Land North East of Oxford Road West of Oxford Canal and East Of Bankside, Banbury, Oxfordshire

Technical Note: Response to Oxfordshire County Council's (Drainage) Comments dated 12th May 2020 for Application 19/01047/OUT-2

22nd May 2020

1 Introduction

This technical note responds to the latest comments provided by Drainage Engineer Adam Littler by email on the 12th May 2020, acting on behalf of Oxfordshire County Council (OCC) Lead Local Flood Authority.

The comments relate to the submission of the Flood Risk Assessment (*10327 FRA02 Rv4*) produced by Brookbanks Consulting Ltd (BCL), in support of the outline application at Land North East of Oxford Road West of Oxford Canal and East Of Bankside, Banbury, Oxfordshire. They are for the majority the same comments are raised by the LLFA in their note dated 29th July 2019 with several additional queries within the email itself.

For this note, the comments are dealt with in order, being the original response document of the 29th July 2019 and then further comments within the email dated 12th May 2020. A revised drainage plan has been produced (10327 DR05 Rev F) which is located within Appendix A of this note.

The application comprises the following:

- *Up to 825 residential units,*
- *Area designated for allotments and green space.*

NCC's commentary is noted in *italics* and BCL's response is noted in **blue**.

2 OCC Drainage Response Note dated 29th July 2019

1. *Confirmation required that the site surface water management proposal is based on full infiltration techniques.*

   All surface water from the site is proposed to be discharged via the infiltration basin in the north of the site. No storm water has been designed to discharge into watercourses, drainage ditches or existing surface water sewers. The rate of infiltration from the basin is 9.06 x10^{-5}. This is indicated on the drainage strategy DR-05 Rev E within Appendix B of the submitted FRA and its revision to F included in Appendix A of this note. It is also within Figure 4d of the FRA. In addition full infiltration testing has been carried out on the site to BRE digest requirements and results included in the FRA. Included as Appendix B in this note is a plan illustrating the location of all that testing for clarity.

2. *Discharge at relevant return periods to be at Greenfield rate.*

   Storm Water from the site is to be completely infiltrated as discussed above and this forms the basis of the design as shown in the FRA; therefore, no surface water is proposed to be discharged from the site to any water courses. This is in line with the preferred drainage train of discharge, Infiltration being the preferred method in the first instance. Given that this is the case it is the infiltration rate that drives the design not the Greenfield runoff rate.

3. *40% Climate Change allowance to be applied to calculations.*

   40% climate change has been applied to the drainage calculations. This is shown on the Source Control calculation within the appendix of the FRA and within paragraphs 4.24 and 4.28 of Chapter 4.

4. *MicroDrainage calculations provided use default Cv values, these are not representative of the site. It is recommended values of 0.95 for roofs and 0.9 for paved areas are applied. The designer must justify where a Cv of less than 0.9 has been used.*

The default Cv values have not been used for this design. As outlined in your previous comments (19/01047/OUT, 26th July 2019) a value of 0.925 was then used within the basin design. As this is an outline application the masterplan has yet to be fixed, therefore, we have continued to use 0.925 Cv value as a compromise between the amount of roof and paved area that will be provided within the site. Microdrainage calculations for the detailed submission when exact roofing and paved areas are known can use specific Cv values.

5. *Calculations should be undertaken for all relevant return periods and identify the critical duration used.*

   The calculations for the 1 in 1-year and 1 in 30-year return periods are included within Appendix B of this note.

   The critical duration that has been used is the 1 in 100 year + 40% climate change, 120-minute storm event. This is indicated in red lettering on the Source Control calculations within the FRA.

6. *Any phasing of the development needs to be demonstrated and how surface water will be managed during this process.*

   Phasing for the development will be determined at Reserved Matters. Currently the drainage plan (DR-05 Rev E) illustrates how each residential parcel will discharge its surface water into the basin which is located at the lowest point of the site. Many factors as well as drainage will determine phasing and the interim drainage for that must be completed at the appropriate time. i.e. RM or detailed application stage.

7. *Explanation required as to whether the pond is proposed as Approach 1 or 2 as detailed in the latest CIRIA (C753) manual. Is the pond proposed to be used for Long Term Storage, confirmation required.*

   The infiltration basin is not designed to discharge into the existing watercourses/ drainage network. It has been designed as a purely infiltration feature, which does not require a discharge runoff rate from the site. i.e. the Approach method described does not apply in this instance.

8. *Freeboard of pond to be demonstrated.*

   The Source Control calculation within the appendix of the FRA shows the basin to be designed to a depth of 1.5m, with a maximum water depth of 1.2m for the 120 min Winter storm event. Therefore in the 1:100yr plus climate change storm event the demonstrated freeboard is 300mm.

9. *Has approval been sought from the LPA under LDA 1991 to discharge to ditchline. If proposal is to discharge to existing ditchlines riparian ownership and maintenance should be demonstrated.*

   Infiltration is the only form of discharge from the site for storm water; therefore, no surface water will be discharged to existing ditchlines, requiring LDA's.

10. *Evidence of Source Control required.*

    On source control for this site we have a serious of swales and an infiltration basin. Given the varying infiltration on the site it is likely that the swales and the green corridors will also store and infiltrate storm water (for a robust design at this stage obviously the calculations only consider the main basin for such infiltration). If further methods of source control are included in a future detained application like water butts or water harvesting, these may be included then, but could not be defined at this stage.

11. *Site should be divided into sub-catchments each dealing with its own surface water requirement. Dispersed site storage and flow control around the site to final pond destination is expected.*

    This is an infiltration design, there is some semblance of each parcel having such drainage features through the swales on site. This is not a particularly large site and other recent development in and around this proposal have their own drainage regimes so in a sense on a larger scale each phase of the larger area is its own sub catchment.

    In addition, when considering an infiltration design the smaller the catchments the less effective an above ground and simple feature such as the basin shown can be. On smaller scales the sensible approach to infiltration becomes engineered solutions such as perforated manholes soakaways or buried crate systems, which are more difficult to maintain and manage.

12. *Conveyance routing around site needs to be demonstrated.*

    The drainage strategy (DR-05 Rev E), located within Appendix B of the FRA, illustrates the proposed locations of swales and pipe network throughout the development. This network will convey surface water from the residential parcels to the infiltration basin located at the north east of the site.

If reference is being made to overland conveyance then at such an outline application as this it is not appropriate to define individual parcel layouts and therefore gardens and road locations to inform a fine grain plan. At this stage we do show however, that the green infrastructure surrounds each parcel and would therefore form the natural breaks and conveyance channels in such events.

13. *Water to be kept at or as close to the surface as possible.*

No underground storage has been designed to store or discharge storm water from the site, a number of swales have also been proposed to convey surface water from the residential catchments to the basin in the north of the site. A pipe network has been combined with the use of swales to convey surface water in order to maintain a balance of open SuDS usable green space and a sensible gravity fed system. Any stored water is by its very nature stored at the surface while it infiltrates.

14. *Pre and Post development (modified flow route) overland surface water flow plan required.*

Firstly, there is no intention to change the topography of the land to the point where drainage would not follow the topography of today. Secondly this is an outline application the internal parcel roads and housing layouts that would dictate such flows are simply not known at this stage, but given the first statement in this answer, this should just be a level of detailed to follow in the RM which reflects broadly the flow routes already demonstrated within the FRA.

15. *Safe ingress/egress needs to be demonstrated.*

A maintenance slope of 1 in 5 has been illustrated on the basin shown on the updated drainage plan (DR-05 Rev F) located in Appendix A of this note.

16. *Sacrificial areas in the event of exceedance should be considered.*

The drainage strategy (DR- 05 Rev E), located within Appendix B of the FRA illustrates an exceedance route for storm water should the basin depth be exceeded. This is shown by the yellow arrows and the key has been amended in the subsequent revised drawing revision F in Appendix A of this note.

17. *Further thought needs to be given to maximising use of green space on site for SuDS incorporation.*

SuDS have been incorporated within all the available green space within the site boundary. The green space through the development must perform many planning functions and requirements. Green space that has no SuDS incorporated has been designated to usable green space such as NEAP and LEAP areas and public footpaths. The system within the FRA has therefore been fully considered in the wider context of all planning requirements.

18. *Treatment and Management train needs to be demonstrated.*

The treatment of surface water is demonstrated within the Water Quality section of Chapter 4 of the FRA. This incorporates paragraphs 4.33 to 4.42 and Figures 4e, 4f and 4g. The management of the proposed SuDS are described in Figure 4h, paragraph 4.46 of the FRA.

19. *Use of full toolbox of appropriate SuDS methods to be demonstrated on plan.*

The combination of swales and an infiltration basin has been used within the development to convey, store and discharge storm water from the site. This is our proposal for the site. further parcel detail can be sort at detailed or RM applications that follow. 3 forms of treatment are already shown within the submitted plan, being piped, then Swales and finally an infiltration basin.

20. *All hardstanding should be of a permeable construction.*

This is an outline application and should not be as descriptive at this time. A detailed application or RM may well propose a range of measures within the parcel design for the eventual scheme and therefore should not be as prescriptive at this stage.

It should be noted that the design that is shown already demonstrates a robust and sustainable approach to drainage for the development

21. *Blue/Green roofs and rainwater harvesting should be considered.*

This is an outline application and as discussed above this level of detail is not known. A detailed application or RM may well propose a range of measures within the parcel design for the eventual scheme and therefore it should not be as prescriptive at this stage.

Again, it should be noted that the design that is shown already demonstrates a robust and sustainable approach to drainage for the development

22. *Confirmation required for half drain down times, for example the attenuation pond.*

    The half drain down time of the critical 1:100 yr event in the infiltration basin is 185 minutes. This is shown within the Source Control calculations within Appendix B of the FRA.

23. *Justification as to whether 10% Urban Creep allowance has been applied required.*

    10% urban creep has been taken into consideration, this can be seen in Figure 4d, paragraph 4.27 of the FRA.

24. *Management and Maintenance plan to be worked up (in draft at this stage) and submitted.*

    The treatment and management of the proposed SuDS are described in Figure 4h, paragraph 4.46 of the FRA. The type of SuDS is shown on the main drainage plan and therefore read together form the proposed management and maintenance regime. If the question is who will do the work then currently it is assumed that the Maintenance would be undertaken by a management company, a typical solution across the country. We are aware of Water Companies potentially now taking into adoption SuDS since legislation change in April of this year, however the pace at which they are moving on this at present, means it is currently still prudent to assume maintenance of such features remains a private matter.

3 OCC Drainage Response Email contents 12th May 2020

A. *I will accept the calculations Cv value but request FEH is confirmed as having been used.*

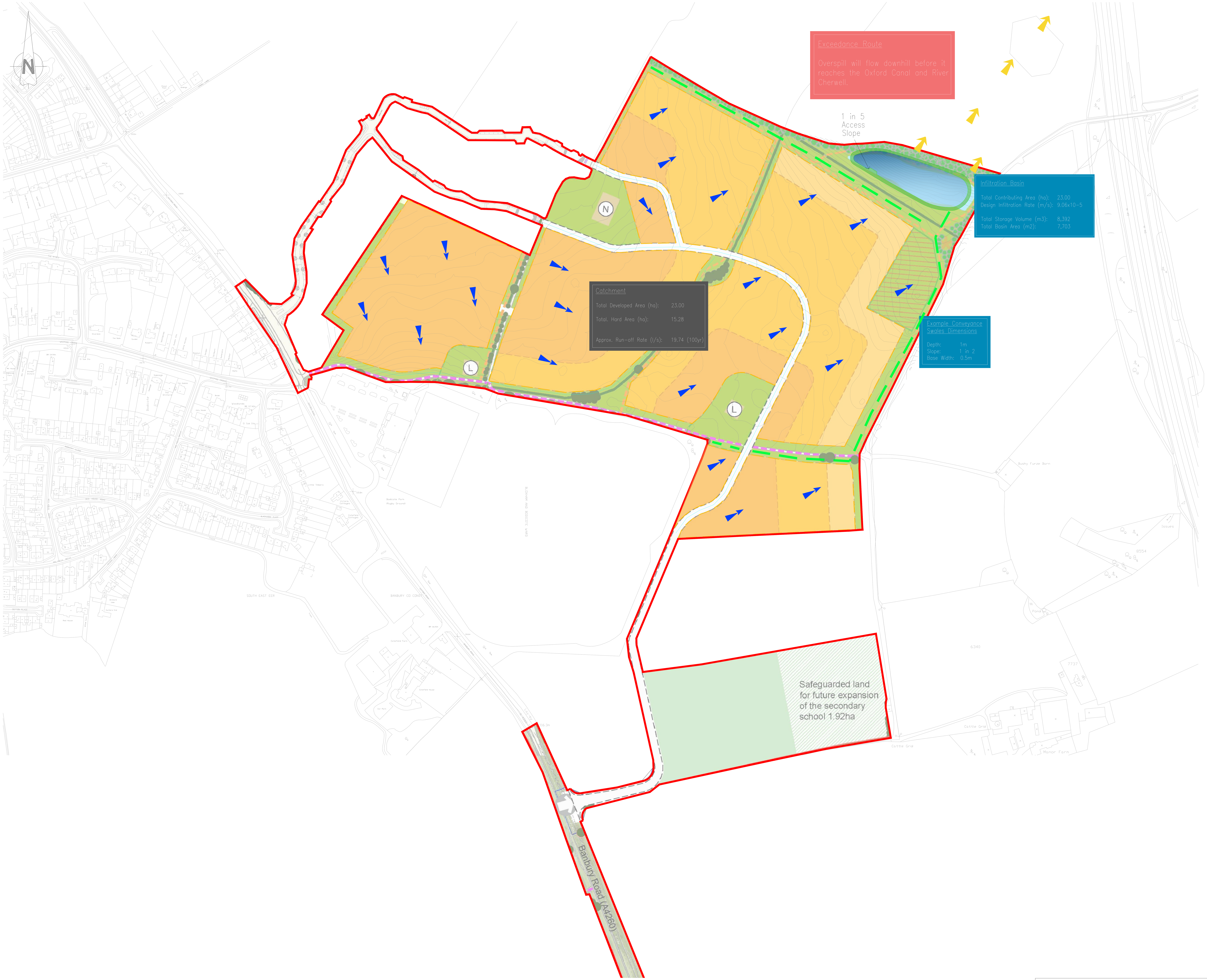
   FEH has been used and the revised calculations are within Appendix B of this Technical Note. It should also be noted that the updated Drainage plan within Appendix A has been amended to account for FEH rainfall calculations.

B. *Please could you also complete the attached pro-forma as this will greatly speed up the technical assessment side of the calculations.*

   Pro-Forma is completed and is within Appendix C of this Technical Note.

Appendix A

Original Drawing Size A1



Construction Design and Management (CDM)
Key Residual Risks

Contractors entering the site should gain permission from the relevant land owners and/or principle contractor working on site at the time of entry. Contractors shall be responsible for carrying out their own risk assessments and for liaising with the relevant services companies and authorities. Listed below are Site Specific key risks associated with the project.

1) Overhead and underground services
2) Street Lighting Cables
3) Working adjacent to water courses and flood plain
4) Soft ground conditions
5) Working adjacent to live highways and railway line
6) Unchartered services
7) Existing buildings with potential asbestos hazards

NOTES:

1. Do not scale from this drawing
2. All dimensions are in metres unless otherwise stated.
3. Brookbanks Consulting Ltd has prepared this drawing for the sole use of the client. The drawing may not be relied upon by any other party without the express agreement of the client and Brookbanks Consulting Ltd. Where any data supplied by the client or from other sources has been used, it has been assumed that the information is correct. No responsibility can be accepted by Brookbanks Consulting Ltd for inaccuracies in the data supplied by any other party. The drawing has been produced based on the assumption that all relevant information has been supplied by those bodies from whom it was requested.
4. No part of this drawing may be copied or duplicated without the express permission of Brookbanks Consulting.

KEY:

- Red Line
- Catchment Boundary
- Flow Direction
- Infiltration Basin and Maintance Strip
- Potential Conveyance Channel Locations
- Indicative Internal Storm Water Sewers
- Exceedance Route Flow Path

F	Updated Infiltration Basin and Key	KM	DS	DS	11.05.20
E	Updated Storm Sewers	KM	DS	DS	10.01.20
D	Updated Parameters Plan and Basin	KM	DS	DS	02.01.20
C	Updated Basin and Conveyance Systems	KM	DS	DS	24.10.19
B	Updated Basin and Conveyance Swales	KM	DS	DS	14.10.19
A	Updated Masterplan and Basins	KM	SO	LW	07.05.19
-	First Issue	KM	SO	LW	21.01.19

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Hallam Land Management

Land South of Bankside, Banbury

Illustrative Surface Water Drainage Strategy

Status: Draft		Status Date: MAY 2020
Drawn: KM	Checked: LW	Date: 21.01.19
Scale: 1:2500	Number: 10327-DR-05	Rev: F

0 50 100 150 200 250
METRES

UNTIL TECHNICAL APPROVAL HAS BEEN OBTAINED FROM THE RELEVANT LOCAL AUTHORITIES, IT SHOULD BE UNDERSTOOD THAT ALL DRAWINGS ARE ISSUED AS PRELIMINARY AND NOT FOR CONSTRUCTION. SHOULD THE CONTRACTOR COMMENCE SITE WORK PRIOR TO APPROVAL BEING GIVEN, IT IS ENTIRELY AT HIS OWN RISK.

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Appendix B

Summary of Results for 1 year Return Period

Half Drain Time : 29 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	0.129	0.129	298.2	828.8	O K
30 min Summer	0.149	0.149	299.8	958.5	O K
60 min Summer	0.157	0.157	300.4	1009.6	O K
120 min Summer	0.152	0.152	300.0	974.4	O K
180 min Summer	0.140	0.140	299.0	897.2	O K
240 min Summer	0.127	0.127	298.0	812.4	O K
360 min Summer	0.102	0.102	296.0	650.2	O K
480 min Summer	0.081	0.081	294.3	516.4	O K
600 min Summer	0.065	0.065	293.0	414.3	O K
720 min Summer	0.054	0.054	292.1	343.5	O K
960 min Summer	0.045	0.045	261.0	283.7	O K
1440 min Summer	0.035	0.035	202.4	221.7	O K
2160 min Summer	0.027	0.027	155.6	170.5	O K
2880 min Summer	0.022	0.022	129.4	140.5	O K
4320 min Summer	0.017	0.017	97.3	105.2	O K
5760 min Summer	0.014	0.014	79.9	86.2	O K
7200 min Summer	0.012	0.012	68.2	73.4	O K
8640 min Summer	0.010	0.010	59.5	63.7	O K
10080 min Summer	0.009	0.009	53.7	57.5	O K
15 min Winter	0.129	0.129	298.2	827.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	31.077	0.0	21
30 min Summer	19.370	0.0	32
60 min Summer	12.073	0.0	50
120 min Summer	7.525	0.0	84
180 min Summer	5.707	0.0	118
240 min Summer	4.691	0.0	150
360 min Summer	3.557	0.0	212
480 min Summer	2.924	0.0	272
600 min Summer	2.511	0.0	328
720 min Summer	2.217	0.0	382
960 min Summer	1.814	0.0	498
1440 min Summer	1.367	0.0	740
2160 min Summer	1.030	0.0	1104
2880 min Summer	0.843	0.0	1468
4320 min Summer	0.626	0.0	2196
5760 min Summer	0.508	0.0	2920
7200 min Summer	0.431	0.0	3648
8640 min Summer	0.377	0.0	4400
10080 min Summer	0.337	0.0	5080
15 min Winter	31.077	0.0	22

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Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	0.149	0.149	299.7	953.6	O K
60 min Winter	0.154	0.154	300.1	985.8	O K
120 min Winter	0.139	0.139	299.0	891.7	O K
180 min Winter	0.118	0.118	297.2	753.7	O K
240 min Winter	0.096	0.096	295.5	617.1	O K
360 min Winter	0.062	0.062	292.8	398.4	O K
480 min Winter	0.047	0.047	275.7	301.4	O K
600 min Winter	0.041	0.041	240.5	263.1	O K
720 min Winter	0.037	0.037	214.1	234.3	O K
960 min Winter	0.031	0.031	179.0	194.2	O K
1440 min Winter	0.023	0.023	135.2	146.7	O K
2160 min Winter	0.018	0.018	103.1	111.6	O K
2880 min Winter	0.014	0.014	82.8	92.1	O K
4320 min Winter	0.011	0.011	62.4	67.2	O K
5760 min Winter	0.009	0.009	50.8	54.8	O K
7200 min Winter	0.008	0.008	45.0	48.0	O K
8640 min Winter	0.007	0.007	39.2	41.7	O K
10080 min Winter	0.006	0.006	33.4	36.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	19.370	0.0	32
60 min Winter	12.073	0.0	52
120 min Winter	7.525	0.0	88
180 min Winter	5.707	0.0	124
240 min Winter	4.691	0.0	156
360 min Winter	3.557	0.0	212
480 min Winter	2.924	0.0	262
600 min Winter	2.511	0.0	322
720 min Winter	2.217	0.0	382
960 min Winter	1.814	0.0	502
1440 min Winter	1.367	0.0	738
2160 min Winter	1.030	0.0	1100
2880 min Winter	0.843	0.0	1480
4320 min Winter	0.626	0.0	2180
5760 min Winter	0.508	0.0	2896
7200 min Winter	0.431	0.0	3664
8640 min Winter	0.377	0.0	4448
10080 min Winter	0.337	0.0	5144

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	1
FEH Rainfall Version	1999
Site Location	GB 449300 233450 SP 49300 33450
C (1km)	-0.022
D1 (1km)	0.318
D2 (1km)	0.302
D3 (1km)	0.269
E (1km)	0.293
F (1km)	2.491
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.925
Cv (Winter)	0.925
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 15.280

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	5.093	4	8	5.093	8	12	5.093

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Model Details

Storage is Online Cover Level (m) 1.500

Infiltration Basin Structure

Invert Level (m) 0.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.32616 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.32616

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	6353.8	0.400	6700.9	0.800	7057.2	1.200	7422.7
0.100	6439.7	0.500	6789.1	0.900	7147.7	1.300	7515.6
0.200	6526.2	0.600	6877.9	1.000	7238.8	1.400	7609.0
0.300	6613.3	0.700	6967.3	1.100	7330.5	1.500	7702.9

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Summary of Results for 30 year Return Period

Half Drain Time : 104 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	0.446	0.446	323.9	2916.5	O K
30 min Summer	0.504	0.504	328.6	3310.5	O K
60 min Summer	0.542	0.542	331.8	3568.1	O K
120 min Summer	0.537	0.537	331.3	3534.5	O K
180 min Summer	0.518	0.518	329.8	3406.7	O K
240 min Summer	0.498	0.498	328.1	3269.1	O K
360 min Summer	0.456	0.456	324.7	2990.4	O K
480 min Summer	0.416	0.416	321.4	2716.9	O K
600 min Summer	0.376	0.376	318.2	2451.5	O K
720 min Summer	0.338	0.338	315.1	2199.9	O K
960 min Summer	0.266	0.266	309.2	1723.7	O K
1440 min Summer	0.156	0.156	300.3	998.5	O K
2160 min Summer	0.064	0.064	293.0	410.3	O K
2880 min Summer	0.045	0.045	261.0	284.2	O K
4320 min Summer	0.033	0.033	190.7	207.0	O K
5760 min Summer	0.026	0.026	149.8	163.0	O K
7200 min Summer	0.022	0.022	126.5	137.2	O K
8640 min Summer	0.019	0.019	109.0	118.3	O K
10080 min Summer	0.017	0.017	97.3	105.2	O K
15 min Winter	0.446	0.446	323.9	2917.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	92.876	0.0	24
30 min Summer	54.978	0.0	37
60 min Summer	32.544	0.0	64
120 min Summer	19.264	0.0	104
180 min Summer	14.176	0.0	136
240 min Summer	11.404	0.0	170
360 min Summer	8.391	0.0	238
480 min Summer	6.750	0.0	306
600 min Summer	5.702	0.0	372
720 min Summer	4.967	0.0	438
960 min Summer	3.978	0.0	562
1440 min Summer	2.908	0.0	798
2160 min Summer	2.126	0.0	1128
2880 min Summer	1.702	0.0	1468
4320 min Summer	1.228	0.0	2200
5760 min Summer	0.974	0.0	2936
7200 min Summer	0.814	0.0	3656
8640 min Summer	0.703	0.0	4352
10080 min Summer	0.621	0.0	5112
15 min Winter	92.876	0.0	24

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Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	0.505	0.505	328.7	3317.0	O K
60 min Winter	0.544	0.544	332.0	3586.5	O K
120 min Winter	0.538	0.538	331.5	3546.3	O K
180 min Winter	0.513	0.513	329.4	3373.8	O K
240 min Winter	0.483	0.483	326.9	3171.7	O K
360 min Winter	0.420	0.420	321.7	2741.5	O K
480 min Winter	0.357	0.357	316.6	2320.4	O K
600 min Winter	0.297	0.297	311.7	1926.6	O K
720 min Winter	0.243	0.243	307.3	1567.0	O K
960 min Winter	0.147	0.147	299.6	945.6	O K
1440 min Winter	0.049	0.049	287.4	312.8	O K
2160 min Winter	0.036	0.036	211.2	229.5	O K
2880 min Winter	0.029	0.029	170.2	184.9	O K
4320 min Winter	0.021	0.021	123.5	133.8	O K
5760 min Winter	0.017	0.017	97.3	105.6	O K
7200 min Winter	0.014	0.014	82.8	89.0	O K
8640 min Winter	0.012	0.012	71.1	76.7	O K
10080 min Winter	0.011	0.011	62.4	67.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	54.978	0.0	37
60 min Winter	32.544	0.0	64
120 min Winter	19.264	0.0	112
180 min Winter	14.176	0.0	144
240 min Winter	11.404	0.0	182
360 min Winter	8.391	0.0	256
480 min Winter	6.750	0.0	326
600 min Winter	5.702	0.0	392
720 min Winter	4.967	0.0	456
960 min Winter	3.978	0.0	574
1440 min Winter	2.908	0.0	738
2160 min Winter	2.126	0.0	1088
2880 min Winter	1.702	0.0	1456
4320 min Winter	1.228	0.0	2168
5760 min Winter	0.974	0.0	2840
7200 min Winter	0.814	0.0	3584
8640 min Winter	0.703	0.0	4312
10080 min Winter	0.621	0.0	5000

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	1999
Site Location	GB 449300 233450 SP 49300 33450
C (1km)	-0.022
D1 (1km)	0.318
D2 (1km)	0.302
D3 (1km)	0.269
E (1km)	0.293
F (1km)	2.491
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.925
Cv (Winter)	0.925
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 15.280

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	5.093	4	8	5.093	8	12	5.093

Model Details

Storage is Online Cover Level (m) 1.500

Infiltration Basin Structure

Invert Level (m) 0.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.32616 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.32616

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**	**Depth (m)**	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	6353.8	0.400	6700.9	0.800	7057.2	1.200	7422.7
0.100	6439.7	0.500	6789.1	0.900	7147.7	1.300	7515.6
0.200	6526.2	0.600	6877.9	1.000	7238.8	1.400	7609.0
0.300	6613.3	0.700	6967.3	1.100	7330.5	1.500	7702.9

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

Half Drain Time : 202 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	0.942	0.942	365.2	6374.1	O K
30 min Summer	1.059	1.059	375.1	7218.5	O K
60 min Summer	1.159	1.159	383.7	7950.9	O K
120 min Summer	1.208	1.208	388.0	8318.5	Flood Risk
180 min Summer	1.191	1.191	386.5	8191.5	O K
240 min Summer	1.162	1.162	384.0	7975.5	O K
360 min Summer	1.104	1.104	379.0	7548.8	O K
480 min Summer	1.052	1.052	374.6	7172.4	O K
600 min Summer	1.004	1.004	370.5	6820.5	O K
720 min Summer	0.957	0.957	366.5	6483.2	O K
960 min Summer	0.861	0.861	358.4	5794.6	O K
1440 min Summer	0.687	0.687	343.8	4569.9	O K
2160 min Summer	0.470	0.470	325.8	3081.4	O K
2880 min Summer	0.304	0.304	312.3	1969.7	O K
4320 min Summer	0.094	0.094	295.4	604.1	O K
5760 min Summer	0.046	0.046	266.9	290.2	O K
7200 min Summer	0.038	0.038	220.0	241.7	O K
8640 min Summer	0.033	0.033	190.7	207.1	O K
10080 min Summer	0.029	0.029	167.3	182.0	O K
15 min Winter	0.943	0.943	365.3	6377.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	192.687	0.0	25
30 min Summer	111.966	0.0	39
60 min Summer	65.060	0.0	66
120 min Summer	37.805	0.0	122
180 min Summer	27.519	0.0	172
240 min Summer	21.968	0.0	200
360 min Summer	15.991	0.0	264
480 min Summer	12.765	0.0	332
600 min Summer	10.718	0.0	402
720 min Summer	9.292	0.0	470
960 min Summer	7.383	0.0	606
1440 min Summer	5.340	0.0	868
2160 min Summer	3.862	0.0	1240
2880 min Summer	3.069	0.0	1592
4320 min Summer	2.190	0.0	2252
5760 min Summer	1.724	0.0	2912
7200 min Summer	1.431	0.0	3672
8640 min Summer	1.230	0.0	4400
10080 min Summer	1.082	0.0	5120
15 min Winter	192.687	0.0	25

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	1.061	1.061	375.3	7232.0	O K
60 min Winter	1.163	1.163	384.1	7985.0	O K
120 min Winter	1.218	1.218	388.8	8391.9	Flood Risk
180 min Winter	1.205	1.205	387.7	8298.5	Flood Risk
240 min Winter	1.168	1.168	384.5	8020.8	O K
360 min Winter	1.098	1.098	378.5	7506.7	O K
480 min Winter	1.028	1.028	372.5	6994.6	O K
600 min Winter	0.958	0.958	366.6	6487.5	O K
720 min Winter	0.888	0.888	360.7	5990.0	O K
960 min Winter	0.748	0.748	348.9	4999.6	O K
1440 min Winter	0.503	0.503	328.5	3304.4	O K
2160 min Winter	0.224	0.224	305.8	1443.3	O K
2880 min Winter	0.062	0.062	292.8	394.7	O K
4320 min Winter	0.037	0.037	217.0	237.2	O K
5760 min Winter	0.030	0.030	173.2	188.0	O K
7200 min Winter	0.025	0.025	144.0	156.3	O K
8640 min Winter	0.021	0.021	123.5	133.7	O K
10080 min Winter	0.019	0.019	109.0	118.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	111.966	0.0	39
60 min Winter	65.060	0.0	66
120 min Winter	37.805	0.0	122
180 min Winter	27.519	0.0	176
240 min Winter	21.968	0.0	210
360 min Winter	15.991	0.0	278
480 min Winter	12.765	0.0	356
600 min Winter	10.718	0.0	430
720 min Winter	9.292	0.0	504
960 min Winter	7.383	0.0	644
1440 min Winter	5.340	0.0	908
2160 min Winter	3.862	0.0	1260
2880 min Winter	3.069	0.0	1528
4320 min Winter	2.190	0.0	2204
5760 min Winter	1.724	0.0	2904
7200 min Winter	1.431	0.0	3680
8640 min Winter	1.230	0.0	4400
10080 min Winter	1.082	0.0	4984

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 449300 233450 SP 49300 33450
C (1km)	-0.022
D1 (1km)	0.318
D2 (1km)	0.302
D3 (1km)	0.269
E (1km)	0.293
F (1km)	2.491
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.925
Cv (Winter)	0.925
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 15.280

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0.100	6439.7	0.500	6789.1	0.900	7147.7	1.300	7515.6
0.200	6526.2	0.600	6877.9	1.000	7238.8	1.400	7609.0
0.300	6613.3	0.700	6967.3	1.100	7330.5	1.500	7702.9

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Appendix C

SuDS Flows and Volumes - LLFA Technical Assessment Pro-forma

This form identifies the information required by Oxfordshire County Council LLFA to enable technical assessment of flows and volumes determined as part of drainage I SuDS calculations.

*Note : * means delete as appropriate; Numbers in brackets refer to accompanying notes.*

SITE DETAILS

1.1 Planning application reference: 19/01047/OUT-2

1.2 Site name: Bankside, Banbury

1.3 Total application site area (1) 400,000 m² . ...•... .40 .ha

1.4 Is the site located in a CDA or LFRZ N

1.5 Is the site located in a SPZ N

VOLUME AND FLOW DESIGN INPUTS

2.1 Site area which is positively drained by SuDS (2) 230,000 m²

2.2 Impermeable area drained pre development (3) 0 m²

2.3 Impermeable area drained post development (3) 152,800 m²

2.4 Additional impermeable area (2.3 minus 2.2) 152,800 m²

2.5 Predevelopment use (4) Greenfield

2.6 Method of discharge (5) Infiltration

2.7 Infiltration rate (where applicable) 0.326 m/hr

2.8 Influencing factors on infiltration

2.9 Depth to highest known ground water table No Groundwater encountered to 2m depth mAOD

2.10 Coefficient of runoff (Cv) (6) 0.925

2.11 Justification for Cv used Between 0.9 and 0.95 as agreed

2.12 FEH rainfall data used (Note that FSR is no longer the preferred rainfall calculation method) Y

2.13 Will storage be subject to surcharge by elevated water levels in watercourse/ sewer N

2.14 Invert level at outlet (invert level of final flow control) N/A mAOD

2.15 Design level used for surcharge water level at point of discharge (14). N/A mAOD

SuDS Flows and Volumes - LLFA Technical Assessment Pro-forma

CALCULATION OUTPUTS

Sections 3 and 4 refer to site where storage is provided by attenuation and I or partial infiltration. Where all flows are infiltrated to ground omit Sections 3 - 5 and complete Section 6.

3.0 Defining rate of runoff from the site

3.2 Max. discharge for 1 in 1 year rainfall ....l/s/ha, ...l/s for the site

3.2 Max. discharge for Qmed rainfall ....l/s/ha, ...l/s for the site

3.3 Max. discharge for 1 in 30 year rainfall ....l/s/ha, ...l/s for the site

3.4 Max. discharge for 1 in 100 year rainfall ....l/s/ha, ...l/s for the site

3.5 Max. discharge for 1 in 100 year plus 40%CC ....l/s/ha, ...l/s for the site

4.0 Attenuation storage to manage peak runoff rates from the site

4.1 Storage - 1 in 1 year ....m^3 ....m^3/m^2 (of developed impermeable area)

4.2 Storage - 1 in 30 year (7 .. .. .m^3 ....m3/m2

4.3 Storage - 1 in 100 year (8) ....m^3 ....m3/m2

4.4 Storage - 1 in 100 year plus 40%CC (9) .. .. .m3 ....m3/m2

5.0 Controlling volume of runoff from the site

5.1 Pre development runoff volume (10) .... m^3 for the site

5.2 Post development runoff volume (unmitigated) (10) . . . . m^3 for the site

5.3 Volume to be controlled/does not leave site (5.2-5.1)............... m^3 for the site

5.4 Volume control provided by
Interception losses (11) m3
Rain harvesting (12) m3
Infiltration (even at very low rates) m3
Separate area designated as long term storage (13) m3

5.5 Total volume control (sum of inputs for 5.4) m3 (15)

6.0 Site storage volumes (full infiltration only)

6.1 Storage - 1 in 30 year (7 3,586.5 m^3 0.023 m^3/m^2 (of developed impermeable area)

6.2 Storage - 1 in 100 year plus CC (9 8391.9 m3 0.055 m3/m2

SuDS Flows and Volumes - LLFA Technical Assessment Pro-forma

Notes

1. All area with the proposed application site boundary to be included.
2. The site area which is positively drained includes all green areas which drain to the SuDS system and area of surface SuDS features. It excludes large open green spaces which do not drain to the SuDS system.
3. Impermeable area should be measured pre and post development. Impermeable surfaces includes, roofs, pavements, driveways and paths where runoff is conveyed to the drainage system.
4. Predevelopment use may impact on the allowable discharge rate. The LLFA will seek for reduction in flow rates to GF status in all instances. The design statement and drawings explain/ demonstrate how flows will be managed from the site.
5. Runoff may be discharge via one or a number of means.
6. Sewers for Adoption 6th Edition recommends a Cv of 100% when designing drainage for impermeable area (assumes no loss of runoff from impermeable surfaces) and 0% for permeable areas. Where lower Cv's are used the application should justify the selection of Cv.
7. Storage for the 1 in 30 year must be fully contained within the SuDS components. Note that standing water within SuDS components such as ponds, basins and swales is not classified as flooding. Storage should be calculated for the critical duration rainfall event.
8. Runoff generated from rainfall events up to the 1 in 100 year will not be allowed to leave the site in an uncontrolled way. Temporary flooding of specified areas to shallow depths (150-300mm) may be permitted in agreement with the LLFA.
9. Climate change is specified as 40% increase to rainfall intensity, unless otherwise agreed with the LLFA / EA.
10. To be determined using the 100 year return period 6 hour duration rainfall event.
11. Where Source Control is provided Interception losses will occur. An allowance of 5mm rainfall depth can be subtracted from the net inflow to the storage calculation where interception losses are demonstrated. The Applicant should demonstrate use of subcatchments and source control techniques.
12. Please refer to Rain harvesting BS for guidance on available storage.
13. Flow diverted to Long term storage areas should be infiltrated to the ground, or where this is not possible, discharged to the receiving water at slow flow rates (maximum 2 l/s/ha). LT storage would not be allowed to empty directly back into attenuation storage and would be expected to drain away over 5-10 days. Typically LT storage may be provided on multi-functional open space or sacrificial car parking areas.
14. Careful consideration should be used for calculations where flow control / storage is likely to be influenced by surcharged sewer or peak levels within a watercourse. Storm sewers are designed for pipe full capacity for 1 in 1 to 1 in 5 year return period. Beyond this, the pipe network will usually be in conditions of surcharge. Where information cannot be gathered from Thames Water, engineering judgement should be used to evaluate potential impact (using sensitivity analysis for example).
15. In controlling the volume of runoff the total volume from mitigation measures should be greater than or equal to the additional volume generated.

Design and Credit to: McCloy Consulting Ltd