








APPENDIX B:

PHOTOS

Photos - On site visit 23/08/2010 to 27/08/2010							
Photo No01		Photo No02		Photo No03		Photo No04	
							
Photo No05		Photo No06		Photo No07		Photo No08	
							

Photos - On site visit 23/08/2010 to 27/08/2010							
Photo No09		Photo No10		Photo No11			
							
Photo No12							
							
Photo No13		Photo No14		Photo No15			
							

APPENDIX C:

ESTIMATION OF THE DESIGN FLOW FOR THE SIZING OF CULVERTS

CALCULATION NOTE



OFFICE OF PUBLIC WORKS

DEVELOPMENT OF ENGINEERING PROPOSALS FOR THE REINSTATEMENT OF CULVERTS ON THE N18 AND THE PROVISION OF NEW CULVERTS ON MINOR ROADS AT KILTARTAN

APPENDIX C

ESTIMATION OF THE PRELIMINARY DESIGN FLOW CALCULATION NOTE

The following is an outline of the hydrological calculations, methods used, and assumptions made.

1 METHOD NO1 : FLOOD STUDY REPORT, 1975 – 6 VARIABLE EQUATION

The Flood Studies Report published by the Natural Environment Research Council (NERC – London) in 1975 provides a number of different ways of predicting flows and volumes for a given return period event. For the application to flood estimation from ungauged natural catchments the most applicable procedure is the statistical approach based on catchment descriptors as set out in the formula below :

$$Q_{bar} = 0.0172 \times AREA^{0.94} \times STMFRQ^{0.27} \times SOIL^{1.23} \times RSMD^{1.03} \times S1085^{0.16} \times (1 - LAKE)^{-0.85}$$

Where :

Q_{bar} = 1 in 1 year flow (m³/s)

$AREA$ = Catchment Area (km²)

$STMFRQ$ = Stream Frequency in terms of the average number of stream junctions per km²

$S1085$ = Representative channel slope (in m/km) defined by points 10% and 85% upstream from the outflow point from the catchment

$SOIL$ = Index determined from five soil types defined by the winter rainfall acceptance potential (WRAP) map

$RSMD$ = Net one day five year rainfall minus the Soil Moisture Deficit (mm)

$LAKE$ = Index of lake area as proportion of total area

Numeric values are as follows :

Variable		Value	Source
AREA	Catchment Area in km ²	291.7	OS Discovery Series Maps
STMFRQ	Stream Frequency (stream junction per km ²)	0.5	OS Discovery Series Maps
S1085	Representative channel slope (in m/km)	3.2	OS Discovery Series Maps and topographical survey
SOIL	Index determined from five soil types	0.3	WRAP map
SAAR	Standard Average Annual Rainfall in mm	1200	Met Eireann
LAKE	Index of lake area as proportion of total area	1.33%	OS Discovery Series Maps

The RSMD value is given as follows :

$$RSMD = 2.48 \times \sqrt{SAAR} - 40$$

$$RSMD = 45.9 \text{ mm}$$

Using this method, the 1 in 1 year flow is as follows :

$$Q_{bar} = 0.0172 \times 291.7^{0.94} \times 0.5^{0.27} \times 0.3^{1.23} \times 45.9^{1.03} \times 3.2^{0.16} \times (1 - 1.33\%)^{-0.85}$$

$$Q_{bar} = 38.8 \text{ m}^3 / \text{s}$$

The 1 in 100 years flow Q_{100} is then generated using the regional curve formula recommended by FSR for Ireland :

$$Q_{100} = Q_{bar} \times (-3.33 + 4.2 \times 100^{1/20})$$

Using this method, the Q_{100} is as follows :

$$Q_{100} = 38.8 \times (-3.33 + 4.2 \times 100^{1/20}) = 76.0 \text{ m}^3 / \text{s}$$

2 METHOD NO2 : FLOOD STUDIES INSTITUTE OF HYDROLOGY REPORT NO124, 1994 (IH124)

The Institute of Hydrology Report No.124 (NERC – London) was published in 1994 and describes research for flood estimation in small catchments. The research was based on 71 small rural catchments. An adjusted regression equation was produced to calculate flows for small rural catchments. This methodology is generally applied to a catchment drained by a well defined watercourse and where the catchments are larger than 0.5km^2 . This is the latest and the current most accepted method for predicting flows. However, as there is no slope function, it has to be compared with one or more of the other methods.

$$Q_{bar} = 0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$$

Variables are already defined above.

Using this method, the 1 in 1 year flow Q_{bar} is as follows :

$$Q_{bar} = 0.00108 \times 291.7^{0.89} \times 1200^{1.17} \times 0.3^{2.17}$$

$$Q_{bar} = 42.7 \text{ m}^3 / \text{s}$$

The 1 in 100 years flow Q_{100} is then generated using the regional curve formula recommended by FSR for Ireland :

$$Q_{100} = Q_{bar} \times (-3.33 + 4.2 \times 100^{1/20})$$

Using this method, the Q_{100} is as follows :

$$Q_{100} = 42.7 \times (-3.33 + 4.2 \times 100^{1/20}) = 83.5 \text{ m}^3 / \text{s}$$

3 **METHOD NO3 : CRUPEDIX METHOD (DEPARTMENT OF AGRICULTURE – FRANCE)**

This method was issued in 1980 by the Department of Agriculture in France and provides a prediction of flows for catchments between 10 and 2,000km².

Parameters are as follows :

$$Q_{bar} = \text{1 in 1 year flow (m}^3/\text{s)}$$

$$AREA = \text{Catchment Area (km}^2\text{)}$$

$$P_{10} = \text{One day ten year rainfall (mm/day)}$$

Numeric values are as follows :

Variable		Value	Source
AREA	Catchment Area in km ²	291.7	OS Discovery Series Maps
P ₁₀	One day ten year rainfall (mm/day)	64	Bilham formula, 1935

Using this method, the 1 in 1 year flow is as follows :

$$Q_{bar} = 42.9 \text{ m}^3 / \text{s}$$

The 1 in 100 years flow Q_{100} is then generated using the regional curve formula recommended by FSR for Ireland :

$$Q_{100} = Q_{bar} \times (-3.33 + 4.2 \times 100^{1/20})$$

Using this method, the Q_{100} is as follows :

$$Q_{100} = 42.9 \times (-3.33 + 4.2 \times 100^{1/20}) = 83.9 \text{ m}^3 / \text{s}$$

APPENDIX D:

HYDROLOGICAL CALCULATION TABLES

Valid for Catchments > 20km²**Method : Flood Studies Report, 1975 - 6 Variable equation**

Area (km ²)	291.7	
C	0.017	C _{IRELAND}
Number of junctions	70	Number of junctions within catchment
STMFRQ	0.5	Average number of stream junctions per km ²
SOIL	0.3	Type of Soil from F.S.R.,1975
SAAR (mm)	1200.0	Standard Average Annual Rainfall
RSMD (mm)	45.9	Net one day five year rainfall minus the Soil Moisture Deficit (mm)
stream length (km)	43.3	Length within Catchment in km
Level at 10% distance (m)	16.0	10% Distance taken from outflow point
Level at 85% distance (m)	120.0	85% Distance taken from outflow point
S1085 (m/km)	3.2	Representative channel slope defined by points 10% and 85% upstream from the outflow point from the catchment
LAKE SURFACE (m ²)	3879440.0	
LAKE	1.330%	Index of lake area as proportion of total area
Qbar (m ³ /s)	38.8	Mean Annual Flood

Generating peak flow for any return period**Method : Flood Studies Report - Recommendation for Ireland**

Return Period T (years)	100.0	
Qbar (m ³ /s)	38.8	Mean annual Flood
QT (m ³ /s)	76.0	peak flow for return period choosen T

Valid for Catchments > 0.5km²

Method : IH 124

Area (km ²)	291.7	Type of Soil from F.S.R.,1975 Standard Average Annual Rainfall Mean Annual Flood
SOIL	0.3	
SAAR (mm)	1200.0	
Qbar (m ³ /s)	42.7	

Generating peak flow for any return period

Method : Flood Studies Report - Recommendation for Ireland

Return Period T (year)	100.0	Mean annual Flood peak flow for return period choosen T
Qbar (m ³ /s)	42.7	
QT (m ³ /s)	83.5	

Valid for Catchments between 10 and 2000km²**Method :** CRUPEDIX (Department of agriculture - France)

Area (km ²)	291.7	Rainfall for 10 years return period (in mm/day) Coeff = 1 in Britany Return period of rainfall event choosen peak flow for 10 years return period	
Rainfall (mm/j)	63.6		
Coeff R	1.0		
Return Period T (years)	10.0		
Q ₁₀ (m ³ /s)	59.3		
90% Confidence Lvl	29.6	118.6	peak flow to be expected between these values for 90% confidence level
70% Confidence Lvl	39.5	88.9	peak flow to be expected between these values for 70% confidence level

Generating peak flow for any return period**Method :** Flood Studies Report - Recommendation for Ireland

Return Period T (years)	100.00	Mean annual Flood peak flow for return period choosen T	
Q _{bar} (m ³ /s) - CRUPEDIX	42.88		
Q _T (m ³ /s) - CRUPEDIX	83.934		