



CALCULATIONS

Company: WTDL Office: London
 Sheet No: 1 of 4 Project No: C11234
 By: S. Tarran Date: 20.09.10
 Checked: S. Brown Date: 20.09.10

Project Title Upper Heyford, Catchment Area 2
 Calculations Title Surface Water Management - Summary Sheet

LOCATION	CALCULATIONS										OPTIONS		
	Surface water at the Site will be managed in accordance with PPS25 requirements, i.e. surface water discharge restricted to the existing rate plus 30% climate change.												
	Existing surface water discharge regime:												
		Area (ha)	Calculation method		Discharge Rate								
	Hard landscaped	9.11	Wallingford (Page 2)		1027.8 l/s								
	Soft landscaped	3.91	IoH 124 (Page 3)		41.8 l/s								
	Maximum allowable discharge rate for 1 in 100 year storm =				1069.6 l/s								
	Proposed surface water discharge regime (60/40 instead of 70/30):												
	Proposed hard landscaped area		7.81 ha		7.81 ha								
	Proposed soft landscaped area		5.21 ha										
	Contributing soft landscaping (10%)*		0.521 ha		0.521 ha								
	Total Area contributing to discharge =				8.331 ha								
	(hard landscaping + contributing soft landscaping)												
	* = Typical contributing discharge from soft landscaping is approximately 10% of the equivalent area of hard landscaping.												
	Initial attenuation estimate												
	An initial estimate of the volume of surface water attenuation has been undertaken, using WinDes Quick Storage Estimate software application. A summary of these calculations are provided on Page 4.												
	The preliminary estimate of surface water attenuation is :				1893 m³								
	Based on an allowable discharge of :		1069 l/s										
	A hard landscaped area of:		8.331 ha										

CALCULATIONS

Company: WTDL Office: London
 Sheet No: 2 of 4 Project No: C11234
 By: S. Tarran Date: 20.09.10
 Checked: S. Brown Date: 20.09.10

Project Title Upper Heyford, Catchment Area 2
 Calculations Title Surface Water Management - Modified Rational Method

LOCATION	CALCULATIONS	OPTIONS
	Calculations based on: Design and Analysis of urban storm drainage. The Wallingford Procedure, Volume 1 Principles methods and practice.	
	User Input Data	
	Existing hard landscaped area	9 ha
	SAAR (From FEH / Windes)	691
	M5_60 (From Windes)	20
	Ratio R (From Windes)	0.405
	PIMP (% impervious)	100.0%
	Soil Type	0.40
	Very Low Runoff (well drained sandy, loamy or earthy peat soils)	0.15
	Low Runoff (Very permeable soils (e.g. gravel, sand)	0.30
	Moderate (Very fine sands, silts and sedimentary clays)	0.40
	High Runoff (Clayey or loamy soils)	0.45
	Very High Runoff (Soils of the wet uplands)	0.50
Fig. 9.7	UCWI (From Figure 9.7 of Wallingford Method)	65
Fig 6.3a/b	Z1 (From Figure 6.3a or 6.3b)	1.00
Tab 6.2/6.3	Z2 (From Table 6.2 & Table 6.3)	2.02
Eqn. 13	Q_p (peak discharge) = 2.78 C _v CR i A	
	Where: Q_p (Peak Discharge) i = rainfall intensity A = Total Area	
	Calculating Rainfall Intensity (i)	
Eqn 6.4	MT-D = Z1 x Z2 x (M5-60min)	
	M5_60 20 Z1 1.00 Z2 2.02	
	Thus M100_60 is: 40.4 mm	
Eqn 7.20	C _v = PR/100	
Eqn 7.3	PR = (0.829 PIMP) + (25.0 SOIL) + (0.078 UCWI) - 20.7	
	PIMP (Percentage of catchment which is impervious)	100.0 %
Page 52	Note: PIMP can not be less than 40%	40.0 %
	Thus value of PIMP to be used	100.0 %
	Soil: 0.40 UCWI: 65	
	PR =	77.27
	Thus C _v =	0.77
Sec 7.10	CR (Recommended for simulation and design)	1.3
	Q_p for 1 in 100 year 60 minute duration =	1,027.8 l/s or 112.8 l/s/ha

CALCULATIONS

Company: WTDL Office: London
 Sheet No: 3 of 4 Project No: C11234
 By: S. Tarran Date: 20.09.10
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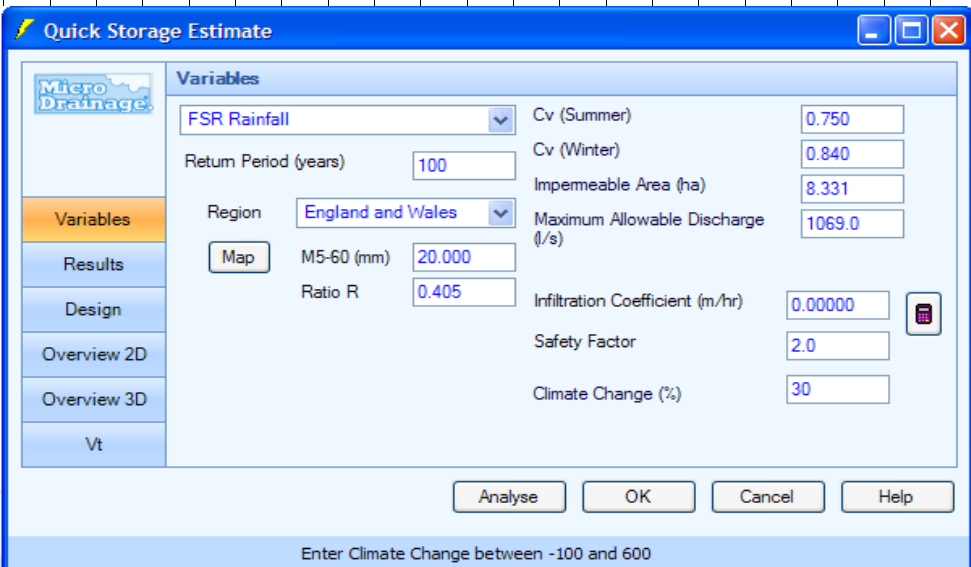
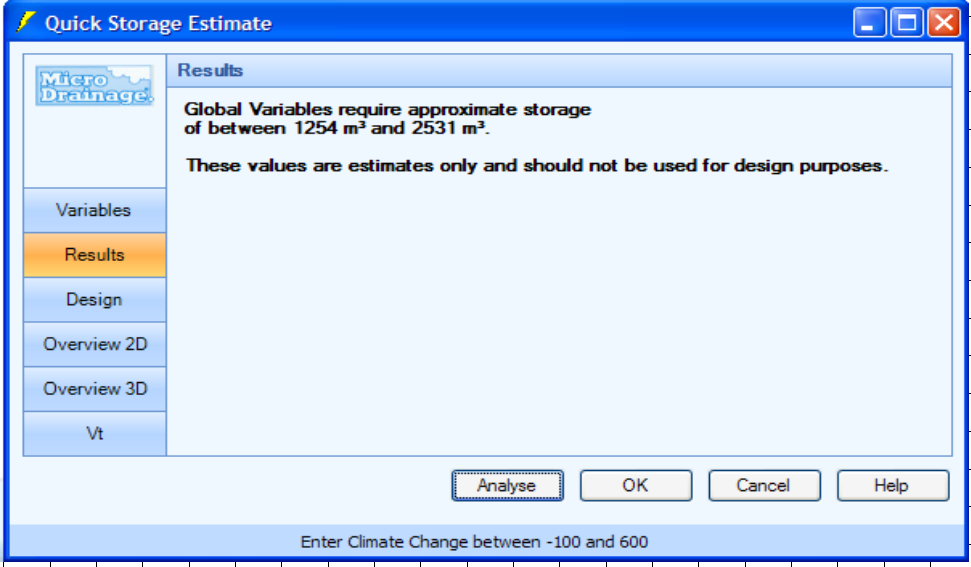
Project Title Upper Heyford, Catchment Area 2
 Calculations Title Surface Water Management - IoH 124

LOCATION	CALCULATIONS	OPTIONS																														
	<p>In order to calculate the rate of surface water discharge from the permeable portion of the Site, the Windes Microdrainage version W.12.4 Source Control module has been utilised. Rural runoff has been calculated using the IoH 124 Methodology, the input and output data for which are shown below;</p> <p>An area of 50ha has been used in the calculations as this is the smallest catchment area which the IoH 124 method can calculate. The 50ha output is then prorated as set out in IoH 124.</p>																															
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Region</th> <th>QBAR (l/s)</th> <th>Q (100yrs) (l/s)</th> <th>Q (1 yrs) (l/s)</th> <th>Q (2 yrs) (l/s)</th> <th>Q (5 yrs) (l/s)</th> </tr> </thead> <tbody> <tr> <td>Region 5</td> <td>167.6</td> <td>596.5</td> <td>145.8</td> <td>149.7</td> <td>216.</td> </tr> <tr> <td>Region 6/Region 7</td> <td>167.6</td> <td>534.5</td> <td>142.4</td> <td>147.6</td> <td>214.</td> </tr> <tr> <td>Region 8</td> <td>167.6</td> <td>405.5</td> <td>130.7</td> <td>148.1</td> <td>206.</td> </tr> <tr> <td>Region 9</td> <td>167.6</td> <td>365.3</td> <td>147.5</td> <td>155.6</td> <td>202.</td> </tr> </tbody> </table>	Region	QBAR (l/s)	Q (100yrs) (l/s)	Q (1 yrs) (l/s)	Q (2 yrs) (l/s)	Q (5 yrs) (l/s)	Region 5	167.6	596.5	145.8	149.7	216.	Region 6/Region 7	167.6	534.5	142.4	147.6	214.	Region 8	167.6	405.5	130.7	148.1	206.	Region 9	167.6	365.3	147.5	155.6	202.	
Region	QBAR (l/s)	Q (100yrs) (l/s)	Q (1 yrs) (l/s)	Q (2 yrs) (l/s)	Q (5 yrs) (l/s)																											
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	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Qbar (1 in 2.333)</td> <td>167.6 l/s/50ha</td> <td>3.4 l/s/ha</td> <td></td> <td></td> <td></td> </tr> <tr> <td>1 in 100</td> <td>534.5 l/s/50ha</td> <td>10.7 l/s/ha</td> <td>or</td> <td>41.8 l/s</td> <td></td> </tr> </table>	Qbar (1 in 2.333)	167.6 l/s/50ha	3.4 l/s/ha				1 in 100	534.5 l/s/50ha	10.7 l/s/ha	or	41.8 l/s																				
Qbar (1 in 2.333)	167.6 l/s/50ha	3.4 l/s/ha																														
1 in 100	534.5 l/s/50ha	10.7 l/s/ha	or	41.8 l/s																												

CALCULATIONS

Company: WTDL Office: London
Sheet No: 4 of 4 Project No: C11234
By: S. Tarran Date: 20.09.10
Checked: S.Brown Date: 20.09.10

Project Title Upper Heyford, Catchment Area 2
Calculations Title Preliminary surface water attenuation volume.

LOCATION	CALCULATIONS	OPTIONS
	In order to calculate the volume of surface water attenuation required for the Site, Windes Microdrainage version W.12.4, Source Control module, Quick Storage Estimate has been used. The input and output data for which are shown below;	
<u>Input:</u>		
<u>Output:</u>		
	As Windes Quick Storage Estimate provides a range of attenuation volumes it is considered that an average value of the range is suitable for preliminary design sizing.	
	Minimum: 1,254 m ³	
	Maximum: 2,531 m ³	
	Preliminary Estimate: 1893 m³	

CALCULATIONS

Company:	WTDL	Office:	London
Sheet No:	1 of 4	Project No:	C11234
By	S. Tarran	Date	20.09.10
Checked:	S. Brown	Date	20.09.10

Project Title Upper Heyford, Catchment Area 3
 Calculations Title Surface Water Management - Summary Sheet

LOCATION	CALCULATIONS	OPTIONS																
	Surface water at the Site will be managed in accordance with PPS25 requirements, i.e. surface water discharge restricted to the existing rate plus 30% climate change.																	
	Existing surface water discharge regime:																	
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 20%;"></th> <th style="width: 20%;">Area (ha)</th> <th style="width: 30%;">Calculation method</th> <th style="width: 30%;">Discharge Rate</th> </tr> </thead> <tbody> <tr> <td>Hard landscaped</td> <td>7.81</td> <td>Wallingford (Page 2)</td> <td>881.2 l/s</td> </tr> <tr> <td>Soft landscaped</td> <td>3.35</td> <td>IoH 124 (Page 3)</td> <td>35.9 l/s</td> </tr> <tr> <td colspan="3">Maximum allowable discharge rate for 1 in 100 year storm =</td> <td>917.1 l/s</td> </tr> </tbody> </table>		Area (ha)	Calculation method	Discharge Rate	Hard landscaped	7.81	Wallingford (Page 2)	881.2 l/s	Soft landscaped	3.35	IoH 124 (Page 3)	35.9 l/s	Maximum allowable discharge rate for 1 in 100 year storm =			917.1 l/s	
	Area (ha)	Calculation method	Discharge Rate															
Hard landscaped	7.81	Wallingford (Page 2)	881.2 l/s															
Soft landscaped	3.35	IoH 124 (Page 3)	35.9 l/s															
Maximum allowable discharge rate for 1 in 100 year storm =			917.1 l/s															
	Proposed surface water discharge regime:																	
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="width: 40%;">Proposed hard landscaped area</td> <td style="width: 20%;">7.81 ha</td> <td style="width: 40%;">7.81 ha</td> </tr> <tr> <td>Proposed soft landscaped area</td> <td>3.35 ha</td> <td></td> </tr> <tr> <td>Contributing soft landscaping (10%)*</td> <td>0.335 ha</td> <td>0.335 ha</td> </tr> <tr> <td colspan="2">Total Area contributing to discharge = (hard landscaping + contributing soft landscaping)</td> <td>8.145 ha</td> </tr> </tbody> </table>	Proposed hard landscaped area	7.81 ha	7.81 ha	Proposed soft landscaped area	3.35 ha		Contributing soft landscaping (10%)*	0.335 ha	0.335 ha	Total Area contributing to discharge = (hard landscaping + contributing soft landscaping)		8.145 ha					
Proposed hard landscaped area	7.81 ha	7.81 ha																
Proposed soft landscaped area	3.35 ha																	
Contributing soft landscaping (10%)*	0.335 ha	0.335 ha																
Total Area contributing to discharge = (hard landscaping + contributing soft landscaping)		8.145 ha																
	* = Typical contributing discharge from soft landscaping is approximately 10% of the equivalent area of hard landscaping.																	
	Initial attenuation estimate																	
	An initial estimate of the volume of surface water attenuation has been undertaken, using WinDes Quick Storage Estimate software application. A summary of these calculations are provided on Page 4.																	
	The preliminary estimate of surface water attenuation is :	1986 m³																
	Based on an allowable discharge of : 917 l/s																	
	A hard landscaped area of: 8.15 ha																	

CALCULATIONS

Company: WTDL

Office: London

Sheet No: 2 of 4

Project No: C11234

By: S. Tarran

Date: 20.09.10

Checked: S. Brown

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Project Title Upper Heyford, Catchment Area 3

Calculations Title Surface Water Management - Modified Rational Method

LOCATION	CALCULATIONS	OPTIONS
	Calculations based on: Design and Analysis of urban storm drainage. The Wallingford Procedure, Volume 1 Principles methods and practice.	
	User Input Data	
	Existing hard landscaped area	7.81 ha
	SAAR (From FEH / Windes)	691
	M5_60 (From Windes)	20
	Ratio R (From Windes)	0.405
	PIMP (% impervious)	100.0%
	Soil Type	0.40
	Very Low Runoff (well drained sandy, loamy or earthy peat soils)	0.15
	Low Runoff (Very permeable soils (e.g. gravel, sand)	0.30
	Moderate (Very fine sands, silts and sedimentary clays)	0.40
	High Runoff (Clayey or loamy soils)	0.45
	Very High Runoff (Soils of the wet uplands)	0.50
Fig. 9.7	UCWI (From Figure 9.7 of Wallingford Method)	65
Fig 6.3a/b	Z1 (From Figure 6.3a or 6.3b)	1.00
Tab 6.2/6.3	Z2 (From Table 6.2 & Table 6.3)	2.02
Eqn. 13	Q_p (peak discharge) = 2.78 C_v CR i A	
	Where: Q_p (Peak Discharge) i = rainfall intensity A = Total Area	
	Calculating Rainfall Intensity (i)	
Eqn 6.4	$MT-D = Z1 \times Z2 \times (M5-60min)$	
	M5_60 20 Z1 1.00 Z2 2.02	
	Thus M100_60 is: 40.4 mm	
Eqn 7.20	$C_v = PR/100$	
Eqn 7.3	$PR = (0.829 PIMP) + (25.0 SOIL) + (0.078 UCWI) - 20.7$	
	PIMP (Percentage of catchment which is impervious)	100.0 %
Page 52	Note: PIMP can not be less than 40%	40.0 %
	Thus value of PIMP to be used	100.0 %
	Soil: 0.40 UCWI: 65	
	PR =	77.27
	Thus C_v =	0.77
Sec 7.10	CR (Recommended for simulation and design)	1.3
	Q_p for 1 in 100 year 60 minute duration =	881.2 l/s or 112.8 l/s/ha

CALCULATIONS

Company: WTDL Office: London
 Sheet No: 3 of 4 Project No: C11234
 By: S. Tarran Date: 20.09.10
 Checked: S. Brown Date: 20.09.10

Project Title Upper Heyford, Catchment Area 3
 Calculations Title Surface Water Management - IoH 124

LOCATION	CALCULATIONS	OPTIONS																														
	<p>In order to calculate the rate of surface water discharge from the permeable portion of the Site, the Windes Microdrainage version W.12.4 Source Control module has been utilised. Rural runoff has been calculated using the IoH 124 Methodology, the input and output data for which are shown below;</p> <p>An area of 50ha has been used in the calculations as this is the smallest catchment area which the IoH 124 method can calculate. The 50ha output is then prorated as set out in IoH 124.</p>																															
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1 in 100	534.5	l/s/50ha	10.7	l/s/ha	or	35.9	l/s																									



CALCULATIONS

Company: WTDL Office: London
 Sheet No: 1 of 4 Project No: C11234
 By: S. Tarran Date: 20.09.10
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Project Title Upper Heyford, Catchment Area 4
 Calculations Title Surface Water Management - Summary Sheet

LOCATION	CALCULATIONS											OPTIONS		
	Surface water at the Site will be managed in accordance with PPS25 requirements, i.e. surface water discharge restricted to the existing rate plus 30% climate change. Further restriction to reduce flows into the eastern watercourse by 10% over the existing situation.													
	Existing surface water discharge regime:													
		Area (ha)	Calculation method	Discharge Rate										
	Hard landscaped	1.65	Wallingford (Page 2)	186.2 l/s										
	Soft landscaped	0.71	IoH 124 (Page 3)	7.6 l/s										
			Maximum allowable discharge rate for 1 in 100 year storm =	193.8 l/s										
	Proposed surface water discharge regime (60/40 instead of 70/30):													
	Proposed hard landscaped area	1.42 ha		1.42 ha										
	Proposed soft landscaped area	0.94 ha												
	Contributing soft landscaping (10%)*	0.094 ha		0.094 ha										
	Total Area contributing to discharge =			1.514 ha										
			(hard landscaping + contributing soft landscaping)											
	* = Typical contributing discharge from soft landscaping is approximately 10% of the equivalent area of hard landscaping.													
	The Environment Agency require a 10% reduction in discharge to the eastern watercourse, namely Catchment Areas 3 and 4, to reduce flood risk downstream.													
	Area 3: allowable discharge 917.1 l/s, 10% =			91.71 l/s										
	Area 4: allowable discharge 193.8 l/s, 10% =			19.38 l/s										
	Total reduction in allowable discharge =			111.09 l/s										
	Discharge from Area 3 to remain as existing, required reduction to be offset in Area 4													
	Allowable discharge (193.8 - 111.09) =			82.7 l/s										
	Initial attenuation estimate													
	An initial estimate of the volume of surface water attenuation has been undertaken, using WinDes Quick Storage Estimate software application. A summary of these calculations are provided on Page 4.													
	The preliminary estimate of surface water attenuation is :													
	Based on an allowable discharge of :		82 l/s											
	A hard landscaped area of:		1.514 ha											

CALCULATIONS

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Sheet No: 2 of 4

Project No: C11234

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Project Title Upper Heyford, Catchment Area 4

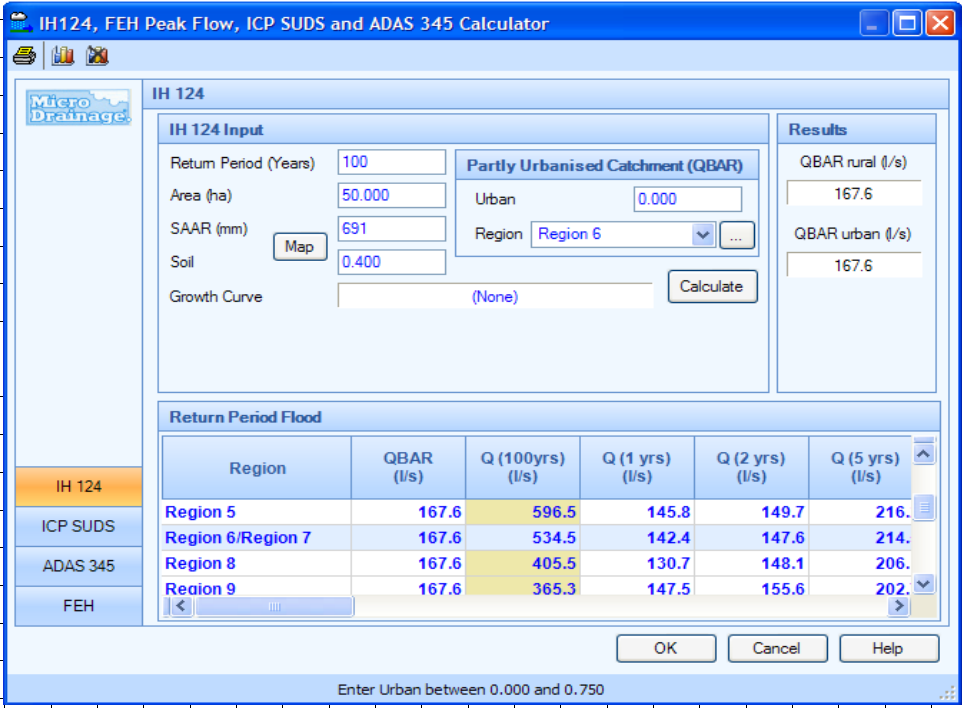
Calculations Title Surface Water Management - Modified Rational Method

LOCATION	CALCULATIONS	OPTIONS
	Calculations based on: Design and Analysis of urban storm drainage. The Wallingford Procedure, Volume 1 Principles methods and practice.	
	User Input Data	
	Existing hard landscaped area	2 ha
	SAAR (From FEH / Windes)	691
	M5_60 (From Windes)	20
	Ratio R (From Windes)	0.405
	PIMP (% impervious)	100.0%
	Soil Type	0.40
	Very Low Runoff (well drained sandy, loamy or earthy peat soils)	0.15
	Low Runoff (Very permeable soils (e.g. gravel, sand)	0.30
	Moderate (Very fine sands, silts and sedimentary clays)	0.40
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Fig 6.3a/b	Z1 (From Figure 6.3a or 6.3b)	1.00
Tab 6.2/6.3	Z2 (From Table 6.2 & Table 6.3)	2.02
Eqn. 13	Q_p (peak discharge) = 2.78 C_v CR i A	
	Where: Q_p (Peak Discharge) i = rainfall intensity A = Total Area	
	Calculating Rainfall Intensity (i)	
Eqn 6.4	$MT-D = Z1 \times Z2 \times (M5-60min)$	
	M5_60 20 Z1 1.00 Z2 2.02	
	Thus M100_60 is: 40.4 mm	
Eqn 7.20	$C_v = PR/100$	
Eqn 7.3	$PR = (0.829 PIMP) + (25.0 SOIL) + (0.078 UCWI) - 20.7$	
	PIMP (Percentage of catchment which is impervious)	100.0 %
Page 52	Note: PIMP can not be less than 40%	40.0 %
	Thus value of PIMP to be used	100.0 %
	Soil: 0.40 UCWI: 65	
	PR =	77.27
	Thus C_v =	0.77
Sec 7.10	CR (Recommended for simulation and design)	1.3
	Q_p for 1 in 100 year 60 minute duration =	186.2 l/s or 112.8 l/s/ha

CALCULATIONS

Company: WTDL Office: London
 Sheet No: 3 of 4 Project No: C11234
 By: S. Tarran Date: 20.09.10
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Project Title Upper Heyford, Catchment Area 4
 Calculations Title Surface Water Management - loH 124

LOCATION	CALCULATIONS	OPTIONS																														
	<p>In order to calculate the rate of surface water discharge from the permeable portion of the Site, the Windes Microdrainage version W.12.4 Source Control module has been utilised. Rural runoff has been calculated using the loH 124 Methodology, the input and output data for which are shown below;</p> <p>An area of 50ha has been used in the calculations as this is the smallest catchment area which the loH 124 method can calculate. The 50ha output is then prorated as set out in loH 124.</p>																															
																																
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CALCULATIONS

Company:	WTDL	Office:	London
Sheet No:	4 of 4	Project No:	C11234
By:	S. Tarran	Date:	20.09.10
Checked:	S. Brown	Date:	20.09.10

Project Title Upper Heyford, Catchment Area 4
 Calculations Title Preliminary surface water attenuation volume.

LOCATION	CALCULATIONS	OPTIONS																		
	In order to calculate the volume of surface water attenuation required for the Site, Windes Microdrainage version W.12.4, Source Control module, Quick Storage Estimate has been used. The input and output data for which are shown below;																			
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Output:																				
	As Windes Quick Storage Estimate provides a range of attenuation volumes it is considered that an average value of the range is suitable for preliminary design sizing.																			
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