Report No: 14/032.01
Revision: 00
Dated: 28th January 2015

Land off Lowfield Road
Bolton upon Dearne
South Yorkshire

Flood Risk Assessment

Client:

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1.0 INTRODUCTION AND BACKGROUND

JOC Consultants Ltd is instructed by Gleeson Developments Ltd (the Client) to prepare a flood risk assessment report for a proposed housing development on land off Lowfield Road, Bolton upon Dearne. The development is the subject of a planning application to Barnsley Metropolitan Borough Council.

References in this report to "the site" are references to the site to which the planning application applies. Specific references to sources of information used in the report are shown in square brackets and are listed in section 9. Figures 1 to 5 are presented immediately following page 10 and the appendices follow thereafter.

This report is prepared specifically for the Client for the purpose of the aforementioned planning application and the report may not be used for any purpose other than for the purpose for which it was commissioned, and it may not be assigned to any third party without our written permission.

In the preparation of this FRA, JOC Consultants Ltd has relied on information provided to us by statutory authorities and by the client and we accept no liability for its accuracy or adequacy or for the consequences of any changes to or re-assessment of this data in the future.

2.0 OBJECTIVES

The objectives of this flood risk assessment are:

1. to establish whether the proposed development is likely to be affected by current or future flooding from any source;

2. to establish whether the proposed development will increase flood risk elsewhere; and

3. to recommend, as appropriate, measures for managing flood risk.

3.0 PLANNING POLICY ON FLOOD RISK

3.1 National Policy

National Planning Policy in relation to flood risk is set out in the National Planning Policy Framework (NPPF) [1] and the Technical Guidance thereto [2]. The NPPF revokes Planning Policy Statement 25 which previously stated the policy on development and flood risk.

3.2 Local Policy

Local policy on development and flood risk is informed by the Barnsley Level 1 Strategic Flood Risk Assessment (SFRA) [3]. Reference to the SFRA is made in subsequent sections of this report.

4.0 LOCATION AND DESCRIPTION OF THE SITE

The site is situated between Lowfield Meadows and Lowfield Lakes, as shown outlined in red in Figure 1. The NGR coordinates at the site are approximately 446094E, 402399N.

The gross area of the site is approximately 2.55ha, and the site has a permeable undeveloped surface.

Existing ground levels are shown on the topographical survey plan, reproduced in Appendix A. The site falls in elevation towards ESE. Ground levels are between 21.97m AOD(N) at the NW corner and 17.43m AOD(N) at the NE corner. The general gradient falls in an ESE direction.

The ground investigation [4] identified *"fine to coarse gravelly sand"* overlying sandstone in the Middle Coal Measures. The investigation concluded from infiltration tests that infiltration drainage will not be a feasible option for this site.

5.0 THE PROPOSED DEVELOPMENT

The proposed development forms Phase 3 of an on-going development. Phases 1 and 2 comprised developments of 60 houses and 58 houses respectively on the land to the west of the site and Phase 3 is a development of 97 houses, as shown in the planning layout plan at Appendix B.

As infiltration drainage is not feasible, it is proposed to discharge surface water from the development to the surface water drainage system in the area at a rate limited to the mean annual run-off rate, or greater if conditions permit. The disposal of surface water is discussed further in section 7.2.

Full details of the proposed development are provided in the plans and documents included with the planning application.

6.0 FLOOD RISK

6.1 Data collection and consultations

Enquiries to the Environment Agency

As the site is in flood zone 1, the Environment Agency was not directly consulted for this FRA, but a review of the data on the Environment Agency website yielded the following evidence:

- the site is in flood zone 1 where the annual probability of fluvial flooding is less than 0.1%;
- the site is not in an area at risk of flooding due the uncontrolled release of water from a reservoir;
- the site is at a 'very low' risk of surface water flooding, the probability of which is less than 0.1%.

Enquiries to the Danvm Drainage Commissioners

We understand from our telephone consultation with the engineer to the Danvm Drainage Commissioners that a surface water discharge into the IDB drainage system, at a rate not exceeding the 'greenfield' run-off rate, will be acceptable in principle, subject to the approval of the detailed design.

6.2 Existing flood defences

The site does not benefit from flood defences, being in flood zone 1.

6.3 History of Flooding

The level 1 SFRA Map 2 shows that the site was unaffected by the following flood events:

- March 1947;
- January 1982;
- Autumn 2000: and
- June 2007.

There is no evidence that the site has been affected by other flood events.

6.4 Risk of fluvial flooding

The Environment Agency flood zone map shows the site to be in flood zone 1, where the annual probability of flooding from rivers or the sea is less than 0.1% (1 in 1000 years). This is confirmed by the SFRA Maps 3 and 4 which show that the site is not in flood zones 3 or 2 respectively.

6.5 Risk of surface water flooding

Risk to the site

As noted in section 6.1 above, the Environment Agency surface water flood map shows the annual probability of this type of flooding to be less than 0.1%

The SFRA Map C3 shows the site to be unaffected by surface water flooding resulting from rainfall having an A.E.P. of 1%.

Effect of the proposed development on rapid-response run-off

Development of the site for housing will increase surface water run-off volume due to the conversion of a significant proportion of the site to impervious area. The extent of impervious area resulting from the proposed development in not known in detail but a reasonable estimate, based on the planning layout plan (see Appendix B), would be approximately 50% of the gross site area.

The effect of the development on rapid response surface water run-off generated by a storm of critical duration in the 3.3% and 1% A.E.P. events is shown in Figures 2 and 3 respectively. It is assumed that run-off from the permeable areas will be equivalent to

the standard percentage run-off, based on the Hydrology of Soil Types database (SPR HOST) which, for this site is 25.4%, according the FEH[1] catchment descriptors. Tables C1 to C4 (see Appendix C) show the effect of the development to be an increase in rapid response run-off volume of approximately 127%. This is a preliminary estimate based on 50% impervious area and this figure should be reviewed and verified at the detailed design stage.

The effect of the development on surface water run-off can be mitigated by the application of sustainable drainage techniques, as recommended in section 7.2 below. Provided such measures are implemented, the development will not increase flood risk elsewhere.

6.6 Risk of sewer flooding

The site is not in an area identified in the SFRA as being at risk from sewer flooding and as there is no history of flooding problems in the vicinity of the site, the risk of this type of flooding is therefore assessed to be low.

6.7 Risk of groundwater flooding

Groundwater flooding of land occurs when the water table rises above the ground surface or enters basements and is typically associated with permeable rock such as chalk. It is unlikely that the site would be affected by groundwater flooding as any rise in the water table would be intercepted by the drainage dykes and the River Dearne. This risk is therefore assessed as low.

6.8 Risk of flooding from canals and reservoirs

The site is not at risk of flooding due to the release of water from reservoirs or canals.

6.9 Appropriate Land Use

The flood risk vulnerability classifications of various types of development are set out in the NPPF Technical Guidance: Table 2, which classifies residential development as "More Vulnerable". As the site lies within flood zone 1 the proposed development is appropriate, in accordance with NPPF Technical Guidance Table 3, with no requirement to pass the Exception Test.

6.10 Effects of Climate Change

The impact of climate change must be assessed over the lifetime of the development. The Technical Guidance to the NPPF is silent on the question of the lifetime of housing but its predecessor, the Practice Guide to PPS 25, recommended a minimum lifetime of 100 years. For the purposes of this assessment, climate change effects should therefore be considered up to the year 2115.

Current estimates of climate change effects suggest an increase in peak river flows of 20% in the period after 2025 and an increase in peak rainfall intensity of 30% in the period 2085 to 2115 [2]. A corresponding increase in rapid response run-off volumes can therefore be expected and should be taken into account in the detailed design of the drainage system for the development.

[1] Flood Estimation Handbook

7.0 FLOOD RISK MANAGEMENT

7.1 Fluvial flood risk

No flood risk management measures are necessary in respect of fluvial flooding.

7.2 Surface water flood risk

The effect of the proposed development on surface water run-off volumes can be mitigated by the implementation of sustainable drainage principles, as recommended in The SUDS Manual [5]. The Building Regulations require surface water to be discharged according to the following preference hierarchy:

1. to ground by infiltration;
2. to a watercourse;
3. to a sewer, if options (1) and (2) are not reasonably practicable.

Section 7.7 of the ground investigation report [4] states:

"Generally, moderate to poor infiltration rates were recorded. Soakaways are therefore not considered to be a viable method of surface water drainage for the proposed development."

On the evidence of the ground investigation it is concluded that infiltration drainage is not a feasible option for the development. Surface water should therefore be discharged to a watercourse or suitable water body. The most likely option would be a discharge directly to the River Dearne, due south of the eastern boundary of the site. Alternatively, a discharge to the drain flowing parallel to Lowfield Lane (see Figure 1) may be feasible, subject to invert levels. Should a discharge to this drain be proposed, IDB would require the flow rate to be limited to the mean annual run-off rate (the 'greenfield' rate). It may also be feasible to discharge surface water into Lowfield Lakes, subject to the permission of the owner.

The mean annual run-off rate for the site is estimated using the IH 124 methodology [6] to be 11.2 l/s. The calculation of this flow rate is provided in Appendix D

The drainage system for the development should ensure:

- no surface water flooding resulting from a rainfall event having an A.E.P. of 33% (1 in 30 years);
- only "tolerable" flooding resulting from a rainfall event having an A.E.P. of 1% (1 in 100 years).

"Tolerable" flooding would be flooding to a depth that does not result in flooding of buildings and which does not prevent safe access and egress to and from the site.

The surface water run-off volumes from the impervious areas only, generated by storms having an annual probability of exceedence of 3.3% and 1%, are shown in Figures 4 and 5 respectively. It is assumed that run-off from permeable areas will not enter the piped

drainage system. The controlled discharge volume, based on a controlled discharge rate equivalent to the mean annual flow rate is also shown and it is apparent that the critical duration in the 3.3% A.E.P. event is approximately 5 hours, and for the 1% A.E.P. event the critical duration is approximately 7 hours. The calculations supporting Figures 4 and 5 are shown in Appendix C Tables C5 and C6. The storage capacity required to detain the excess volume from these events is estimated to be 390m^3 and 620m^3 respectively.

It is emphasised that the estimates of storage capacity in this report are preliminary and take no account of time of concentration. The required storage capacity will be verified as part of the detailed drainage design, when the location of the surface water outfall is known.

It is recommended that a detailed drainage design is prepared for the site, based on sustainable drainage principles, as recommended in the SUDS Manual [5], if practicable.

7.3 Sewer flooding risk

No flood risk management measures are necessary in respect of sewer flooding.

7.4 Ground water flood risk

No flood risk management measures are necessary in respect of groundwater flooding.

7.5 Flood risk from reservoirs and canals

No flood risk management measures are necessary in respect of flooding from reservoirs and canals.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

1. The site is situated in flood zone 1 where the annual probability of flooding from fluvial or tidal sources is less than 0.1%.

2. There is no historical evidence of the site having been affected by flooding.

3. The risk of surface water flooding is assessed to be very low.

4. The risk of flooding from existing sewers in the vicinity of the site is assessed to be low.

5. The risk of groundwater flooding at the site is assessed to be low.

6. The site is not in an area at risk from flooding due to the failure of a reservoir dam or the breach of a canal.

7. The development will not result in the loss of any floodplain storage.

8. Climate change effects will increase surface water run-off volumes over the lifetime of the development but will not alter the assessments of flood risk at the site.

9. Infiltration drainage will not be feasible, owing to the low permeability of underlying strata.

10. The effect of the development on surface water run-off can be reduced to an acceptable level by the implementation of the flood risk management measures stated in section 7.2 of this report.

11. The development falls within the "More Vulnerable" classification in Table 2 of the Technical Guidance to the NPPF.

12. The development is not required to pass the Exception Test.

8.2 Recommendations

1. A detailed surface water drainage design should be prepared and submitted to Barnsley Metropolitan District Council for approval, prior to the commencement of the development. This recommendation can be secured by an appropriately worded condition on the grant of planning permission.

9.0 REFERENCES

1. National Planning Policy Framework. Department for Communities and Local Government. March 2012.

2. Technical Guidance to the National Planning Policy Framework. Department for Communities and Local Government. March 2012.

3. Barnsley Strategic Flood Risk Assessment, Level 1, September 2010.

4. Geotechnical and Geo-environmental Phase 3 Lowfield Road, Bolton on Dearne. Report No. 37666-001, Eastwood and Partners, December 2014.

5. The SUDS Manual, B. Woods-Ballard et al. CIRIA Report No. C697, 2007.

6. Flood estimation for small catchments. Institute of Hydrology Report No. 124, June 1994.

7. Development and flood risk. Guidance for the construction industry. CIRIA Report No. C624. 2004.

Lowfield Road Phase 3 Development
Bolton upon Dearne

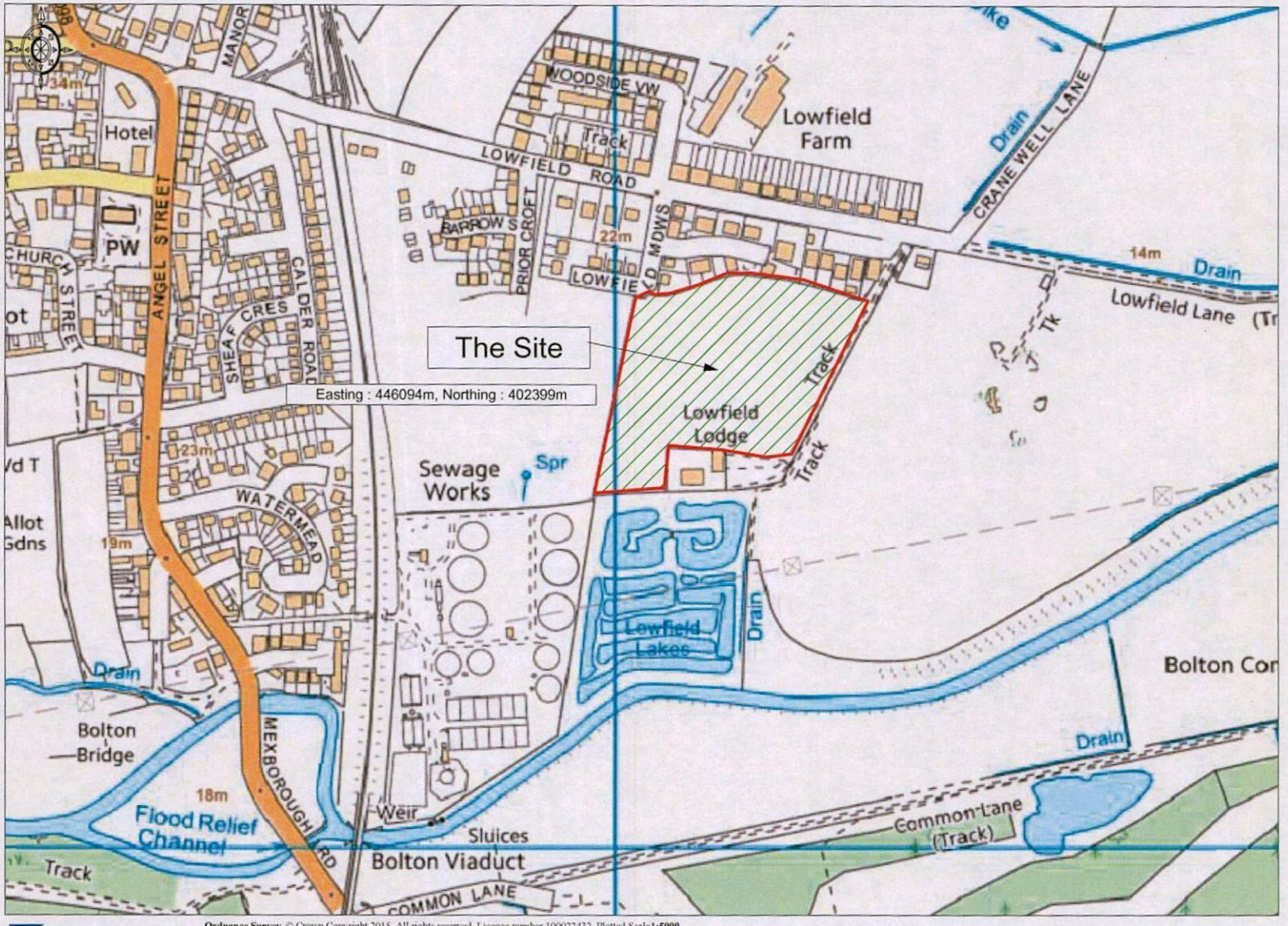


Figure 1: Location Plan

Figure 2: Effect of the development on rapid response surface water run-off (3.3% A.E.P event)

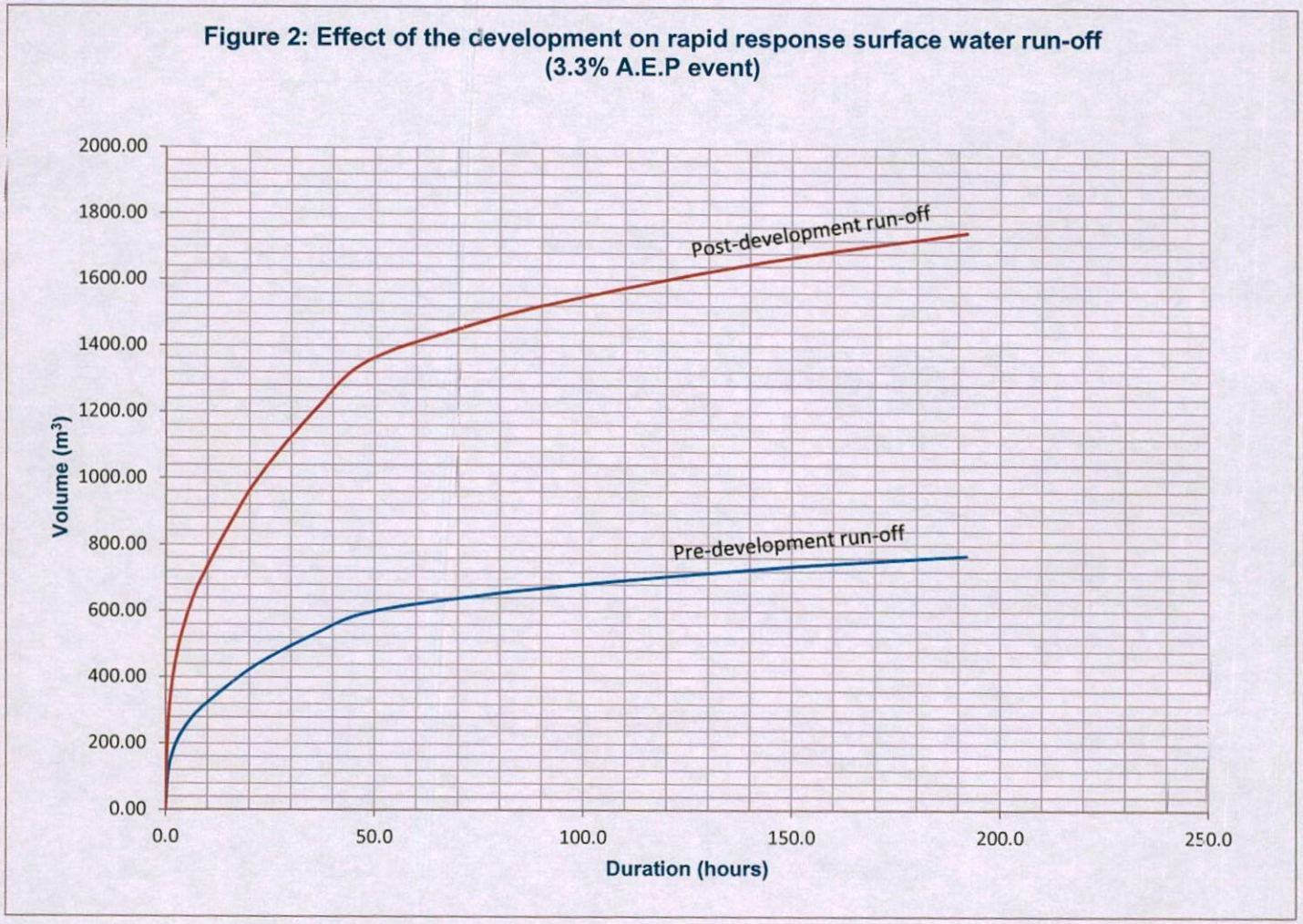


Figure 3: Effect of the development on rapid response surface water run-off (1% A.E.P. event)

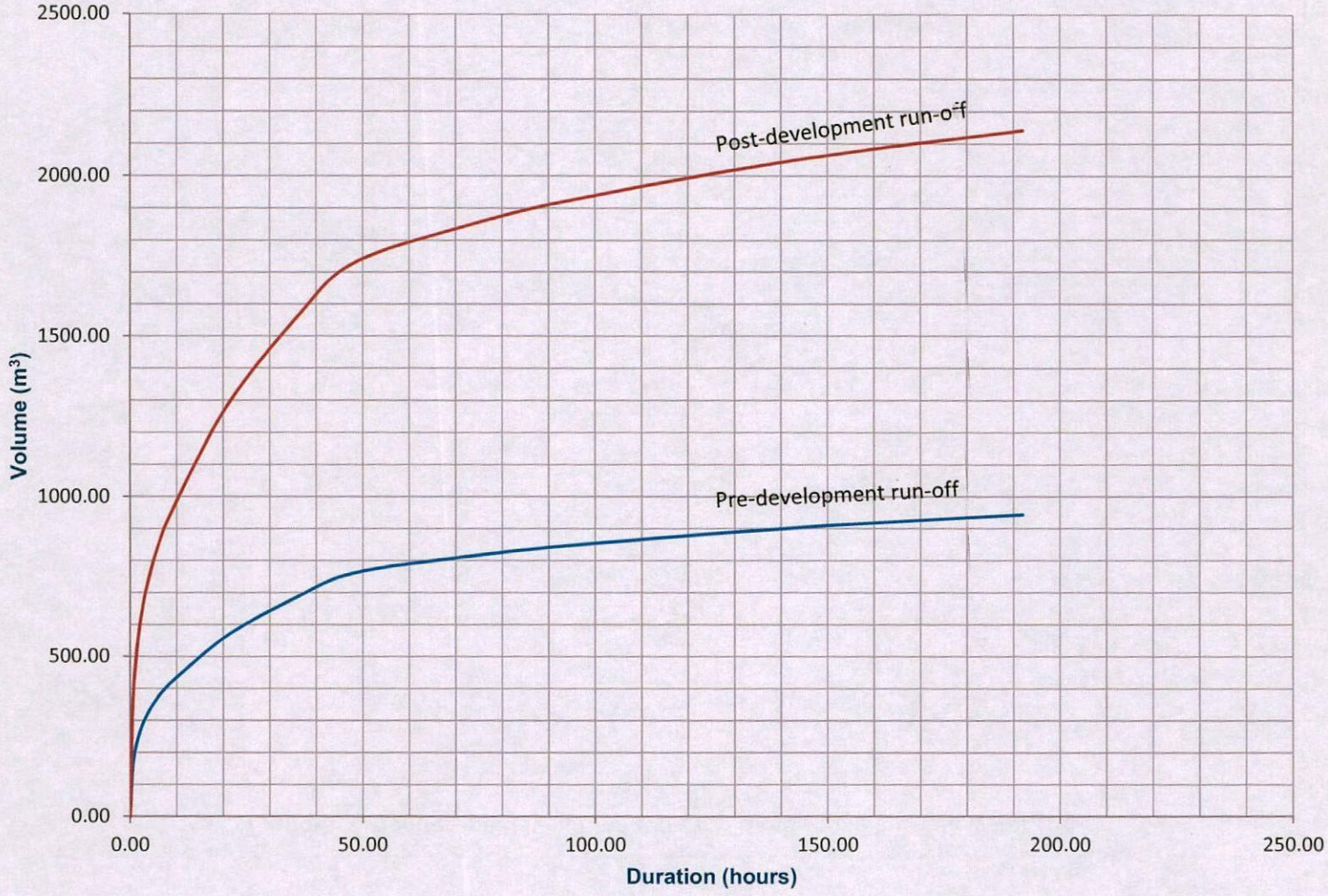


Figure 4: Surface water run-off from a 3.3% A.E.P. rainfall event including CCA (post-development)

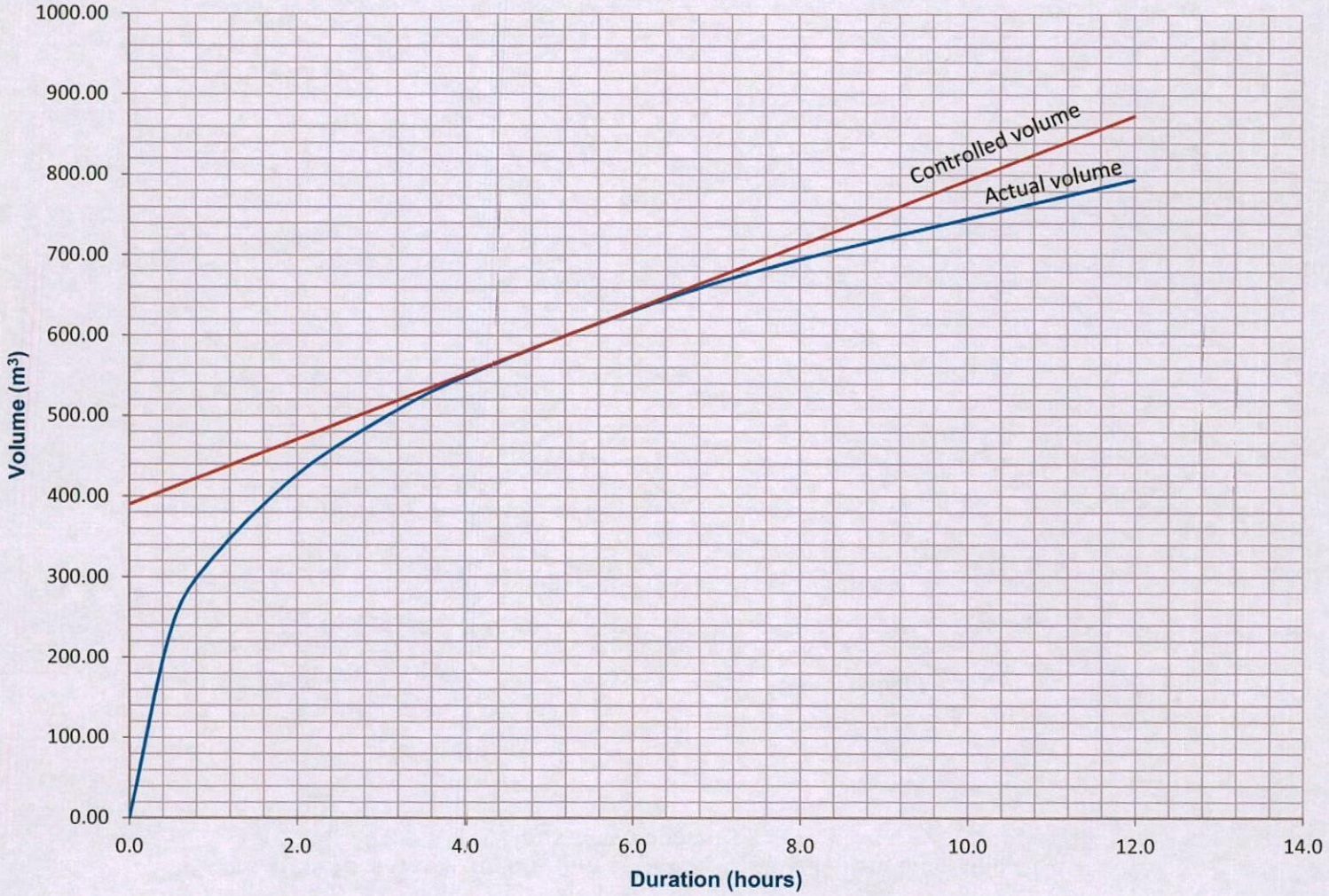
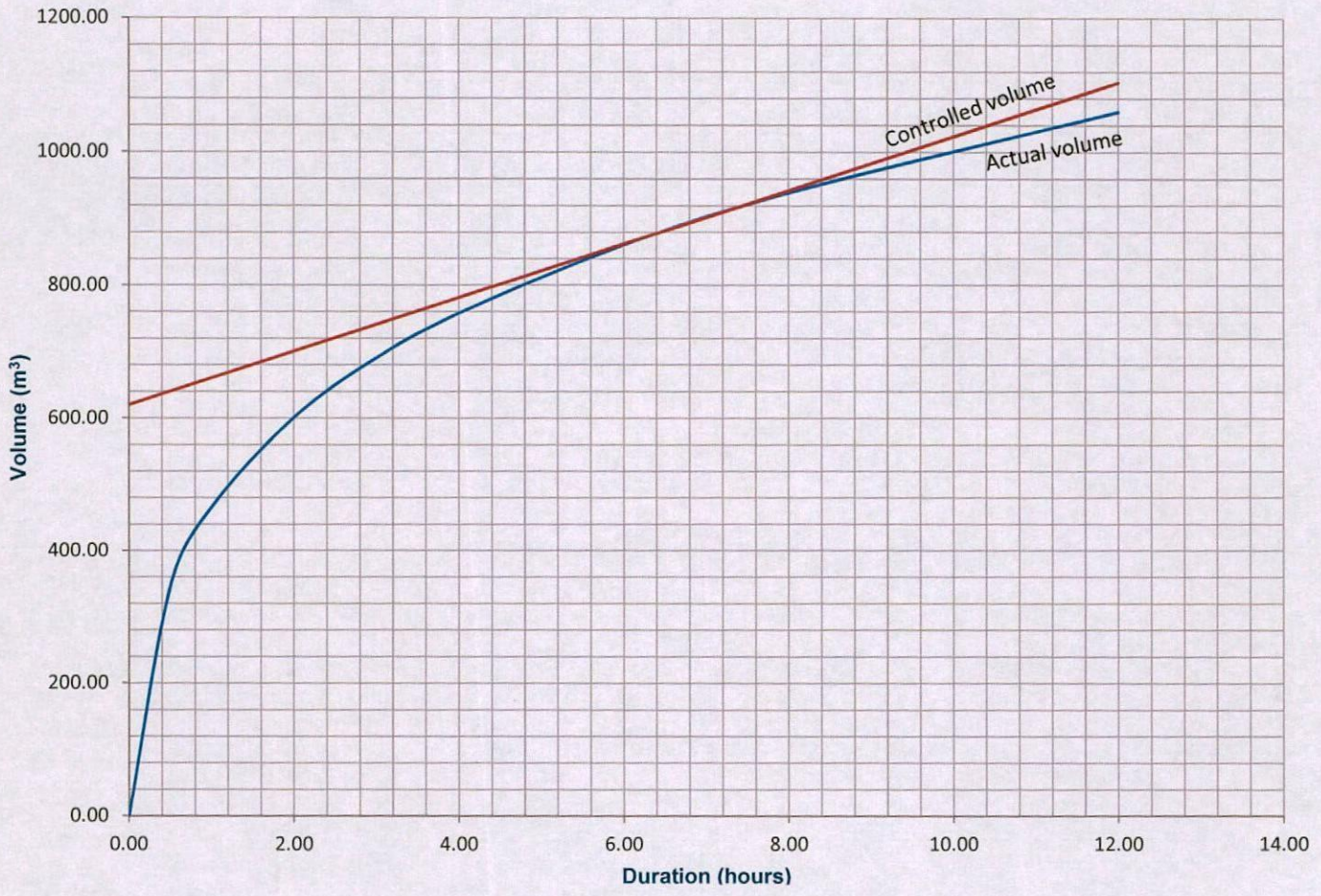
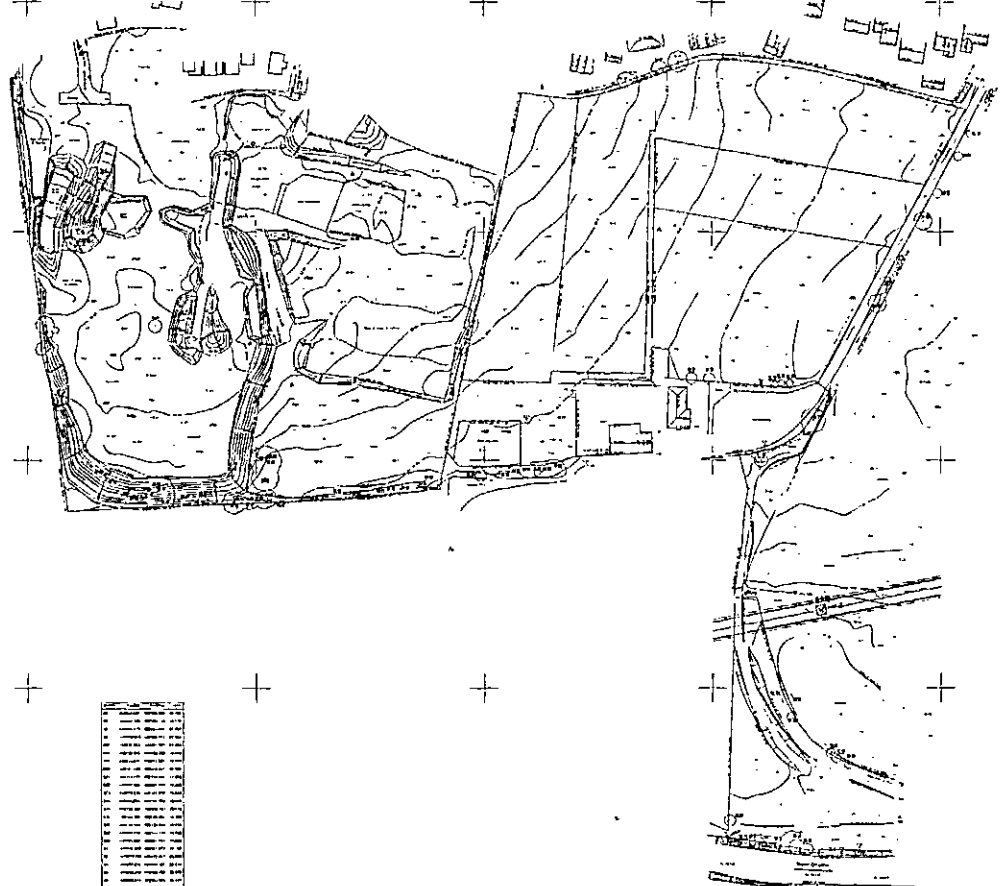


Figure 5: Surface water run-off from a 1% A.E.P. rainfall event including CCA (post-development)



APPENDIX A

Topographical survey plan



HAYDOCK & TOUD

SITE SURVEY

LOWFIELD ROAD
BOLTON ON DEARNE.
PHASE 2 & 3

S8204

APPENDIX B

Planning Layout Plan

Drawing No: 449/3 dated 28th November 2014

- NOT FOR USE ON SITE -
PROVISIONAL LAYOUT DRAWING, SUBJECT TO PLANNING APPROVAL

0m 10m 20m 30m 40m 50m 60m 70m 80m 90m 100m

Existing tree to be removed

Existing tree to be retained and protected during construction to B-tish Standard 5837:1991.

Areas of new tree planting see schedule for species

New shelter/ ground cover planting

Grass to Park corridor

ramp Paving slab recessed paths to level threshold for principle entrance. Gradient not to exceed 1:12 for maximum 9.00m length

Private drives

1.80m high screen wall

S.W. boarded vertical screen fence 1.80m high (100 x 22mm boards with 22mm gaps, 2No. 75 x 25mm rails, 100 x 100mm posts @ 1.875m centres).

Plot division fence, post & wire

SS9 Name type code reference number

8 Plot number

bc Materials code reference refer to schedule

Garages location

P indicates parking spaces compliant car sizes, all other to be Gleesons standard spaces

Parking bays

FFL100 Proposed floor levels subject to a tolerance of +/- 0.5m

HOUSE TYPE

code	type	no
201	2 bed semi det/ terr	19
202	2 bed semi det.	8
301	3 bed semi det.	15
302	3 bed semi det.	16
303	3 bed semi det.	6
304	3 bed detached	6
309	3 bed semi det.	14
310	3 bed detached	2
403	4 bed detached	1
404	4 bed detached	4
405	4 bed detached	2
406	4 bed detached	3
TOTAL		**97**

gleeson

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LOWFIELD ROAD
BOLTON ON DEARNE 3

planning layout

GLEESON HOMES & REGENERATION

Scale	1:500 at A1
Date	28.11.14
Dwg No	4493-

APPENDIX C

Surface water run-off calculations: Tables C1 to C6

Table C1: Rapid response run-off from 3.3% A.E.P. rainfall event: existing condition

Duration	Rainfall	Area (m^2)			Volume (m^3)		
	at Site	Impervious	Pervious	Total	Impervious	Pervious	Run-off
hours	mm	Area (ha)	Area (ha)	Area (ha)	Area	Area	Volume
		C_v	SPR HOST				
		90.0%	25.4%				
0.0	0.0	0.00	2.55	2.55	0.00	0.00	0.00
0.5	15.8	0.00	2.55	2.55	0.00	102.26	102.26
1.0	21.7	0.00	2.55	2.55	0.00	140.44	140.44
2.0	28.6	0.00	2.55	2.55	0.00	185.10	185.10
3.0	33.2	0.00	2.55	2.55	0.00	214.87	214.87
4.0	36.8	0.00	2.55	2.55	0.00	238.17	238.17
6.0	42.3	0.00	2.55	2.55	0.00	273.76	273.76
8.0	46.6	0.00	2.55	2.55	0.00	301.59	301.59
12.0	53.3	0.00	2.55	2.55	0.00	344.95	344.95
18.0	62.6	0.00	2.55	2.55	0.00	405.14	405.14
24.0	70.2	0.00	2.55	2.55	0.00	454.33	454.33
36.0	82.2	0.00	2.55	2.55	0.00	531.99	531.99
48.0	91.9	0.00	2.55	2.55	0.00	594.77	594.77
72.0	99.2	0.00	2.55	2.55	0.00	642.01	642.01
96.0	104.6	0.00	2.55	2.55	0.00	676.96	676.96
144.0	112.7	0.00	2.55	2.55	0.00	729.39	729.39
192.0	118.7	0.00	2.55	2.55	0.00	768.22	768.22

Table C2: Rapid response run-off from 1% A.E.P. rainfall event: existing condition

Duration	Rainfall	Area (m^2)			Volume (m^3)		
	at Site	Impervious	Pervious	Total	Impervious	Pervious	Run-off
hours	mm	Area (ha)	Area (ha)	Area (ha)	Area	Area	Volume
		Cv 90.0%	SPR HOST 25.4%				
0.00	0.0	0.00	2.55	2.55	0.00	0.00	0.00
0.50	23.2	0.00	2.55	2.55	0.00	150.15	150.15
1.00	31.2	0.00	2.55	2.55	0.00	201.92	201.92
2.00	40.3	0.00	2.55	2.55	0.00	260.82	260.82
3.00	46.3	0.00	2.55	2.55	0.00	299.65	299.65
4.00	50.8	0.00	2.55	2.55	0.00	328.77	328.77
6.00	57.7	0.00	2.55	2.55	0.00	373.43	373.43
8.00	63.0	0.00	2.55	2.55	0.00	407.73	407.73
12.00	71.1	0.00	2.55	2.55	0.00	460.15	460.15
18.00	82.6	0.00	2.55	2.55	0.00	534.58	534.58
24.00	91.8	0.00	2.55	2.55	0.00	594.12	594.12
36.00	106.2	0.00	2.55	2.55	0.00	687.32	687.32
48.00	117.6	0.00	2.55	2.55	0.00	761.10	761.10
72.0	125.4	0.00	2.55	2.55	0.00	811.58	811.58
96.0	131.2	0.00	2.55	2.55	0.00	849.12	849.12
144.0	139.6	0.00	2.55	2.55	0.00	903.48	903.48
192.0	145.7	0.00	2.55	2.55	0.00	942.96	942.96

Table C3: Rapid response run-off from 3.3% A.E.P. rainfall event: post development condition

Duration	Rainfall	Area (m^2)			Volume (m^3)			
	at Site	Impervious	Pervious	Total	Impervious	Pervious	Run-off	% increase
hours	mm	Area (ha)	Area (ha)	Area (ha)	Area	Area	Volume	in run-off volume
		Cv 90.0%	SPR HOST 25.4%					
0.0	0.0	1.27	1.27	2.55	0.00	0.00	0.00	
0.5	15.8	1.27	1.27	2.55	181.16	51.13	232.29	127%
1.0	21.7	1.27	1.27	2.55	248.81	70.22	319.03	127%
2.0	28.6	1.27	1.27	2.55	327.93	92.55	420.48	127%
3.0	33.2	1.27	1.27	2.55	380.67	107.43	488.11	127%
4.0	36.8	1.27	1.27	2.55	421.95	119.08	541.03	127%
6.0	42.3	1.27	1.27	2.55	485.01	136.88	621.89	127%
8.0	46.6	1.27	1.27	2.55	534.32	150.80	685.11	127%
12.0	53.3	1.27	1.27	2.55	611.14	172.48	783.61	127%
18.0	62.6	1.27	1.27	2.55	717.77	202.57	920.34	127%
24.0	70.2	1.27	1.27	2.55	804.91	227.16	1032.08	127%
36.0	82.2	1.27	1.27	2.55	942.51	266.00	1208.50	127%
48.0	91.9	1.27	1.27	2.55	1053.73	297.38	1351.11	127%
72.0	99.2	1.27	1.27	2.55	1137.43	321.01	1458.43	127%
96.0	104.6	1.27	1.27	2.55	1199.34	338.48	1537.83	127%
144.0	112.7	1.27	1.27	2.55	1292.22	364.69	1656.91	127%
192.0	118.7	1.27	1.27	2.55	1361.01	384.11	1745.12	127%

Table C4: Rapid response run-off from 1% A.E.P. rainfall event: post development condition

Duration	Rainfall at Site	Area (m^2)			Volume (m^3)			
hours	mm	Impervious Area (ha)	Pervious Area (ha)	Total Area (ha)	Impervious Area	Pervious Area	Run-off Volume	% increase in run-off volume
		C_v 90.0%	C_v 25.4%					
0.00	0.0	1.27	1.27	2.55	0.00	0.00	0.00	
0.50	23.2	1.27	1.27	2.55	266.01	75.07	341.09	127%
1.00	31.2	1.27	1.27	2.55	357.74	100.96	458.70	127%
2.00	40.3	1.27	1.27	2.55	462.08	130.41	592.49	127%
3.00	46.3	1.27	1.27	2.55	530.88	149.82	680.70	127%
4.00	50.8	1.27	1.27	2.55	582.47	164.39	746.86	127%
6.00	57.7	1.27	1.27	2.55	661.59	186.71	848.30	127%
8.00	63.0	1.27	1.27	2.55	722.36	203.87	926.22	127%
12.00	71.1	1.27	1.27	2.55	815.23	230.08	1045.31	127%
18.00	82.6	1.27	1.27	2.55	947.09	267.29	1214.38	127%
24.00	91.8	1.27	1.27	2.55	1052.58	297.06	1349.64	127%
36.00	106.2	1.27	1.27	2.55	1217.69	343.66	1561.35	127%
48.00	117.6	1.27	1.27	2.55	1348.40	380.55	1728.95	127%
72.00	125.4	1.27	1.27	2.55	1437.84	405.79	1843.63	127%
96.00	131.2	1.27	1.27	2.55	1504.34	424.56	1928.90	127%
144.00	139.6	1.27	1.27	2.55	1600.65	451.74	2052.39	127%
192.00	145.7	1.27	1.27	2.55	1670.60	471.48	2142.08	127%

Table C5: Post-development rapid response run-off from impervious area (3.3% A.E.P. rainfall event including CCA)

Duration	Rainfall	Area (m^2)			Volume (m^3)			Controlled run off	Tangent
hours	at Site mm	Impervious Area (ha)	Pervious Area (ha)	Total Area (ha)	Impervious Area	Pervious Area	Run-off Volume	m^3	m^3
		C_v 90.0%	C_v 0.0%					Controlled rate (l/s) 11.2	
0.0	0.0	1.27	1.27	2.55	0.00	0.00	0.00	0.00	390.00
0.5	20.5	1.27	1.27	2.55	235.51	0.00	235.51	20.16	410.16
1.0	28.2	1.27	1.27	2.55	323.46	0.00	323.46	40.32	430.32
2.0	37.2	1.27	1.27	2.55	426.31	0.00	426.31	80.64	470.64
3.0	43.2	1.27	1.27	2.55	494.87	0.00	494.87	120.96	510.96
4.0	47.8	1.27	1.27	2.55	548.53	0.00	548.53	161.28	551.28
6.0	55.0	1.27	1.27	2.55	630.52	0.00	630.52	241.92	631.92
8.0	60.6	1.27	1.27	2.55	694.61	0.00	694.61	322.56	712.56
12.0	69.3	1.27	1.27	2.55	794.48	0.00	794.48	483.84	873.84
18.0	81.4	1.27	1.27	2.55	933.10	0.00	933.10	725.76	1115.76
24.0	91.3	1.27	1.27	2.55	1046.39	0.00	1046.39	967.68	1357.68
36.0	106.9	1.27	1.27	2.55	1225.26	0.00	1225.26	1451.52	1841.52
48.0	119.5	1.27	1.27	2.55	1369.84	0.00	1369.84	1935.36	2325.36
72.00	129.0	1.27	1.27	2.55	1478.66	0.00	1478.66	2903.04	3293.04
96.00	136.0	1.27	1.27	2.55	1559.15	0.00	1559.15	3870.72	4260.72
144.00	146.5	1.27	1.27	2.55	1679.88	0.00	1679.88	5806.08	6196.08
192.00	154.3	1.27	1.27	2.55	1769.32	0.00	1769.32	7741.44	8131.44
								Total Storage Requirement (m^3)	390.00

Table C6: Post-development rapid response run-off from impervious area (1% A.E.P. rainfall event including CCA)

Duration	Rainfall	Area (m^2)			Volume (m^3)			Controlled run off	Tangent
	at Site	Impervious	Pervious	Total	Impervious	Pervious	Run-off		
hours	mm	Area (ha)	Area (ha)	Area (ha)	Area	Area	Volume	m^3	m^3
		C_v	C_v					Controlled rate (l/s)	
		90.0%	0.0%					11.2	
0.00	0.0	1.27	1.27	2.55	0.00	0.00	0.00	0.00	620.00
0.50	30.2	1.27	1.27	2.55	345.81	0.00	345.81	20.16	540.16
1.00	40.6	1.27	1.27	2.55	465.06	0.00	465.06	40.32	560.32
2.00	52.4	1.27	1.27	2.55	600.70	0.00	600.70	80.64	700.64
3.00	60.2	1.27	1.27	2.55	690.14	0.00	690.14	120.96	740.96
4.00	66.0	1.27	1.27	2.55	757.21	0.00	757.21	161.28	781.28
6.00	75.0	1.27	1.27	2.55	860.06	0.00	860.06	241.92	861.92
8.00	81.9	1.27	1.27	2.55	939.07	0.00	939.07	322.56	942.56
12.00	92.4	1.27	1.27	2.55	1059.80	0.00	1059.80	483.84	1103.84
18.00	107.4	1.27	1.27	2.55	1231.22	0.00	1231.22	725.76	1345.76
24.00	119.3	1.27	1.27	2.55	1368.35	0.00	1368.35	967.68	1587.68
36.00	138.1	1.27	1.27	2.55	1583.00	0.00	1583.00	1451.52	2071.52
48.00	152.9	1.27	1.27	2.55	1752.92	0.00	1752.92	1935.36	2555.36
72.00	163.0	1.27	1.27	2.55	1869.19	0.00	1869.19	2903.04	3523.04
96.00	170.6	1.27	1.27	2.55	1955.64	0.00	1955.64	3870.72	4490.72
144.00	181.5	1.27	1.27	2.55	2080.85	0.00	2080.85	5806.08	6426.08
192.00	189.4	1.27	1.27	2.55	2171.78	0.00	2171.78	7741.44	8361.44
								Total Storage Requirement (m^3)	620.00

APPENDIX D

Estimate of mean annual run-off rate

14/032: Lowfield Road, Bolton upon Dearne

IH 124 Estimate of greenfield run off rate

	East	North
NGR:	446094	402399

From IH 124 Eqn 7.1:

$Qbar_{rural} = 0.00108AREA^{0.89}SAAR^{1.17}SOIL^{2.17}$

where:

$Qbar_{rural}$: Catchment mean annual peak flow rate (m^3/s)

AREA: Catchment area (km^2)

SAAR: Standard annual average rainfall

SOIL: Soil index

Soil Class	1	2	3	4	5
SOIL Index	0.15	0.3	0.4	0.45	0.5

Site area	2.548	ha	From topographical survey
AREA:	0.5	km^2	Initial estimate based on 50ha
SAAR	699	mm	FEH CD ROM
Soil Class	4		Wallingford Map 1.4.1
SOIL	0.45		Soil W.R.A.P. Class for Site NGR: 4

$Qbar_{rural}$ is estimated for a catchment of 50ha and adjusted to site area:

$Qbar_{rural}$ =	0.219	m^3/s
=	219.29	l/s
Rate per ha	4.39	l/s
Mean annual site run-off	11.2	l/s

End of Report