Addendum Surface Water Drainage Statement

for proposed redevelopment of

55 Fitzroy Park

Camden

N6 6JA

for

The Turner Stokes Family

and the Springer Family

LBH4480suds Ver. 1.1

December 2018

LBH WEMBLEY ENGINEERING

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Foreword-Guidance Notes

GENERAL

This report has been prepared for a specific client and to meet a specific brief. The preparation of this report may have been affected by limitations of scope, resources or time scale required by the client. Should any part of this report be relied on by a third party, that party does so wholly at its own risk and LBH WEMBLEY Engineering disclaims any liability to such parties.

The observations and conclusions described in this report are based solely upon the agreed scope of work. LBH WEMBLEY Engineering has not performed any observations, investigations, studies or testing not specifically set out in the agreed scope of work and cannot accept any liability for the existence of any condition, the discovery of which would require performance of services beyond the agreed scope of work.

VALIDITY

Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances shall be at the client's sole and own risk. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should therefore not be relied upon in the future and any such reliance on the report in the future shall again be at the client's own and sole risk.

THIRD PARTY INFORMATION

The report may present an opinion based upon information received from third parties. However, no liability can be accepted for any inaccuracies or omissions in that information.

1 Introduction

1.1 Background

It is proposed to redevelop this property through removal of the existing large house and replacement of this by five new smaller homes.

In addition to other planning assessment, a specific hydrological and hydrogeological impact assessment was prepared for the proposed development in recognition of the special situation of this site and the sensitive nature of neighbouring properties and the wider neighbourhood, including the important wildlife habitats of the Hampstead Heath nature reserve and the Highgate Ponds which lie a short distance below the site.

1.2 Brief

LBH WEMBLEY has been appointed to assess these potential impacts and to assist with the design of the development to achieve an exemplar positive impact.

This addendum document has been prepared to provide additional information and detail on the surface water drainage system that has been requested by the Basement Impact Assessment auditor and to provide additional reassurance to local residents and their specialist advisors.

1.3 Surface Water Planning Policy

The Camden Local plan requires all developments to utilise Sustainable Drainage Systems (SuDS) . Additionally, the Camden Planning Guidance for Sustainability (CPG3) (July 2015, updated March 2018) states:

"*All developments are expected to manage drainage and surface water on-site or as close to the site as possible, using Sustainable Drainage Systems (SUDS) and the hierarchy set out below.*

The Council will expect plans and application documents to describe how water will be managed within the development, including an explanation of the proposed SUDS, the reasons why certain SUDS have been ruled out and detailed information on materials and landscaping.

The Council will expect developments to achieve a greenfield surface water run-off rate once SUDS have been installed. As a minimum, surface water run-off rates should be reduced by 50% across the development."

The surface water drainage strategy for this site is therefore required to incorporate SuDS principles as laid out in the Non-Statutory Technical Standards for Sustainable Drainage Systems[1] and the London Plan[2].

[1] DEFRA March 2015 Non-Statutory Technical Standards (NSTS) for sustainable drainage systems

[2] London Plan Chapter Five - London's Responses to Climate Change Policy 5.1.3 Sustainable Drainage

1.4 SUDS Hierarchy

The aim is to discharge surface run off as high as is reasonably practicable up the following hierarchy of drainage options as outlined by the drainage hierarchy in the London Plan Policy (Policy 5.13, Section 2.3) and the Camden Local Plan:

- Store rainwater for later use
- Use infiltration techniques, such as porous surfaces in non-clay areas
- Attenuate rainwater in ponds or open water features for gradual release
- Attenuate rainwater by storing in tanks or sealed water features for gradual release
- Discharge rainwater direct to a watercourse
- Discharge rainwater to a surface water sewer/drain
- Discharge rainwater to the combined sewer

All proposed SUDS components follow National Planning Practice Guidance and Non-Statutory Technical Standards and take the Camden's SFRA (2014) into consideration.

2 Site Analysis

2.1 Existing Situation (Pre-Development)

The site has been described previously in the hydrological and hydrogeological report and the concept SuDS design presented in that submission included a contoured plan of the present site together with an illustrated analysis of the present surface water flow paths.

2.2 Proposed SuDS

The opportunities for SuDS features to be incorporated in the new development were explored in the above report, along with the design principles that are proposed. Further detail has now been requested and the following sections provide additional information on the existing situation and the proposed development. The presence of perched groundwater running along the upper surface of the London Clay is evidence of some permeability within the overlying strata. The SuDS scheme will therefore be designed to accommodate the possibility of infiltration while not relying upon this for effectiveness.

2.3 Existing Catchment Areas

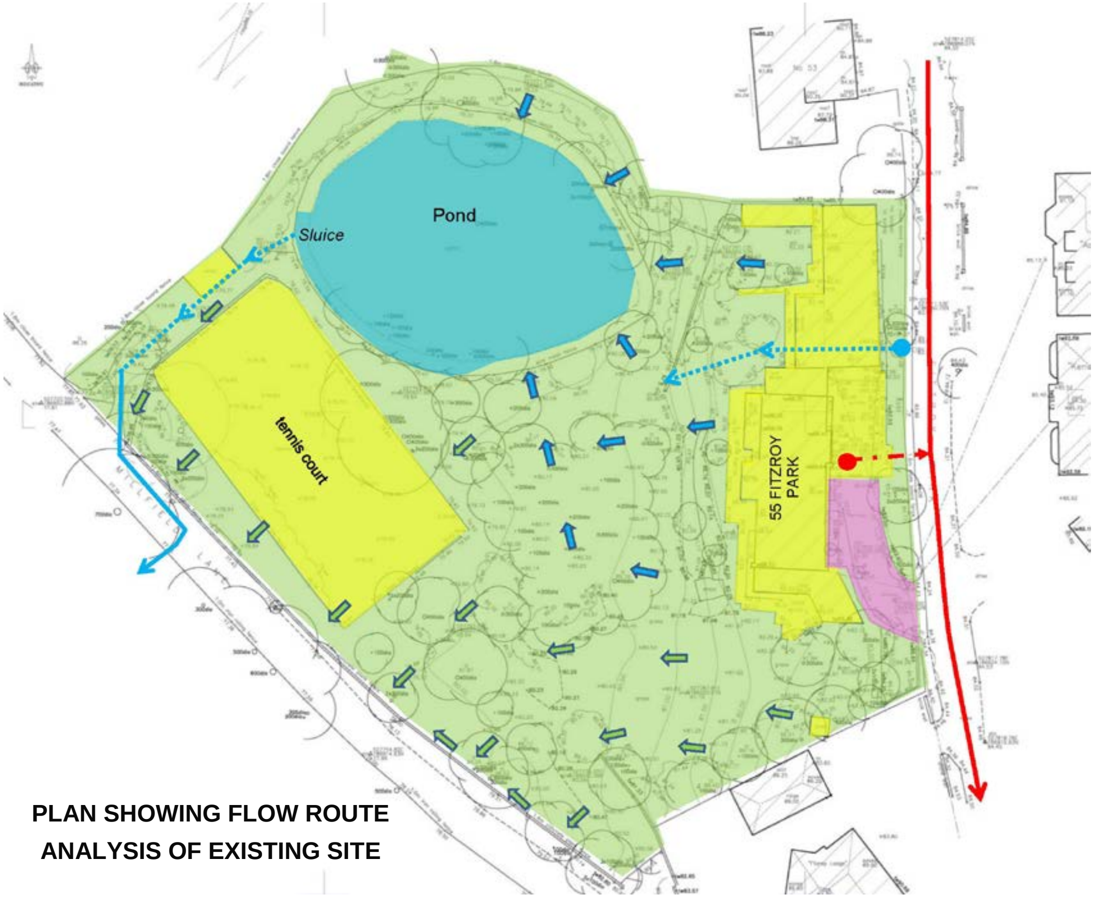
The site can at present be divided into two catchments; firstly there is an area around the house and driveway that drains into the combined sewer that runs beneath Fitzroy Park, and secondly there is the remainder of the site which drains across Millfield Lane to the Heath. Although some of the rainfall incident upon the roof of the existing house is likely to find its way into the combined sewer, it is assumed for present purposes that the entire existing roof drains to the garden.

The existing garden area, although draining entirely to the Heath, may be sub-divided into a northerly section that feeds into the pond and thereby to the Heath and a more southerly section that bypasses the pond and feeds directly to the Millfield Land boundary.

It is apparent that the pond is fed by surface run-off, for although the feed to the pond has previously been suggested to comprise a network of pipes or land-drains, but there appear to be no evidence of this and a ground probing radar survey undertaken around the pond perimeter failed to detect anything other than a single stopped up drainage pipe that formerly ran from the adjacent property known as the Water house.

The outflow from the pond is controlled by an adjustable sluice that discharges into a 100mm drainage pipe. This pipe emerges from the bank that leads down to Millfield Lane, giving rise to a permanent trickle of water that exits below a gate onto Millfield Lane and meanders across the lane onto the Heath.

Photos showing permanent trickle of water from pond outfall discharging across Millfield Lane into the Nature Reserve



PLAN SHOWING FLOW ROUTE ANALYSIS OF EXISTING SITE

PLAN SHOWING PROPOSED SUDS AND FLOW ROUTE ANALYSIS

KEY:

- Impermeable Driveway
- Impermeable structure
- Permeable Garden
- Pond
- Surface flow path via pond
- Surface flow path (direct)
- Surface water pipe
- Connection to combined sewer
- Green roof
- Permeable Paving
- Swale

Schedule of approximate areas used for SuDS assessment

Area Description		Permeable	EXISTING	PROPOSED	Volumetric Run-Off Coefficient (C_V) (excl. Routing Coefficient C_R = 1.3)		Remarks
Existing buildings		N	392 m²		0.77		
Existing patios		N	65 m²		0.77		
Tennis Court		N	542 m²		0.7		
Plots 1-3	Green roofs	N		253 m²	0.40		
	Patios	Y		50 m²	0.62		
	Remainder	N		84 m²	0.77		
Plots 4-5	Green roofs	N		298 m²	0.40		
	Patios	Y		50 m²	0.62		
	Remainder	N		53 m²	0.77		
Driveway		N	93 m²	110 m²	0.77		
Footpaths		Y	542 m²		0.62		
Gardens / soft landscaping via pond		Y	743 m²	750 m²	0.3		
Gardens / soft landscaping (direct)		Y	2,598 m²	2,564 m²	0.3		
Swales		Y		60 m²	0.77		
Swales		Y		60 m²	0.77		
Pond		Y	642 m²	642 m²	0.77		
Total via Pond:			1,842 m²	1,890 m²	0.58	0.53	*Area Weighted C_V for Existing /Proposed*
Total (direct):			3,140 m²	3,075 m²	0.37	0.34	
TOTAL:			**5,075 m²**	**5,075 m²**	0.44	0.4	

3 Storage Calculations

Modelled rainfall data (from the Flood Estimation Handbook 2013 model) for the site has been obtained from the Centre for Ecology and Hydrology (CEH). This data suggests that during a 6 hour storm during a 1 in 100 storm event, 63mm of rainfall would be expected.

3.1 Calculation of Greenfield run-off from site

HR Wallingford's run-off rate estimation tool can be used in accordance with the IH124 method to quantify the greenfield run-off from the site characteristics for a range of return periods. The standard average rainfall for the site of 659mm and a standard percentage run-off of 0.47 were used in the calculation.

$$Q_{bar}(m^3/s) = 0.00108(0.01 \times AREA)^{0.89} \times SAAR^{1.17} \times SPR^{2.17}$$

Qbar - mean annual flood flow from a rural catchment (approximately 2.3 year return period).

AREA- area of the catchment in ha.

SAAR - standard average annual rainfall for the period 1941 to 1970 in mm (SAAR 41-70).

SPR - Standard Percentage run-off coefficient for the SOIL category.

Run-off for the site area (5075 sqm)		
Return Period	Greenfield run-off rate (l/s)	Run-off volume in 6 hour storm event (m^3)
1 in 1 year	1.94	42
1 in 30 year	5.48	118
1 in 100 year	7.28	157

3.2 SUDS Considerations

The first consideration for SUDS will be the use of above-ground collection and storage opportunities including green roofs and rainwater harvesting techniques to reduce disposal needs.

There is clearly scope for some infiltration in those areas of the site underlain by made ground and superficial deposits, but given the variable nature of these infiltration, while permitted will not be relied upon in the calculations. Thus, while infiltration will be encouraged through the use of permeable paving and swales, attenuation storage volumes are to be calculated on the basis of zero infiltration.

3.3 Drainage Proposals

The surface drainage strategy comprises direction of surface water from Plots 1,2 and 3 towards the pond A dry open vegetated swale is to be provided at the bottom of the gardens to these plots and this will overspill to the pond in storm conditions.

Any water not infiltrating either directly or through the pond base, will exit the pond via the sluice and will be directed to a porous stone filled wet vegetated linear swale running beside Millfield Lane constructed at the topographic low of the site on the southwest boundary. This swale will also be fed by two performed pipe runs leading from the patio areas to Plots 4 and 5.

Subject to the further advice from the Corporation of London, the outlet(s) from this swale system will be variously designed to achieve one of the following outcomes:

- to minimise the surface water discharge across Millfield Lane
- to maintain the existing rate of discharge across Millfield Lane
- to increase the rate of discharge across Millfield Lane

Drainage from the proposed new parking areas will directed via a system of interceptors to the combined sewer beneath Fitzroy Park.

3.4 Attenuation Storage

Calculations have been undertaken to quantify the volume of attenuation storage required for a variety of storm events and durations.

It can be seen that, ignoring the benefit of any infiltration, a storage volume of approximately 150 m^2 is required.

This storage could be partly provided by rainwater harvesting and infiltration, blue roofs or below-ground tanks but for present purposes it has been shown that it could be satisfactorily achieved through a combination of green roofs, porous sub-bases and an open swale. The proposed linear wetland swale beside Millfield Lane has been ignored as it is expected to be generally saturated.

4 Conclusion

This addendum surface water drainage statement provides further demonstration that the sustainability requirements of Camden with regards to SuDS will be met for this development, providing both resilience to anticipated climate change whilst ensuring the reliability of the natural water supply to the Highgate Ponds.

Appendix

Camden Drainage Pro-Forma

Outline SuDS Calculations

Surface Water Drainage Pro-forma for new developments

LBH 4529

1. Site Details

Site	55 FITZROY PARK
Address & post code or LPA reference	N6 6JA
Grid reference	527780, 186940
Is the existing site developed or Greenfield?	Developed
Is the development in a LFRZ or in an area known to be at risk of surface or ground water flooding? If yes, please demonstrate how this is managed, in line with DP23?	No
Total Site Area served by drainage system (excluding open space) (Ha)*	0.51

* The Greenfield runoff off rate from the development which is to be used for assessing the requirements for limiting discharge flow rates and attenuation storage from a site should be calculated for the area that forms the drainage network for the site whatever size of site and type of drainage technique. Please refer to the Rainfall Runoff Management document or CIRIA manual for detail on this.

2. Impermeable Area

	Existing	Proposed	Difference (Proposed-Existing)	Notes for developers
Impermeable area (ha)	0.11	0.08	-0.03	If the proposed amount of impermeable surface is greater, then runoff rates and volumes will increase. Section 6 must be filled in. If proposed impermeability is equal or less than existing, then section 6 can be skipped and section 7 filled in.
Drainage Method (infiltration/sewer/watercourse)	Infiltration /watercourse /sewer	Infiltration /watercourse /sewer	N/A	If different from the existing, please fill in section 3. If existing drainage is by infiltration and the proposed is not, discharge volumes may increase. Fill in section 6.

3. Proposing to Discharge Surface Water via

	Yes	No	Evidence that this is possible	Notes for developers
Existing and proposed Drainage calculations	Yes		HR Wallingford	Please provide Drainage calculations of existing and proposed run-off rates and volumes in accordance with a recognised methodology or the results of a full infiltration test (see line below) if infiltration is proposed.
Infiltration	Yes		Infiltration will be permitted but not relied upon .	e.g. soakage tests. Section 6 (infiltration) must be filled in if infiltration is proposed.
To watercourse	Yes		There is a pond system	e.g. Is there a watercourse nearby?
To surface water sewer		No	There is no nearby surface water sewer but there is a combined sewer	Confirmation from sewer provider that sufficient capacity exists for this connection.
Combination of above	Yes		See above.	e.g. part infiltration part discharge to sewer or watercourse. Provide evidence above.
Has the drainage proposal had regard to the SuDS hierarchy?	Yes		see report.	Evidence must be provided to demonstrate that the proposed Sustainable Drainage strategy has had regard to the SuDS hierarchy as outlined in Section 2.5 above.
Layout plan showing where the sustainable drainage infrastructure will be located on site.	Yes		See report	Please provide plan reference numbers showing the details of the site layout showing where the sustainable drainage infrastructure will be located on the site. If the development is to be constructed in phases this should be shown on a separate plan and confirmation should be provided that the sustainable drainage proposal for each phase can be constructed and can operate independently and is not reliant on any later phase of development.

4. Peak Discharge Rates – This is the maximum flow rate at which storm water runoff leaves the site during a particular storm event.

	Existing Rates (l/s) (from Wallingford online tool and Procedure)	Proposed Rates (l/s) (taken as 50% existing)	Difference (l/s) (Proposed - Existing)	% Difference (Difference / existing x 100)	Notes for developers
Greenfield QBAR	2.28	N/A	N/A	N/A	QBAR is approx. 1 in 2 storm event. Provide this if Section 6 (QBAR) is proposed.
1 in 1	45.60	22.8	22.80	-50%	Proposed discharge rates (with mitigation) should aim to be equivalent to greenfield rates for all corresponding storm events. As a minimum, peak discharge rates must be reduced by 50% from the existing sites for all corresponding rainfall events.
1 in 30	105.00	52.5	52.50	-50%	
1in 100	131.70	65.85	65.85	-50%	
1 in 100 plus climate change	N/A	65.85	N/A	N/A	The proposed 1 in 100 +CC peak discharge rate (with mitigation) should aim to be equivalent to greenfield rates. As a minimum, proposed 1 in 100 +CC peak discharge rate

5. Calculate additional volumes for storage – The total volume of water leaving the development site. New hard surfaces potentially restrict the amount of stormwater that can go to the ground, so this needs to be controlled so not to make flood risk worse to properties downstream.

	Greenfield runoff volume (m^3) (6 hours storm)	Existing Volume (m^3)	Proposed Volume (m^3)	Difference (m^3) (Proposed-Existing)	Notes for developers
1 in 1	42	63	57	-6	Proposed discharge volumes (with mitigation) should be constrained to a value as close as is reasonably practicable to the greenfield runoff volume wherever practicable and as a minimum should be no greater than existing volumes for all corresponding storm events. Any increase in volume increases flood risk elsewhere. Where volumes are increased section 6 must be filled in.
1 in 30	118	141	128	-13	
1 in 100 6 hour	157	183	166	-17	
1 in 100 6 hour plus climate change	N/A	N/A	233 Unmitigated 183 Mitigated	49.9 m3	The proposed 1 in 100 +CC discharge volume should be constrained to a value as close as is reasonably practicable to the greenfield runoff volume wherever practicable. As a minimum, to mitigate for climate change the proposed 1 in 100 +CC volume discharge from site must be no greater than the existing 1 in 100 storm event. If not, flood risk increases under climate change.

6. Calculate attenuation storage – Attenuation storage is provided to enable the rate of runoff from the site into the receiving watercourse to be limited to an acceptable rate to protect against erosion and flooding downstream. The attenuation storage volume is a function of the degree of development relative to the greenfield discharge rate.

		Notes for developers
Storage Attenuation volume (Flow rate control) required to meet greenfield run off rates (m_3)	183.8 m3	Volume of water to attenuate on site if discharging at a greenfield run off rate. Can't be used where discharge volumes are increasing
Storage Attenuation volume (Flow rate control) required to reduce rates by 50% (m_3)	141.5 m3	Volume of water to attenuate on site if discharging at a 50% reduction from existing rates. Can't be used where discharge volumes are increasing
Storage Attenuation volume (Flow rate control) required to meet [OTHER RUN OFF RATE (as close to greenfield rate as possible)] (m_3) . 3 x Greenfield	85.2 m3	Volume of water to attenuate on site if discharging at a rate different from the above – please state in 1st column what rate this volume corresponds to. On previously developed sites, runoff rates should not be more than three times the calculated greenfield rate. Can't be used where discharge volumes are increasing
Storage Attenuation volume (Flow rate control) required to retain rates as existing (m_3)	49.9 m3	Volume of water to attenuate on site if discharging at existing rates. Can't be used where discharge volumes are increasing
Percentage of attenuation volume stored above ground,	78%	Percentage of attenuation volume which will be held above ground in swales/ponds/basins/green roofs etc. If 0, please demonstrate why.

7. How is Storm Water stored on site?

Storage is required for the additional volume from site but also for holding back water to slow down the rate from the site. This is known as attenuation storage and long term storage. The idea is that the additional volume does not get into the watercourses, or if it does it is at an exceptionally low rate. You can either infiltrate the stored water back to ground, or if this isn't possible hold it back with on site storage. Firstly, can infiltration work on site?

			Notes for developers
Infiltration	**State the Site's Geology and known Source Protection Zones (SPZ)**	**Made Ground over London Clay (nil SPZ)**	Avoid infiltrating in made ground. Infiltration rates are highly variable and refer to Environment Agency website to identify and source protection zones (SPZ)
	Are infiltration rates suitable?	**1x10-6 m/s**	Infiltration rates should be no lower than 1x10 -6 m/s.
	State the distance between a proposed infiltration device base and the ground water (GW) level	**Varies**	Need 1m (min) between the base of the infiltration device & the water table to protect Groundwater quality & ensure GW doesn't enter infiltration devices. Avoid infiltration where this isn't possible.
	Were infiltration rates obtained by desk study or infiltration test?	**Desk Study & SI Assessment**	Infiltration rates can be estimated from desk studies at most stages of the planning system if a back up attenuation scheme is provided..
	Is the site contaminated? If yes, consider advice from others on whether infiltration can happen.	**NO**	Advice on contaminated Land in Camden can be found on our supporting documents webpage Water should not be infiltrated through land that is contaminated. The Environment Agency may provide bespoke advice in planning consultations for contaminated sites that should be considered.
In light of the above, is infiltration feasible?	**Yes/No? If the answer is No, please identify how the storm water will be stored prior to release**	**Yes but not to be relied upon. Ie. Attenuatuion storage is calcuated without infiltration**	If infiltration is not feasible how will the additional volume be stored?. The applicant should then consider the following options in the next section.

Storage requirements

The developer must confirm that either of the two methods for dealing with the amount of water that needs to be stored on site.

Option 1 Simple – Store both the additional volume and attenuation volume in order to make a final discharge from site at the greenfield run off rate. This is preferred if no infiltration can be made on site. This very simply satisfies the runoff rates and volume criteria.

Option 2 Complex – If some of the additional volume of water can be infiltrated back into the ground, the remainder can be discharged at a very low rate of 2 l/sec/hectare.
A combined storage calculation using the partial permissible rate of 2 l/sec/hectare and the attenuation rate used to slow the runoff from site.

		Notes for developers
Please confirm what option has been chosen and how much storage is required on site.	Complex	The developer at this stage should have an idea of the site characteristics and be able to explain what the storage requirements are on site and how it will be achieved.

8. Please confirm

		Notes for developers
Which Drainage Systems measures have been used, including green roofs?	152 m3 STORAGE comprising 83 m3 Green Roofs, 36 m3 Swale and 33m3 below ground porous sub-base (or tanks)	SUDS can be adapted for most situations even where infiltration isn't feasible e.g. impermeable liners beneath some SUDS devices allows treatment but not infiltration. See CIRIA SUDS Manual C697.
Drainage system can contain in the 1 in 30 storm event without flooding	YES	This a requirement for sewers for adoption & is good practice even where drainage system is not adopted.
Will the drainage system contain the 1 in 100 +CC storm event? If no please demonstrate how buildings and utility plants will be protected.	NO - see FRA the buildings are protected	National standards require that the drainage system is designed so that flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.
Any flooding between the 1 in 30 & 1 in 100 plus climate change storm events will be safely contained on site.	YES - see FRA there is an exceedance route over the pond sluice	**Safely:** not causing property flooding or posing a hazard to site users i.e. no deeper than 300mm on roads/footpaths. Flood waters must drain away at section 6 rates. Existing rates can be used where runoff volumes are not increased.

How will exceedance events be catered on site without increasing flood risks (both on site and outside the development)?	**YES - see FRA there is an exceedance route over the pond sluice**	**Safely:** not causing property flooding or posing a hazard to site users i.e. no deeper than 300mm on roads/footpaths. Flood waters must drain away at section 6 rates. Existing rates can be used where runoff volumes are not increased. Exceedance events are defined as those larger than the 1 in 100 +CC event.
How are rates being restricted (vortex control, orifice etc)	**Orifice**	Detail of how the flow control systems have been designed to avoid pipe blockages and ease of maintenance should be provided.
Please confirm the owners/adopters of the entire drainage systems throughout the development. Please list all the owners.	**TBA**	If these are multiple owners then a drawing illustrating exactly what features will be within each owner's remit must be submitted with this Proforma.
How is the entire drainage system to be maintained?	**TBA**	If the features are to be maintained directly by the owners as stated in answer to the above question please answer yes to this question and submit the relevant maintenance schedule for each feature. If it is to be maintained by others than above please give details of each feature and the maintenance schedule. Clear details of the maintenance proposals of all elements of the proposed drainage system must be provided. Details must demonstrate that maintenance and operation requirements are economically proportionate. Poorly maintained drainage can lead to increased flooding problems in the future.

9. Evidence Please identify where the details quoted in the sections above were taken from. i.e. Plans, reports etc. Please also provide relevant drawings that need to accompany your proforma, in particular exceedance routes and ownership and location of SuDS (maintenance access strips etc

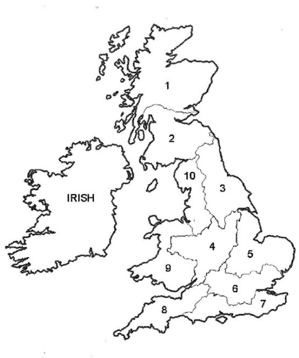
Pro-forma Section	Document reference where details quoted above are taken from	Page Number
Section 2	Suds report	9
Section 3	Suds report	8
Section 4	Calculation Sheets	var
Section 5	Calculation Sheets	var
Section 6	Calculation Sheets	var
Section 7	Suds report	var
Section 8	Suds report	var

The above form should be completed using evidence from the Flood Risk Assessment and site plans. It should serve as a summary sheet of thedrainage proposals and should clearly show that the proposed rate and volume as a result of development will not be increasing. If there is an increase in rate or volume, the rate or volume section should be completed to set out how the additional rate/volume is being dealt with.drainage proposals and should clearly show that the proposed rate and volume as a result of development will not be increasing. If there is an increase in rate or volume, the rate or volume section should be completed to set out how the additional rate/volume is being dealt with.

This form is completed using factual information from the Flood Risk Assessment and Site Plans and can be used as a summary of the surface water drainage strategy on this site.

VERSION	DATE	COMMENT	AUTHORISED
1.0	12th Dec 2018	Initial Issue	**Seamus Lefroy-Brooks** **BSc(hons) MSc CEng MICE CGeol FGS CEnv MIEnvSc FRGS SiLC** **RoGEP UK Registered Ground Engineering Adviser NQMS SQP DoWCoP QP**

GREENFIELD RUN-OFF



Catchment Area: 5075sqm 0.508ha

PO Code : SW4 0NH

Hydrological Region: 6 *From Wallingford on-line tool*

SAAR: 659mm *From Wallingford on-line tool*

SOIL type: 4 *From Wallingford on-line tool*

SPR: 0.47 *Derived as follows:*

SOIL	Sand	Clayey Sand	Sandy Clay	Clay	Rock
	1	2	3	4	5
SPR	0.1	0.3	0.37	0.47	0.53

From Wallingford on-line tool using Area = 50ha and IH 124 Method

Qbar: 224.93 *Calculated from SPR and SAAR*

Greenfield Peak Run-off Rate:		*Growth curve Factor*
1 in 1	*191.2 l/sec*	*0.85*
1 in 30	*517.4 l/sec*	*2.30*
1 in 100	*717.5 l/sec*	*3.19*
1 in 200	*841.3 l/sec*	*3.74*

Extrapolated for catchment area

Qbar:	**2.28 l/sec**
Greenfield Peak Run-off Rate:	
1 in 1	**1.94 l/sec**
1 in 30	**5.25 l/sec**
1 in 100	**7.28 l/sec**
1 in 200	**8.54 l/sec**

National Non-Statutory Guidance:
For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.

For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.

Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.

SuDs CALCULATIONS			
Project:	55 FITZROY PARK		
GREENFIELD RUN-OFF			
Sheet 1 of 9			
Project Reference:	LBH 4480		
Date:	12/12/2018	Rev:	A
Client:	The Turner Stokes Family & the Springer Family		

LBH WEMBLEY ENGINEERING

RAINFALL PEAK INTENSITY (i)

M5-60 : 20 *From Wallingford Fig A1*
r: 0.42 *From Wallingford Fig A2*

D Duration		Z1	M5-D
5min	5min	0.38	7.6mm
10min	10min	0.55	11.0mm
15min	15min	0.65	13.0mm
30min	30min	0.75	15.0mm
1hr	60min	1.00	20.0mm
2hr	120min	1.20	24.0mm
4hr	240min	1.40	28.0mm
6hr	360min	1.60	32.0mm
10hr	600min	1.70	34.0mm
24hr	1440min	2.20	44.0mm
48hr	2880min	2.50	50.0mm

			Z2								
D Duration		**M5-D**	**M1-D**	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	7.6mm	0.62	0.79	0.89	0.97	1.02	1.19	1.36	1.43	1.79
10min	10min	11.0mm	0.61	0.79	0.90	0.97	1.03	1.22	1.41	1.49	1.91
15min	15min	13.0mm	0.61	0.79	0.90	0.97	1.03	1.22	1.41	1.49	1.91
30min	30min	15.0mm	0.62	0.81	0.90	0.97	1.03	1.24	1.44	1.53	1.99
1hr	60min	20.0mm	0.64	0.81	0.90	0.97	1.03	1.24	1.45	1.54	2.03
2hr	120min	24.0mm	0.64	0.81	0.90	0.97	1.03	1.24	1.45	1.54	2.03
4hr	240min	28.0mm	0.66	0.82	0.91	0.97	1.03	1.24	1.44	1.53	2.01
6hr	360min	32.0mm	0.68	0.83	0.91	0.97	1.03	1.22	1.42	1.51	1.97
10hr	600min	34.0mm	0.68	0.83	0.91	0.97	1.03	1.22	1.42	1.51	1.97
24hr	1440min	44.0mm	0.70	0.84	0.92	0.97	1.02	1.19	1.38	1.47	1.89
48hr	2880min	50.0mm	0.72	0.85	0.93	0.98	1.02	1.17	1.34	1.42	1.81

			MT-D								
D Duration		**M5-D**	**M1-D**	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	7.6mm	4.7mm	6.0mm	6.8mm	7.4mm	7.8mm	9.0mm	10.3mm	10.8mm	13.6mm
10min	10min	11.0mm	6.7mm	8.7mm	9.9mm	10.7mm	11.3mm	13.4mm	15.5mm	16.4mm	21.0mm
15min	15min	13.0mm	7.9mm	10.3mm	11.7mm	12.6mm	13.4mm	15.9mm	18.3mm	19.4mm	24.8mm
30min	30min	15.0mm	9.3mm	12.2mm	13.5mm	14.6mm	15.5mm	18.6mm	21.6mm	22.9mm	29.9mm
1hr	60min	20.0mm	12.8mm	16.2mm	18.0mm	19.4mm	20.6mm	24.8mm	29.0mm	30.9mm	40.6mm
2hr	120min	24.0mm	15.4mm	19.4mm	21.6mm	23.3mm	24.7mm	29.8mm	34.8mm	37.0mm	48.7mm
4hr	240min	28.0mm	18.5mm	23.0mm	25.5mm	27.2mm	28.8mm	34.7mm	40.3mm	42.9mm	56.3mm
6hr	360min	32.0mm	21.8mm	26.6mm	29.1mm	31.0mm	33.0mm	39.0mm	45.4mm	48.4mm	63.0mm
10hr	600min	34.0mm	23.1mm	28.2mm	30.9mm	33.0mm	35.0mm	41.5mm	48.3mm	51.5mm	67.0mm
24hr	1440min	44.0mm	30.8mm	37.0mm	40.5mm	42.7mm	44.9mm	52.4mm	60.7mm	64.5mm	83.2mm
48hr	2880min	50.0mm	36.0mm	42.5mm	46.5mm	49.0mm	51.0mm	58.5mm	67.0mm	71.0mm	90.5mm

			Intensity i								
D Duration			**M1-D**	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	0.08hr	56.5mm/hr	72.0mm/hr	81.2mm/hr	88.5mm/hr	93.0mm/hr	108.5mm/hr	124.0mm/hr	130.1mm/hr	163.2mm/hr
10min	10min	0.17hr	40.3mm/hr	52.1mm/hr	59.4mm/hr	64.0mm/hr	68.0mm/hr	80.5mm/hr	93.1mm/hr	98.3mm/hr	126.1mm/hr
15min	15min	0.25hr	31.7mm/hr	41.1mm/hr	46.8mm/hr	50.4mm/hr	53.6mm/hr	63.4mm/hr	73.3mm/hr	77.5mm/hr	99.3mm/hr
30min	30min	0.50hr	18.6mm/hr	24.3mm/hr	27.0mm/hr	29.1mm/hr	30.9mm/hr	37.2mm/hr	43.2mm/hr	45.8mm/hr	59.7mm/hr
1hr	60min	1.00hr	12.8mm/hr	16.2mm/hr	18.0mm/hr	19.4mm/hr	20.6mm/hr	24.8mm/hr	29.0mm/hr	30.9mm/hr	40.6mm/hr
2hr	120min	2.00hr	7.7mm/hr	9.7mm/hr	10.8mm/hr	11.6mm/hr	12.4mm/hr	14.9mm/hr	17.4mm/hr	18.5mm/hr	24.4mm/hr
4hr	240min	4.00hr	4.6mm/hr	5.7mm/hr	6.4mm/hr	6.8mm/hr	7.2mm/hr	8.7mm/hr	10.1mm/hr	10.7mm/hr	14.1mm/hr
6hr	360min	6.00hr	3.6mm/hr	4.4mm/hr	4.9mm/hr	5.2mm/hr	5.5mm/hr	6.5mm/hr	7.6mm/hr	8.1mm/hr	10.5mm/hr
10hr	600min	10.00hr	2.3mm/hr	2.8mm/hr	3.1mm/hr	3.3mm/hr	3.5mm/hr	4.1mm/hr	4.8mm/hr	5.1mm/hr	6.7mm/hr
24hr	1440min	24.00hr	1.3mm/hr	1.5mm/hr	1.7mm/hr	1.8mm/hr	1.9mm/hr	2.2mm/hr	2.5mm/hr	2.7mm/hr	3.5mm/hr
48hr	2880min	48.00hr	0.6mm/hr	0.8mm/hr	0.8mm/hr	0.9mm/hr	0.9mm/hr	1.1mm/hr	1.3mm/hr	1.3mm/hr	1.7mm/hr
48hr	2880min	48.00hr	0.8mm/hr	0.9mm/hr	1.0mm/hr	1.0mm/hr	1.1mm/hr	1.2mm/hr	1.4mm/hr	1.5mm/hr	1.9mm/hr

SuDs CALCULATIONS

Project: 55 FITZROY PARK

RAINFALL PEAK INTENSITY

Project Reference: LBH 4480

Date: 12/12/2018 Rev: A

Client: The Turner Stokes Family & the Springer Family

LBH WEMBLEY ENGINEERING

GREENFIELD PEAK RUN-OFF

Hydrological Region: 6 *From Wallingford on-line tool* **Qbar: 2.28 l/sec**

D Duration			Run-Off Q								
			M1-D	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	0.08hr	1.94 l/sec	2.01 l/sec	2.31 l/sec	2.62 l/sec	2.92 l/sec	3.70 l/sec	4.49 l/sec	5.48 l/sec	7.28 l/sec
10min	10min	0.17hr	1.94 l/sec	2.01 l/sec	2.31 l/sec	2.62 l/sec	2.92 l/sec	3.70 l/sec	4.49 l/sec	5.48 l/sec	7.28 l/sec
15min	15min	0.25hr	1.94 l/sec	2.01 l/sec	2.31 l/sec	2.62 l/sec	2.92 l/sec	3.70 l/sec	4.49 l/sec	5.48 l/sec	7.28 l/sec
30min	30min	0.50hr	1.94 l/sec	2.01 l/sec	2.31 l/sec	2.62 l/sec	2.92 l/sec	3.70 l/sec	4.49 l/sec	5.48 l/sec	7.28 l/sec
1hr	60min	1.00hr	1.94 l/sec	2.01 l/sec	2.31 l/sec	2.62 l/sec	2.92 l/sec	3.70 l/sec	4.49 l/sec	5.48 l/sec	7.28 l/sec
2hr	120min	2.00hr	1.94 l/sec	2.01 l/sec	2.31 l/sec	2.62 l/sec	2.92 l/sec	3.70 l/sec	4.49 l/sec	5.48 l/sec	7.28 l/sec
4hr	240min	4.00hr	1.94 l/sec	2.01 l/sec	2.31 l/sec	2.62 l/sec	2.92 l/sec	3.70 l/sec	4.49 l/sec	5.48 l/sec	7.28 l/sec
6hr	360min	6.00hr	1.94 l/sec	2.01 l/sec	2.31 l/sec	2.62 l/sec	2.92 l/sec	3.70 l/sec	4.49 l/sec	5.48 l/sec	7.28 l/sec
10hr	600min	10.00hr	1.94 l/sec	2.01 l/sec	2.31 l/sec	2.62 l/sec	2.92 l/sec	3.70 l/sec	4.49 l/sec	5.48 l/sec	7.28 l/sec
24hr	1440min	24.00hr	1.94 l/sec	2.01 l/sec	2.31 l/sec	2.62 l/sec	2.92 l/sec	3.70 l/sec	4.49 l/sec	5.48 l/sec	7.28 l/sec
48hr	2880min	48.00hr	1.94 l/sec	2.01 l/sec	2.31 l/sec	2.62 l/sec	2.92 l/sec	3.70 l/sec	4.49 l/sec	5.48 l/sec	7.28 l/sec

D Duration			Run-Off Volume								
			M1-D	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	0.08hr	0.6 m3	0.6 m3	0.7 m3	0.8 m3	0.9 m3	1.1 m3	1.3 m3	1.6 m3	2.2 m3
10min	10min	0.17hr	1.2 m3	1.2 m3	1.4 m3	1.6 m3	1.8 m3	2.2 m3	2.7 m3	3.3 m3	4.4 m3
15min	15min	0.25hr	1.7 m3	1.8 m3	2.1 m3	2.4 m3	2.6 m3	3.3 m3	4.0 m3	4.9 m3	6.6 m3
30min	30min	0.50hr	3.5 m3	3.6 m3	4.2 m3	4.7 m3	5.3 m3	6.7 m3	8.1 m3	9.9 m3	13.1 m3
1hr	60min	1.00hr	7.0 m3	7.2 m3	8.3 m3	9.4 m3	10.5 m3	13.3 m3	16.2 m3	19.7 m3	26.2 m3
2hr	120min	2.00hr	14.0 m3	14.5 m3	16.7 m3	18.8 m3	21.0 m3	26.6 m3	32.3 m3	39.5 m3	52.4 m3
4hr	240min	4.00hr	27.9 m3	28.9 m3	33.3 m3	37.7 m3	42.1 m3	53.3 m3	64.7 m3	78.9 m3	104.9 m3
6hr	360min	6.00hr	41.9 m3	43.4 m3	50.0 m3	56.5 m3	63.1 m3	79.9 m3	97.0 m3	118.4 m3	157.3 m3
10hr	600min	10.00hr	69.9 m3	72.3 m3	83.3 m3	94.2 m3	105.2 m3	133.1 m3	161.6 m3	197.3 m3	262.2 m3
24hr	1440min	24.00hr	167.7 m3	173.6 m3	199.9 m3	226.2 m3	252.5 m3	319.6 m3	387.9 m3	473.4 m3	629.2 m3
48hr	2880min	48.00hr	335.3 m3	347.2 m3	399.8 m3	452.4 m3	505.0 m3	639.1 m3	775.9 m3	946.8 m3	1258.5 m3

SuDs CALCULATIONS

Project: 55 FITZROY PARK

GREENFIELD PEAK RUN-OFF

Project Reference: LBH 4480

Date: 12/12/2018 Rev: A

Client: The Turner Stokes Family & the Springer Family

LBH WEMBLEY ENGINEERING

EXISTING PEAK RUN-OFF

C_V: 0.44 *Volumetric Run-Off Coefficient*

C_R: 1.3 *Routing Coefficient*

			Run-Off Q								
D Duration			M1-D	M2-D	M3-D	M4-D	M5-D	M10-D	M20-D	M30-D	M100-D
5min	5min	0.08hr	45.6 l/sec	58.1 l/sec	65.5 l/sec	71.4 l/sec	75.1 l/sec	87.6 l/sec	100.1 l/sec	105.0 l/sec	131.7 l/sec
10min	10min	0.17hr	32.5 l/sec	42.1 l/sec	47.9 l/sec	51.7 l/sec	54.9 l/sec	65.0 l/sec	75.1 l/sec	79.4 l/sec	101.7 l/sec
15min	15min	0.25hr	25.6 l/sec	33.2 l/sec	37.8 l/sec	40.7 l/sec	43.2 l/sec	51.2 l/sec	59.2 l/sec	62.5 l/sec	80.2 l/sec
30min	30min	0.50hr	15.0 l/sec	19.6 l/sec	21.8 l/sec	23.5 l/sec	24.9 l/sec	30.0 l/sec	34.9 l/sec	37.0 l/sec	48.2 l/sec
1hr	60min	1.00hr	10.3 l/sec	13.1 l/sec	14.5 l/sec	15.7 l/sec	16.6 l/sec	20.0 l/sec	23.4 l/sec	24.9 l/sec	32.8 l/sec
2hr	120min	2.00hr	6.2 l/sec	7.8 l/sec	8.7 l/sec	9.4 l/sec	10.0 l/sec	12.0 l/sec	14.0 l/sec	14.9 l/sec	19.7 l/sec
4hr	240min	4.00hr	3.7 l/sec	4.6 l/sec	5.1 l/sec	5.5 l/sec	5.8 l/sec	7.0 l/sec	8.1 l/sec	8.7 l/sec	11.4 l/sec
6hr	360min	6.00hr	2.9 l/sec	3.6 l/sec	3.9 l/sec	4.2 l/sec	4.4 l/sec	5.3 l/sec	6.1 l/sec	6.5 l/sec	8.5 l/sec
10hr	600min	10.00hr	1.9 l/sec	2.3 l/sec	2.5 l/sec	2.7 l/sec	2.8 l/sec	3.3 l/sec	3.9 l/sec	4.2 l/sec	5.4 l/sec
24hr	1440min	24.00hr	1.0 l/sec	1.2 l/sec	1.4 l/sec	1.4 l/sec	1.5 l/sec	1.8 l/sec	2.0 l/sec	2.2 l/sec	2.8 l/sec
48hr	2880min	48.00hr	0.6 l/sec	0.7 l/sec	0.8 l/sec	0.8 l/sec	0.9 l/sec	1.0 l/sec	1.1 l/sec	1.2 l/sec	1.5 l/sec

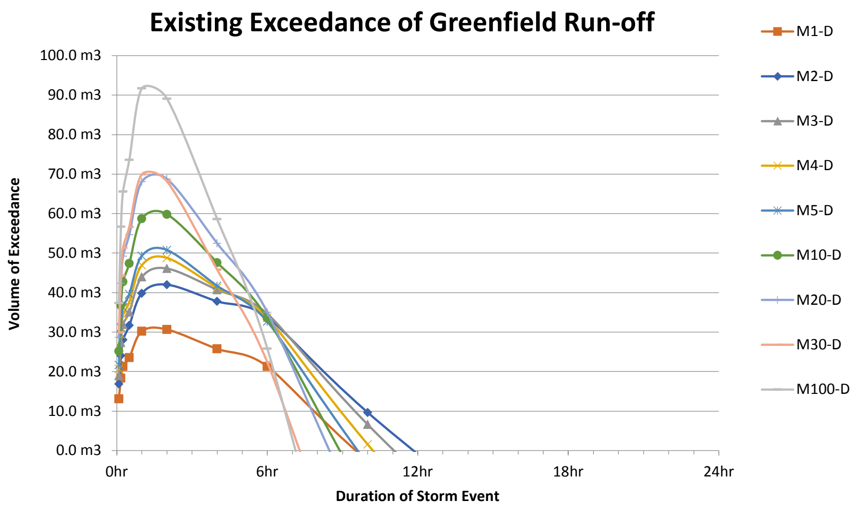
			Run-Off Volume								
D Duration			M1-D	M2-D	M3-D	M4-D	M5-D	M10-D	M20-D	M30-D	M100-D
5min	5min	0.08hr	13.7 m3	17.4 m3	19.7 m3	21.4 m3	22.5 m3	26.3 m3	30.0 m3	31.5 m3	39.5 m3
10min	10min	0.17hr	19.5 m3	25.2 m3	28.8 m3	31.0 m3	32.9 m3	39.0 m3	45.1 m3	47.6 m3	61.0 m3
15min	15min	0.25hr	23.0 m3	29.8 m3	34.0 m3	36.6 m3	38.9 m3	46.1 m3	53.3 m3	56.3 m3	72.1 m3
30min	30min	0.50hr	27.0 m3	35.3 m3	39.2 m3	42.3 m3	44.9 m3	54.0 m3	62.8 m3	66.5 m3	86.7 m3
1hr	60min	1.00hr	37.2 m3	47.1 m3	52.3 m3	56.4 m3	59.8 m3	72.0 m3	84.3 m3	89.7 m3	118.0 m3
2hr	120min	2.00hr	44.6 m3	56.5 m3	62.8 m3	67.6 m3	71.8 m3	86.5 m3	101.1 m3	107.6 m3	141.5 m3
4hr	240min	4.00hr	53.7 m3	66.7 m3	74.0 m3	78.9 m3	83.8 m3	100.9 m3	117.1 m3	124.7 m3	163.5 m3
6hr	360min	6.00hr	63.2 m3	77.2 m3	84.6 m3	90.2 m3	95.8 m3	113.4 m3	132.0 m3	140.7 m3	183.1 m3
10hr	600min	10.00hr	67.2 m3	82.0 m3	89.9 m3	95.8 m3	101.7 m3	120.5 m3	140.3 m3	149.5 m3	194.6 m3
24hr	1440min	24.00hr	89.5 m3	107.4 m3	117.6 m3	124.0 m3	130.4 m3	152.1 m3	176.4 m3	187.5 m3	241.6 m3
48hr	2880min	48.00hr	104.6 m3	123.5 m3	135.1 m3	142.4 m3	148.2 m3	170.0 m3	194.6 m3	206.3 m3	262.9 m3

			Exceedance of Greenfield Run-Off Volume								
D Duration			M1-D	M2-D	M3-D	M4-D	M5-D	M10-D	M20-D	M30-D	M100-D
5min	5min	0.08hr	13.1 m3	16.8 m3	19.0 m3	20.6 m3	21.6 m3	25.2 m3	28.7 m3	29.9 m3	37.3 m3
10min	10min	0.17hr	18.3 m3	24.0 m3	27.4 m3	29.4 m3	31.2 m3	36.8 m3	42.4 m3	44.3 m3	56.7 m3
15min	15min	0.25hr	21.3 m3	28.0 m3	31.9 m3	34.3 m3	36.3 m3	42.7 m3	49.2 m3	51.3 m3	65.6 m3
30min	30min	0.50hr	23.5 m3	31.7 m3	35.1 m3	37.6 m3	39.6 m3	47.4 m3	54.7 m3	56.7 m3	73.6 m3
1hr	60min	1.00hr	30.2 m3	39.8 m3	44.0 m3	46.9 m3	49.3 m3	58.7 m3	68.1 m3	69.9 m3	91.7 m3
2hr	120min	2.00hr	30.7 m3	42.0 m3	46.1 m3	48.8 m3	50.8 m3	59.8 m3	68.8 m3	68.2 m3	89.1 m3
4hr	240min	4.00hr	25.7 m3	37.8 m3	40.7 m3	41.2 m3	41.7 m3	47.6 m3	52.5 m3	45.8 m3	58.6 m3
6hr	360min	6.00hr	21.3 m3	33.8 m3	34.6 m3	33.6 m3	32.6 m3	33.5 m3	35.0 m3	22.3 m3	25.8 m3
10hr	600min	10.00hr	-2.7 m3	9.7 m3	6.6 m3	1.6 m3	-3.5 m3	-12.6 m3	-21.4 m3	-47.8 m3	-67.6 m3
24hr	1440min	24.00hr	-78.2 m3	-66.2 m3	-82.3 m3	-102.2 m3	-122.1 m3	-167.4 m3	-211.5 m3	-285.9 m3	-387.6 m3
48hr	2880min	48.00hr	-230.7 m3	-223.7 m3	-264.7 m3	-310.0 m3	-356.8 m3	-469.1 m3	-581.2 m3	-740.6 m3	-995.6 m3

C_V:

Catchment Area: 5075sqm 0.44

0.44



SuDs CALCULATIONS	
Project:	55 FITZROY PARK
EXISTING PEAK RUN-OFF	
Sheet 4 of 9	
Project Reference:	LBH 4480
Date: 12/12/2018	Rev: A
Client:	The Turner Stokes Family & the Springer Family

LBH WEMBLEY ENGINEERING

POST- DEVELOPMENT PEAK RUN-OFF + CC

C_V: 0.44 *Volumetric Run-Off Coefficient* Climate Change Allowance: 40%

C_R: 1.3 *Routing Coefficient*

D Duration			Run-Off Q								
			M1-D	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	0.08hr	63.9 l/sec	81.4 l/sec	91.7 l/sec	99.9 l/sec	105.1 l/sec	122.6 l/sec	140.1 l/sec	147.0 l/sec	184.4 l/sec
10min	10min	0.17hr	45.5 l/sec	58.9 l/sec	67.1 l/sec	72.3 l/sec	76.8 l/sec	91.0 l/sec	105.1 l/sec	111.1 l/sec	142.4 l/sec
15min	15min	0.25hr	35.8 l/sec	46.4 l/sec	52.9 l/sec	57.0 l/sec	60.5 l/sec	71.7 l/sec	82.8 l/sec	87.5 l/sec	112.2 l/sec
30min	30min	0.50hr	21.0 l/sec	27.5 l/sec	30.5 l/sec	32.9 l/sec	34.9 l/sec	42.0 l/sec	48.8 l/sec	51.7 l/sec	67.4 l/sec
1hr	60min	1.00hr	14.5 l/sec	18.3 l/sec	20.3 l/sec	21.9 l/sec	23.3 l/sec	28.0 l/sec	32.8 l/sec	34.9 l/sec	45.9 l/sec
2hr	120min	2.00hr	8.7 l/sec	11.0 l/sec	12.2 l/sec	13.2 l/sec	14.0 l/sec	16.8 l/sec	19.7 l/sec	20.9 l/sec	27.5 l/sec
4hr	240min	4.00hr	5.2 l/sec	6.5 l/sec	7.2 l/sec	7.7 l/sec	8.1 l/sec	9.8 l/sec	11.4 l/sec	12.1 l/sec	15.9 l/sec
6hr	360min	6.00hr	4.1 l/sec	5.0 l/sec	5.5 l/sec	5.8 l/sec	6.2 l/sec	7.4 l/sec	8.6 l/sec	9.1 l/sec	11.9 l/sec
10hr	600min	10.00hr	2.6 l/sec	3.2 l/sec	3.5 l/sec	3.7 l/sec	4.0 l/sec	4.7 l/sec	5.5 l/sec	5.8 l/sec	7.6 l/sec
24hr	1440min	24.00hr	1.4 l/sec	1.7 l/sec	1.9 l/sec	2.0 l/sec	2.1 l/sec	2.5 l/sec	2.9 l/sec	3.0 l/sec	3.9 l/sec
48hr	2880min	48.00hr	0.8 l/sec	1.0 l/sec	1.1 l/sec	1.2 l/sec	1.2 l/sec	1.4 l/sec	1.6 l/sec	1.7 l/sec	2.1 l/sec

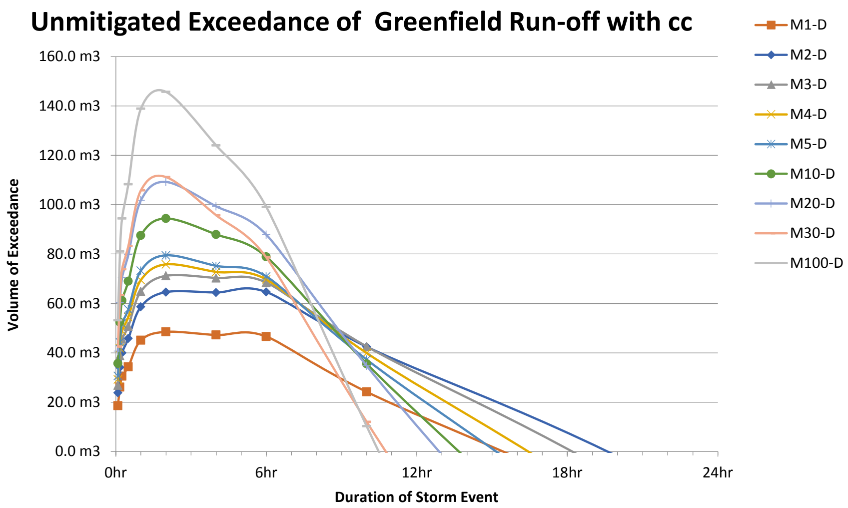
D Duration			Run-Off Volume								
			M1-D	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	0.08hr	19.2 m3	24.4 m3	27.5 m3	30.0 m3	31.5 m3	36.8 m3	42.0 m3	44.1 m3	55.3 m3
10min	10min	0.17hr	27.3 m3	35.3 m3	40.3 m3	43.4 m3	46.1 m3	54.6 m3	63.1 m3	66.7 m3	85.5 m3
15min	15min	0.25hr	32.3 m3	41.8 m3	47.6 m3	51.3 m3	54.5 m3	64.5 m3	74.6 m3	78.8 m3	101.0 m3
30min	30min	0.50hr	37.8 m3	49.4 m3	54.9 m3	59.2 m3	62.8 m3	75.7 m3	87.9 m3	93.1 m3	121.4 m3
1hr	60min	1.00hr	52.1 m3	65.9 m3	73.2 m3	78.9 m3	83.8 m3	100.9 m3	118.0 m3	125.5 m3	165.1 m3
2hr	120min	2.00hr	62.5 m3	79.1 m3	87.9 m3	94.7 m3	100.5 m3	121.0 m3	141.5 m3	150.7 m3	198.2 m3
4hr	240min	4.00hr	75.2 m3	93.4 m3	103.6 m3	110.5 m3	117.3 m3	141.2 m3	164.0 m3	174.6 m3	228.9 m3
6hr	360min	6.00hr	88.5 m3	108.0 m3	118.4 m3	126.2 m3	134.1 m3	158.8 m3	184.8 m3	197.0 m3	256.4 m3
10hr	600min	10.00hr	94.0 m3	114.8 m3	125.8 m3	134.1 m3	142.4 m3	168.7 m3	196.4 m3	209.3 m3	272.4 m3
24hr	1440min	24.00hr	125.3 m3	150.3 m3	164.6 m3	173.6 m3	182.5 m3	213.0 m3	247.0 m3	262.5 m3	338.2 m3
48hr	2880min	48.00hr	146.4 m3	172.9 m3	189.1 m3	199.3 m3	207.4 m3	237.9 m3	272.5 m3	288.8 m3	368.1 m3

D Duration			Exceedance of Greenfield Run-Off Volume								
			M1-D	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	0.08hr	18.6 m3	23.8 m3	26.8 m3	29.2 m3	30.7 m3	35.7 m3	40.7 m3	42.5 m3	53.1 m3
10min	10min	0.17hr	26.1 m3	34.1 m3	38.9 m3	41.8 m3	44.3 m3	52.4 m3	60.4 m3	63.4 m3	81.1 m3
15min	15min	0.25hr	30.5 m3	40.0 m3	45.5 m3	48.9 m3	51.8 m3	61.2 m3	70.5 m3	73.9 m3	94.4 m3
30min	30min	0.50hr	34.3 m3	45.8 m3	50.7 m3	54.5 m3	57.6 m3	69.0 m3	79.8 m3	83.3 m3	108.3 m3
1hr	60min	1.00hr	45.1 m3	58.7 m3	64.9 m3	69.5 m3	73.3 m3	87.6 m3	101.8 m3	105.8 m3	138.9 m3
2hr	120min	2.00hr	48.5 m3	64.6 m3	71.2 m3	75.8 m3	79.5 m3	94.4 m3	109.2 m3	111.2 m3	145.7 m3
4hr	240min	4.00hr	47.2 m3	64.5 m3	70.3 m3	72.8 m3	75.2 m3	88.0 m3	99.3 m3	95.7 m3	124.0 m3
6hr	360min	6.00hr	46.6 m3	64.6 m3	68.5 m3	69.7 m3	70.9 m3	78.9 m3	87.8 m3	78.6 m3	99.1 m3
10hr	600min	10.00hr	24.2 m3	42.5 m3	42.6 m3	39.9 m3	37.2 m3	35.6 m3	34.7 m3	12.0 m3	10.2 m3
24hr	1440min	24.00hr	-42.4 m3	-23.3 m3	-35.2 m3	-52.6 m3	-69.9 m3	-106.6 m3	-141.0 m3	-210.9 m3	-291.0 m3
48hr	2880min	48.00hr	-188.9 m3	-174.3 m3	-210.6 m3	-253.1 m3	-297.5 m3	-401.2 m3	-503.4 m3	-658.0 m3	-890.4 m3

C_V:

Catchment Area: 5075sqm 0.44

0.44



SuDs CALCULATIONS

Project: 55 FITZROY PARK

POST-DEV. PEAK RUN-OFF

Sheet 5 of 9

Project Reference: LBH 4480

Date: 12/12/2018 Rev: A

Client: The Turner Stokes Family & the Springer Family

LBH WEMBLEY ENGINEERING

POST- DEVELOPMENT & SOURCE MITIGATION PEAK RUN-OFF + CC

C_V:	0.40	*Volumetric Run-Off Coefficient*	Climate Change Allowance: 40%
C_R:	1.3	*Routing Coefficient*	

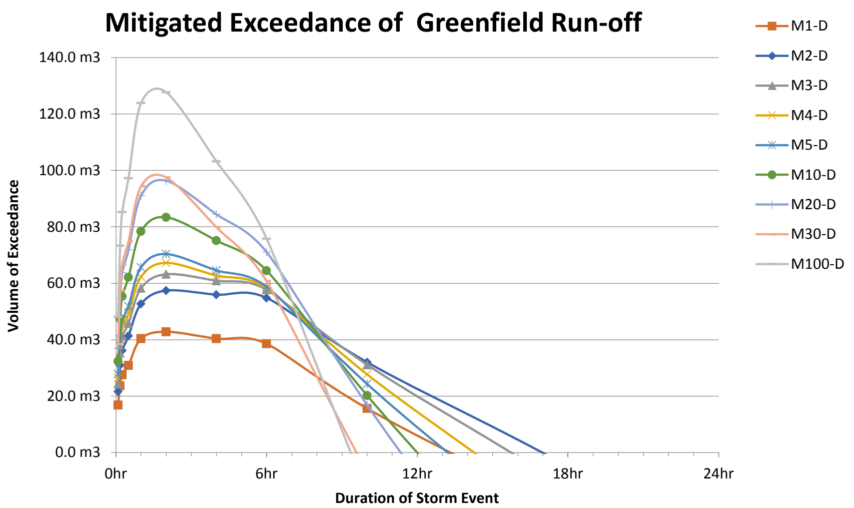
D Duration			Run-Off Q								
			M1-D	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	0.08hr	58.1 l/sec	74.0 l/sec	83.4 l/sec	90.9 l/sec	95.5 l/sec	111.5 l/sec	127.4 l/sec	133.6 l/sec	167.7 l/sec
10min	10min	0.17hr	41.4 l/sec	53.6 l/sec	61.0 l/sec	65.8 l/sec	69.8 l/sec	82.7 l/sec	95.6 l/sec	101.0 l/sec	129.5 l/sec
15min	15min	0.25hr	32.6 l/sec	42.2 l/sec	48.1 l/sec	51.8 l/sec	55.0 l/sec	65.2 l/sec	75.3 l/sec	79.6 l/sec	102.0 l/sec
30min	30min	0.50hr	19.1 l/sec	25.0 l/sec	27.7 l/sec	29.9 l/sec	31.7 l/sec	38.2 l/sec	44.4 l/sec	47.0 l/sec	61.3 l/sec
1hr	60min	1.00hr	13.1 l/sec	16.6 l/sec	18.5 l/sec	19.9 l/sec	21.2 l/sec	25.5 l/sec	29.8 l/sec	31.7 l/sec	41.7 l/sec
2hr	120min	2.00hr	7.9 l/sec	10.0 l/sec	11.1 l/sec	12.0 l/sec	12.7 l/sec	15.3 l/sec	17.9 l/sec	19.0 l/sec	25.0 l/sec
4hr	240min	4.00hr	4.7 l/sec	5.9 l/sec	6.5 l/sec	7.0 l/sec	7.4 l/sec	8.9 l/sec	10.4 l/sec	11.0 l/sec	14.5 l/sec
6hr	360min	6.00hr	3.7 l/sec	4.5 l/sec	5.0 l/sec	5.3 l/sec	5.6 l/sec	6.7 l/sec	7.8 l/sec	8.3 l/sec	10.8 l/sec
10hr	600min	10.00hr	2.4 l/sec	2.9 l/sec	3.2 l/sec	3.4 l/sec	3.6 l/sec	4.3 l/sec	5.0 l/sec	5.3 l/sec	6.9 l/sec
24hr	1440min	24.00hr	1.3 l/sec	1.6 l/sec	1.7 l/sec	1.8 l/sec	1.9 l/sec	2.2 l/sec	2.6 l/sec	2.8 l/sec	3.6 l/sec
48hr	2880min	48.00hr	0.8 l/sec	0.9 l/sec	1.0 l/sec	1.0 l/sec	1.1 l/sec	1.3 l/sec	1.4 l/sec	1.5 l/sec	1.9 l/sec

D Duration			Run-Off Volume								
			M1-D	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	0.08hr	17.4 m3	22.2 m3	25.0 m3	27.3 m3	28.7 m3	33.4 m3	38.2 m3	40.1 m3	50.3 m3
10min	10min	0.17hr	24.8 m3	32.1 m3	36.6 m3	39.5 m3	41.9 m3	49.6 m3	57.3 m3	60.6 m3	77.7 m3
15min	15min	0.25hr	29.3 m3	38.0 m3	43.3 m3	46.6 m3	49.5 m3	58.6 m3	67.8 m3	71.6 m3	91.8 m3
30min	30min	0.50hr	34.4 m3	44.9 m3	49.9 m3	53.8 m3	57.1 m3	68.8 m3	79.9 m3	84.7 m3	110.4 m3
1hr	60min	1.00hr	47.3 m3	59.9 m3	66.6 m3	71.7 m3	76.2 m3	91.7 m3	107.2 m3	114.1 m3	150.1 m3
2hr	120min	2.00hr	56.8 m3	71.9 m3	79.9 m3	86.1 m3	91.4 m3	110.0 m3	128.7 m3	137.0 m3	180.1 m3
4hr	240min	4.00hr	68.3 m3	84.9 m3	94.2 m3	100.4 m3	106.6 m3	128.4 m3	149.1 m3	158.7 m3	208.1 m3
6hr	360min	6.00hr	80.5 m3	98.2 m3	107.7 m3	114.8 m3	121.9 m3	144.4 m3	168.0 m3	179.1 m3	233.1 m3
10hr	600min	10.00hr	85.5 m3	104.3 m3	114.4 m3	121.9 m3	129.5 m3	153.4 m3	178.5 m3	190.3 m3	247.7 m3
24hr	1440min	24.00hr	113.9 m3	136.7 m3	149.7 m3	157.8 m3	165.9 m3	193.6 m3	224.5 m3	238.6 m3	307.5 m3
48hr	2880min	48.00hr	133.1 m3	157.1 m3	171.9 m3	181.2 m3	188.6 m3	216.3 m3	247.7 m3	262.5 m3	334.6 m3

D Duration			Exceedance of Greenfield Run-Off Volume								
			M1-D	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	0.08hr	16.8 m3	21.6 m3	24.3 m3	26.5 m3	27.8 m3	32.3 m3	36.9 m3	38.4 m3	48.1 m3
10min	10min	0.17hr	23.6 m3	30.9 m3	35.2 m3	37.9 m3	40.1 m3	47.4 m3	54.7 m3	57.3 m3	73.3 m3
15min	15min	0.25hr	27.6 m3	36.2 m3	41.2 m3	44.3 m3	46.9 m3	55.3 m3	63.7 m3	66.7 m3	85.3 m3
30min	30min	0.50hr	30.9 m3	41.3 m3	45.8 m3	49.1 m3	51.9 m3	62.1 m3	71.8 m3	74.8 m3	97.3 m3
1hr	60min	1.00hr	40.3 m3	52.7 m3	58.2 m3	62.3 m3	65.6 m3	78.4 m3	91.1 m3	94.4 m3	123.9 m3
2hr	120min	2.00hr	42.8 m3	57.4 m3	63.2 m3	67.2 m3	70.4 m3	83.4 m3	96.3 m3	97.5 m3	127.7 m3
4hr	240min	4.00hr	40.4 m3	56.0 m3	60.9 m3	62.7 m3	64.6 m3	75.1 m3	84.4 m3	79.8 m3	103.2 m3
6hr	360min	6.00hr	38.5 m3	54.8 m3	57.7 m3	58.2 m3	58.7 m3	64.5 m3	71.0 m3	60.7 m3	75.8 m3
10hr	600min	10.00hr	15.6 m3	32.0 m3	31.1 m3	27.7 m3	24.3 m3	20.2 m3	16.9 m3	-7.0 m3	-14.5 m3
24hr	1440min	24.00hr	-53.8 m3	-36.9 m3	-50.2 m3	-68.4 m3	-86.5 m3	-125.9 m3	-163.4 m3	-234.8 m3	-321.8 m3
48hr	2880min	48.00hr	-202.2 m3	-190.0 m3	-227.8 m3	-271.2 m3	-316.4 m3	-422.8 m3	-528.1 m3	-684.3 m3	-923.9 m3

		C_V:
Catchment Area:	5075sqm	0.40

0.40



SuDs CALCULATIONS	
Project:	55 FITZROY PARK
POST-DEV.-MIT. PEAK RUN-OFF	
Sheet 6 of 9	
Project Reference:	LBH 4480
Date: 12/12/2018	Rev: A
Client:	The Turner Stokes Family & the Springer Family

LBH WEMBLEY ENGINEERING

POST- DEVELOPMENT & SOURCE MITIGATION PEAK RUN-OFF + CC

C_V:	0.40	*Volumetric Run-Off Coefficient*	Climate Change Allowance:	40%	
C_R:	1.3	*Routing Coefficient*			

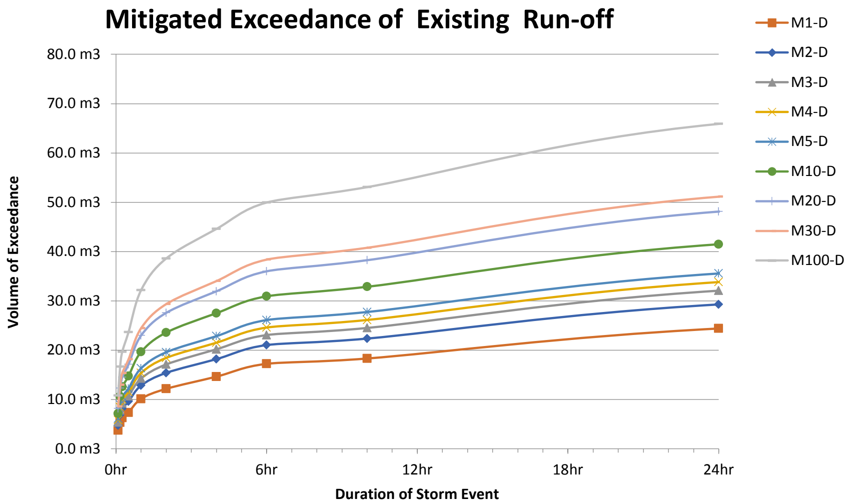
D Duration			Run-Off Q								
			M1-D	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	0.08hr	58.1 l/sec	74.0 l/sec	83.4 l/sec	90.9 l/sec	95.5 l/sec	111.5 l/sec	127.4 l/sec	133.6 l/sec	167.7 l/sec
10min	10min	0.17hr	41.4 l/sec	53.6 l/sec	61.0 l/sec	65.8 l/sec	69.8 l/sec	82.7 l/sec	95.6 l/sec	101.0 l/sec	129.5 l/sec
15min	15min	0.25hr	32.6 l/sec	42.2 l/sec	48.1 l/sec	51.8 l/sec	55.0 l/sec	65.2 l/sec	75.3 l/sec	79.6 l/sec	102.0 l/sec
30min	30min	0.50hr	19.1 l/sec	25.0 l/sec	27.7 l/sec	29.9 l/sec	31.7 l/sec	38.2 l/sec	44.4 l/sec	47.0 l/sec	61.3 l/sec
1hr	60min	1.00hr	13.1 l/sec	16.6 l/sec	18.5 l/sec	19.9 l/sec	21.2 l/sec	25.5 l/sec	29.8 l/sec	31.7 l/sec	41.7 l/sec
2hr	120min	2.00hr	7.9 l/sec	10.0 l/sec	11.1 l/sec	12.0 l/sec	12.7 l/sec	15.3 l/sec	17.9 l/sec	19.0 l/sec	25.0 l/sec
4hr	240min	4.00hr	4.7 l/sec	5.9 l/sec	6.5 l/sec	7.0 l/sec	7.4 l/sec	8.9 l/sec	10.4 l/sec	11.0 l/sec	14.5 l/sec
6hr	360min	6.00hr	3.7 l/sec	4.5 l/sec	5.0 l/sec	5.3 l/sec	5.6 l/sec	6.7 l/sec	7.8 l/sec	8.3 l/sec	10.8 l/sec
10hr	600min	10.00hr	2.4 l/sec	2.9 l/sec	3.2 l/sec	3.4 l/sec	3.6 l/sec	4.3 l/sec	5.0 l/sec	5.3 l/sec	6.9 l/sec
24hr	1440min	24.00hr	1.3 l/sec	1.6 l/sec	1.7 l/sec	1.8 l/sec	1.9 l/sec	2.2 l/sec	2.6 l/sec	2.8 l/sec	3.6 l/sec
48hr	2880min	48.00hr	0.8 l/sec	0.9 l/sec	1.0 l/sec	1.0 l/sec	1.1 l/sec	1.3 l/sec	1.4 l/sec	1.5 l/sec	1.9 l/sec

D Duration			Run-Off Volume								
			M1-D	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	0.08hr	17.4 m3	22.2 m3	25.0 m3	27.3 m3	28.7 m3	33.4 m3	38.2 m3	40.1 m3	50.3 m3
10min	10min	0.17hr	24.8 m3	32.1 m3	36.6 m3	39.5 m3	41.9 m3	49.6 m3	57.3 m3	60.6 m3	77.7 m3
15min	15min	0.25hr	29.3 m3	38.0 m3	43.3 m3	46.6 m3	49.5 m3	58.6 m3	67.8 m3	71.6 m3	91.8 m3
30min	30min	0.50hr	34.4 m3	44.9 m3	49.9 m3	53.8 m3	57.1 m3	68.8 m3	79.9 m3	84.7 m3	110.4 m3
1hr	60min	1.00hr	47.3 m3	59.9 m3	66.6 m3	71.7 m3	76.2 m3	91.7 m3	107.2 m3	114.1 m3	150.1 m3
2hr	120min	2.00hr	56.8 m3	71.9 m3	79.9 m3	86.1 m3	91.4 m3	110.0 m3	128.7 m3	137.0 m3	180.1 m3
4hr	240min	4.00hr	68.3 m3	84.9 m3	94.2 m3	100.4 m3	106.6 m3	128.4 m3	149.1 m3	158.7 m3	208.1 m3
6hr	360min	6.00hr	80.5 m3	98.2 m3	107.7 m3	114.8 m3	121.9 m3	144.4 m3	168.0 m3	179.1 m3	233.1 m3
10hr	600min	10.00hr	85.5 m3	104.3 m3	114.4 m3	121.9 m3	129.5 m3	153.4 m3	178.5 m3	190.3 m3	247.7 m3
24hr	1440min	24.00hr	113.9 m3	136.7 m3	149.7 m3	157.8 m3	165.9 m3	193.6 m3	224.5 m3	238.6 m3	307.5 m3
48hr	2880min	48.00hr	133.1 m3	157.1 m3	171.9 m3	181.2 m3	188.6 m3	216.3 m3	247.7 m3	262.5 m3	334.6 m3

D Duration			Exceedance of Existing Run-Off Volume								
			M1-D	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	0.08hr	3.7 m3	4.8 m3	5.4 m3	5.8 m3	6.1 m3	7.2 m3	8.2 m3	8.6 m3	10.8 m3
10min	10min	0.17hr	5.3 m3	6.9 m3	7.8 m3	8.5 m3	9.0 m3	10.6 m3	12.3 m3	13.0 m3	16.6 m3
15min	15min	0.25hr	6.3 m3	8.1 m3	9.3 m3	10.0 m3	10.6 m3	12.6 m3	14.5 m3	15.3 m3	19.7 m3
30min	30min	0.50hr	7.4 m3	9.6 m3	10.7 m3	11.5 m3	12.2 m3	14.7 m3	17.1 m3	18.1 m3	23.7 m3
1hr	60min	1.00hr	10.1 m3	12.8 m3	14.3 m3	15.4 m3	16.3 m3	19.6 m3	23.0 m3	24.5 m3	32.2 m3
2hr	120min	2.00hr	12.2 m3	15.4 m3	17.1 m3	18.4 m3	19.6 m3	23.6 m3	27.6 m3	29.3 m3	38.6 m3
4hr	240min	4.00hr	14.6 m3	18.2 m3	20.2 m3	21.5 m3	22.9 m3	27.5 m3	31.9 m3	34.0 m3	44.6 m3
6hr	360min	6.00hr	17.2 m3	21.0 m3	23.1 m3	24.6 m3	26.1 m3	30.9 m3	36.0 m3	38.4 m3	49.9 m3
10hr	600min	10.00hr	18.3 m3	22.4 m3	24.5 m3	26.1 m3	27.7 m3	32.9 m3	38.3 m3	40.8 m3	53.1 m3
24hr	1440min	24.00hr	24.4 m3	29.3 m3	32.1 m3	33.8 m3	35.6 m3	41.5 m3	48.1 m3	51.1 m3	65.9 m3
48hr	2880min	48.00hr	28.5 m3	33.7 m3	36.8 m3	38.8 m3	40.4 m3	46.4 m3	53.1 m3	56.3 m3	71.7 m3

		C_V:
Catchment Area:	5075sqm	0.40

0.40



SuDs CALCULATIONS	
Project:	55 FITZROY PARK
POST-DEV.-MIT. PEAK RUN-OFF	
Sheet 7 of 9	
Project Reference:	LBH 4480
Date: 12/12/2018	Rev: A
Client:	The Turner Stokes Family & the Springer Family

LBH WEMBLEY ENGINEERING

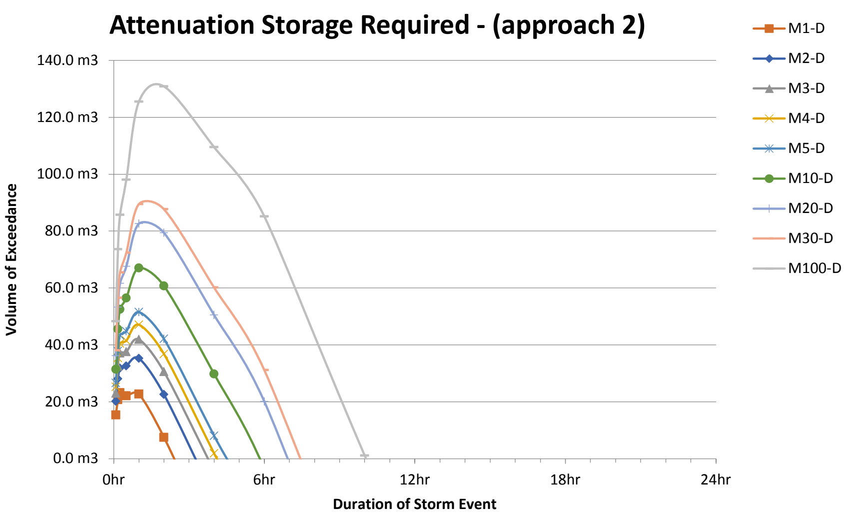
POST- DEVELOPMENT & SOURCE MITIGATION PEAK RUN-OFF + CC ATTENUATION STORAGE REQUIREMENTS

Proposed Discharge Rate: **6.85 l/sec** (approach 2, using 3 x QBar)
2.28 l/sec *QBar* 1.02 l/sec *(2.0 l/sec/ha)*

			INFLOW								
D Duration			**M1-D**	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	0.08hr	17.4 m3	22.2 m3	25.0 m3	27.3 m3	28.7 m3	33.4 m3	38.2 m3	40.1 m3	50.3 m3
10min	10min	0.17hr	24.8 m3	32.1 m3	36.6 m3	39.5 m3	41.9 m3	49.6 m3	57.3 m3	60.6 m3	77.7 m3
15min	15min	0.25hr	29.3 m3	38.0 m3	43.3 m3	46.6 m3	49.5 m3	58.6 m3	67.8 m3	71.6 m3	91.8 m3
30min	30min	0.50hr	34.4 m3	44.9 m3	49.9 m3	53.8 m3	57.1 m3	68.8 m3	79.9 m3	84.7 m3	110.4 m3
1hr	60min	1.00hr	47.3 m3	59.9 m3	66.6 m3	71.7 m3	76.2 m3	91.7 m3	107.2 m3	114.1 m3	150.1 m3
2hr	120min	2.00hr	56.8 m3	71.9 m3	79.9 m3	86.1 m3	91.4 m3	110.0 m3	128.7 m3	137.0 m3	180.1 m3
4hr	240min	4.00hr	68.3 m3	84.9 m3	94.2 m3	100.4 m3	106.6 m3	128.4 m3	149.1 m3	158.7 m3	208.1 m3
6hr	360min	6.00hr	80.5 m3	98.2 m3	107.7 m3	114.8 m3	121.9 m3	144.4 m3	168.0 m3	179.1 m3	233.1 m3
10hr	600min	10.00hr	85.5 m3	104.3 m3	114.4 m3	121.9 m3	129.5 m3	153.4 m3	178.5 m3	190.3 m3	247.7 m3
24hr	1440min	24.00hr	113.9 m3	136.7 m3	149.7 m3	157.8 m3	165.9 m3	193.6 m3	224.5 m3	238.6 m3	307.5 m3
48hr	2880min	48.00hr	133.1 m3	157.1 m3	171.9 m3	181.2 m3	188.6 m3	216.3 m3	247.7 m3	262.5 m3	334.6 m3

			OUTFLOW								
D Duration			**M1-D**	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	0.08hr	2.1 m3	2.1 m3	2.1 m3	2.1 m3	2.1 m3	2.1 m3	2.1 m3	2.1 m3	2.1 m3
10min	10min	0.17hr	4.1 m3	4.1 m3	4.1 m3	4.1 m3	4.1 m3	4.1 m3	4.1 m3	4.1 m3	4.1 m3
15min	15min	0.25hr	6.2 m3	6.2 m3	6.2 m3	6.2 m3	6.2 m3	6.2 m3	6.2 m3	6.2 m3	6.2 m3
30min	30min	0.50hr	12.3 m3	12.3 m3	12.3 m3	12.3 m3	12.3 m3	12.3 m3	12.3 m3	12.3 m3	12.3 m3
1hr	60min	1.00hr	24.7 m3	24.7 m3	24.7 m3	24.7 m3	24.7 m3	24.7 m3	24.7 m3	24.7 m3	24.7 m3
2hr	120min	2.00hr	49.3 m3	49.3 m3	49.3 m3	49.3 m3	49.3 m3	49.3 m3	49.3 m3	49.3 m3	49.3 m3
4hr	240min	4.00hr	98.6 m3	98.6 m3	98.6 m3	98.6 m3	98.6 m3	98.6 m3	98.6 m3	98.6 m3	98.6 m3
6hr	360min	6.00hr	147.9 m3	147.9 m3	147.9 m3	147.9 m3	147.9 m3	147.9 m3	147.9 m3	147.9 m3	147.9 m3
10hr	600min	10.00hr	246.6 m3	246.6 m3	246.6 m3	246.6 m3	246.6 m3	246.6 m3	246.6 m3	246.6 m3	246.6 m3
24hr	1440min	24.00hr	591.8 m3	591.8 m3	591.8 m3	591.8 m3	591.8 m3	591.8 m3	591.8 m3	591.8 m3	591.8 m3
48hr	2880min	48.00hr	1183.5 m3	1183.5 m3	1183.5 m3	1183.5 m3	1183.5 m3	1183.5 m3	1183.5 m3	1183.5 m3	1183.5 m3

			ATTENUATION STORAGE REQUIRED TO MEET PROPOSED DISCHARGE RATE								
D Duration			**M1-D**	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	0.08hr	15.4 m3	20.1 m3	23.0 m3	25.2 m3	26.6 m3	31.4 m3	36.2 m3	38.0 m3	48.2 m3
10min	10min	0.17hr	20.7 m3	28.0 m3	32.5 m3	35.3 m3	37.8 m3	45.5 m3	53.2 m3	56.5 m3	73.6 m3
15min	15min	0.25hr	23.2 m3	31.8 m3	37.1 m3	40.5 m3	43.3 m3	52.5 m3	61.6 m3	65.5 m3	85.6 m3
30min	30min	0.50hr	22.1 m3	32.6 m3	37.6 m3	41.5 m3	44.8 m3	56.4 m3	67.5 m3	72.3 m3	98.0 m3
1hr	60min	1.00hr	22.7 m3	35.2 m3	41.9 m3	47.1 m3	51.5 m3	67.0 m3	82.6 m3	89.5 m3	125.5 m3
2hr	120min	2.00hr	7.5 m3	22.6 m3	30.6 m3	36.8 m3	42.1 m3	60.7 m3	79.4 m3	87.6 m3	130.8 m3
4hr	240min	4.00hr	-30.3 m3	-13.7 m3	-4.4 m3	1.8 m3	8.0 m3	29.8 m3	50.5 m3	60.1 m3	109.5 m3
6hr	360min	6.00hr	-67.5 m3	-49.7 m3	-40.3 m3	-33.2 m3	-26.1 m3	-3.6 m3	20.1 m3	31.1 m3	85.2 m3
10hr	600min	10.00hr	-161.1 m3	-142.2 m3	-132.2 m3	-124.6 m3	-117.1 m3	-93.2 m3	-68.1 m3	-56.3 m3	1.1 m3
24hr	1440min	24.00hr	-477.9 m3	-455.1 m3	-442.1 m3	-434.0 m3	-425.8 m3	-398.2 m3	-367.2 m3	-353.1 m3	-284.3 m3
48hr	2880min	48.00hr	-1050.4 m3	-1026.4 m3	-1011.6 m3	-1002.3 m3	-995.0 m3	-967.2 m3	-935.8 m3	-921.0 m3	-848.9 m3



SuDs CALCULATIONS

Project: 55 FITZROY PARK

STORAGE REQUIREMENTS

Sheet 8 of 9

Project Reference: LBH 4480

Date: 12/12/2018 Rev: A

Client: The Turner Stokes Family & the Springer Family

LBH WEMBLEY ENGINEERING

POST- DEVELOPMENT & SOURCE MITIGATION PEAK RUN-OFF + CC ATTENUATION STORAGE REQUIREMENTS

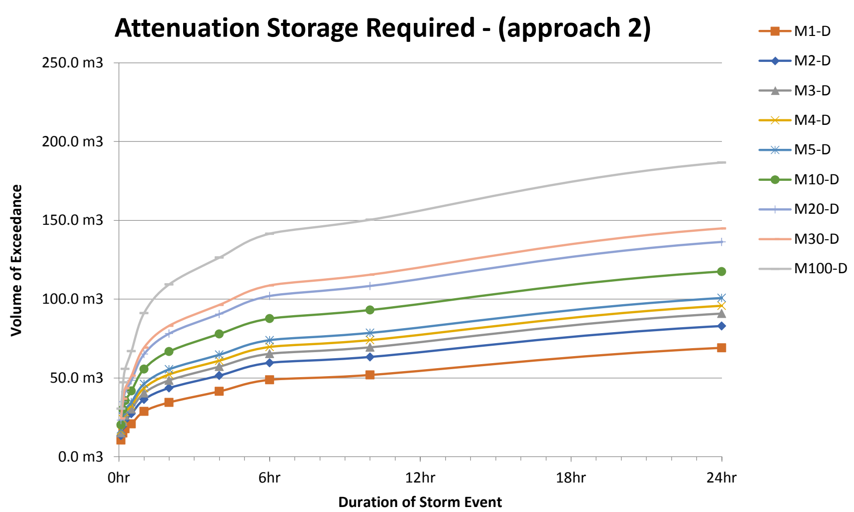
Proposed Discharge Rate: **Variable** (approach 2, using 50% existing)

2.28 l/sec *QBar* 1.02 l/sec *(2.0 l/sec/ha)*

			INFLOW								
D Duration			M1-D	M2-D	M3-D	M4-D	M5-D	M10-D	M20-D	M30-D	M100-D
5min	5min	0.08hr	17.4 m3	22.2 m3	25.0 m3	27.3 m3	28.7 m3	33.4 m3	38.2 m3	40.1 m3	50.3 m3
10min	10min	0.17hr	24.8 m3	32.1 m3	36.6 m3	39.5 m3	41.9 m3	49.6 m3	57.3 m3	60.6 m3	77.7 m3
15min	15min	0.25hr	29.3 m3	38.0 m3	43.3 m3	46.6 m3	49.5 m3	58.6 m3	67.8 m3	71.6 m3	91.8 m3
30min	30min	0.50hr	34.4 m3	44.9 m3	49.9 m3	53.8 m3	57.1 m3	68.8 m3	79.9 m3	84.7 m3	110.4 m3
1hr	60min	1.00hr	47.3 m3	59.9 m3	66.6 m3	71.7 m3	76.2 m3	91.7 m3	107.2 m3	114.1 m3	150.1 m3
2hr	120min	2.00hr	56.8 m3	71.9 m3	79.9 m3	86.1 m3	91.4 m3	110.0 m3	128.7 m3	137.0 m3	180.1 m3
4hr	240min	4.00hr	68.3 m3	84.9 m3	94.2 m3	100.4 m3	106.6 m3	128.4 m3	149.1 m3	158.7 m3	208.1 m3
6hr	360min	6.00hr	80.5 m3	98.2 m3	107.7 m3	114.8 m3	121.9 m3	144.4 m3	168.0 m3	179.1 m3	233.1 m3
10hr	600min	10.00hr	85.5 m3	104.3 m3	114.4 m3	121.9 m3	129.5 m3	153.4 m3	178.5 m3	190.3 m3	247.7 m3
24hr	1440min	24.00hr	113.9 m3	136.7 m3	149.7 m3	157.8 m3	165.9 m3	193.6 m3	224.5 m3	238.6 m3	307.5 m3
48hr	2880min	48.00hr	133.1 m3	157.1 m3	171.9 m3	181.2 m3	188.6 m3	216.3 m3	247.7 m3	262.5 m3	334.6 m3

			OUTFLOW(50%)								
D Duration			M1-D	M2-D	M3-D	M4-D	M5-D	M10-D	M20-D	M30-D	M100-D
5min	5min	0.08hr	6.8 m3	8.7 m3	9.8 m3	10.7 m3	11.3 m3	13.1 m3	15.0 m3	15.8 m3	19.8 m3
10min	10min	0.17hr	9.7 m3	12.6 m3	14.4 m3	15.5 m3	16.5 m3	19.5 m3	22.5 m3	23.8 m3	30.5 m3
15min	15min	0.25hr	11.5 m3	14.9 m3	17.0 m3	18.3 m3	19.5 m3	23.0 m3	26.6 m3	28.1 m3	36.1 m3
30min	30min	0.50hr	13.5 m3	17.6 m3	19.6 m3	21.1 m3	22.4 m3	27.0 m3	31.4 m3	33.3 m3	43.4 m3
1hr	60min	1.00hr	18.6 m3	23.5 m3	26.1 m3	28.2 m3	29.9 m3	36.0 m3	42.1 m3	44.8 m3	59.0 m3
2hr	120min	2.00hr	22.3 m3	28.2 m3	31.4 m3	33.8 m3	35.9 m3	43.2 m3	50.6 m3	53.8 m3	70.8 m3
4hr	240min	4.00hr	26.8 m3	33.4 m3	37.0 m3	39.5 m3	41.9 m3	50.4 m3	58.6 m3	62.4 m3	81.8 m3
6hr	360min	6.00hr	31.6 m3	38.6 m3	42.3 m3	45.1 m3	47.9 m3	56.7 m3	66.0 m3	70.3 m3	91.6 m3
10hr	600min	10.00hr	33.6 m3	41.0 m3	44.9 m3	47.9 m3	50.9 m3	60.3 m3	70.1 m3	74.7 m3	97.3 m3
24hr	1440min	24.00hr	44.7 m3	53.7 m3	58.8 m3	62.0 m3	65.2 m3	76.1 m3	88.2 m3	93.7 m3	120.8 m3
48hr	2880min	48.00hr	52.3 m3	61.7 m3	67.5 m3	71.2 m3	74.1 m3	85.0 m3	97.3 m3	103.1 m3	131.5 m3

			ATTENUATION STORAGE REQUIRED TO MEET PROPOSED DISCHARGE RATE								
D Duration			M1-D	M2-D	M3-D	M4-D	M5-D	M10-D	M20-D	M30-D	M100-D
5min	5min	0.08hr	10.6 m3	13.5 m3	15.2 m3	16.5 m3	17.4 m3	20.3 m3	23.2 m3	24.3 m3	30.5 m3
10min	10min	0.17hr	15.1 m3	19.5 m3	22.2 m3	24.0 m3	25.4 m3	30.1 m3	34.8 m3	36.8 m3	47.2 m3
15min	15min	0.25hr	17.8 m3	23.1 m3	26.3 m3	28.3 m3	30.1 m3	35.6 m3	41.1 m3	43.5 m3	55.7 m3
30min	30min	0.50hr	20.9 m3	27.3 m3	30.3 m3	32.7 m3	34.7 m3	41.8 m3	48.5 m3	51.4 m3	67.0 m3
1hr	60min	1.00hr	28.7 m3	36.4 m3	40.4 m3	43.6 m3	46.2 m3	55.7 m3	65.1 m3	69.3 m3	91.1 m3
2hr	120min	2.00hr	34.5 m3	43.6 m3	48.5 m3	52.3 m3	55.5 m3	66.8 m3	78.1 m3	83.2 m3	109.4 m3
4hr	240min	4.00hr	41.5 m3	51.5 m3	57.2 m3	61.0 m3	64.7 m3	77.9 m3	90.5 m3	96.4 m3	126.3 m3
6hr	360min	6.00hr	48.8 m3	59.6 m3	65.4 m3	69.7 m3	74.0 m3	87.6 m3	102.0 m3	108.7 m3	141.5 m3
10hr	600min	10.00hr	51.9 m3	63.4 m3	69.5 m3	74.0 m3	78.6 m3	93.1 m3	108.4 m3	115.5 m3	150.4 m3
24hr	1440min	24.00hr	69.1 m3	83.0 m3	90.9 m3	95.8 m3	100.8 m3	117.5 m3	136.3 m3	144.9 m3	186.7 m3
48hr	2880min	48.00hr	80.8 m3	95.4 m3	104.4 m3	110.0 m3	114.5 m3	131.3 m3	150.4 m3	159.4 m3	203.2 m3



SuDs CALCULATIONS

Project: 55 FITZROY PARK

STORAGE REQUIREMENTS

Sheet 9 of 9

Project Reference: LBH 4480

Date: 12/12/2018 Rev: A

Client: The Turner Stokes Family
& the Springer Family

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