates and attenuation volumes will be confirmed during the later stages of design and planning. An indicative assessment has been provided in section 5.4 of the ODS.

Table 5—2 Existing Catchment Greenfield Runoff Rate Summary

Existing Catchment	Catchment Area (Ha)	1 in 2 yr (l/s)	1 in 30 yr (l/s)	1 in 100 yr (l/s)	1 in 100 yr +40% CC (l/s)	QBAR (l/s)	Point of Discharge
E1	17	10.5	25.6	34.7	48.5	11.3	Rowel Brook Discharge Point 1 +Infiltration
E2	10	7.3	15.9	21.5	30.2	7.1	Rowel Brook Discharge Point 2
E3	21	25.1	51.6	69.6	97.4	22.6	Rowel Brook Discharge Point 3+Infiltration
E4	38	59.1	137.7	185.4	259.6	59.9	Existing unnamed watercourse (ditch)+Infiltration

E5	6	5.1	12.5	16.9	23.7	5.5	Infiltration
E6	5	3	7.3	9.9	13.8	3.2	Infiltration

*As per LLFA guidance – The discharge rates for all storms up to the 1 in 100-year storm event will be limited to the QBAR rate (or 2l/s/ha whichever is greater) – Given the early stage of design BH is using the more conservative QBAR values above rather than 2l/s/ha, with the understanding that this may change as the design develops.

Table 1 Existing greenfield run-off rates for multiple storm events (Table 5-2 from ODS)

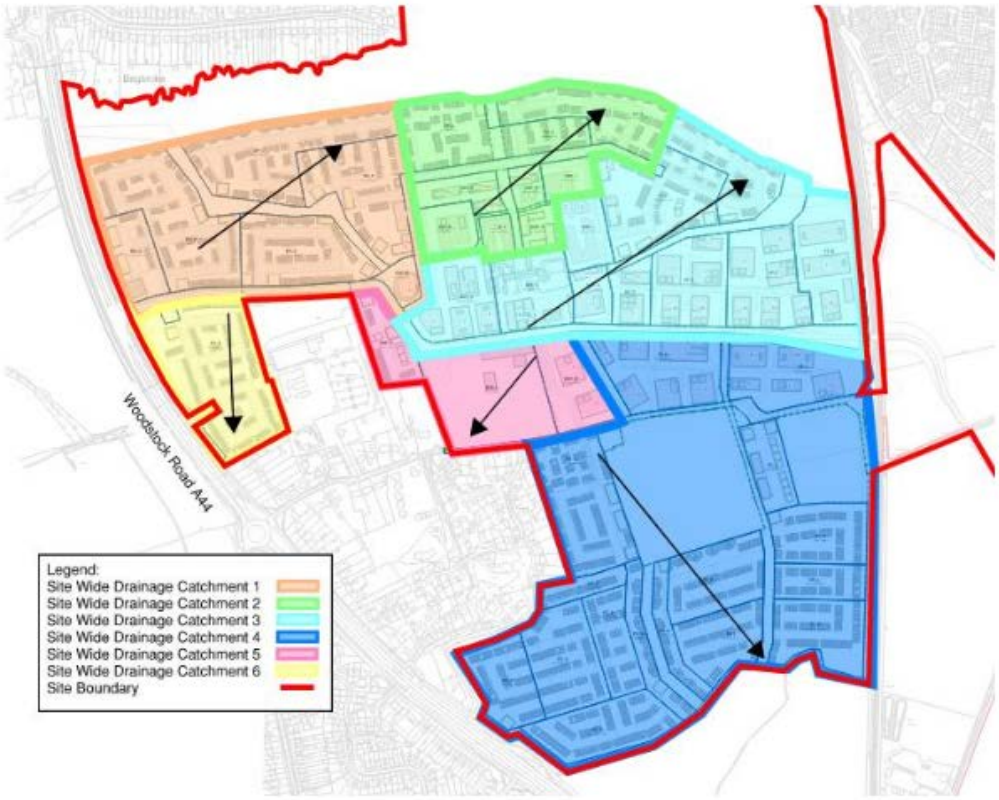


Figure 5—3 Overall Site drainage catchments

Figure 2-1 Overall site proposed drainage catchments (Figure 5-3 from ODS). (Note: Arrows represent indicative flow directions)

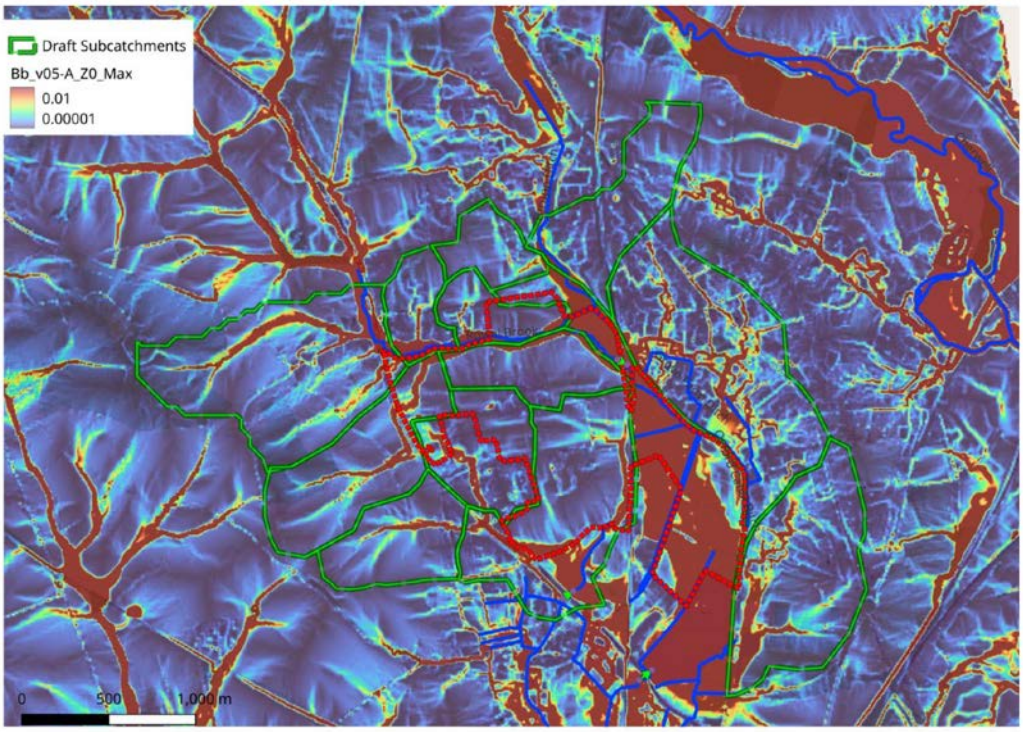


Figure 5 Preliminary results of the Direct Rainfall Model (unit flow, m2/s)

Figure 2-2 Existing subcatchments extracted from the EVY Flood Estimation Report

2.2 LLFA Comment 2

LLFA Comment 2: The yellow catchment along Woodstock Road is shown to discharge to the same outfall, which is currently facing flooding issues, this is the same outfall as PR9. Clarification is required on the exact outfall location as its not shown on plan.

As outlined in Table 5-2 of the Drainage Strategy, it is proposed that Catchment 6 is drained through infiltration up to the 1:100 +40% climate change ('CC') allowance storm event. Attenuation storage will be provided on site and the estimated storage volumes are provided in Table 5-4 of the ODS.

Initial infiltration testing has been undertaken on the site and recorded in ES Vol 3 Appendix 15.1 Desk Study Review and Ground Investigation - 19114-HYD-XX-XX-RP-GE-01002-S2-P08 (an extract is provided in Appendix A). Further testing will need to be undertaken to inform the detailed drainage design for the site.

Section 4.1 of the Flood Risk Assessment identifies an offsite overland flow route from the PR9 site which flows over the A44 and across the north west corner of the site as shown in Figure 2-3 below. To mitigate the flood risk to the masterplan in this location, a swale is proposed within the site boundary along Woodstock Road which will act to re-route the flood water along this designated corridor before overtopping and flowing north into the Rowel Brook. This is an additional measure to those proposed in the surface water drainage strategy. Further details are provided in section 4.1.1 of the FRA.

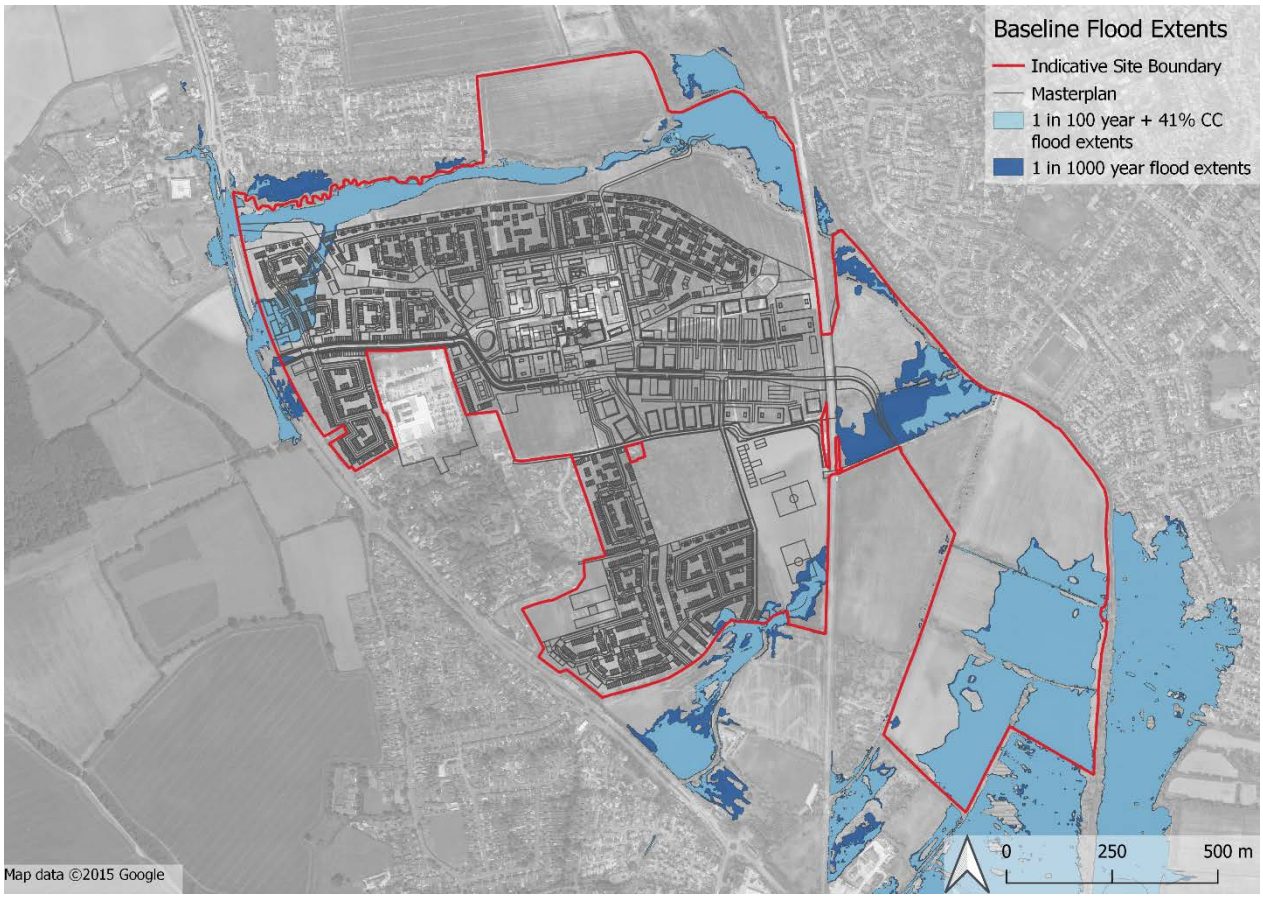


Figure 2-3 Baseline Fluvial Modelling Results with illustrative masterplan overlaid for the 1 in 100 year + 41% CC and the 1 in 1000 year flood extents (Extracted from Figure 17 of the Flood Risk Assessment)

2.3 LLFA Comment 3

LLFA Comment 3: Phasing plan to be provided, to demonstrate each phase and how it will stand alone in terms of discharging surface water to prevent flood risk.

The stormwater catchments shown in the Outline Drainage Strategy are aligned to the indicative preliminary construction phasing of the site.

The phased delivery of the Proposed Development is a reserved matter that will be submitted to and approved by the Council at later stages of planning.

2.4 LLFA Comment 4

LLFA Comment 4: Provide agreed points of surface water discharge. Consent to be provided from the relevant party to make drainage connections and to confirm capacity of the existing outfalls, to ensure the proposed surface water loads does not increase flood risk to the neighbouring sites.

The proposed points of discharge are provided in Table 1 (Table 5-2 in ODS). These are via infiltration and/ or watercourses. The number and location of these points of discharge will be confirmed through later stages of design and planning as the masterplan is developed.

No connection to existing headwalls is proposed as part of the outline drainage strategy. Approval of any proposed outfall structures will be sought from the relevant consenting authority, acknowledging that the consenting process is separate to planning but will likely occur in parallel.

2.5 LLFA Comment 5

LLFA Comment 5: Infiltration testing according to BRE 365 to be provided with its location plan.

The excerpts provided in Appendix A from ES Vol 3 Appendix 15.1 Desk Study Review and Ground Investigation - 19114-HYD-XX-XX-RP-GE-01002-S2-P08 show the location and specification of Infiltration tests carried out on Site. This confirms that testing has been carried out in line with BRE365 requirements.

2.6 LLFA Comment 6

LLFA Comment 6: Provide calculations for the proposed SuDS, to ensure attenuation volumes can be achieved. Calculations required for all storm events up to and including the 1:100-year storm event plus 40% climate change.

Preliminary sizing of the attenuation required has been provided within Table 5-4 of the ODS. The calculations requested are provided in Appendix B. The screenshots present the key parameters that were used within Microdrainage for the calculation of the required attenuation within each of the proposed catchments, and the results tab for each.

The ODS sets out the strategy for the provision of SuDS within the residential and commercial areas of the masterplan. SUDs are proposed to be provided both on plot and within the wider masterplan area. The proportion of attenuation provided within the plot versus wider masterplan areas will be developed through the later stages of design and planning. This will also be detailed in the design guidelines to the plot developers.

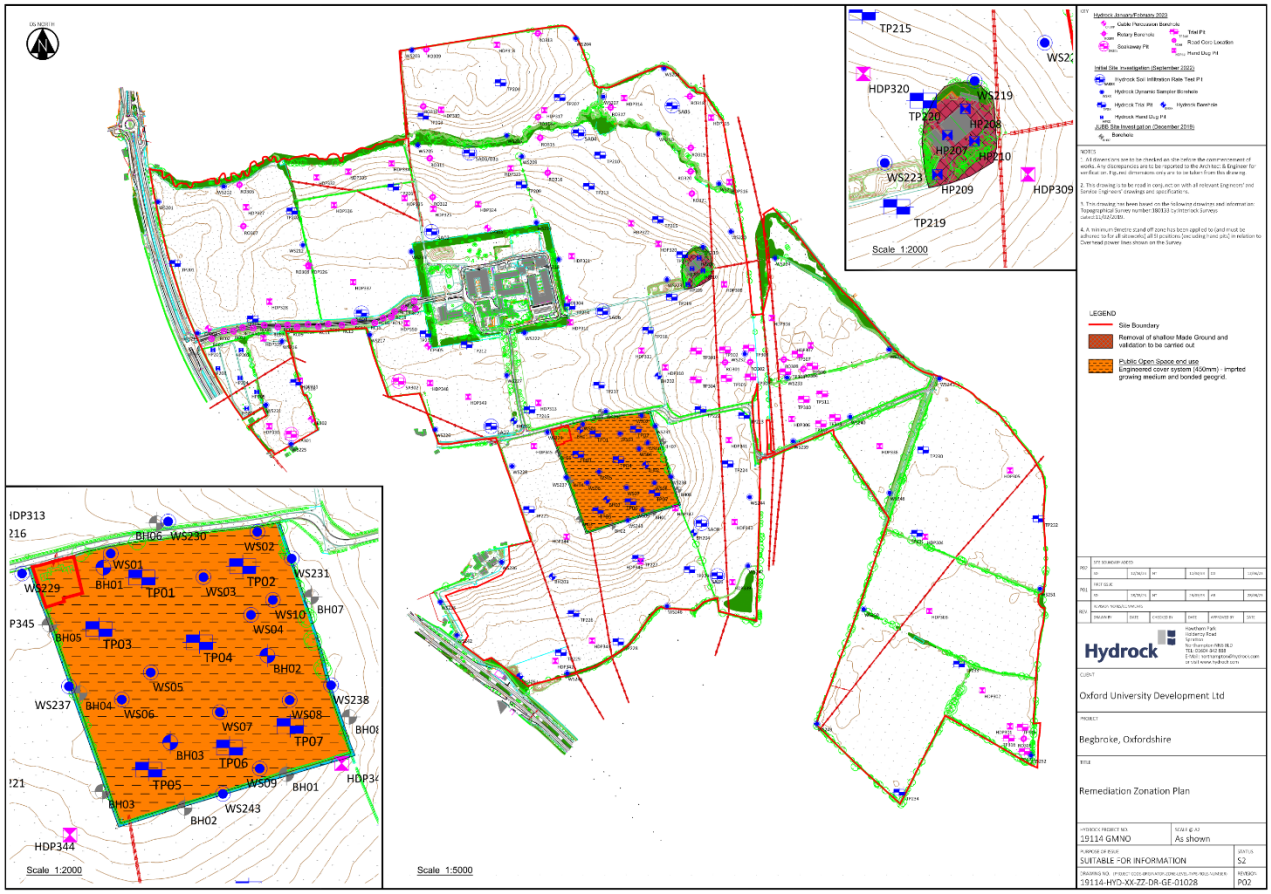
2.7 LLFA Comment 7

LLFA Comment 7: Surface water catchment plan to be provided, showing the extent of the impermeable areas, and stating the area after allowing for 10% urban creep.

The outline drainage strategy has been designed based on the illustrative masterplan. An allowance for impermeable areas has been detailed within section 5.4.3.2 Runoff Volume Assessment detailing the process undertaken, to reflect the site constraints, and permeability of the site to demonstrate that the outline strategy would be feasible. A detailed

drainage strategy will be provided with reserved matters applications and will include the extent of impermeable areas, including an allowance for 10% urban creep.

3 Appendix A Excerpts from Es Vol 3 Appendix 15.1 Desk Study Review



Sustainable drainage	Assessment of the infiltration rate data the ground model concludes: • The Alluvium, proven along the northern and southern edges of the site (and expected to be present along the eastern edge), is considered unsuitable for infiltration drainage due to a combination of high clay content (low permeability) and the presence of groundwater. • The thicker River Terrace Deposits in the centre of the site (at a topographic high) are considered suitable (subject to further testing) for infiltration drainage where there is sufficient depth of gravel present above the water table. However, there will need to be sufficient thickness of permeable soil above the water table to allow soakaway design. • The thinner River Terrace Deposits in the north, south and east of the site, at the topographic lower points, are considered unsuitable for infiltration due to shallow groundwater levels resulting in limited storage capacity, generally due to a limited thickness of River Terrace Deposits, merging with the Alluvium and overlying the Oxford Clay. • The Kellaways Clay Member and Oxford Clay Member (sub-cropping around the periphery of the northern part of the site, and present at depth below the site), are considered unsuitable for infiltration drainage due to their low permeability (high clay content). • Infiltration drainage should not be installed in the historical landfill site, located in the central-south of the site. The civils designer and flood risk designer will need to take groundwater water levels into account when designing the attenuation ponds. The design options available are to either: • increase the base level of the pond, so it is above the groundwater table; or • line the pond. It should be noted that if it is proposed to line the ponds, the potential hydrostatic uplift needs to be considered with the design and the liner will need to be placed at an over excavated depth and covered with soil to prevent the liner lifting.

4. GROUND INVESTIGATIONS

4.1 Site works

4.1.1 Rationale

The ground investigation works, including the rationale which was based on the findings of the preliminary risk assessment is summarised in Table 4.1. Works have been undertaken in several stages and comprise: landfill investigation; preliminary soil infiltration investigation; site wide preliminary investigation; Sandy Lane railway bridge and canal bridge investigation; and groundwater levels investigation.

Table 4.1: Investigation rationale

Location	Purpose – Preliminary Investigation.
Landfill investigation	
BH01 - BH03	Cable percussion boreholes to investigate the thickness of the landfill. To allow collection of samples for contamination testing. Installation of gas and groundwater monitoring and sampling wells in the Oxford Clay Formation.
WS01, WS02, WS09 & WS10	Dynamic sampled boreholes to investigate the extent of the landfill. To allow collection of samples for contamination testing. Installation of gas and leachate/groundwater monitoring and sampling wells in the landfill.
WS03-WS08	Dynamic sampled boreholes to assess shallow ground conditions within the known location of the landfill. To allow collection of samples for contamination testing. Installation of gas and leachate/groundwater monitoring and sampling wells in the landfill.
TP01-TP07	Machine dug trial pits to assess the shallow ground conditions To allow collection of samples for contamination testing.
Preliminary soil infiltration investigation	
SA01 – SA09	Machine dug trial pits to investigate the shallow geology on a very wide spacing across the site. To allow for soil infiltration rate testing. (The locations of tests were designed to provide an indication of infiltration potential at areas identified as potential attenuation pond locations in the north (SA03, SA04 and SA05) and south (SA08 and SA09) and also across the central part of the site (SA01, SA02, SA06 and SA07), where gravels were expected to be thicker.
SA301 – SA302	Machine dug trial pits to investigate the shallow geology in the west of the site. To allow for soil infiltration rate testing.

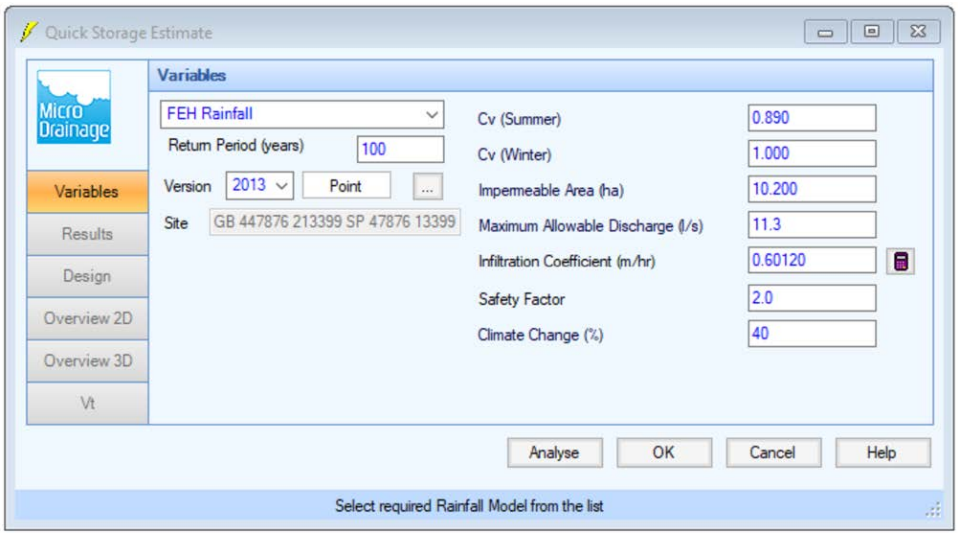
5.4.3 Infiltration tests

The results of the infiltration testing undertaken are summarised in Table 5.4. The results sheets are presented in Appendix C. Testing was carried out in general accordance with BRE Digest 365 (BRE DG365) (2016).

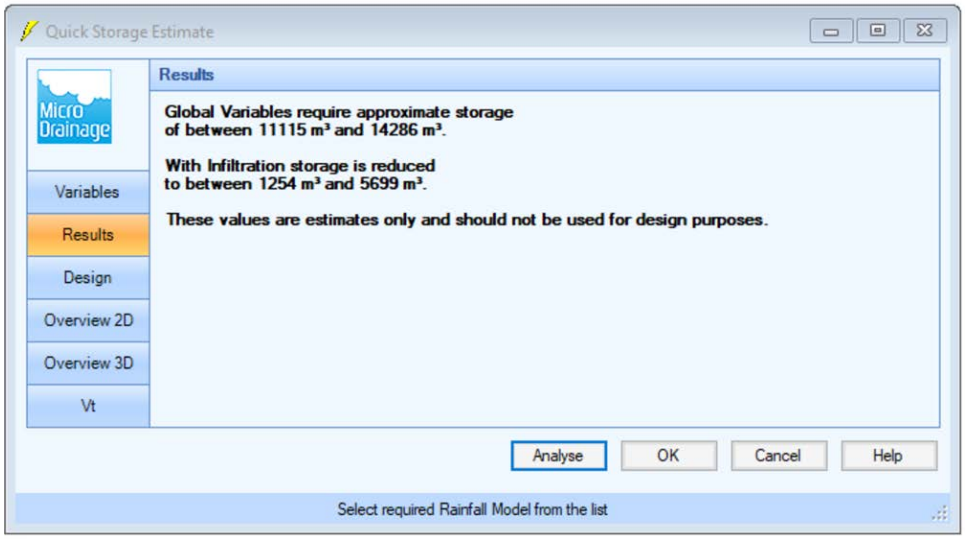
Table 5.4: Infiltration test results

Stratum	Location	Depth to base of pit (m bgl)	Infiltration rate (m/s)		
			Run 1	Run 2	Run 3
River Terrace Deposits	SA01	1.20 – 2.00	1.67×10^{-4}	1.91×10^{-4}	1.40×10^{-4}
	SA02	1.00 – 2.00	6.05×10^{-5}	3.47×10^{-5}	4.05×10^{-5}
	SA06	-	Destroyed by ploughing between installation and test.		
	SA07	1.30 – 2.10	1.92×10^{-4}	1.81×10^{-4}	1.35×10^{-4}
	SA301	1.00 – 1.60	7.13×10^{-5}	8.13×10^{-5}	8.09×10^{-5}
	SA302	1.40 – 2.50	2.25×10^{-4}	1.44×10^{-4}	1.40×10^{-4}
Alluvium	SA04	0.70 – 1.40	No water added due to standing groundwater level of 0.70m bgl decreasing to 0.75m bgl over 3 days.		
	SA03a	0.46 – 1.00	Infiltration rate too slow to calculate.		
	SA09	0.50 – 1.10	Infiltration rate too slow to calculate.		
Kellaways Clay Member	SA05	0.50 – 1.40	No water added due to standing groundwater level of 0.50m bgl decreasing to 0.61m bgl over 3 days.		
	SA08	1.00 – 2.00	Infiltration rate too slow to calculate.		

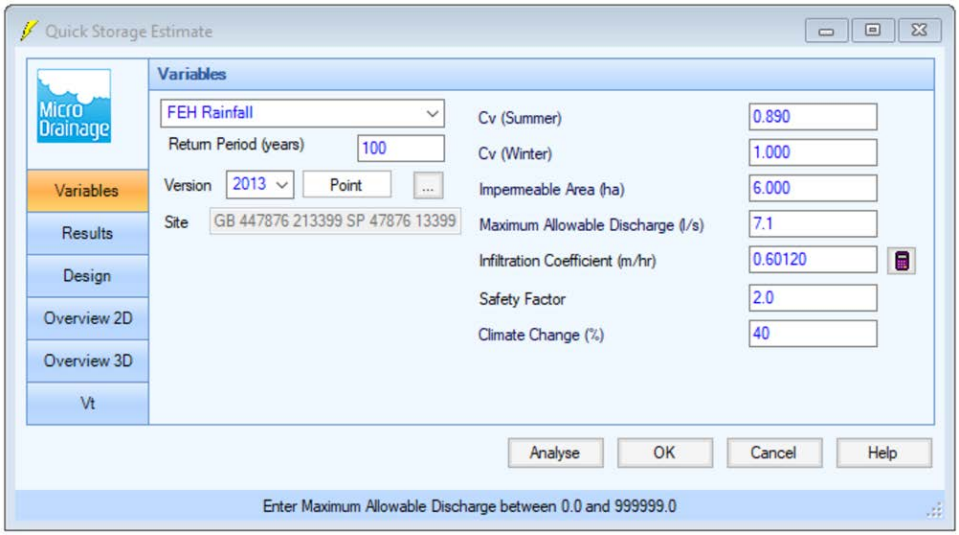
4 Appendix B Attenuation Storage Calculations



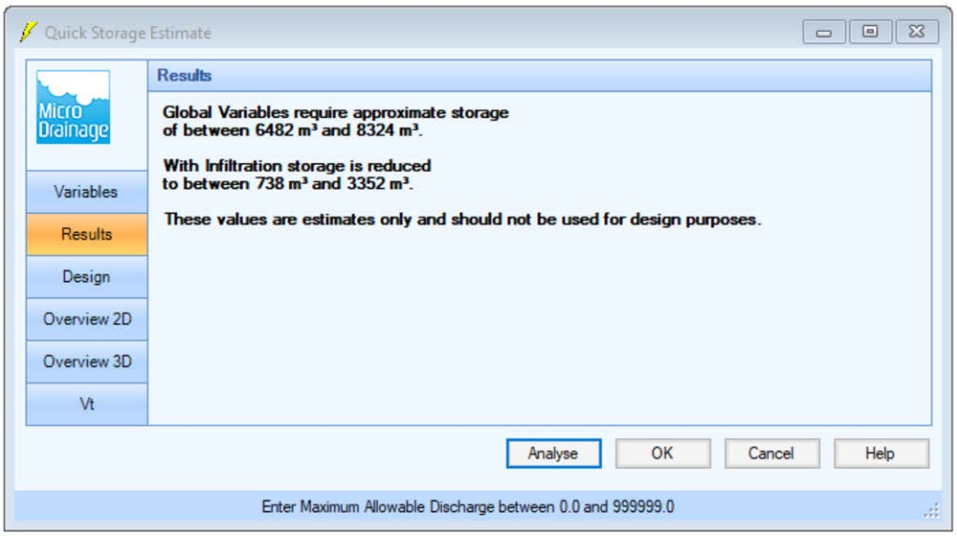
Proposed Catchment 1 Key Parameters



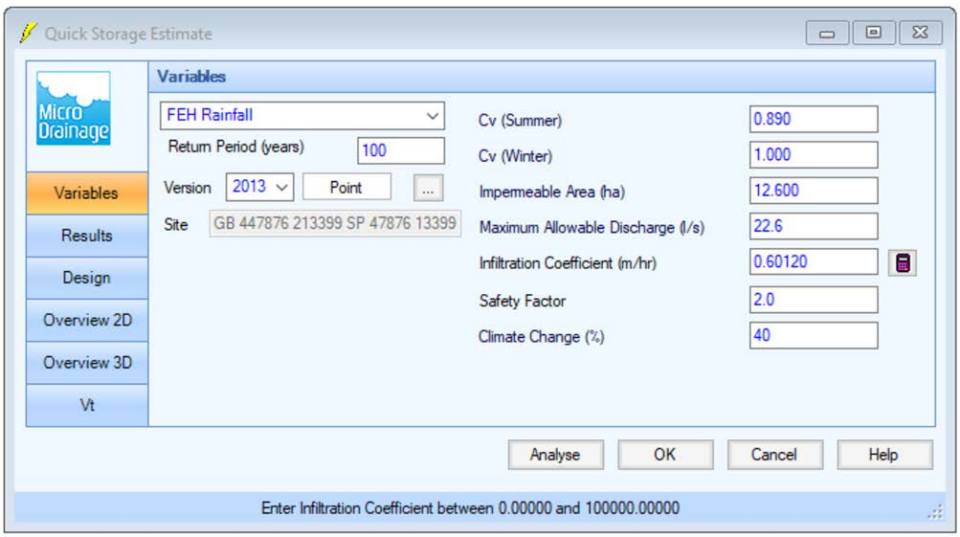
Proposed Catchment 1 Required Attenuation Results



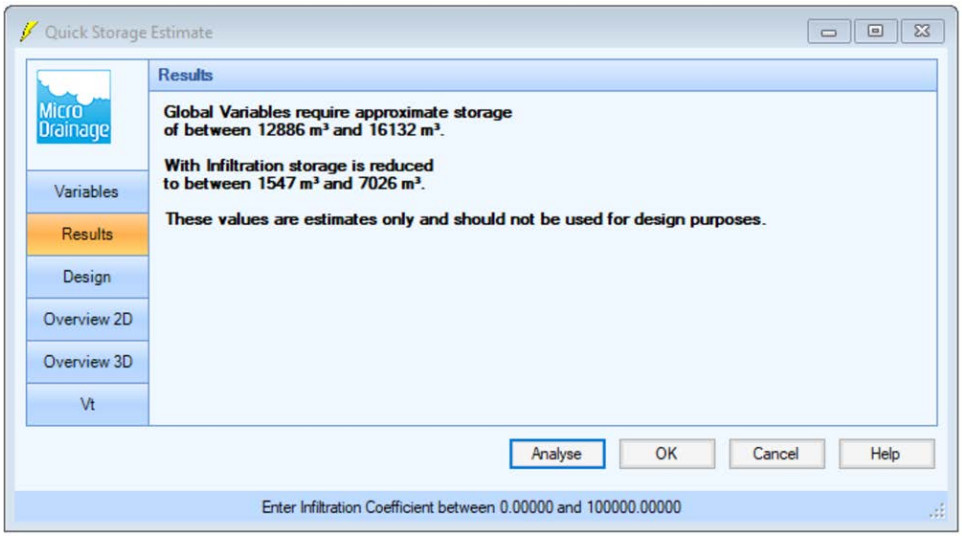
Proposed Catchment 2 Key Parameters



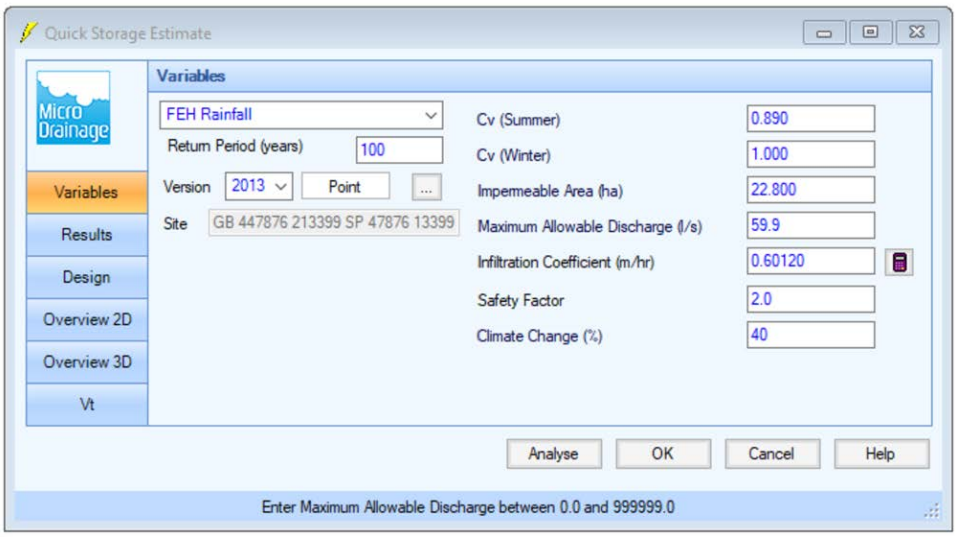
Proposed Catchment 2 Required Attenuation Results



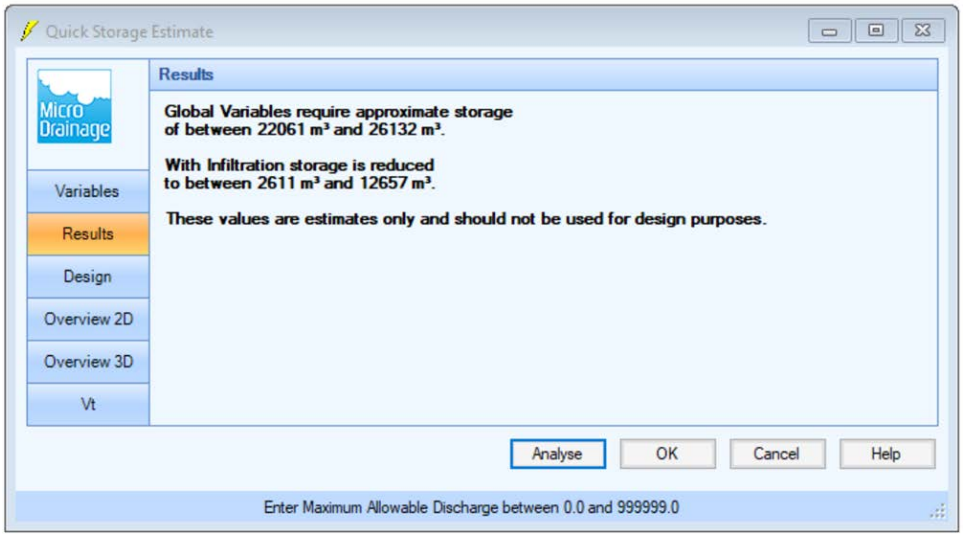
Proposed Catchment 3 Key Parameters



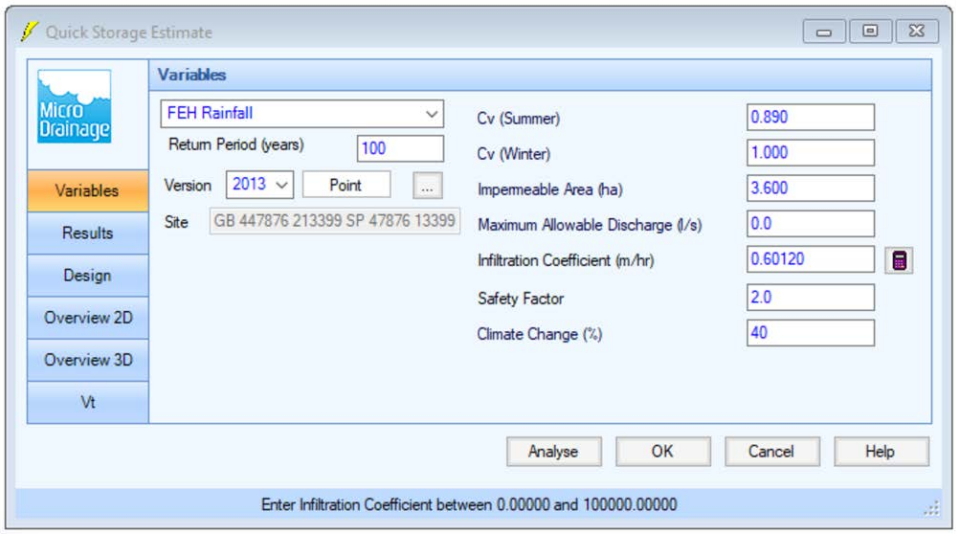
Proposed Catchment 3 Required Attenuation Results



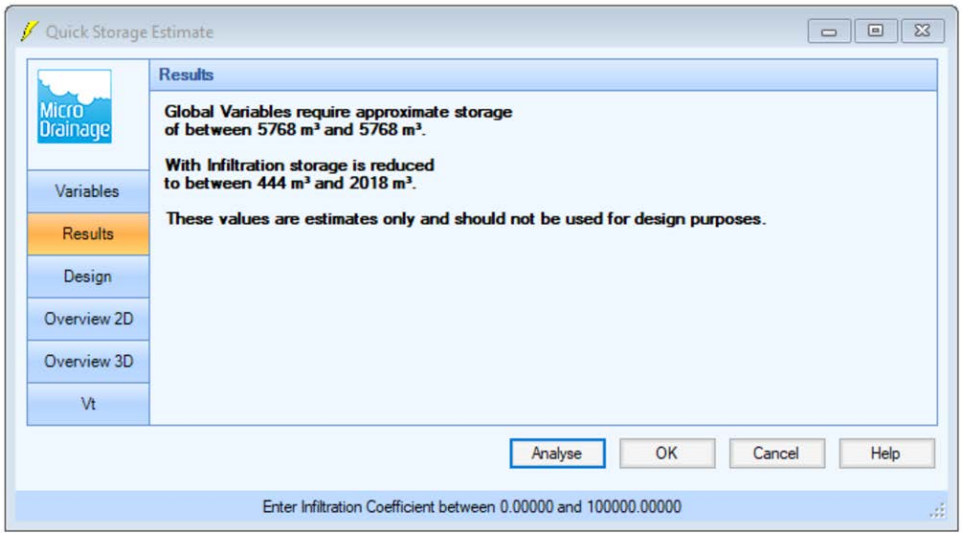
Proposed Catchment 4 Key Parameters



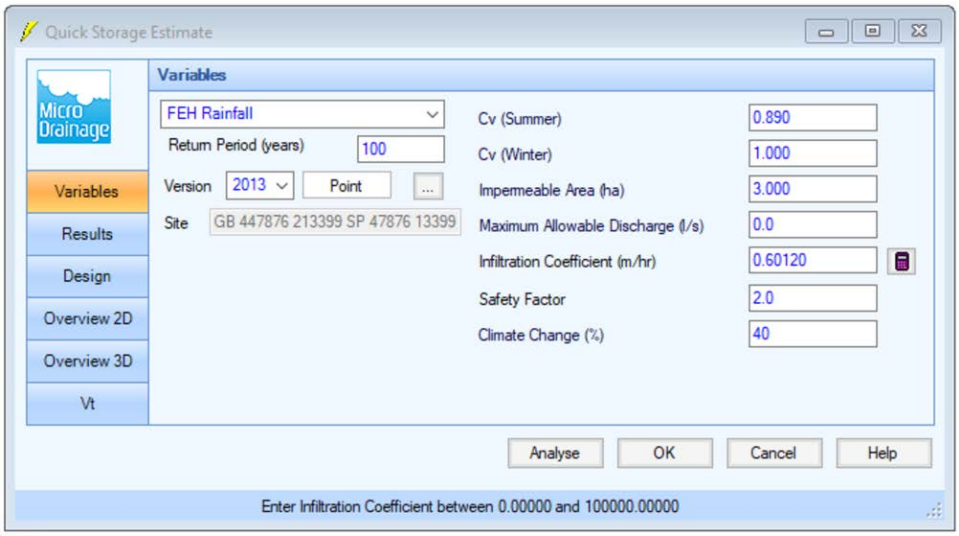
Proposed Catchment 4 Required Attenuation Results



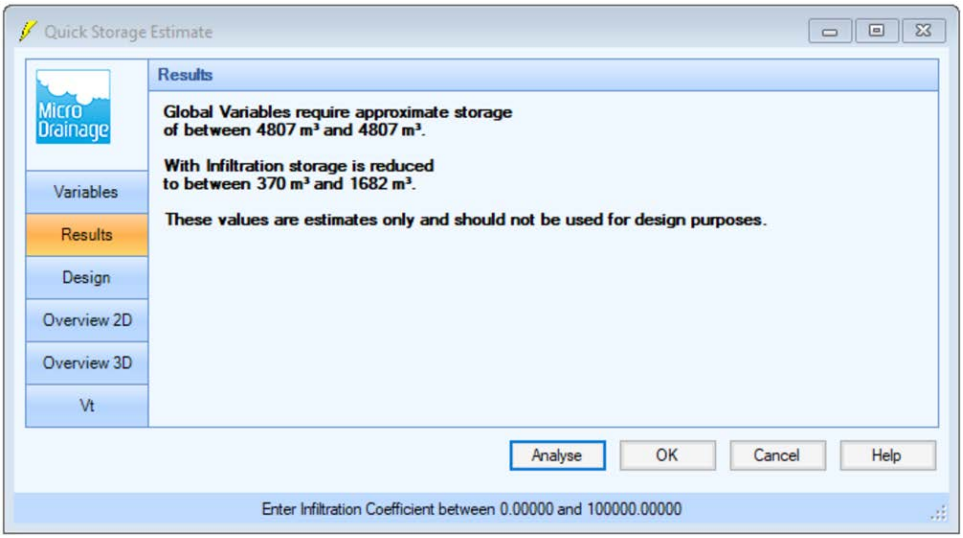
Proposed Catchment 5 Key Parameters



Proposed Catchment 5 Required Attenuation Results



Proposed Catchment 6 Key Parameters



Proposed Catchment 6 Required Attenuation Results