KILGALLEN & PARTNERS
CONSULTING ENGINEERS

Kelland Homes

Zoning Submission Regarding Lands at Newtown Little & Newtownpark, Blessington, Co. Kildare

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Flood Risk

Kelland Homes **Kelland Homes Limited** **Russell Square Centre,** **Unit 5 Fortunestown Way,** **Tallaght,** **Dublin 24**	**Document Ref. No.** **20003-OFR** **Issue 01**	**Kilgallen & Partners** **Consulting Engineers** **Well Road,** **Portlaoise** **Co. Laois**

REVISION HISTORY

Client	Kelland Homes
Project	Zoning Submission Regarding Lands at Newtown Little & Newtownpark, Blessington, Co. Kildare
Title	Flood Risk

Date	**Detail of Issue**	**Issue No.**	**Origin**	**Checked**	**Approved**
23/05/22	Initial client issue	01	CP	PB	PB

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1. INTRODUCTION

Kelland Homes Ltd. ['the Applicant'] is seeking an amendment to the draft Kildare County Development Plan 2023 – 2029 comprising the re-classification of lands ['the Site'] at Newtown Little & Newtownpark, Blessington, Co. Kildare.

The extent of the Site and the streams located in or close to it are shown on Figure 1-1.

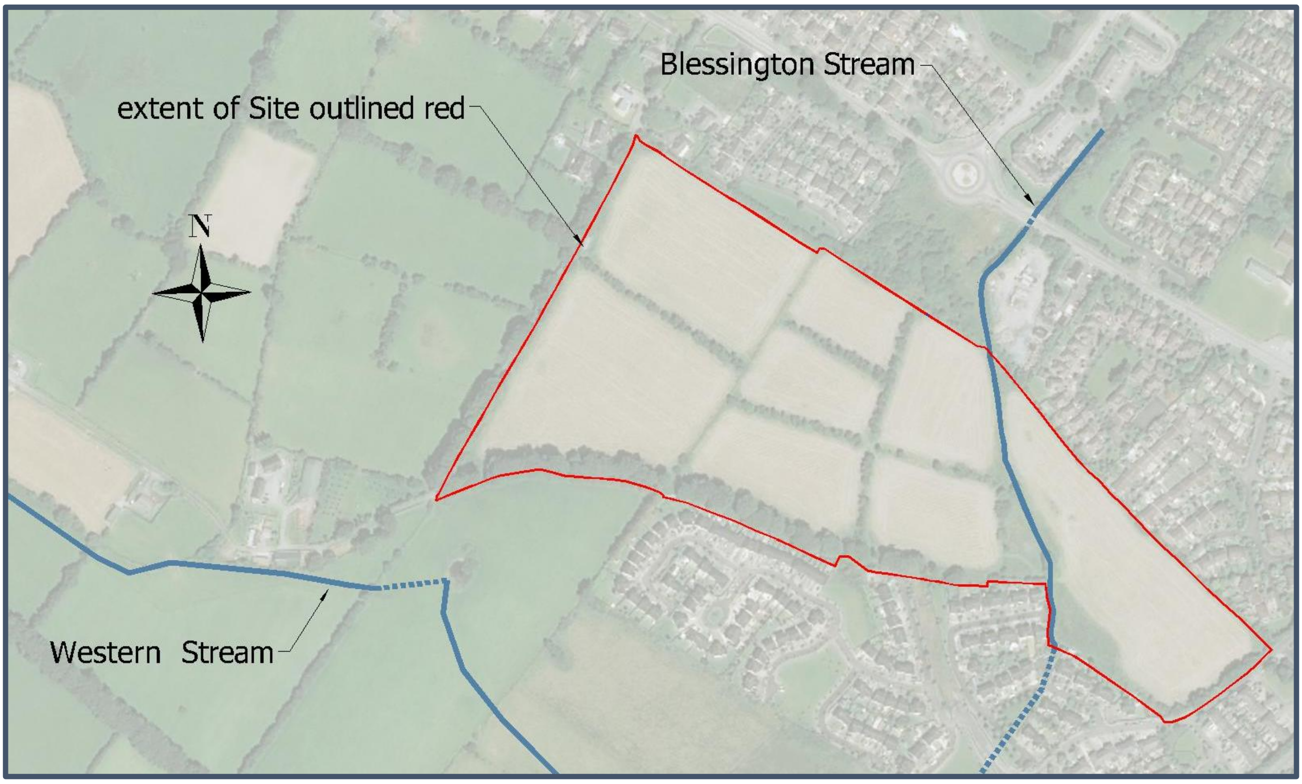


Figure 1-1 Site Location and Context

Figure 1-2 is reproduced from the draft County Development Plan and shows the land-use classification proposed at the Site. This proposed classification differs from the current development plan in that:

- an area of land, corresponding to a flow path for fluvial overland flow through the Site during extreme events, has been re-classified from New Residential to Amenity;
- all lands within the Site located east of the Blessington Stream and a corridor adjacent to the western boundary of the Blessington Stream have been re-classified from New Residential to Amenity;

This proposed classification severs the western part of the Site. This report proposes an alternative route for overland flow through the Site which would allow this severance to be eliminated (Sections 2 and 3 refer).

This proposed classification eliminates development in the eastern side of the Site. This report demonstrates that the eastern part of the Site can be developed in compliance with the Flood Risk Management Guidelines. (Section 4 refers).

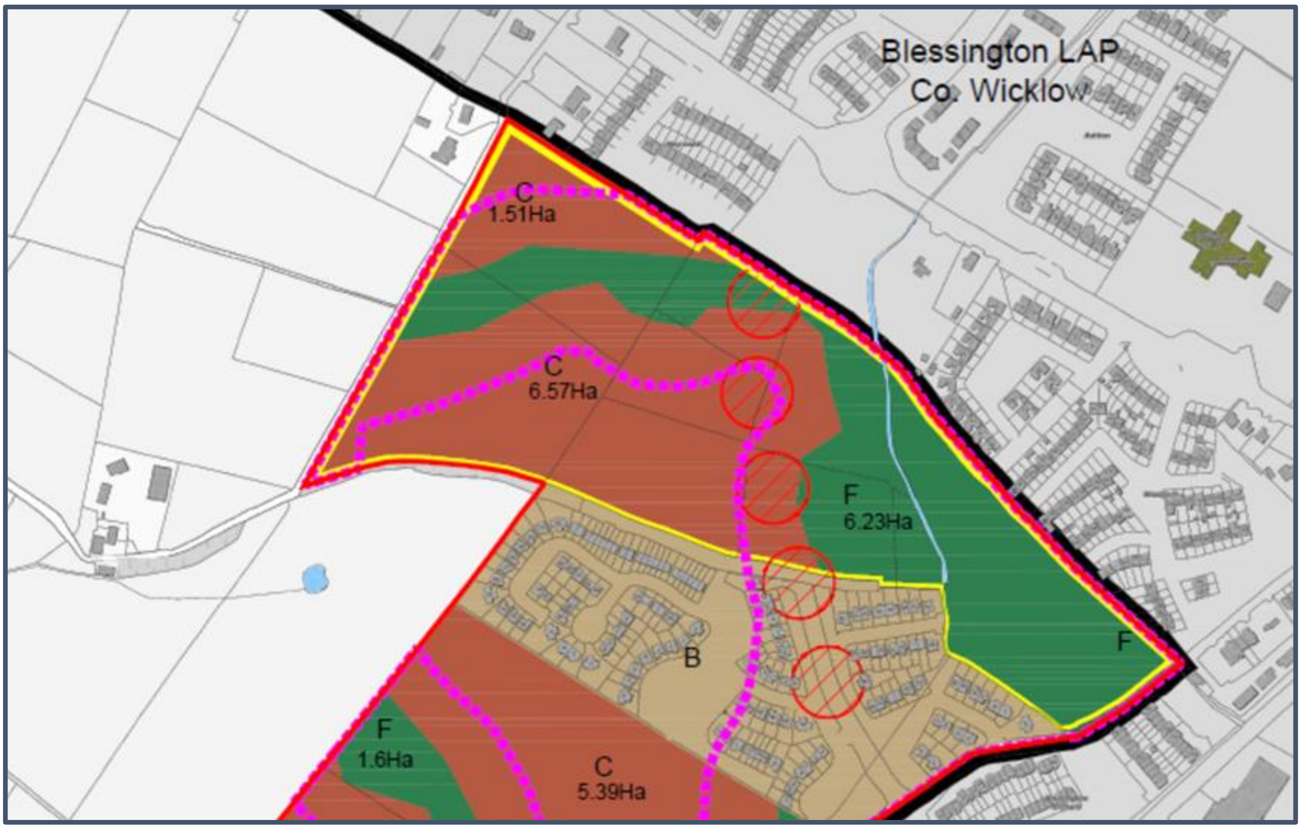


Figure 1-2 Proposed Land-Use Classification

2. FLOOD RISK AT THE SITE ARISING FROM OVERLAND FLOW

CFRAM maps prepared for the CFRAM study programme flood risk from overland flow. The source of this overland flow is a watercourse ['the Western Stream'] which flows in a southerly direction to the west of the Site. The mapping suggests that during extreme rainfall events, the hydraulic capacity of the watercourse will be exceeded, and the exceedance water will flow overland to the western boundary of the Site. This overland flow pattern is similar to and consistent with the flood risk identified in the SFRA prepared for the draft County Development Plan 2023 – 2029. A copy of the relevant CFRAM flood risk map is provided in Appendix A.

Figure 2-1 shows the route for this overland flow through the Site.

The Western Stream is culverted at a point approximately 100m west of the Development Site. The culvert comprises a 450mm dia. pipe and is of lower hydraulic capacity than the channel / ponds upstream and downstream of it. This lower hydraulic capacity is the primary cause the overland flow which occurs upstream of the culvert.

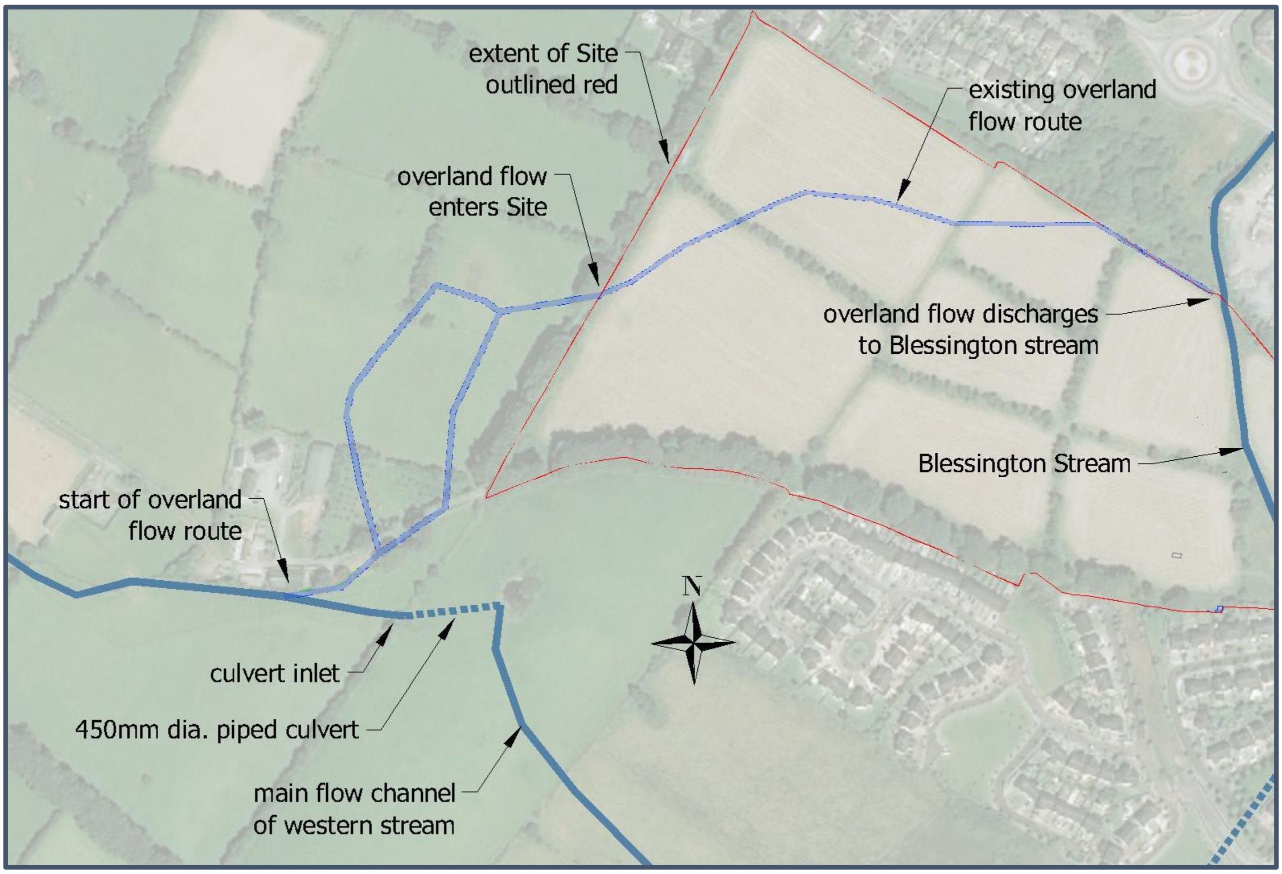


Figure 2-1 Overland Flow Route

3. ALTERNATIVE ROUTE FOR OVERLAND FLOW

3.1. Calculation of overland flow rate

The catchment for the Western Stream is shown in Figure 3-1 and measures 0.76km^2.

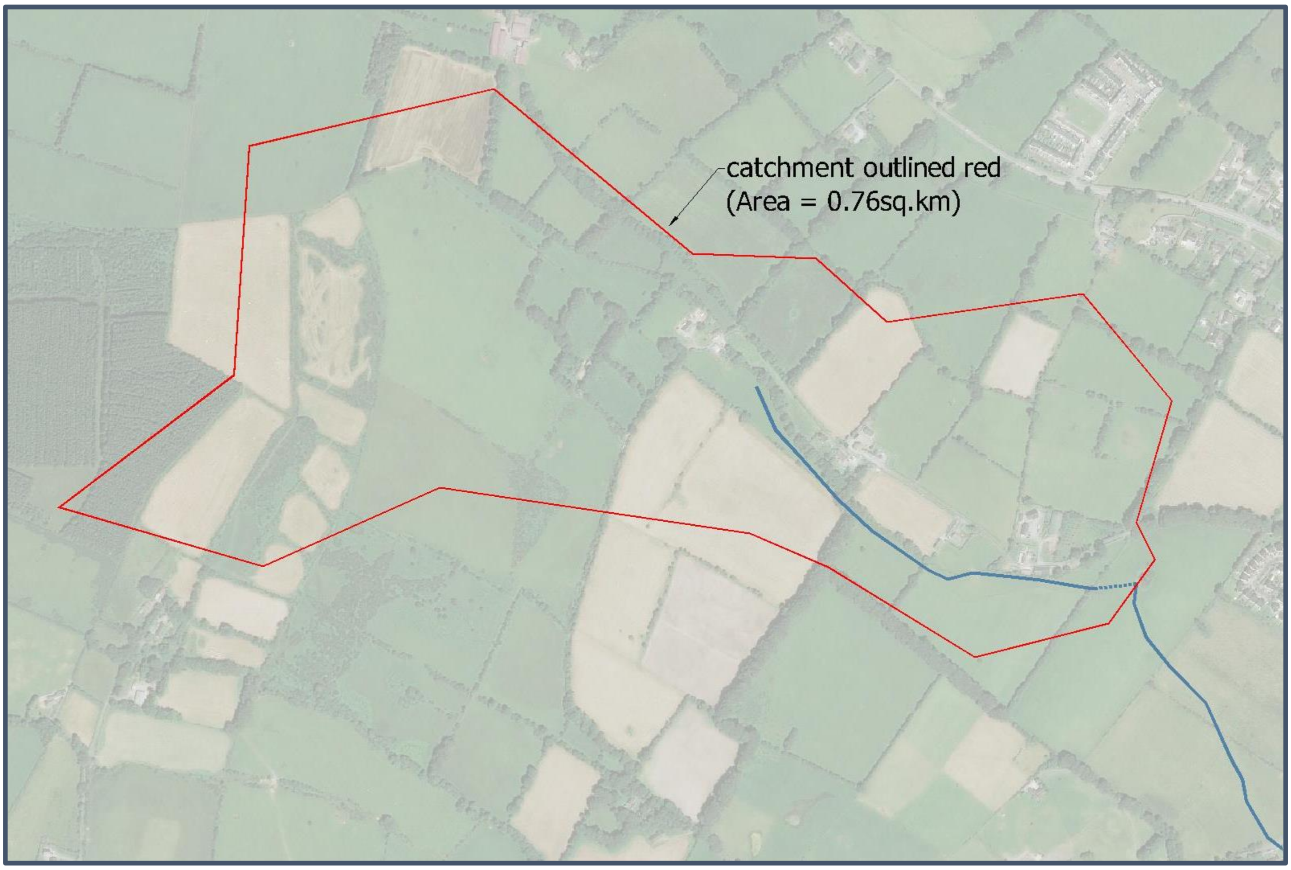


Figure 3-1 Catchment of Watercourse west of Site

The OPW Web Portal advises particular caution where peak flows are being estimated for catchments of less than 25km^2. Accordingly, peak flows in the watercourse are estimated using IH124 (Flood Estimation for Small Catchments). Details of these calculations are included in Appendix B and the results summarised in Table 3-1. These estimates include a climate change factor of +20%. Table 3-1 also shows the equivalent peak flood flows as predicted by CFRAM. The CFRAM flows are higher and so, applying the precautionary principles, these higher flows are used for this assessment.

Return Period	Symbol	IH124 (m^3/s)	CFRAM (m^3/s)s
Mean Annual Average	Q_{bar}	0.32	
100 years (1% AEP)	Q_{100}	1.04	1.36
1000 years (0.1% AEP)	Q_{1000}	1.38	2.40

Table 3-1 Peak Overland Flow (after applying 20% Climate Change Factor)

The piped culvert that restricts the capacity of the watercourse is 450mm dia. Based on the following conservative assumptions, the rate of overland flow through the Site is estimated to be 2.0m^3/s.

- the headwater at the culvert inlet cannot exceed 1.0m, the culvert has a capacity of 0.4m^3/s;
- during a 0.1% AEP event, all flow exceeding the capacity of the culvert becomes overland flow to the Development Site.

3.2. Alternative Route for Overland Flow

Figure 3-2 shows an alternative route for the overland flow risk at the Site. This alternative route is created by forming an open channel to the north of the existing route which has the capacity to carry the overland flow rate associated with the 0.1% AEP event.

Details of the alternative overland flow route are provided in Appendix C.

The alternative route is selected to be as close to the northern boundary of the Site as possible and thus minimise the severance caused by the need to accommodate this overland flow risk.

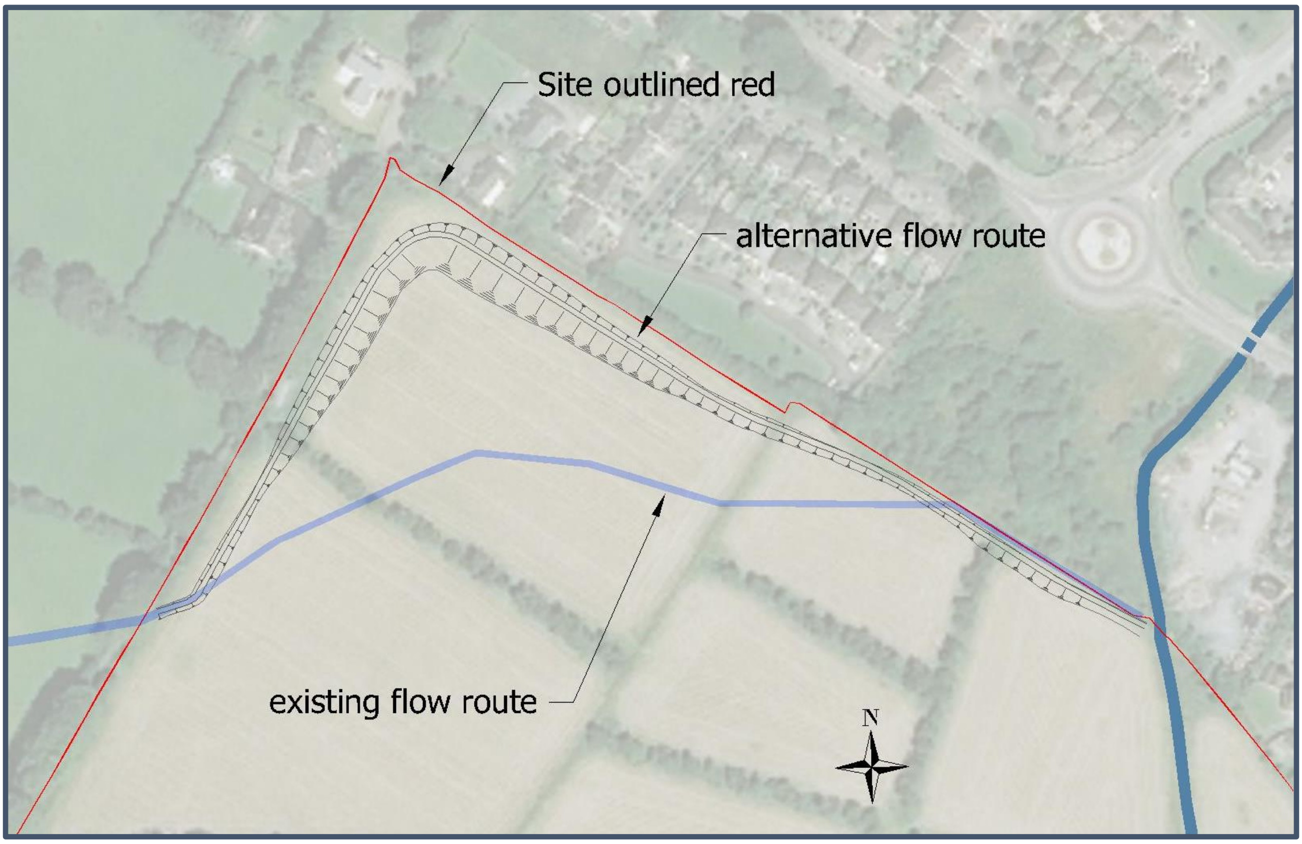


Figure 3-2 Alternative Route for Overland Flow

4. DEVELOPMENT OF THE EASTERN SIDE OF THE SITE

A preliminary design for development of the Site was prepared in 2003 [referred to hereafter as 'the Development']. As part of the design process, an initial assessment of flood risk was carried out in accordance with the Flood Risk Management Guidelines. This initial assessment identified indicators of fluvial flood risk at the Site and so detailed assessment of fluvial flood was carried out.

4.1 Estimating Peak Flood Flows

The catchment area for the stream, shown on Figure 4-1, measures 6.48 km^2.

Figure 4-1 Catchment Area for Stream

The OPW provides a Web Portal for estimating peak flood flows in natural catchments (Flood Studies Update (FSU) Web Portal). While the use of this Portal is generally considered best practice for the estimation of flood flows, the Portal advises particular caution where peak flows are being estimated for catchments of less than 25km^2. Accordingly, peak flows in the stream are estimated using IH124 (Flood Estimation for Small Catchments). Details of these calculations are included in Appendix D and the results summarised in Table 4-1. These estimates include a climate change factor of +20%.

Table 4-1 also shows the equivalent peak flood flows as predicted by CFRAM. The CFRAM flows are slightly higher and so, applying the precautionary principles, these higher flows are used for this assessment.

Return Period	Symbol	IH124 (m^3/s)	CFRAM (m^3/s)
Mean Annual Average	Q_{bar}	0.478	
100 years (1% AEP)	Q_{100}	6.99	7.01
1000 years (0.1% AEP)	Q_{1000}	9.28	9.68

Table 4-1 Peak Fluvial Flows (after applying 20% Climate Change Factor)

4.2 Model

A topographical survey was carried out for the study area by a third-party land surveyor. The results of this survey were imported into the industry standard software package Infrastructure Ultimate Design Suite to create a 3D digital terrain model for the study area.

A hydrological model was prepared to simulate flow patterns during the 100 year and 1000 year rainfall events. This model was developed using the River and Flood Analysis module of the industry standard package Infrastructure Ultimate Design Suite produced by Autodesk. The hydrological modelling within this module is itself based on the HEC-RAS modelling software produced by the US Army Corps of Engineers.

The module calculates flood risk zones for the catchment based on the peak flood flows and the following:

- the terrain model;
- cross-sectional data for the river channel;
- dimensions of culverts and other drainage structures;
- appropriate values for the roughness coefficient 'Manning's n' as determined from visual inspection of the Development Site.

The flow volumes in Table 4-1 significantly exceed the capacity of the 1200mm dia. culvert into which the stream discharges at the southern boundary. Surcharged water will overtop the wall at the southern boundary when the surcharged water level reaches 194.80m. The model therefore assumes a downstream water level of 194.80m.

4.3 Existing Fluvial Flood Risk Zones at the Site

Figure 4-2 contains a map showing the existing fluvial flood risk zones determined using the hydrological model described above superimposed on the emerging layout for the Development.. Peak water levels are as follows:

- 1.0% AEP Flood Event 194.80m
- 0.1% AEP Flood Event 194.82m

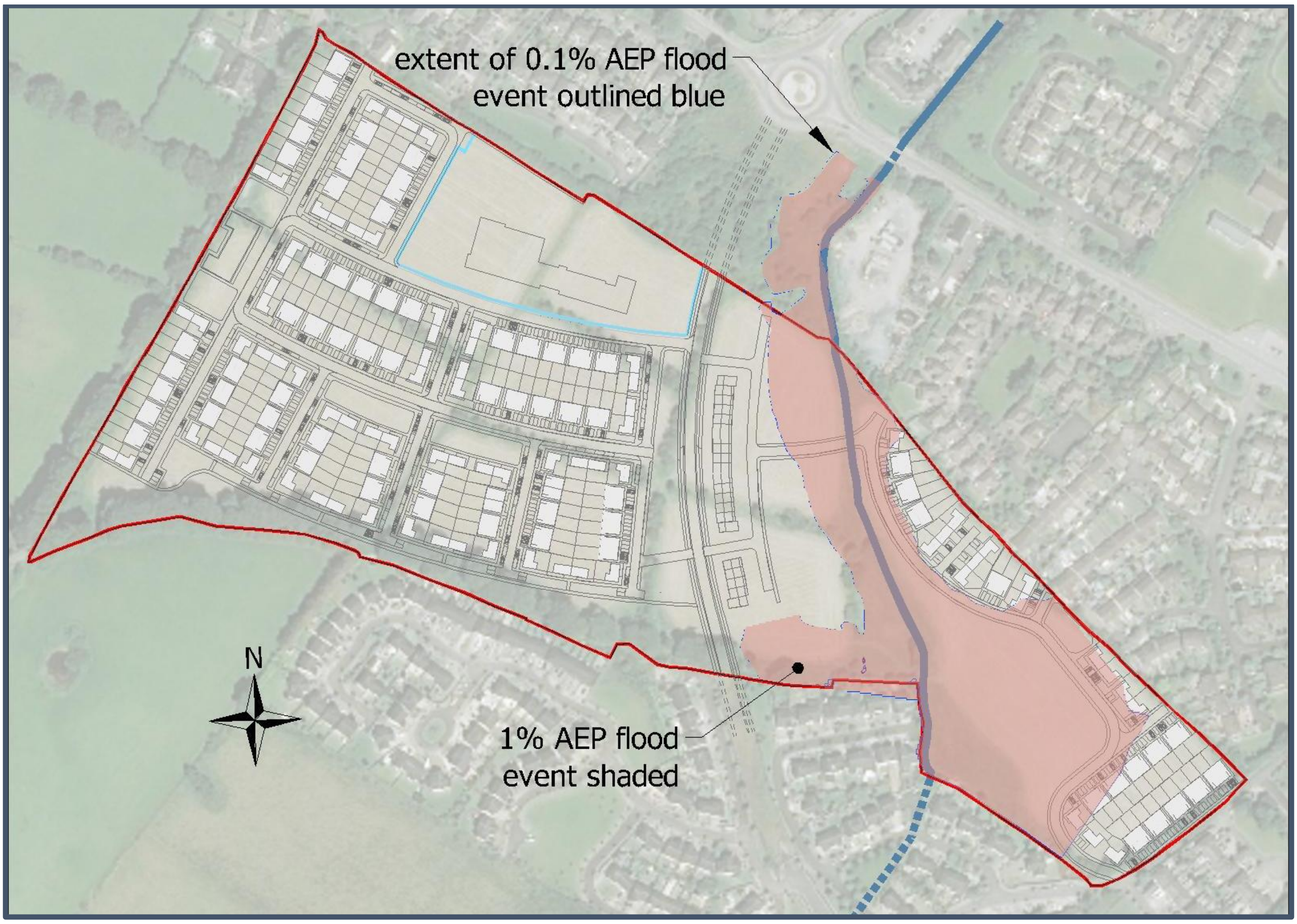


Figure 4-2
Existing Flood Risk Zones Associated with Blessington Stream superimposed on the Development Layout

4.4 Compensatory Storage

While the layout of the Development is broadly cognisant of fluvial flood risk, elements of the proposed development, in particular roads, encroach on the flood risk zones. This creates the potential for the proposed development to displace floodplain storage and thereby increase flood risk elsewhere. To prevent this, it is necessary to provide compensatory storage within the Site. Compensatory storage is provided by reducing the existing ground level immediately adjacent to the stream to create a basin. Figure 4-3 shows the general layout of the two compensatory storage areas that are proposed.

The requirements for providing compensatory storage are set out in the Appendix to the Flood Risk Management Guidelines. Normally it is calculated by comparing volumes taken by the development and the volume offered by the compensatory storage for a number of horizontal slices through the range defined above - the thickness of a slice should be typically 0.1 metres.

The compensatory volume should be at the same level (within reasonable working limits) as the lost storage for each slice. Compensatory storage cannot be located in an area where water-vulnerable development is proposed.

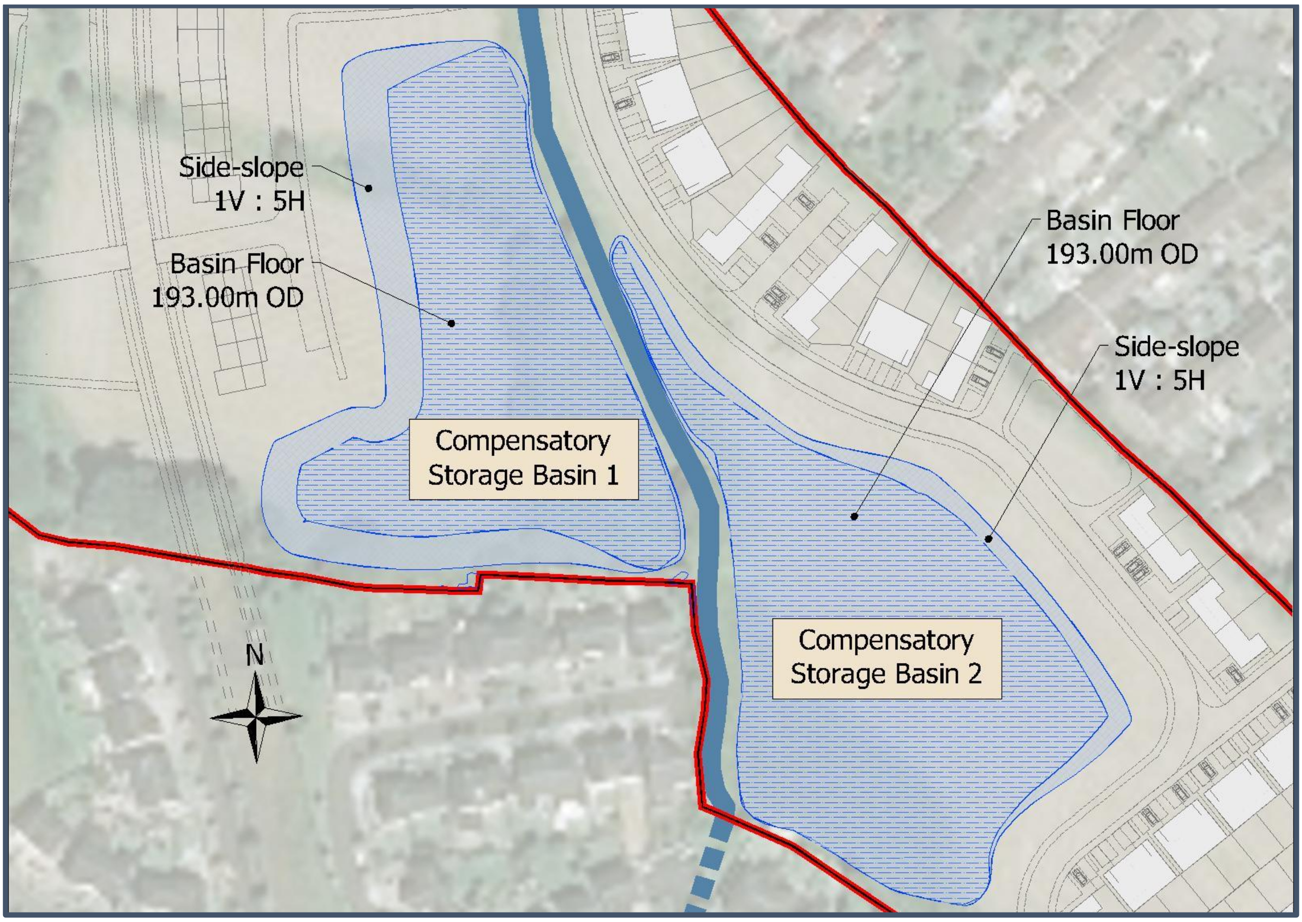


Figure 4-3 Compensatory Storage Basins

The industry standard package Infrastructure Ultimate Design Suite (by Autodesk) was used to create surface models for the existing site and for the finished level of the proposed development. Comparison models were then created using these surfaces.

Table 4-2 presents the results of this modelling and shows that for nearly all elevation intervals, the volume of compensatory storage provided actually exceeds the volume of floodplain storage displaced. There is loss of floodplain at only the highest levels. Cumulatively, significantly more floodplain storage will be available upon completion of the proposed development than is currently available, thereby reducing fluvial flood risk elsewhere.

Elevation (m OD)	Storage Available		Change in Storage
	Pre-Development	Post-Development	
193.00	663	799	136
193.10	754	1,645	891
193.20	853	1,703	850
193.30	956	1,749	793
193.40	1,060	1,789	729
193.50	1,164	1,828	664
193.60	1,277	1,875	598
193.70	1,426	1,937	511
193.80	1,562	2,016	454
193.90	1,703	2,109	406
194.00	1,821	2,171	350
194.10	1,931	2,224	293
194.20	2,041	2,270	229
194.30	2,164	2,312	148
194.40	2,309	2,353	44
194.50	2,489	2,394	-95
194.60	2,716	2,436	-280
194.70	2,995	2,490	-505
194.80	3,277	2,570	-707
		Cumulative change in Storage	5,509

Table 4-2 Available Floodplain Storage : Pre- and Post-Development

4.5 Flood Risk Zones Post-Development

Figure 4-4 shows the flood risk zones associated with the Stream Post-Development. Flood Risk zones are confined to open spaces and do not encroach on water-vulnerable elements of the proposed development. Peak water levels are effectively the same as pre-development:

- 1.0% AEP Flood Event 194.81m
- 0.1% AEP Flood Event 194.82m

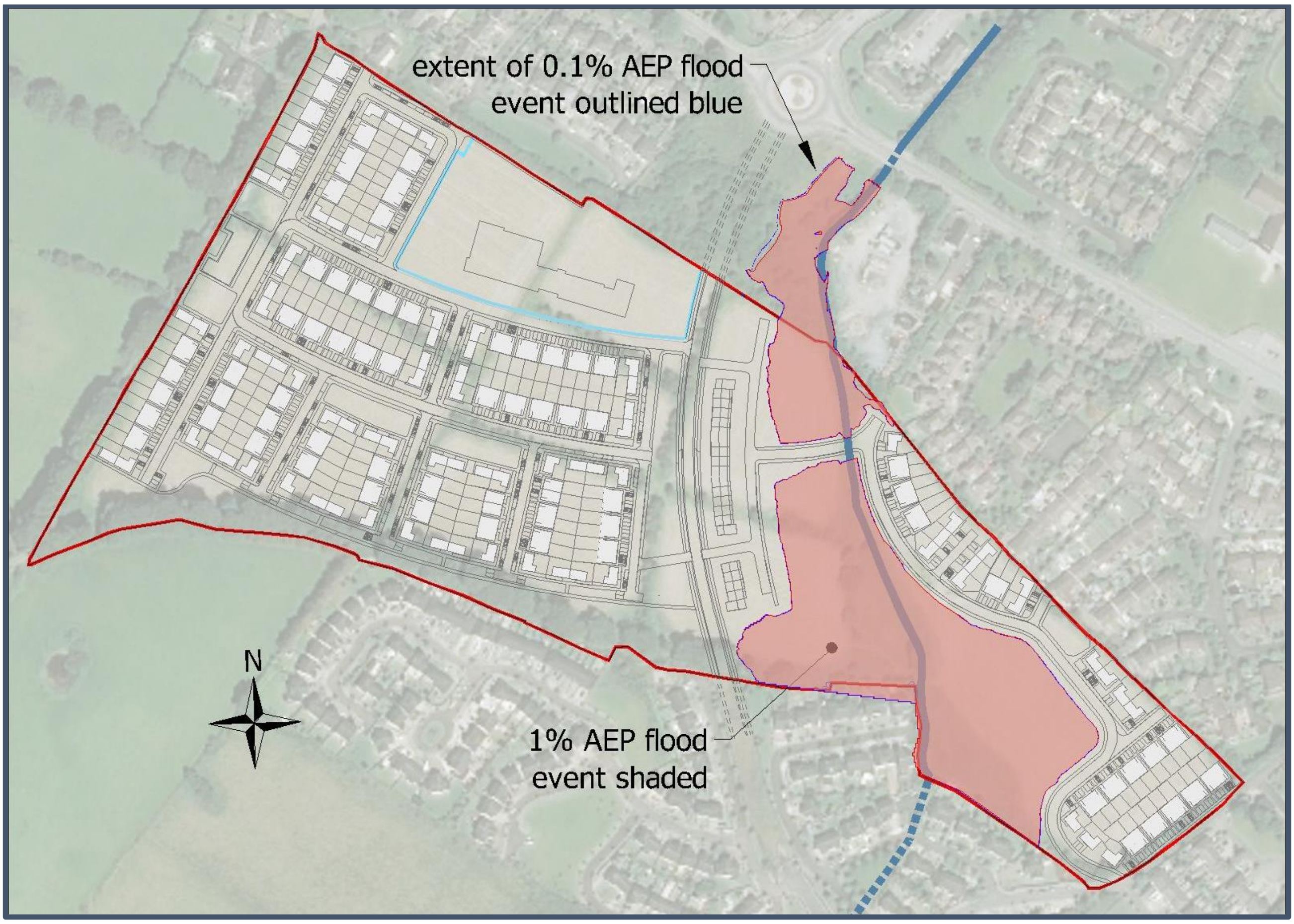


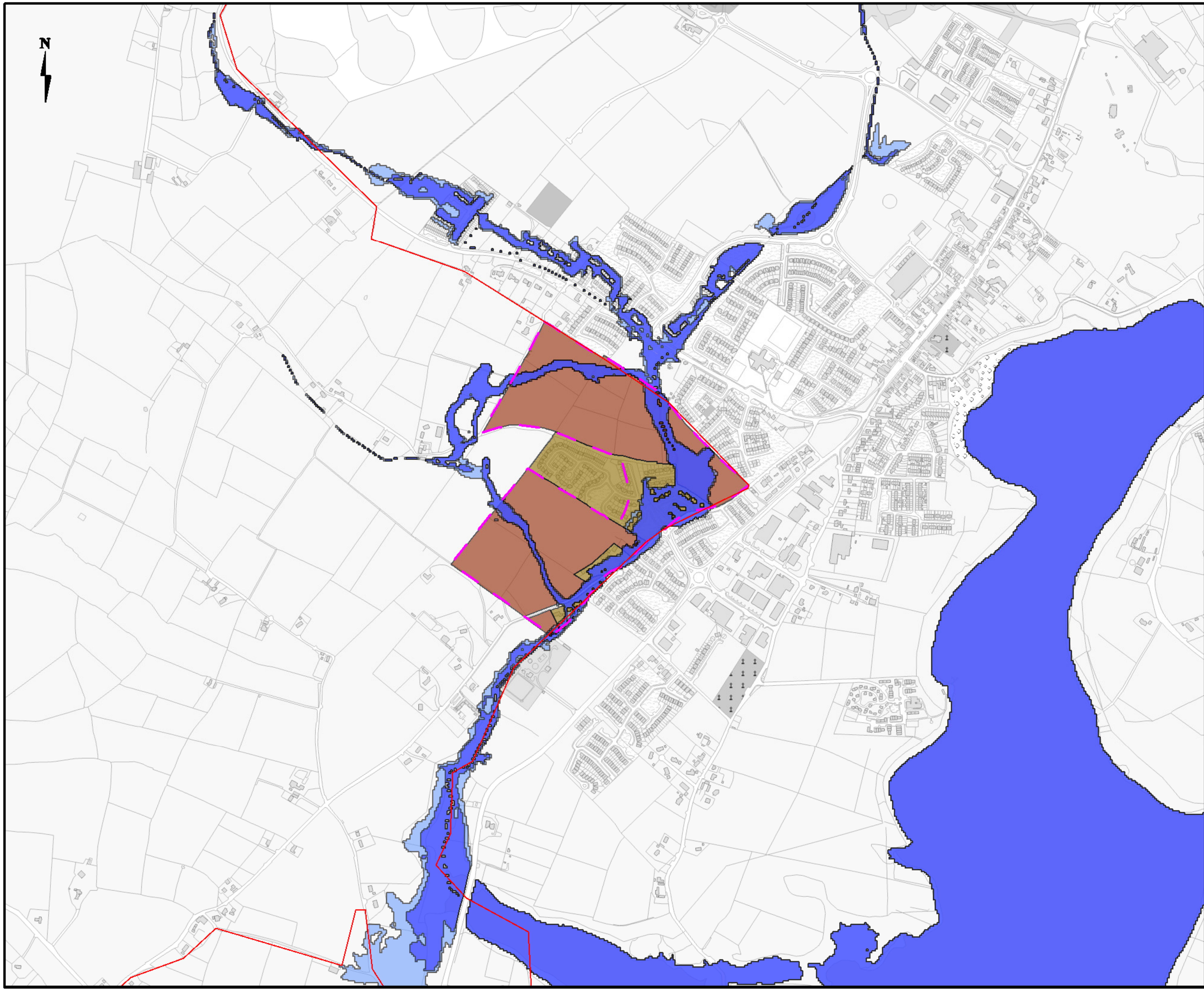
Figure 4-4 Flood Risk Zones Associated with Blessington Stream - Post-Development

4.6 Conclusion

The detailed assessment demonstrates that development of the eastern part of the Site is possible while achieving full compliance with the Flood Risk Management Guidelines.

Appendix A

Flood Risk Map for Blessington Environs (extract from SFRA for draft Development Plan 2023 – 2029)



Legend

- Flood Zone A - 1 % AEP Flood Extent (1 in 100 chance in any given year)
- Flood Zone B - 0.1% AEP Flood Extent (1 in 1000 chance in any given year)
- Indicative Flood Extents
- Defended Area
- Flood Risk Assessment
- County Boundary

Client: Kildare County Council

Project: *Strategic Flood Risk Assessment*

Title: Blessington Environs

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Issue Details

Drawn by:	RK	Project No.	MDW0710
Checked by:	BT	File Ref.	MDW0710Mi0014F01
Approved by:	SK		
Scale:	1:10,000 @ A3	Drawing No.	Mi0014
Date:	13/09/2016	Rev.	F01

Notes

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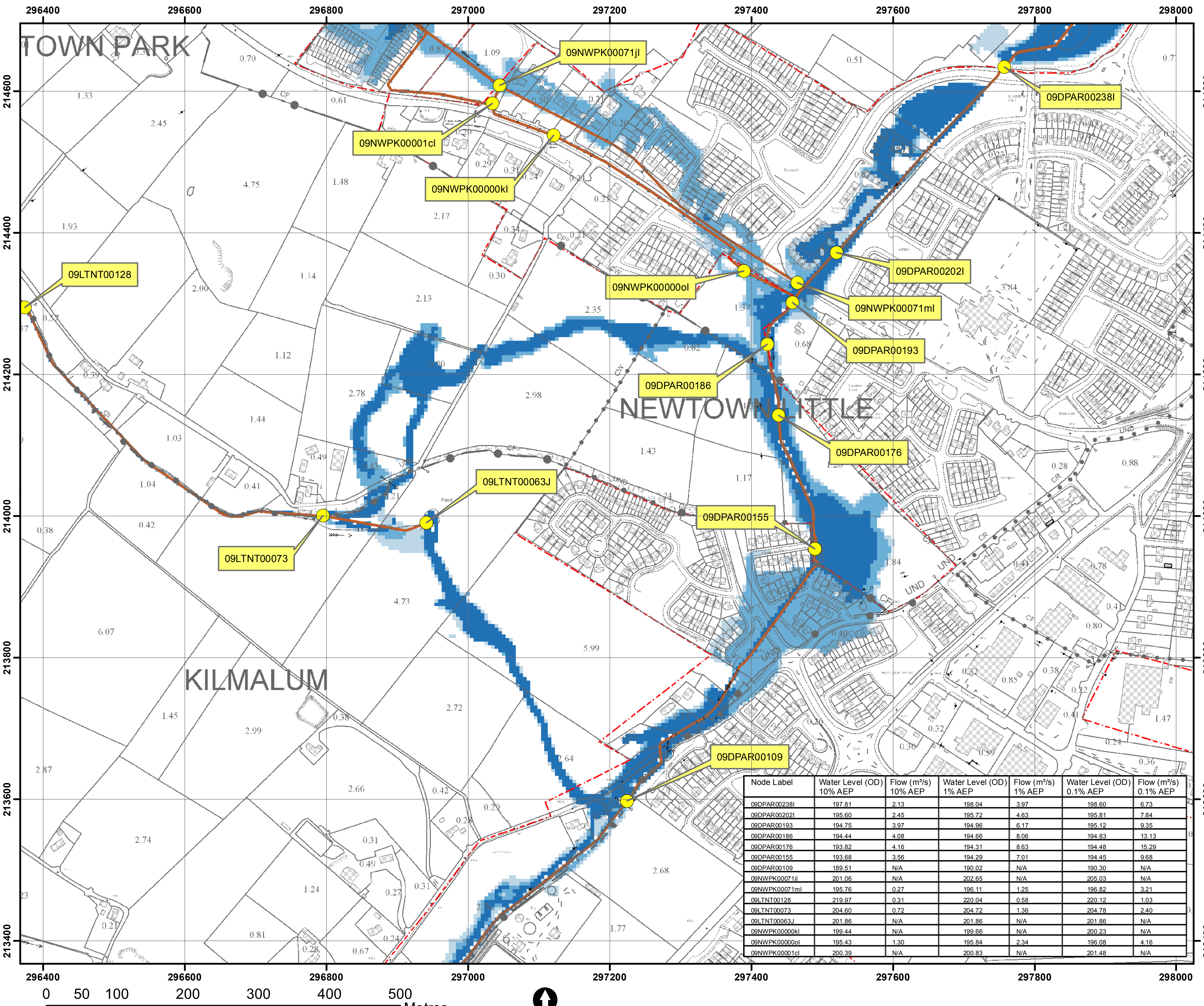
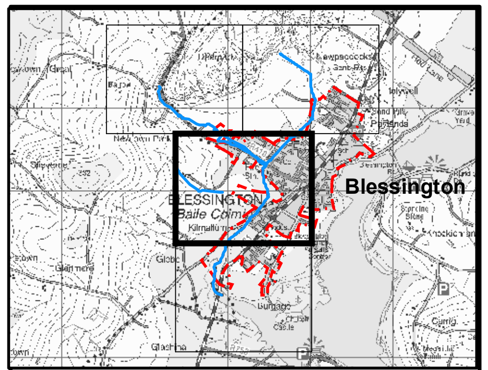
CFRAM Flood Risk Map



Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 1% AEP	Flow (m³/s) 1% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
09DPAR00238I	197.81	2.13	198.04	3.97	198.60	6.73
09DPAR00202I	195.60	2.45	195.72	4.63	195.81	7.84
09DPAR00193	194.75	3.97	194.96	6.17	195.12	9.35
09DPAR00186	194.44	4.08	194.66	8.06	194.83	13.13
09DPAR00176	193.82	4.16	194.31	8.63	194.48	15.29
09DPAR00155	193.68	3.56	194.29	7.01	194.45	9.68
09DPAR00109	189.51	N/A	190.02	N/A	190.30	N/A
09NWPK00071jl	201.06	N/A	202.65	N/A	205.03	N/A
09NWPK00071ml	195.76	0.27	196.11	1.25	196.82	3.21
09LTNT00128	219.97	0.31	220.04	0.58	220.12	1.03
09LTNT00073	204.60	0.72	204.72	1.36	204.78	2.40
09LTNT00063J	201.86	N/A	201.86	N/A	201.86	N/A
09NWPK00000kl	199.44	N/A	199.66	N/A	200.23	N/A
09NWPK00000ol	195.43	1.30	195.84	2.34	196.08	4.16
09NWPK00001cl	200.39	N/A	200.83	N/A	201.48	N/A



IMPORTANT USER NOTE:
THE VIEWER OF THIS MAP SHOULD REFER TO THE DISCLAIMER, GUIDANCE NOTES AND CONDITIONS OF USE THAT ACCOMPANY THIS MAP.

Legend

- 10% Fluvial AEP Event
- 1% Fluvial AEP Event
- 0.1% Fluvial AEP Event
- Modelled River Centreline
- AFA Extents
- Node Point
- Node ID: Node Label

FINAL

REV:	NOTE:	DATE:

EASTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

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Map:
Blessington Fluvial Flood Extent Maps

Map Type: EXTENT
Source: FLUVIAL
Map Area: HPW
Scenario: CURRENT

Drawn By : F.M.C. **Date :** 26 July 2016
Checked By : T.D. **Date :** 26 July 2016
Approved By : S.P. **Date :** 26 July 2016

Drawing No. :
E09BLE_EXFCD_F0_02

Map Series : 2 of 4

Drawing Scale : 1:5,000 @A3

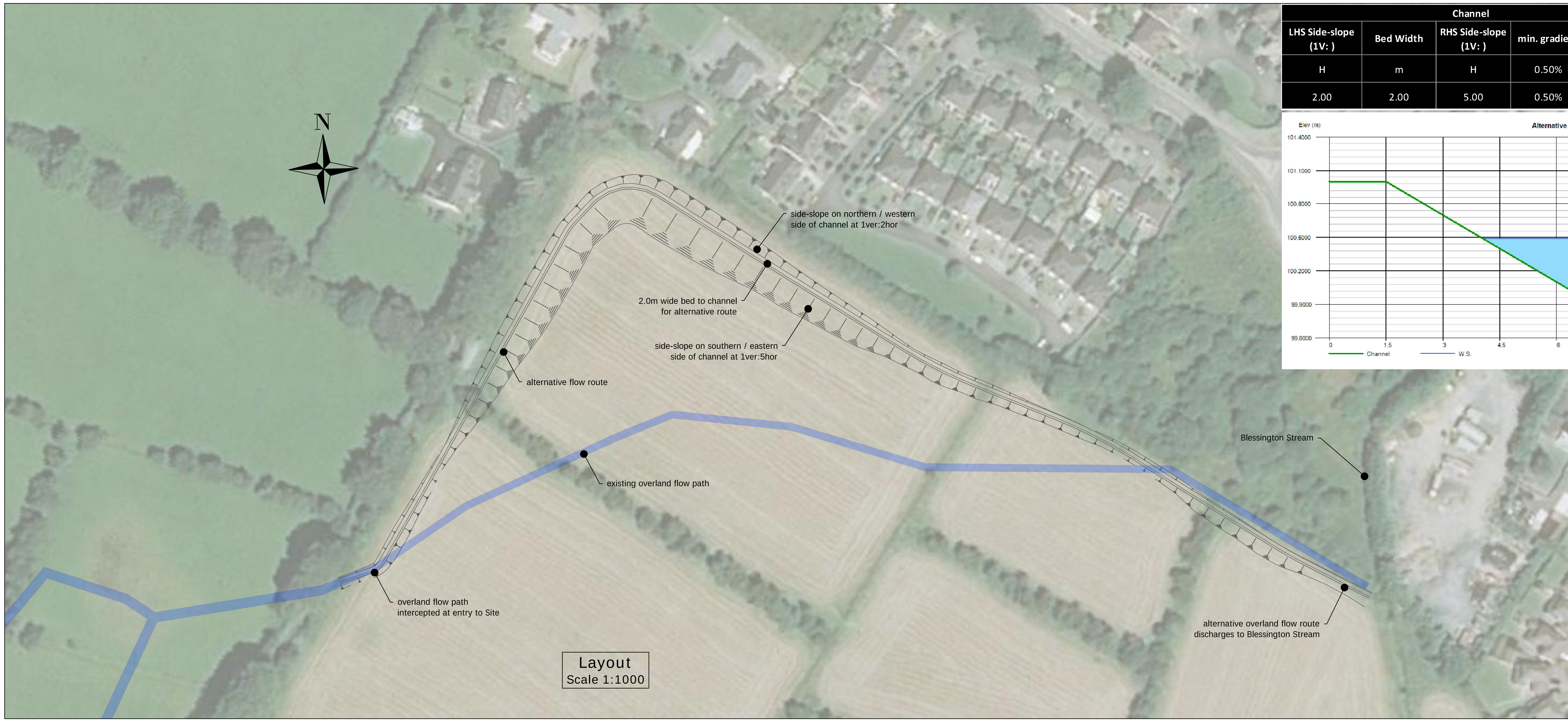
Appendix B

Estimation of Run-off from Catchment for Western Catchment

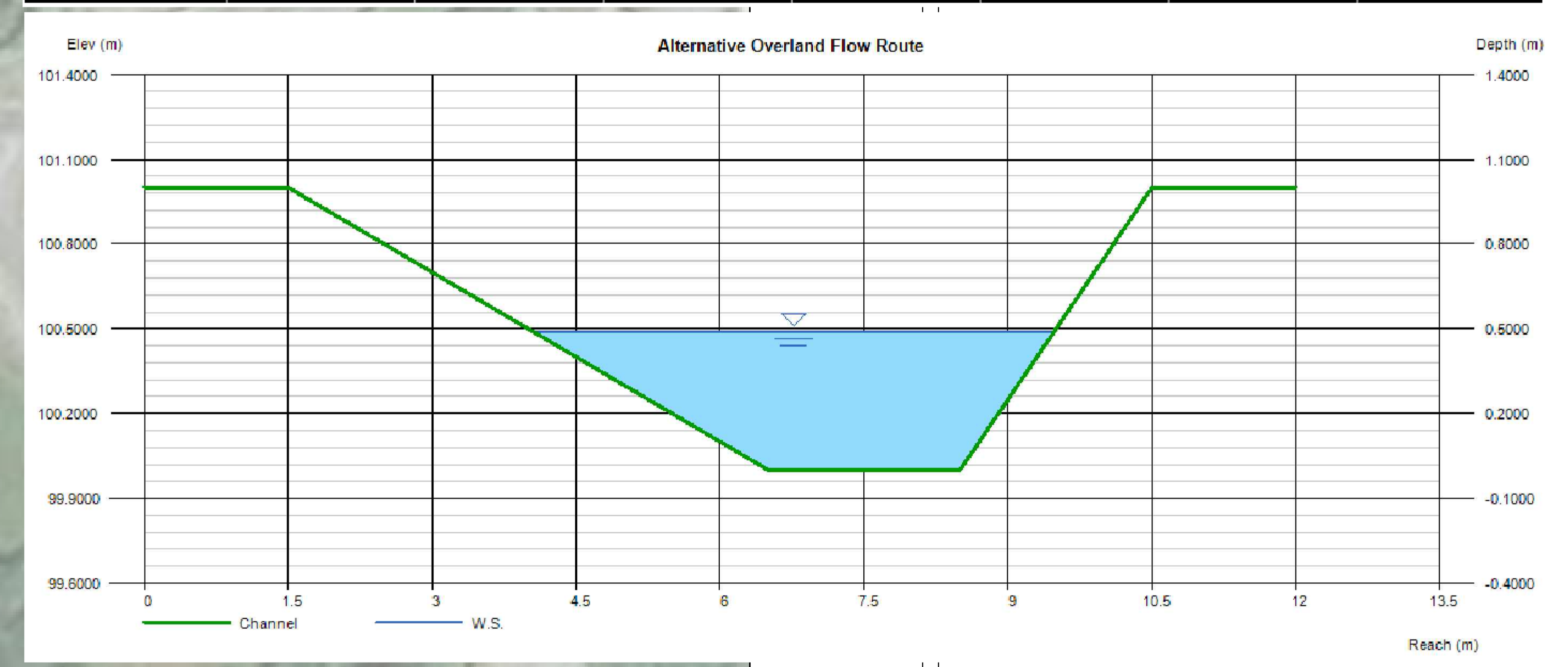
Estimation of Q_{100} For Blessington SSFRA - IH124			
Characteristic	**Value**	**Unit**	**Source**
Area (A)	0.8	km^2	FSU
Average Annual Rainfall (SAAR)	966	mm	
G1 % =	0	%	Fig I 4.18
G2 % =	100	%	Fig I 4.18
G3 % =	0	%	Fig I 4.18
G4 % =	0	%	Fig I 4.18
G5 % =	0	%	Fig I 4.18
Soil index (G) =	0.30	%	
$Q_{BAR\ RURAL}$ =	0.19	m3/sec	
CWI =	123		Fig I 6.62
CIND =	30.16		Eqn 7.2
NC =	0.69		Eqn 7.3
URBAN =	20.0	%	
$Q_{BAR\ URBAN}$ / $Q_{BAR\ RURAL}$ =	1.387		Eqn 7.4
Q_{BAR} =	0.268	m3/sec	
Q_{100} / Q_{BAR} (Ireland)	1.96		FSR - Ireland
$Q_{1,000}$ / Q_{BAR} (Ireland)	2.6		FSR - Ireland
Q_{100} =	0.524	m3/sec	
$Q_{1,000}$ =	0.696	m3/sec	
Factorial Error Factor =	1.651		Page 37 IOH124
Climate Change Factor =	1.2		GDSDS
Q_{100} =	**1.04**	**m3/sec**	
$Q_{1,000}$ =	**1.38**	**m3/sec**	

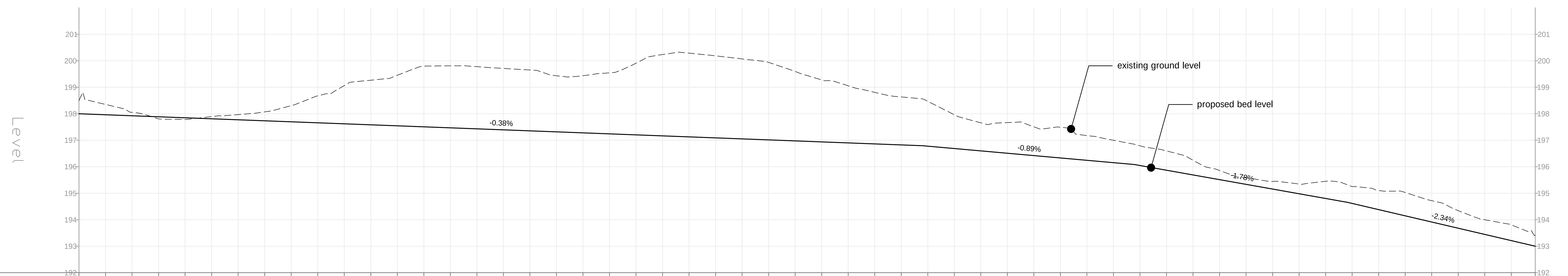
Appendix C

Details of Alternative Route for Overland Flow



Channel					Design Flow	Results	
LHS Side-slope (1V:)	Bed Width	RHS Side-slope (1V:)	min. gradient	n		Depth of Flow	Flow Velocity
H	m	H	0.50%	0.03	(m^3/s)	(m)	(m/s)
2.00	2.00	5.00	0.50%	0.03	2.00	0.49	1.11





Chainage	00.0m	10.0m	20.0m	30.0m	40.0m	50.0m	60.0m	70.0m	80.0m	90.0m	100.0m	110.0m	120.0m	130.0m	140.0m	150.0m	160.0m	170.0m	180.0m	190.0m
Finished Level	198.000	197.962	197.924	197.886	197.848	197.810	197.772	197.734	197.696	197.658	197.620	197.582	197.544	197.506	197.468	197.431	197.393	197.355	197.317	197.279
Existing Level	198.492	198.350	198.053	197.808	197.782	197.892	197.966	198.069	198.304	198.675	199.061	199.264	199.450	199.799	199.807	199.776	199.709	199.651	199.432	199.434
Level Difference	0.49	0.39	0.13	-0.08	-0.07	0.08	0.19	0.34	0.61	1.02	1.44	1.68	1.91	2.29	2.34	2.35	2.32	2.30	2.12	2.16

Chainage	200.0m	210.0m	220.0m	230.0m	240.0m	250.0m	260.0m	270.0m	280.0m	290.0m	300.0m	310.0m	320.0m	330.0m	340.0m	350.0m	360.0m	370.0m	380.0m	390.0m
Finished Level	197.241	197.203	197.165	197.127	197.089	197.051	197.013	196.975	196.937	196.899	196.861	196.823	196.776	196.687	196.598	196.509	196.420	196.331	196.242	196.153
Existing Level	199.541	199.905	200.234	200.286	200.183	200.067	199.937	199.595	199.274	199.053	198.806	198.633	198.469	197.962	197.657	197.664	197.507	197.489	197.175	196.999
Level Difference	2.30	2.70	3.07	3.16	3.09	3.02	2.92	2.62	2.34	2.15	1.94	1.81	1.69	1.28	1.06	1.16	1.09	1.16	0.93	0.85

Chainage	400.0m	410.0m	420.0m	430.0m	440.0m	450.0m	460.0m	470.0m	480.0m	490.0m	500.0m	510.0m	520.0m	530.0m	540.0m	549.0m
Finished Level	196.045	195.867	195.689	195.512	195.334	195.156	194.978	194.801	194.614	194.380	194.146	193.912	193.679	193.445	193.211	193.000
Existing Level	196.789	196.597	196.244	195.857	195.583	195.446	195.348	195.450	195.251	195.099	195.027	194.719	194.342	193.997	193.806	193.405
Level Difference	0.74	0.73	0.55	0.35	0.25	0.29	0.37	0.65	0.64	0.72	0.88	0.81	0.66	0.55	0.59	0.41

Profile Through Channel for Alternative Overland Flow Route
Scale H 1:1000 V 1:100

REV	DATE	BY	DETAILS

STATUS
FOR ZONING SUBMISSION PURPOSES ONLY. NOT TO BE USED FOR ANY OTHER PURPOSE.

CLIENT
KELLAND HOMES LTD.

PROJECT
ZONING SUBMISSION FOR LANDS AT NEWTOWN LITTLE & NEWTOWNPARK, BLESSINGTON, CO. KILDARE

TITLE
Alternative Overland Flow Route

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DRN:	DRAWING NO.:		REV.:
SC	20003-OFR-01		00
CHKD:	SCALE:	SIZE:	DATE:
PB	as shown @ A1	A1	23/05/22

Appendix D

Estimation of Peak Flow in Catchment of Blessington Stream

Estimation of Q_{100} For Blessington SSFRA - IH124

Characteristic	Value	Unit	Source
Area (A)	6.5	km^2	FSU
Average Annual Rainfall (SAAR)	966	mm	
G1 % =	0	%	Fig I 4.18
G2 % =	100	%	Fig I 4.18
G3 % =	0	%	Fig I 4.18
G4 % =	0	%	Fig I 4.18
G5 % =	0	%	Fig I 4.18
Soil index (G) =	0.30	%	
$Q_{BAR\ RURAL}$ =	1.30	m3/sec	
CWI =	123		Fig I 6.62
CIND =	30.16		Eqn 7.2
NC =	0.69		Eqn 7.3
URBAN =	20.0	%	
$Q_{BAR\ URBAN} / Q_{BAR\ RURAL}$ =	1.387		Eqn 7.4
Q_{BAR} =	1.801	m3/sec	
Q_{100} / Q_{BAR} (Ireland)	1.96		FSR - Ireland
$Q_{1,000} / Q_{BAR}$ (Ireland)	2.6		FSR - Ireland
Q_{100} =	3.529	m3/sec	
$Q_{1,000}$ =	4.682	m3/sec	
Factorial Error Factor =	1.651		Page 37 IOH124
Climate Change Factor =	1.2		GDSDS
Q_{100} =	**6.99**	**m3/sec**	
$Q_{1,000}$ =	**9.28**	**m3/sec**	