RPS

PROJECT:

BROCKHILL EAST, Phase 2

REDDITCH

DRAINAGE & FLOOD RISK STATEMENT

For

PERSIMMON HOMES SOUTH MIDLANDS AND GALLAGHER ESTATES

July 2013

Our Ref: AAC 4835

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QUALITY MANAGEMENT

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Date:	31 July 2013
Project Number/Document Reference:	AAC4835

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1 INTRODUCTION

1.1 PURPOSE OF REPORT

- This report considers the flood risk associated with the development of a parcel of greenfield land known as Brockhill East, Phase 2 on the northern outskirts of Redditch. The southern portion of the land falls within the Redditch Borough Council boundary with the northern portion being within Bromsgrove District Council's boundary.
- This report also sets out the proposed foul and surface water drainage strategy for the proposed development.

1.2 SITE DETAILS

- The site bounds the Birmingham to Redditch railway line to the east, Weights Lane to the north and an industrial development off Winsor Road to the south.
- Development by Persimmon Homes of a parcel of land known as Brockhill East Phase 1, located immediately to the south of Brockhill East Phase 2 is currently underway.
- An indicative masterplan for Brockhill East Phase 2 can be found in appendix A of this report. This also shows the phase 1 development.
- The phase 2 development parcel occupies approx 83 hectares, and the development proposals include residential parcels, a mixed use local centre and employment parcels. There are also extensive areas of public open space/amenity space including tree and woodland planting, as well as a network of surface water features which will provide a sustainable means of surface water runoff control.
- The approximate proposed impermeable area of the site is estimated to be 30% of the site area, this
 equates to 24.9 hectares (this includes highway infrastructure, roofs, hard standings, driveways and
 car parks etc).
- The Red Ditch flows through the site in a south easterly direction before turning to follow a north easterly route alongside but outside of the south eastern boundary of the site. It then turns again to flow in a south easterly direction adjacent to the railway boundary before passing beneath Windsor Road.
- The site is relatively steeply sloping and falls within the catchment of the Red Ditch.



2 FLOOD RISK

2.1 NATURE OF FLOOD RISK

- The Environment Agency is responsible for the provision of information pertaining to flood risk from tidal and main watercourses throughout England and Wales. The EA provides an online information service through its Flood Map data an extract of which is provided in Figure 1.1 below. The site is wholly in flood zone 1 and therefore not prone to flooding from main watercourses.
- The Red Ditch is not classified as a main watercourse therefore Clive Wilson, Redditch Borough Council's Operations Manager Asset Maintenance has indicated that there may be a requirement to hydraulically model the Red Ditch in order to determine the extent of any flood zone associated with it. This modelling work would be undertaken and included within a Flood Risk Assessment for the site at the formal planning application stage. Suitable hydraulic modelling was undertaken and approved as part of the planning submission for phase 1, the hydraulic model used for this will be extended as required to fully assess any flood issues that may affect the phase 2 development. It is however thought that due to the steeply sloping nature of the phase 2 site any flooding would be contained within a very narrow corridor along the Red Ditch. Any proposed development would be kept well outside of any areas of potential flooding.
- Surface Water run-off from the impermeable areas of the proposed development will discharge at
 existing greenfield run off rates to the Red Ditch. Appropriate surface water detention facilities such
 as ponds and swales will be provided throughout the development to sufficiently accommodate flows
 arising from storms up to a 1 in 100 year event plus a 30% allowance for future climate change. As a
 consequence of the development flows within the development and downstream would be better
 regulated reducing the risk of flooding to properties to the south and east.
- The surface water drainage will fully comply with the requirements of the Land Drainage Act, the Flood Water Management Act, Severn Trent Water, Redditch Borough Council and Bromsgrove District Council.





Figure 1.1: Extract from EA Flood Map (downloaded on 30.07.2013)

Based upon the Ordnance Survey map with the Permission of the Controller of Her Majesty's Stationery Office. © Crown copyright Licence No. 100020449 RPS Design Group Ltd



3 SURFACE WATER DRAINAGE

3.1 SURFACE WATER DRAINAGE STRATEGY

- Surface water drainage within the development site will be designed to accommodate flows arising from storms up to a 1 in 100 year event plus a 30% allowance for future climate change without any surface flooding or risk to lower lying properties.
- Flows should be limited to existing greenfield run off rates and discharge to the Red Ditch which runs through and outside the site.
- The greenfield run off rates have been calculated using Microdrainage software: ICP SUDS Mean Annual Flood, the results of which are as follows:

Impermeable area	24.9 hectares
Qbar run-off rate	109.4 litres/second
1 in 100 year run-off rate	281.1 litres/second

The results are contained in appendix B.

 Surface Water detention volumes have been calculated again using Microdrainage software, the results of which are as follows:

Impermeable Area	24.9 hectares
Detention Volume, for Qbar Outflow	16882.7m ³
Detention Volume, for 1 in 100 year Outflow	13410.3m ³

The results are contained in appendix C.

- The proposed surface water detention ponds shown on the masterplan contained in appendix A are of sufficient size to accommodate the flows arising from a 1 in 100 year storm plus a 30% allowance for future climate change, with an outflow no greater than the Qbar run off rate.
- The drainage proposals are subject to detailed design, following completion of a detailed development plan. At that time the actual impermeable areas will be utilised and the greenfield runoff rate re-calculated as necessary.
- The use of infiltration methods as means of surface water disposal will also be investigated following the undertaking of ground investigation works, however from the results obtained for phase 1 it is unlikely that such methods will be viable.



 The proposed detention ponds and other surface water features will be designed to provide sufficient treatment trains for surface water quality improvements, permanently wet ponds with reed beds and other natural features will be provided in the ponds which as well as improving water quality will also have amenity value and help to increase and enhance biodiversity etc.



4 FOUL WATER DRAINAGE

4.1 FOUL WATER DRAINAGE STRATEGY

- Severn Trent Water were commissioned by Persimmon Homes South Midlands to carry out various hydraulic modelling assessments of the foul water sewer network in the vicinity of the site to establish whether available capacity is available to accommodate foul water flows from the development.
- From the results of the modelling it was established that there was sufficient capacity to accommodate flows from phase 1 of the development within the foul water sewer infrastructure to the south of the site (Windsor Road), however it was identified that there would not be sufficient capacity within the immediate vicinity of the site to accommodate the foul flows arising from Phase 2 without the risk of flooding.
- Severn Trent Water have therefore advised that foul water from the Phase 2 development site would need to gravitate to a single new foul water pumping station, flows would then be pumped over the River Arrow and gravitate via a new trunk sewer through the Arrow Valley or around the outskirts of Redditch before outfalling to the existing public sewer system downstream of Ipsley Church Lane (where sufficient capacity exists) before finally discharging to the Spernall Sewage Treatment Works.
- This would provide a suitable and sustainable outfall.
- This solution would not exacerbate any existing flooding problems, and the new trunk sewer could be utilised to convey flows from other adjacent areas where flooding may be occurring thus improving capacities and alleviating occurrences of flooding.
- Severn Trent Water cannot refuse a sewer connection on capacity grounds, and as such they are
 obliged to upgrade the existing sewer system as necessary sufficient to accommodate new
 development flows (at their expense). They are required to carry out the improvement works within a
 reasonable time, which for major improvement works could be a number of years. Bearing this in
 mind the developer is continuing to discuss the development proposals with Severn Trent Water to
 ensure that the development will be deliverable and improvement works are completed at the
 necessary time.



5 CONCLUSIONS

5.1 FLOOD RISK

- As demonstrated in section 2 of this report, the site is not at risk of flooding from main watercourses and is located in flood zone 1
- Hydraulic modelling will be carried out to establish whether there is any potential flooding from the Red Ditch; no development would be carried out in any such areas.
- Surface water outflow from the site will be limited to existing greenfield run off rates, and suitable on site surface water detention facilities provided. As a consequence there will be no increase risk of flooding to the site or lower lying land outside the development site.
- In conclusion for the aforementioned reasons the proposed development would not increase flood risk.

5.2 SURFACE WATER DRAINAGE

- As demonstrated in section 3 of this report, a suitable surface water drainage solution can be provided with outflows at greenfield run-off rates to the Red Ditch.
- Sufficient space is provided on the current masterplan to accommodate the required surface water detention features.
- In conclusion for the aforementioned reasons a suitable and sustainable surface water drainage solution for proposed development is deliverable.

5.3 FOUL WATER DRAINAGE

 As demonstrated in section 4 of this report, a suitable foul water drainage solution can be provided in accordance with the requirements of Severn Trent Water.



- Some off site improvement works are required, all of which are deliverable and may have benefits to areas downstream where capacity problems exist and flooding occurs.
- In conclusion for the aforementioned reasons a suitable and sustainable foul water drainage solution for proposed development is deliverable.

5.4 ADDITIONAL REQUIREMENTS FOR FORMAL PLANNING APPLICATION IN RESPECT OD FLOOD RISK AND DRAINAGE

- Hydraulic Modelling of Red Ditch.
- Preparation of Flood Risk Assessment.
- Further dialogue and agreement with Redditch Borough Councils Land Drainage Officer.
- Further dialogue and agreement with Severn Trent Water with regard to the provision of foul water drainage outfall.
- Further preliminary but more detailed designs of surface water infrastructure and surface water detention facilities.
- Completion of detailed foul and surface water drainage strategy.



APPENDICES



A. APPENDIX A

Drawing No. AAH4936-121-A Phase 2 Masterplan

Brockhill East, Redditch Phase 2 Masterplan Redditch/Bromsgrove-1:2500@AI-17.05.13-AG



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PERSIMMON



CHARLES CHURCH

$\land \land \land$ Key 8

Existing Trees & Hedgerows Proposed Residential Parcels

Proposed Woodland Planting

Proposed Tree Planting

Mixed Use Local Certre (with indicative gateway frontage)

Employment (with indicative gateway frontage)

Public Open Space / Amenity Space

Indicative Drainage Basin / Existing Water Feature

Main Street / Main Internal Loop Road

Shared Surface Spaces / Local Streets

Lowan's Hill Farm (proposed conversion)

Phase I Site Boundary Vehicle Access Points



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21-Rev A



B. APPENDIX B

Greenfield run-off calculations





C. APPENDIX C

Surface Water Detention Volumes:

- 1. Qbar outflow rate
- 2. I in 100 year outflow rate

RPS Group Plc		Page I
Highfield House 5 Ridgeway Quinton Business Park Birmingham B32 IAF	Brockhill East, Phase 2 Surface Water Attenuation 109.4I/sec outflow Qbar	Micro
Date 30 July 2013 File East Qbar.srcx	Designed by A Granger Checked by	<u>Dramage</u>
Micro Drainage	Source Control 2013.1.1	

Summary of Results for 100 year Return Period (+30%)

	Storm Event		n Max Max Level Depth (m) (m)		Max Control (1/s)	Max Volume (m³)	Status
15	min	Summer	98.344	0.344	50.7	5779.5	ОК
30	min	Summer	98.450	0.450	65.7	7564.6	O K
60	min	Summer	98.560	0.560	79.0	9401.7	O K
120	min	Summer	98.668	0.668	89.4	11220.7	OK
180	min	Summer	98.727	0.727	93.7	12217.5	ОК
240	min	Summer	98.765	0.765	96.1	12855.8	O K
360	min	Summer	98.812	0.812	98.9	13648.1	ОК
480	min	Summer	98.842	0.842	100.6	14147.5	OK
600	min	Summer	98.861	0.861	101.7	14459.4	OK
720	min	Summer	98.872	0.872	102.3	14649.1	O K
960	min	Summer	98.880	0.880	102.8	14791.9	ОК
1440	min	Summer	98.882	0.882	102.9	14816.7	ОК
2160	min	Summer	98.875	0.875	102.5	14705.0	OK
2880	min	Summer	98.861	0.861	101.7	14463.1	O K
4320	min	Summer	98.821	0.821	99.4	13788.4	OK
5760	min	Summer	98.776	0.776	96.7	13035.3	OK
7200	min	Summer	98.732	0.732	94.0	12296.6	OK
8640	min	Summer	98.691	0.691	91.2	11611.5	OK
10080	min	Summer	98.654	0.654	88.2	10989.8	OK
15	min	Winter	98.385	0.385	56.7	6473.0	OK
30	min	Winter	98.504	0.504	72.6	8474.5	OK
60	min	Winter	98.627	0.627	85.8	10537.2	OK
120	min	Winter	98.749	0.749	95.1	12701 0	OK
180	min	Winter	98.817	0.817	101 7	13/21.2	OK
240	min	Winter	98.860	0.860	101.7	15260 1	OK
360	min	Winter	98.915	0.915	104.7	15058 5	OK
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15 30 60 120 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200 8640 10080	stor Even min min min min min min min min min mi	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.851 7.658 6.089 4.401 3.176 2.517 1.811 1.433 1.194 1.028 0.906	Floor Volu (m ³	ded Disc ume Voi 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 10 0.0 11 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 25 0.0 26 0.0 26 0.0 26	tharge T3 1ume m³) 0017.7 996.9 332.3 9841.3 0691.4 9257.2 004.2 513.8 8869.8 9122.0 2413.4 9453.9 9241.9 9731.7 9821.9 5140.7 5985.1 5515.4 5654.5 5454.5	me-Peak (mins) 31 45 74 134 192 252 368 486 606 724 958 1166 1544 1956 2772 3576 4392 5112 5944
15 30 60 120 180 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200 8640 10080 15	stor Even min min min min min min min min min mi	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.851 7.658 6.089 4.401 3.176 2.517 1.811 1.433 1.194 1.028 0.906 124.774	Floor Volu (m ³	ded Disc ume Voi 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 10 0.0 11 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 25 0.0 26 0.0 26 0.0 26 0.0 3	tharge T3 1ume m³) 1017.7 996.9 332.3 9841.3 2691.4 9257.2 1004.2 13.8 8691.8 122.0 2413.4 9124.9 9731.7 9821.9 5140.7 5985.1 5515.4 5654.5 3400.7 9400.7	me-Peak (mins) 31 45 74 134 192 252 368 486 606 724 958 1166 1544 1956 2772 3576 4392 5112 5944 30
15 30 60 120 180 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200 8640 10080 15 30	stor Even min min min min min min min min min mi	summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.851 7.658 6.089 4.401 3.176 2.517 1.811 1.433 1.194 1.028 0.906 124.774 81.962	Floor Volu (m ³	ded Disc ume Voi 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 10 0.0 11 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 25 0.0 26 0.0 26 0.0 3 0.0 4	tharge T3 1ume m³) 1017.7 996.9 332.3 9841.3 2691.4 9257.2 1004.2 13.8 869.8 122.0 2413.4 9124.9 9731.7 9821.9 5140.7 5985.1 5515.4 5654.5 3400.7 1481.4	me-Peak (mins) 31 45 74 134 192 252 368 486 606 724 958 1166 1544 1956 2772 3576 4392 5112 5944 30 45
15 30 60 120 180 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200 8640 10080 15 30 60	stor Even min min min min min min min min min mi	summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.851 7.658 6.089 4.401 3.176 2.517 1.811 1.433 1.194 1.028 0.906 124.774 81.962 51.304	Floor Volu (m ³	ded Disc ume Voi 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 10 0.0 11 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 25 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26	tharge T3 1ume m³) 0017.7 996.9 332.3 9841.3 0691.4 9257.2 004.2 513.8 869.8 9222.0 2413.4 9453.9 92124.9 9731.7 9821.9 5140.7 5985.1 5515.4 5654.5 3400.7 4481.4 3222.0	me-Peak (mins) 31 45 74 134 192 252 368 486 606 724 958 1166 1544 1956 2772 3576 4392 5112 5944 30 45 74
15 30 60 120 180 240 360 480 600 720 960 1440 2880 4320 5760 7200 8640 10080 15 30 60 120	stor Even min min min min min min min min min mi	summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.851 7.658 6.089 4.401 3.176 2.517 1.811 1.433 1.194 1.028 0.906 124.774 81.962 51.304	Floor Volu (m ³	ded Disc ume Voi 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 10 0.0 11 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 25 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26	tharge T3 1ume m³) 1017.7 996.9 332.3 9841.3 2691.4 9257.2 1004.2 13.8 8691.8 122.0 2413.4 9124.9 9731.7 985.1 5515.4 5654.5 3400.7 1481.4 3222.0 987.7	me-Peak (mins) 31 45 74 134 192 252 368 486 606 724 958 1166 1544 1956 2772 3576 4392 5112 5944 30 45 74 132
15 30 60 120 180 240 360 480 600 720 960 1440 2880 4320 5760 7200 8640 10080 15 30 60 120 180	stor Even min min min min min min min min min mi	summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.851 7.658 6.089 4.401 3.176 2.517 1.811 1.433 1.194 1.028 0.906 124.774 81.962 51.304 31.039 22.830	Floor Volu (m ³	ded Disc ume Voi 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 10 0.0 11 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 25 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26	tharge T3 1ume m³) 0017.7 996.9 332.3 9841.3 0691.4 9257.2 004.2 513.8 8691.8 9222.0 2413.4 9453.9 92124.9 9731.7 985.1 5515.4 5654.5 3400.7 4481.4 3222.0 9877.8 9798.6	me-Peak (mins) 31 45 74 134 192 252 368 486 606 724 958 1166 1544 1956 2772 3576 4392 5112 5944 30 45 74 132 188
15 30 60 120 180 240 360 480 600 720 960 1440 2880 4320 5760 7200 8640 10080 15 30 60 120 180 240	stor Even min min min min min min min min min mi	summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.851 7.658 6.089 4.401 3.176 2.517 1.811 1.433 1.194 1.028 0.906 124.774 81.962 51.304 31.039 22.830 18.253	Floor Volu (m ³	ded Disc ume Voi 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 10 0.0 11 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 25 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26 0.0 10 0.0 10 0	tharge T3 1ume m³) 0017.7 996.9 332.3 9841.3 0691.4 9257.2 004.2 513.8 8691.4 9257.2 004.2 513.8 841.3 99124.9 9731.7 985.1 5515.4 5654.5 3400.7 54481.4 3222.0 9877.8 9798.6 1406.0	me-Peak (mins) 31 45 74 134 192 252 368 486 606 724 958 1166 1544 1956 2772 3576 4392 5112 5944 30 45 74 132 188 246
15 30 60 120 180 240 360 480 600 720 960 1440 2880 4320 5760 7200 8640 10080 15 30 60 120 180 240 360	stor Even min min min min min min min min min mi	summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.851 7.658 6.089 4.401 3.176 2.517 1.811 1.433 1.194 1.028 0.906 124.774 81.962 51.304 31.039 22.830 18.253 13.251	Floor Volu (m ³	ded Disc Imme Voi 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 3 0.0 10 0.0 11 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 12 0.0 25 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26 0.0 26 0.0 10 0.0 10 0.0 10 0.0 10 0	tharge T3 1ume m³) 0017.7 996.9 332.3 9841.3 0691.4 9257.2 004.2 513.8 8691.4 9257.2 004.2 513.8 841.3 9691.4 9257.2 004.2 513.8 869.8 2122.0 9124.9 9731.7 985.1 5515.4 5654.5 3400.7 4481.4 3222.0 9877.8 9798.6 1406.0 217.9 979.2	me-Peak (mins) 31 45 74 134 192 252 368 486 606 724 958 1166 1544 1956 2772 3576 4392 5112 5944 30 45 74 132 188 246 362

RPS Group Pic	Page 2	
Highfield House 5 Ridgeway Quinton Business Park Birmingham B32 IAF	Brockhill East, Phase 2 Surface Water Attenuation 109.4I/sec outflow Qbar	Micro
Date 30 July 2013 File East Qbar.srcx	Designed by A Granger Checked by	<u>Drainage</u>
Micro Drainage	Source Control 2013.1.1	

Summary of Results for 100 year Return Period (+30%)

	Stor Even	m t	Max Level (m)	Max Depth (m)	M Con (1	ax trol /s)	Max Volu (m ³	me)	Statu	18
600	min	Winter	98.973	0.973	1	07.7	16339	9.2	0	ĸ
720	min	Winter	98.987	0.987	1	08.4	16585	5.3	0	к
960	min	Winter	99.001	1.001	1	09.1	16822	2.7	0	к
1440	min	Winter	98.998	0.998	1	08.9	16759	9.1	0	к
2160	min	Winter	98.981	0.981	1	08.1	16489	9.0	0	к
2880	min	Winter	98.955	0.955	1	06.8	16047	7.4	0	к
4320	min	Winter	98.889	0.889	1	03.2	14928	3.9	0	к
5760	min	Winter	98.820	0.820		99.3	13767	7.7	0	к
7200	min	Winter	98.755	0.755		95.4	12683	3.7	0	к
8640	min	Winter	98.697	0.697		91.6	11716	5.2	0	ĸ
10080	min	Winter	98.647	0.647		87.6	10872	2.3	0	ĸ
	Stor	m	Rain	Floo	ded	Discl	arge	Tir	ne-Pea	ak
	Even	t	(mm/hr)	Volu	me	Vol	ume	(mins)	
				(m ³)	(m	3)			
600	min	Winter	8.85	1	0.0	130	090.4		5	92
720	min	Winter	7.658	3	0.0	133	339.0		71	06
960	min	Winter	6.08	9	0.0	130	504.5		93	26
1440	min	Winter	4.40	L	0.0	13	554.3		13:	28
2160	min	Winter	3.170	5	0.0	213	323.7		164	48
2880	min	Winter	2.51	7	0.0	21	955.1		21	08
4320	min	Winter	1.81	1	0.0	21	941.6		29	92
5760	min	Winter	1.43	3	0.0	28	162.6		38	56
7200	min	Winter	1.19	1	0.0	29:	110.9		46	80
0000									E 4	10
8640	min	Winter	1.02	В	0.0	29	709.8		54	to

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RPS Group Plc	Page 3	
Highfield House 5 Ridgeway Quinton Business Park Birmingham B32 AF	Brockhill East, Phase 2 Surface Water Attenuation 109.4I/sec outflow Qbar	Micro
Date 30 July 2013 File East Qbar.srcx	Designed by A Granger Checked by	Dramace
Micro Drainage	Source Control 2013.1.1	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (vears)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.500	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 24.900

Time	(mins)	Area									
From:	To:	(ha)									
0	4	6.225	4	8	6.225	8	12	6.225	12	16	6.225

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RPS Group Plc		Page 4
Highfield House 5 Ridgeway Quinton Business Park Birmingham B32 IAF	Brockhill East, Phase 2 Surface Water Attenuation 109.41/sec outflow Qbar	Micro
Date 30 July 2013 File East Qbar.srcx	Designed by A Granger Checked by	Denece
Micro Drainage	Source Control 2013.1.1	
	Model Details	

2

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m ²)								
0.000	16800.0	0.600	16800.0	1.200	16800.0	1.800	16800.0	2.400	16800.0
0.100	16800.0	0.700	16800.0	1.300	16800.0	1.900	16800.0	2.500	16800.0
0.200	16800.0	0.800	16800.0	1.400	16800.0	2.000	16800.0		
0.300	16800.0	0.900	16800.0	1.500	16800.0	2.100	16800.0		
0.400	16800.0	1.000	16800.0	1.600	16800.0	2.200	16800.0		
0.500	16800.0	1.100	16800.0	1.700	16800.0	2.300	16800.0		

Hydro-Brake[®] Outflow Control

Design Head (m) 1.000 Hydro-Brake® Type Md8 Invert Level (m) 98.000 Design Flow (l/s) 109.4 Diameter (mm) 412

Depth (m)	Flow (1/s) Depth	(m)	Flow (1	/s)	Depth (m)	Flow	(l/s)	Depth (m)	Flow	(1/s)	Depth (m) Flow	(1/s)
0.100	12.	6 0.	.800	9	8.2	2.00)	148.5	4.000		207.9	7.00	D	275.0
0.200	28.	2 1	.000	10	9.0	2.20)	155.3	4.500		220.5	7.50	0	284.6
0.300	44.	0 1.	.200	11	8.2	2.40)	161.9	5.000		232.4	8.00	0	294.0
0.400	58.	8 1.	.400	12	6.5	2.60	0	168.2	5.500		243.7	8.50	0	303.0
0.500	72.	1 1	.600	13	4.2	3.00)	180.4	6.000		254.6	9.00	0	311.8
0.600	83.	2 1	. 800	14	1.5	3.50)	194.6	6.500		265.0	9.50	0	320.3

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RPS Group Plc	PS Group Pic					
Highfield House 5 Ridgeway Quinton Business Park Birmingham B32 1 AF	Brockhill East, Phase 2 Surface Water Attenuation 281.11/sec outflow	Micro				
Date 30 July 2013 File East 1 in 100.srcx	Designed by A Granger Checked by	<u>Dramage</u>				
Micro Drainage	Source Control 2013.1.1					

Summary of Results for 100 year Return Period (+30%)

Storm Event		Max Max Level Dept (m) (m)		Max Control (1/s)	Max Volume (m³)	Status		
	15	min	Summer	98.426	0.426	126.7	5714.	вок
	30	min	Summer	98.555	0.555	167.1	7435.	5 ОК
	60	min	Summer	98.682	0.682	204.5	9136.	зок
	120	min	Summer	98.795	0.795	234.9	10657.	6 ОК
	180	min	Summer	98.846	0.846	247.5	11342.	7 O K
	240	min	Summer	98.870	0.870	253.2	11664.	зок
	360	min	Summer	98.884	0.884	256.5	11848.	зок
	480	min	Summer	98.891	0.891	258.0	11936.	9 O K
	600	min	Summer	98.893	0.893	258.5	11970.	в ок
	720	min	Summer	98.893	0.893	258.4	11965.	6 O K
	960	min	Summer	98.885	0.885	256.7	11863.	4 O K
	1440	min	Summer	98.856	0.856	249.8	3 11471.	8 O K
	2160	min	Summer	98.802	0.802	236.6	5 10744.	5 ОК
	2880	min	Summer	98.749	0.749	222.8	3 10033.	о ок
	4320	min	Summer	98.659	0.659	197.9	8829.	4 O K
	5760	min	Summer	98.590	0.590	177.7	7 7902.	7 O K
	7200	min	Summer	98.535	0.535	161.3	7176.	2 O K
	8640	min	Summer	98.491	0.491	147.4	6586.	9 O K
	10080	min	Summer	98.456	0.456	136.3	6110.	5 O K
	15	min	Winter	98.478	0.478	143.3	6400.	5 ОК
	30	min	Winter	98.622	0.622	187.2	8331.	7 O K
	60	min	Winter	98.765	0.765	227.0	10246.	4 O K
	120	min	Winter	98.894	0.894	258.0	5 11977.	9 ОК
	180	min	Winter	98.953	0.953	271.0	5 12773.	8 O K
	240	min	Winter	98.982	0.982	277.	5 13164.	9 O K
	360	min	Winter	99.001	1.001	281.3	1 13414.	8 O K
	480	min	Winter	99.001	1.001	281.	1 13410.	3 O K
			** · · · · · · ·	22.001				J 0 10
		Stor	m	Rain	Floo	ded Dis	charge T	ime-Peak
		Stor	m	Rain (mm/hr)	Floo	ded Dis une Vo	charge T lume	ime-Peak (mins)
		Stor	m it	Rain (mm/hr)	Floo Volu (m ³	ded Dis me Vo	charge T olume m ³)	ime-Peak (mins)
	15	Stor	m it	Rain (mm/hr)	Floo Volu (m ³	ded Dis me Vo	charge T blume m ³)	ime-Peak (mins)
	15	Stor Ever	Summer	Rain (mm/hr)	Floo Volu (m ³	ded Dis me Vo) (charge T blume m ³) 4728.7	ime-Peak (mins)
	15 30	Stor Ever min min	Summer	Rain (mm/hr) 124.774 81.962	Floo Volu (m ³	ded Dis me Vc) (0.0 0.0	charge T plume (m ³) 4728.7 6292.3 9152.8	<pre>ime-Peak (mins) 30 44 72</pre>
	15 30 60	stor Ever min min min	Summer Summer	Rain (mm/hr) 124.774 81.962 51.304	Floo Volu (m ³	ded Dis me Vc) (0.0 0.0 0.0 0.0 0.0	charge T blume m ³) 4728.7 6292.3 9152.8 1099.2	Sime-Peak (mins) 30 44 72 130
	15 30 60 120	Stor Ever min min min min	Summer Summer Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830	Floo Volu (m ³	ded Dis me Vc) (0.0 0.0 0.0 0.0 0.0 1 0.0 1	charge T lume m ³) 4728.7 6292.3 9152.8 1099.2 2250.9	30 44 72 130 186
	15 30 60 120 180	min min min min min min	Summer Summer Summer Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253	Floo Volu (m ³	ded Dis me Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1	charge T olume (m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9	30 44 72 130 186 244
	15 30 60 120 180 240	min min min min min min min	Summer Summer Summer Summer Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253	Floo Volu (m ³	ded Dis ume Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1	charge T olume (m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201 3	30 44 72 130 186 244 330
	15 30 60 120 180 240 360	stor Even min min min min min min	Summer Summer Summer Summer Summer Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562	Floo Volu (m ³	ded Dis ume Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1	charge T olume m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1	30 (mins) 30 44 72 130 186 244 330 386
	15 30 60 120 180 240 360 480	stor Ever min min min min min min min	Summer Summer Summer Summer Summer Summer Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562	Floo Volu (m ³	ded Dis mme Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1	charge T)lume (m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1 5748.8	30 44 72 130 186 244 330 386 448
	15 30 60 120 180 240 360 480 600	stor Ever min min min min min min min min	Summer Summer Summer Summer Summer Summer Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.851 7,658	Floo Volu (m ³	ded Dis mme Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1	charge T)lume m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1 5748.8 6310.1	30 44 72 130 186 244 330 386 448 514
	15 30 60 120 180 240 360 480 600 720	stor Ever min min min min min min min min	Summer Summer Summer Summer Summer Summer Summer Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.851 7.658 6.089	Floo Volu (m ³	ded Dis mme Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1	charge T olume (m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1 5748.8 6310.1 7188.0	30 44 72 130 186 244 330 386 448 514 650
	15 30 60 120 180 240 360 480 600 720 960	stor even min min min min min min min min min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.853 7.658 6.089 4.401	Floo Volu (m ³	ded Dis mme Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1	charge T)lume m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1 5748.8 6310.1 7188.0 8323.5	30 44 72 130 186 244 330 386 448 514 650 924
	15 30 60 120 180 240 360 480 600 720 960 1440	stor Ever min min min min min min min min min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.853 7.658 6.089 4.401 3.176	Floo Volu (m ³	ded Dis mme Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 2	charge T olume m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1 5748.8 6310.1 7188.0 8323.5 1162.7	30 44 72 130 186 244 330 386 448 514 650 924 1328
	15 30 60 120 180 240 360 480 600 720 960 1440 2160	stor Ever min min min min min min min min min min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.853 7.658 6.089 4.401 3.176	Floo Volu (m ³	ded Dis mme Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 2	charge T olume m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1 5748.8 6310.1 7188.0 8323.5 1162.7 2297.2	30 44 72 130 186 244 330 386 448 514 650 924 1328 1716
	15 30 60 120 240 360 480 600 720 960 1440 2160 280 2160	stor Ever min min min min min min min min min min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.853 7.658 6.089 4.407 3.176 2.517	Floo Volu (m ³	ded Dis mme Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 2 0.0 2 0.0 2	charge T olume m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1 5748.8 6310.1 7188.0 8323.5 1162.7 2297.2 3740.0	30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476
	15 30 60 120 240 360 480 600 720 960 1440 2160 2880 4320 5760	stor Ever min min min min min min min min min min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.853 7.658 6.089 4.401 3.176 2.517 1.811	Floo Volu (m ³	ded Discussion mme Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 2 0.0 2 0.0 2 0.0 2	charge T olume m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1 5748.8 6310.1 7188.0 8323.5 1162.7 2297.2 3740.0 5651.2	30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232
	15 30 60 120 240 360 720 960 1440 2160 2880 4320 5760	stor Ever min min min min min min min min min min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.853 7.658 6.089 4.401 3.176 2.517 1.811 1.433 1.194	Floo Volu (m ³	ded Discussion mme Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2	charge T olume m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1 5748.8 6310.1 7188.0 8323.5 1162.7 2297.2 3740.0 5651.2 6691.1	30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968
	15 30 60 120 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200	Stor Ever min min min min min min min min min min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.853 7.658 6.089 4.401 3.176 2.517 1.811 1.433 1.194 1.029	Floo Volu (m ³	ded Discussion mme Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2	charge T olume m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1 5748.8 6310.1 7188.0 8323.5 1162.7 2297.2 3740.0 5651.2 6691.1 7521.0	Sime-Peak (mins) 30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680
	15 30 60 120 240 360 480 600 720 2160 2160 2160 2160 2380 4320 5760 7200 8640	Stor Ever min min min min min min min min min min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.853 7.658 6.089 4.401 3.176 2.517 1.811 1.433 1.194 1.026 0.900	Floo Volu (m ³	ded Discussion mme Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2	charge T olume m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1 5748.8 6310.1 7188.0 8323.5 1162.7 2297.2 3740.0 5651.2 6691.1 7521.0 8113.3	Sime-Peak (mins) 30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680 5448
	15 30 60 120 240 360 480 600 720 960 1440 2160 2880 4320 5760 7200 8640	stor Ever min min min min min min min min min min	Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.853 7.658 6.089 4.401 3.176 2.517 1.811 1.433 1.194 (0.906	Floo Volu (m ³	ded Discussion mme Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2	charge T olume m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1 5748.8 6310.1 7188.0 8323.5 1162.7 2297.2 3740.0 5651.2 6691.1 7521.0 8113.3 5329.9	Sime-Peak (mins) 30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680 5448 30
	15 30 60 120 240 360 480 600 7200 8640 10080 10080	stor Ever min min min min min min min min min min	Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.853 7.658 6.089 4.401 3.176 2.517 1.817 1.433 1.194 1.026 0.906 124.774	Floo Volu (m ³	ded Discussion mme Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2	charge T olume m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1 5748.8 6310.1 7188.0 8323.5 1162.7 2297.2 3740.0 5651.2 6691.1 7521.0 8113.3 5329.9 7084.2	Sime-Peak (mins) 30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680 5448 30 44
	15 30 60 120 240 360 480 600 7200 8640 10080 15 30 60 20 5760 7200 8640 10080 15 30 60 20 20 20 20 20 20 20 20 20 20 20 20 20	stor Ever min min min min min min min min min min	Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.853 7.658 6.089 4.401 3.176 2.517 1.817 1.433 1.194 1.026 0.906 124.774 81.965	Floo Volu (m ³	ded Dis mme Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2	charge T olume m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1 5748.8 6310.1 7188.0 8323.5 1162.7 2297.2 3740.0 5651.2 6691.1 7521.0 8113.3 5329.9 7084.2 0271.9	Sime-Peak (mins) 30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680 5448 30 44 72
	15 30 60 120 240 360 480 600 720 2860 2160 2160 2160 37200 8640 10080 15 30 60	stor Ever min min min min min min min min min min	Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.853 7.658 6.089 4.401 3.176 2.517 1.817 1.433 1.194 1.026 0.906 124.774 81.963 51.304	Floo Volu (m ³ 	ded Discussion mme Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 2 0.0	charge T olume m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1 5748.8 6310.1 7188.0 8323.5 1162.7 2297.2 3740.0 5651.2 6691.1 7521.0 8113.3 5329.9 7084.2 0271.9 2452.9	Sime-Peak (mins) 30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680 5448 30 44 72
	15 30 60 120 240 360 480 600 720 960 1440 2160 2160 4320 5760 7200 8640 10080 15 30 60 120	stor Ever min min min min min min min min min min	Summer Summer	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.853 7.658 6.089 4.401 3.176 2.517 1.817 1.433 1.194 1.026 0.906 124.774 81.963 51.304	Floo Volu (m ³ 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	ded Discussion mme Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1	charge T olume m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1 5748.8 6310.1 7188.0 8323.5 1162.7 2297.2 3740.0 5651.2 6691.1 7521.0 8113.3 5329.9 7084.2 0271.9 2452.9 3743.0	Sime-Peak (mins) 30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680 5448 30 44 72 128 182
	15 30 60 120 180 240 360 480 600 7200 8640 10080 15 30 60 120 8640 10080 15 30 60 120	stor Ever min min min min min min min min min min	Summer Su	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.853 7.658 6.089 4.401 3.176 2.517 1.817 1.433 1.194 1.026 0.906 124.774 81.963 51.304	Floo Volu (m ³ 	ded Discussion mme Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1	charge T olume m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1 5748.8 6310.1 7188.0 8323.5 1162.7 2297.2 3740.0 5651.2 6691.1 7521.0 8113.3 5329.9 7084.2 0271.9 2452.9 3743.0 4645.9	Sime-Peak (mins) 30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680 5448 30 44 72 128 182 238
	15 30 60 120 180 240 360 480 600 720 960 1440 2880 4320 5760 7200 8640 10080 15 300 60 120 1800 240	stor Ever min min min min min min min min min min	Summer Su	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.853 7.658 6.089 4.401 3.176 2.517 1.817 1.433 1.194 1.026 0.906 124.774 81.963 51.304 31.039 22.830 18.255	Floo Volu (m ³ 	ded Discussion mme Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1	charge T olume m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1 5748.8 6310.1 7188.0 8323.5 1162.7 2297.2 3740.0 5651.2 6691.1 7521.0 8113.3 5329.9 7084.2 0271.9 2452.9 3743.0 4645.9 5927.8	Sime-Peak (mins) 30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680 5448 30 44 72 128 182 238 348
	15 30 60 120 180 240 360 480 600 720 960 1440 2880 4320 5760 7200 8640 10080 15 300 60 120 180 2400	Stor Ever min min min min min min min min min min	Summer Su	Rain (mm/hr) 124.774 81.962 51.304 31.039 22.830 18.253 13.251 10.562 8.853 7.658 6.089 4.401 3.176 2.517 1.811 1.433 1.194 1.026 0.906 124.774 81.963 51.304 31.039 22.833 18.255 13.255	Floo Volu (m ³ 	ded Discussion mme Vc 0.0 0.0 0.0 0.0 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 2 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1 0.0 1	charge T olume m ³) 4728.7 6292.3 9152.8 1099.2 2250.9 3056.9 4201.3 5066.1 5748.8 6310.1 7188.0 8323.5 1162.7 2297.2 3740.0 5651.2 6691.1 7521.0 8113.3 5329.9 7084.2 0271.9 2452.9 3743.0 4645.9 5927.8 6896.5	Sime-Peak (mins) 30 44 72 130 186 244 330 386 448 514 650 924 1328 1716 2476 3232 3968 4680 5448 30 44 72 128 182 238 348 402

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RPS Group Plc	Page 2		
Highfield House 5 Ridgeway Quinton Business Park Birmingham B32 AF	Brockhill East, Phase 2 Surface Water Attenuation 281.11/sec outflow	Micro	
Date 30 July 2013 File East 1 in 100.srcx	Designed by A Granger Checked by	<u>Drainage</u>	
Micro Drainage	Source Control 2013.1.1		

Summary of Results for 100 year Return Period (+30%)

Storm		Max	Max Max		ax	Max		Status		
	Even	t	Level	Depth	Con	trol	Volu	ne		
			(m)	(m)	(1	/s)	(m ³)		
600	min	Winter	99.000	1.000	2	81.0	13408	1.3	0	K
720	min	Winter	98.995	0.995	2	80.0	13340	.3	0	ĸ
960	min	Winter	98.976	0.976	2	76.2	13078	3.3	0	К
1440	min	Winter	98.921	0.921	2	64.8	12347	.9	0	ĸ
2160	min	Winter	98.835	0.835	2	44.9	11197	1.3	0	К
2880	min	Winter	98.759	0.759	2	25.6	10175	5.5	0	К
4320	min	Winter	98.640	0.640	1	92.6	8577	7.4	0	к
5760	min	Winter	98.554	0.554	1	66.9	7426	5.2	0	К
7200	min	Winter	98.490	0.490	1	47.1	6571	1.1	0	к
8640	min	Winter	98.441	0.441	1	31.5	5911	1.1	0	К
10080	min	Winter	98.402	0.402	1	18.8	5385	5.8	0	K
	Stor	m	Rain	Flooded		d Discharge Ti		Ti	ime-Peak	
	Even	t	(mm/hr)	Volu	Volume Vol		ume	(mins)	
				(m ³)	(m	13)			
600	min	Winter	8.85	1	0.0	17	661.3		4	72
720	min	Winter	7.65	8	0.0	18:	290.3		5	48
960	min	Winter	6.08	9	0.0	19:	274.2		7	00
1440	min	Winter	4.40	1	0.0	20	546.7		9	94
2160	min	Winter	3.17	6	0.0	23	713.5		14	12
2880	min	Winter	2.51	7	0.0	24	987.9		18	20
4320	min	Winter	1.81	1	0.0	26	619.5		26	00
5760	min	Winter	1.43	3	0.0	28	732.7		33	52
7200	min	Winter	1.19	4	0.0	29	900.6		41	12
8640	min	Winter	1.02	8	0.0	30	838.0		48	48
10080	min	Winter	0.90	6	0.0	31	527.0		55	60

RPS Group Plc	Page 3			
Highfield House 5 Ridgeway Quinton Business Park Birmingham B32 IAF	Brockhill East, Phase 2 Surface Water Attenuation 281.11/sec outflow	Micro		
Date 30 July 2013 File East 1 in 100.srcx	Designed by A Granger Checked by	<u>Dramage</u>		
Micro Drainage	Source Control 2013.1.1			

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.500	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 24.900

Time	(mins)	Area									
From:	To:	(ha)									
0	4	6.225	4	8	6.225	8	12	6.225	12	16	6.225

RPS Group Plc	Page 4		
Highfield House 5 Ridgeway Quinton Business Park Birmingham B32 IAF	Brockhill East, Phase 2 Surface Water Attenuation 281.11/sec outflow	Micro	
Date 30 July 2013 File East in 100.srcx	Designed by A Granger Checked by	Dramage	
Micro Drainage	Source Control 2013.1.1		

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m) Area (m^2) Depth (m) Area (m^2) Depth (m) Area (m^2) Depth (m) Area (m^2) Depth (m) Area (m^2)

0.000	13402.0	0.600	13402.0	1.200	13402.0	1.800	13402.0	2.400	13402.0
0.100	13402.0	0.700	13402.0	1.300	13402.0	1.900	13402.0	2.500	13402.0
0.200	13402.0	0.800	13402.0	1.400	13402.0	2.000	13402.0		
0.300	13402.0	0.900	13402.0	1.500	13402.0	2.100	13402.0		
0.400	13402.0	1.000	13402.0	1.600	13402.0	2.200	13402.0		
0.500	13402.0	1.100	13402.0	1.700	13402.0	2.300	13402.0		

Hydro-Brake® Outflow Control

Design Head (m) 1.000 Hydro-Brake® Type Md8 Invert Level (m) 98.000 Design Flow (l/s) 281.1 Diameter (mm) 664

Depth (m)	Flow (1/s)								
0.100	23.4	0.800	236.1	2.000	395.6	4.000	542.4	7.000	714.4
0.200	53.6	1.000	281.0	2.200	412.4	4.500	574.2	7.500	739.4
0.300	85.8	1.200	312.5	2.400	428.5	5.000	604.6	8.000	763.6
0.400	118.3	1.400	336.8	2.600	444.0	5.500	633.7	8.500	787.1
0.500	150.1	1.600	358.3	3.000	473.7	6.000	661.6	9.000	809.9
0.600	180.7	1.800	377.7	3.500	509.0	6.500	688.5	9.500	832.1