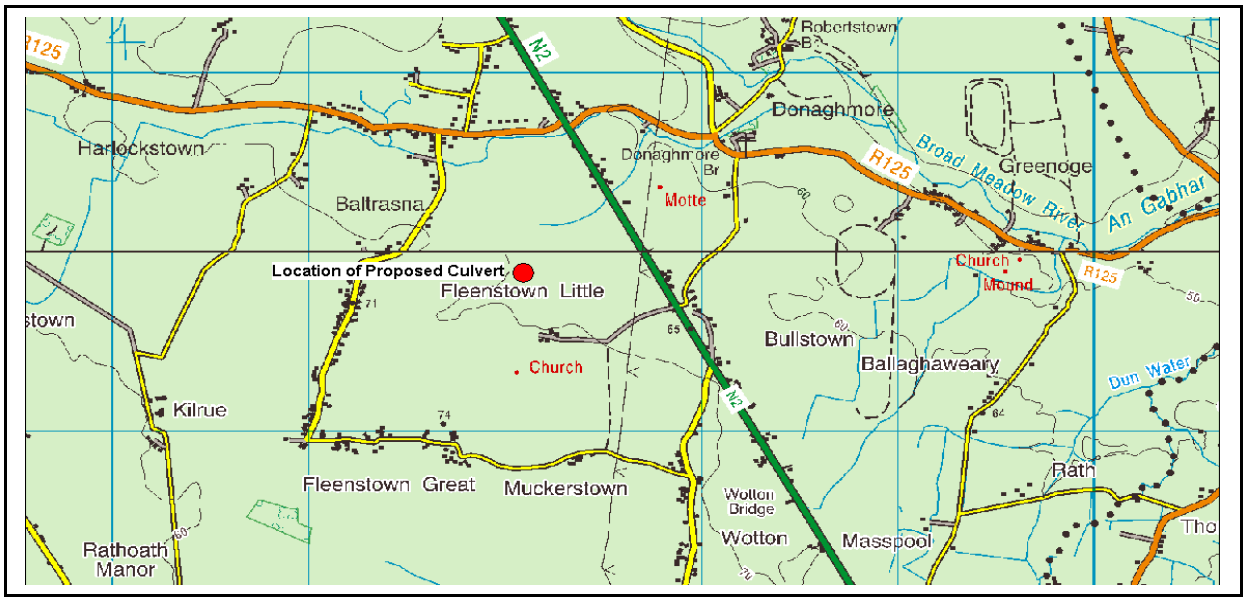
APPLICATION FORM AF-50:
CONSENT UNDER SECTION 50, ARTERIAL DRAINAGE ACT, 1945

APPLICATION DETAILS				
Name of Applicant:				
Company / authority:				
Address:				
Date of Application:				
Client (if appropriate):				
BRIDGE DETAILS				
Bridge Name: Culvert SC8A				
Purpose (ring appropriate box)	**Public Road**	Private Road	Footbridge	Other
Road Number (or Name): N2 Ashbourne Bypass				
River: **C1/6/1 Tributary River**		Catchment: Broadmeadow River		
County: **Meath**		Grid Reference: **E 307065.768, N 249834.209**		
Location: The culvert is located in the townland of Fleenstwon \Little Wesr of the Existing N2 between Finglas and Ashbourne				
Type of Works (ring appropriate box	New Bridge	Replacement Bridge	Alterations	



Location Map

Hydrological Calculations

Culvert SC8A

OPW standards for Section 50 consent have been revised since the submission of this application. This application is for illustrative purposes only. Some amendments and annotations have been made. No drawings have been provided with the examples. Please refer to the current Section 50 brochure for current standards.

1.0 Introduction

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

2.0 Catchments

Areas of catchments were determined from OS Discovery Series Maps with amendments following review of Office of Public Works drainage scheme channel maps and 6 inch to mile maps. The catchments over the full length of the new road scheme are shown on Drawing *CATCH 01.* Drawing *CATCH SC8A* shows the area of the catchment contributing to individual watercourses and culvert.

3.0 Estimation of Design Flood

3.1 Flood Studies Report, 1975 – 6 variable equation.

The six variable equation is not applicable to a catchment of the size contributing to the flow through culvert SC8A.

3.2 Institute of Hydrology Report No 124, 1994

Report No. 124 derives an equation to estimate flood flows for small rural catchments (less then 25km^2). The equation has a factorial standard error (fse) of 1.65

$$\mathbf{Qbar_{rural} = 0.00108 (AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17})}$$

The following are a list of the variables and how each one was determined.

	Variable	Value	Source
AREA	Catchment area km2	2.5	Drawing *CATCH 01*
SAAR	Standard Annual Rainfall	850	F.S.R Vol. V Fig. II 3.1
SOIL	Soil Index	0.3	F.S.R Vol. V Fig. I 4.18

A value of 850 mm for Mean Annual Rainfall was used in the calculations.

A high level of confidence cannot be ascribed to SOIL value from Fig. I 4.18 for such a small catchment. A SOIL value of 0.4 was used to allow for discrepancies.
Flow for 100 year return period (Q_{100}) was calculated by multiplying the results by a growth factor of 1.96 for Irish conditions, and the factorial standard error associated with the equation of 1.65.

Calculations using this method are summarised in *Table 2.*
The following additional information was obtained from Met Eireann Annual

Rainfall (30 years): Dunshauglin 853mm,
Dublin Airport 730mm
Rainfall Return: M5 2min = 2.9mm

3.3 OPW Flow Records

The catchment has been subjected to a drainage scheme and is maintained on a regular basis. Design flows (for a 3 year return period) on the watercourses under the auspices of the OPW along the road alignment were obtained from the OPW at a meeting, 11th February 2004. These records were adjusted for 100 year return period. The results are summarised in *Table 3.*

4.0 Conclusion

A Design Factor for factorial standard error of 1.65 was applied to the results of the Institute of Hydrology 124 equation.

As the channel forms part of a drainage scheme and is regularly maintained, a further factor of 1.6 was applied to the same results.

The results were compared and the greatest value was used for the design of culverts. The comparison of results are provided in *Table 4.*

The greatest value of flow at the culvert location is as follows.

Culvert SC8A 5.30m³/s

Table 2 Calculations of Q_{100} – Flood Report No 124

Culvert No	Area km sq	SAAR mm	SOIL index	Q_{BAR} m^3/s	Q_{100} m^3/s	Q_{100} x 1.65 fse m^3/s	(Q_{100} x 1.65) x 1.6 m3/s
SC8A	2.5	850	0.400	0.89	1.75	2.89	**4.63**

Table 3 Calculations of Q_{100} from OPW Records

Culvert No	OPW Watercourse No	Q_3 ft^3/s	Q_3 m^3/s	Q_{100} m^3/s
SC8A	C1/6/1	105	2.97	5.30

Table 4 Comparison of Results

Culvert No	FSR No 124	OPW	Greater Flow
SC8A	4.63	5.30	5.30

Hydraulic Calculations

Culvert SC8A

1.0 Structure Details

Upstream Bed Level	64.633	U/S Invert Level	64.458
Downstream Bed Level	64.363	D/S Invert Level	64.188
Length	64.399 m		

2.0 Preliminary Analysis of the Culvert

To ensure entry and exit head losses ($k*v^2/2g$) are kept to a minimum and that afflux due to structure (rise in water level) is within OPW guideline limits (max allowable afflux of 0.3m), a barrel velocity of approximately 2.0m/s or less is required. In addition, design is to allow for depression of the invert by 175mm and free surface flow with a minimum freeboard of 300mm. A 1.8m and 2.1m diameter pipe are considered.

Pipe Diameter (m)	Total Cross Sectional Area (m^2)	Bed Cross Sectional Area (m^2)	Freeboard Cross Sectional Area (m^2)	Effective Cross Sectional Area (m^2)	Velocity (m/s)
1.8	2.54	0.12	0.27	2.15	2.47
2.1	3.46	0.14	0.30	3.02	1.75

The preliminary analysis indicates that a 2.1m diameter pipe is required to avoid excessive head loss and provide a freeboard.

3.0 Detailed Analysis

A detailed analysis was undertaken using CulvertMaster® software (without allowance for depression of invert). A copy of the report is attached. A 2.1m

diameter pipe culvert is proposed. A headwater level of 66.35m is estimated which provides a freeboard of 0.38m.

Culvert Calculator Report
Culvert SC8A

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	66.38 m	Headwater Depth/Height	0.81
Computed Headwater Elevation	66.35 m	Discharge	5.3000 m³/s
Inlet Control HW Elev.	66.21 m	Tailwater Elevation	65.81 m
Outlet Control HW Elev.	66.35 m	Control Type	Outlet Control

Grades			
Upstream Invert	64.63 m	Downstream Invert	64.36 m
Length	64.40 m	Constructed Slope	0.004193 m/m

Hydraulic Profile			
Profile	S1	Depth, Downstream	1.45 m
Slope Type	Steep	Normal Depth	1.01 m
Flow Regime	Subcritical	Critical Depth	1.09 m
Velocity Downstream	2.05 m/s	Critical Slope	0.003235 m/m

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.13 m
Section Size	2100 mm	Rise	2.13 m
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	66.35 m	Upstream Velocity Head	0.41 m
Ke	0.50	Entrance Loss	0.20 m

Inlet Control Properties			
Inlet Control HW Elev.	66.21 m	Flow Control	N/A
Inlet Type	Square edge w/headwall	Area Full	3.6 m²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		