

# N77 Ballyragget Village to Ballynaslee Road Improvement Scheme

Flood Risk Assessment

Kilkenny County Council

November 2020



# Notice

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## Document history

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# 1. Introduction

Atkins were commissioned by Kilkenny County Council (KCC) to prepare a Flood Risk Assessment (FRA) in relation to the N77 Ballyragget Village to Ballynaslee Road Improvement Scheme.

## 1.1. Relevant Guidance

This FRA has been undertaken in consideration with 'The Planning System and Flood Risk Management – Guidelines for Planning Authorities' DOEHLG November 2009, which is the latest guidance document.

The guidance has been issued to ensure that flood risk is a key consideration for developers, planning & regional authorities and the public in preparing and submitting development proposals. The principles of the guidance are as follows:

- Avoid the risk, where possible
- Substitute less vulnerable users, where avoidance is not possible, and
- Mitigate and manage the risk, where avoidance and substitution are not possible

A staged approach is recommended within the guidance document in relation to identifying and assessing flood risk. The three stages of appraisal and assessment are as follows:

- Stage 1 Flood risk identification
- Stage 2 Initial flood risk assessment
- Stage 3 Detailed flood risk assessment

## 1.2. Flood Risk

Flood risk can be quantified by relating the probability of the flood event occurring to the consequence of the flood. Probability, in flood event terms, is gauged by potential annual occurrence/return period and flood consequence is dependent on the nature of the flood hazard and the vulnerability of the inundated area. The source-pathway-receptor model considers the components of flood risk.



The source is the hazard with the potential to cause harm through flooding (e.g. rainfall, high sea levels). The pathway is the mechanism by which the source can affect the receptor (e.g. inadequate drainage, overtopping of coastal defences) and finally, the receptor is anything which is affected by the flood event (e.g. people, infrastructure, property).

## 1.3. Causes of Flooding

The Planning System and Flood Risk Management Guidelines requires a FRA to consider all potential causes of flooding including the following:

- Coastal flooding
- Inland flooding
  - Overland flow
  - River flooding
  - Flooding from artificial drainage systems
  - Groundwater flooding
  - Estuarial flooding
- Failure of infrastructure

## 1.4. Floodplains

A river flood plain is a low-lying area which receives excess flood water when the flow within the watercourse exceeds the capacity of the channel. A coastal flood plain is an area which, during high tide or increased sea levels, becomes inundated with sea water.

## 1.5. Assessing Flood Risk

In the context of the 'Planning System and Flood Risk Management Guidelines, DOEHLG, 2009' three flood zones are designated in the consideration of flood risk to a particular site. The three flood zones are described in Table 1-1 below.

**Table 1-1 Flood Zone Description**

<b>Flood Zone</b>	<b>Description</b>
Flood 'Zone A'	where the probability of flooding is the highest (greater than 1% or 1 in 100 year for watercourse flooding or 0.5% or 1 in 200 for coastal flooding).
Flood 'Zone B'	where the probability of flooding is moderate (between 0.1% or 1 in 1000 year and 1% or 1 in 100 year for watercourse flooding, and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding).
Flood 'Zone C'	where the probability of flooding is low or negligible (less than 0.1% or 1 in 1000 year for both watercourse and coastal flooding). Flood Zone 'C' covers all areas which are not in Zones 'A' or 'B'.

The planning implications for each of the flood zones are:

**Zone A - High probability of flooding.** Most types of development would be considered inappropriate in this zone. Development in this zone should be avoided and/or only considered in exceptional circumstances, such as in city and town centres, or in the case of essential infrastructure that cannot be located elsewhere, and where the Justification Test has been applied. Only water-compatible development, such as docks and marinas, dockside activities that require a waterside location, amenity open space, outdoor sports and recreation, would be considered appropriate in this zone.

**Zone B - Moderate probability of flooding.** Highly vulnerable development, such as hospitals, residential care homes, Garda, fire and ambulance stations, dwelling houses and primary strategic transport and utilities infrastructure, would generally be considered inappropriate in this zone, unless the requirements of the Justification Test can be met. Less vulnerable development, such as retail, commercial and industrial uses, sites used for short-let for caravans and camping and secondary strategic transport and utilities infrastructure, and water-compatible development might be considered appropriate in this zone. In general however, less vulnerable development should only be considered in this zone if adequate lands or sites are not available in Zone C and subject to a flood risk assessment to the appropriate level of detail to demonstrate that flood risk to and from the development can or will adequately be managed.

**Zone C - Low probability of flooding.** Development in this zone is appropriate from a flood risk perspective (subject to assessment of flood hazard from sources other than rivers and the coast) but would need to meet the normal range of other proper planning and sustainable development considerations.

## 2. Scheme Description

### 2.1. Scheme Location

The proposed scheme is located over a 2.44km section of the existing N77 carriageway between Ballyragget Village and Ballynaslee, Co. Kilkenny. The purpose of the scheme is to improve and upgrade this existing section of carriageway which is proposed to be achieved by road widening and partial offline realignment. The general scheme extents are displayed in Figure 2-1 below.

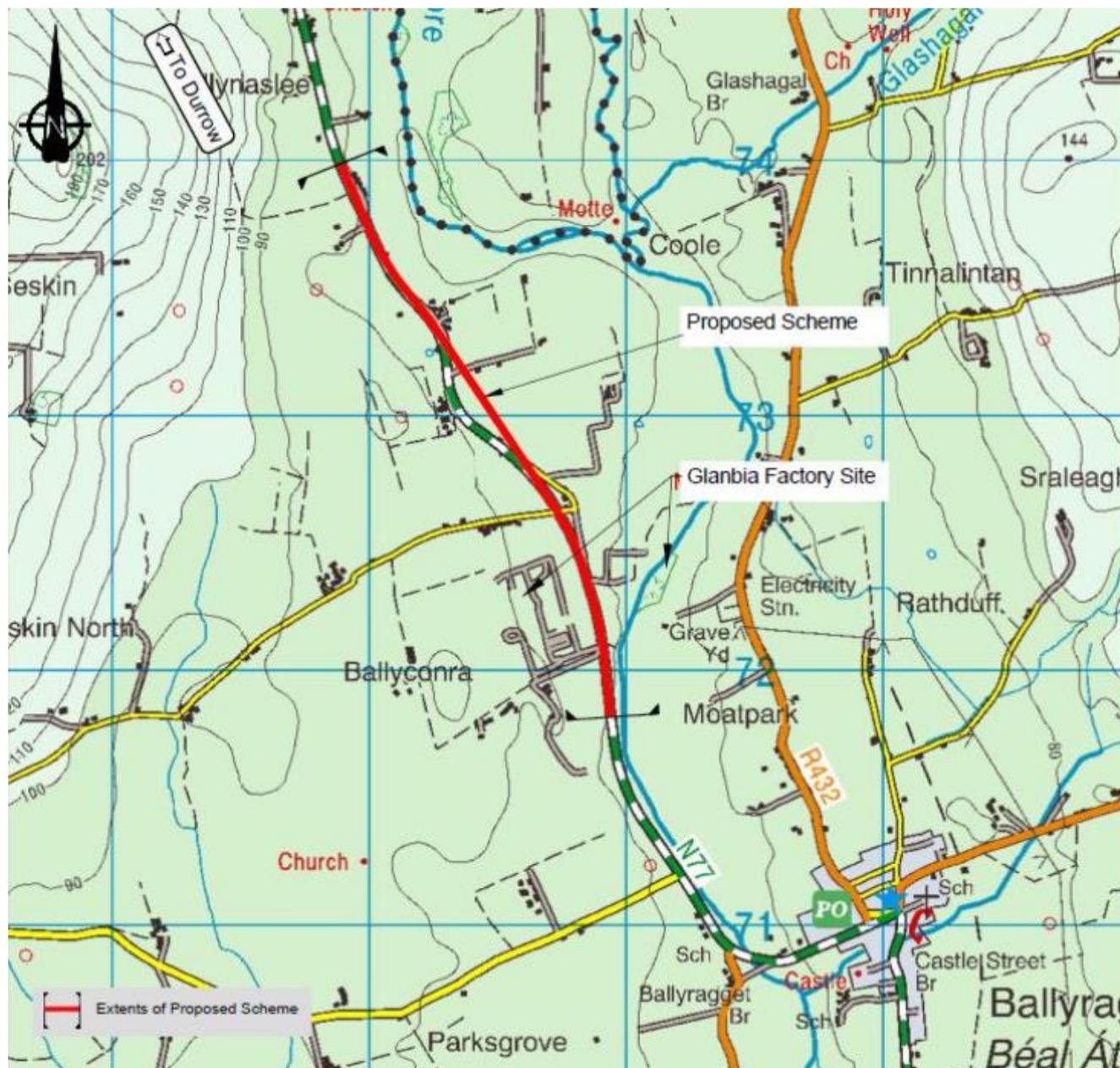


Figure 2-1 - Scheme Location

### 2.2. Existing Conditions

The existing section of the N77 under review is a single carriageway National Secondary Route road with a 100km/h speed limit. The carriageways narrowest section spans for approximately 1km with single carriage way lane widths of 3.5-3.6m wide and 0.2-0.5m wide hard shoulder strips. Grassed verges bound the existing carriageway beyond the hard shoulder extents. Surface water from the southernmost section of the existing carriageway (approximately 400m) is collected via a network of road gullies and conveyed in a southerly

direction towards Ballyragget within a closed drainage system. Surface water drainage from the vicinity of the entrance to the Glanbia's Ballyragget Plant discharges into a drainage system which ultimately makes its way to the Glanbia Wastewater Treatment Plant. There is no surface water drainage system in place along the remainder of the existing carriageway. Over edge surface water falls across the carriageway and onto the grassed verge where it infiltrates into the surrounding ground over time.

Due to the scheme's rural location, the general land use is agricultural with a small number of detached residential houses accessed directly off the existing carriageway. Most notably, Glanbia's Ballyragget Plant is located to the south west of the scheme and is accessed via the section of N77 under review.

### 2.3. Topography

The existing ground and road levels along the scheme generally increase steadily in a northerly direction from 66.610mOD at the southern tie in point to 79.681mOD at the northern extents. Areas of localised depressions in the existing ground and road topography are present along the scheme extents as displayed within the long sections contained within the General Arrangement Drawings submitted as part of the planning application. The lands surrounding the existing carriageway are relatively shallow in topography.

Beyond the immediate site extents, areas of high ground bound the existing road to the east and west which both naturally fall towards the River Nore watercourse. Figure 2-2 below displays the contours surrounding the scheme area, obtained from the GeoHive website viewer.

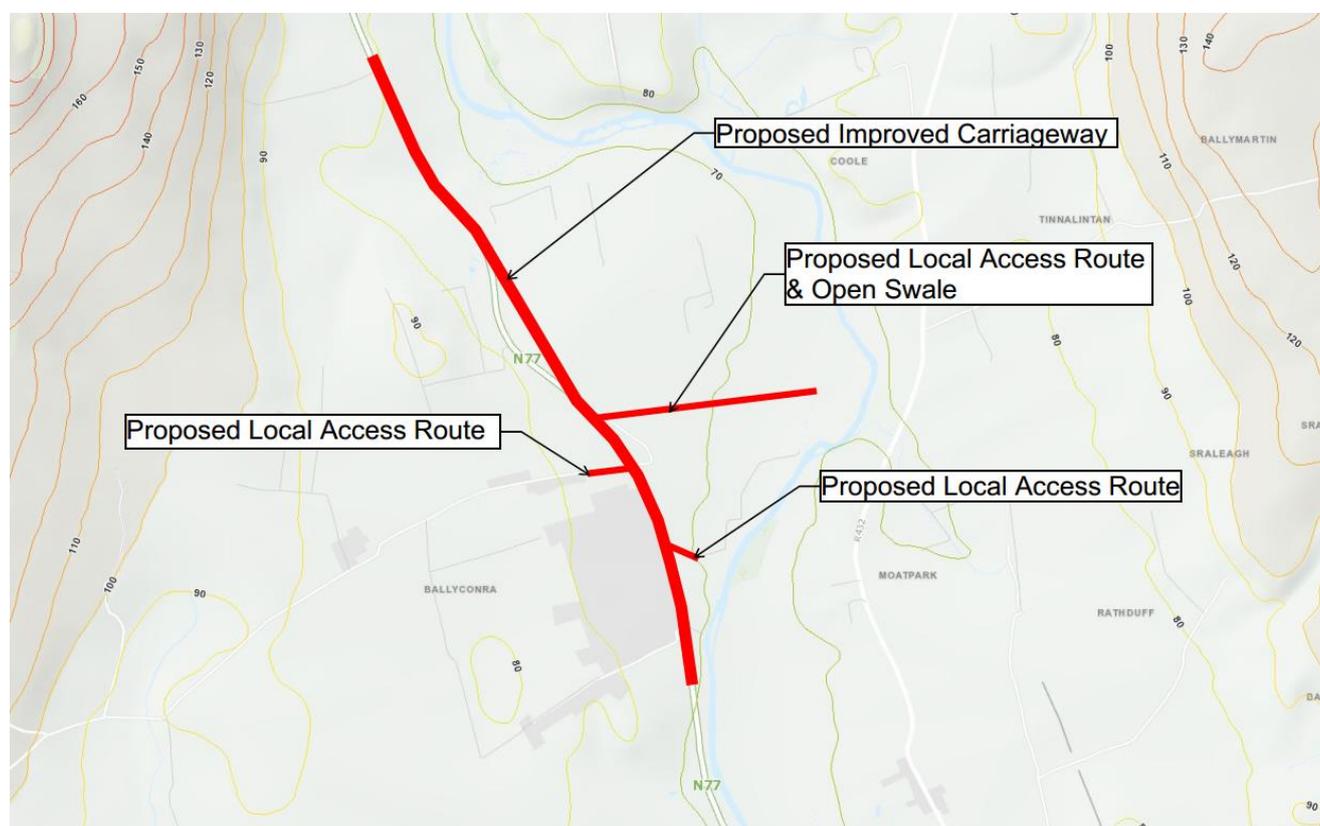
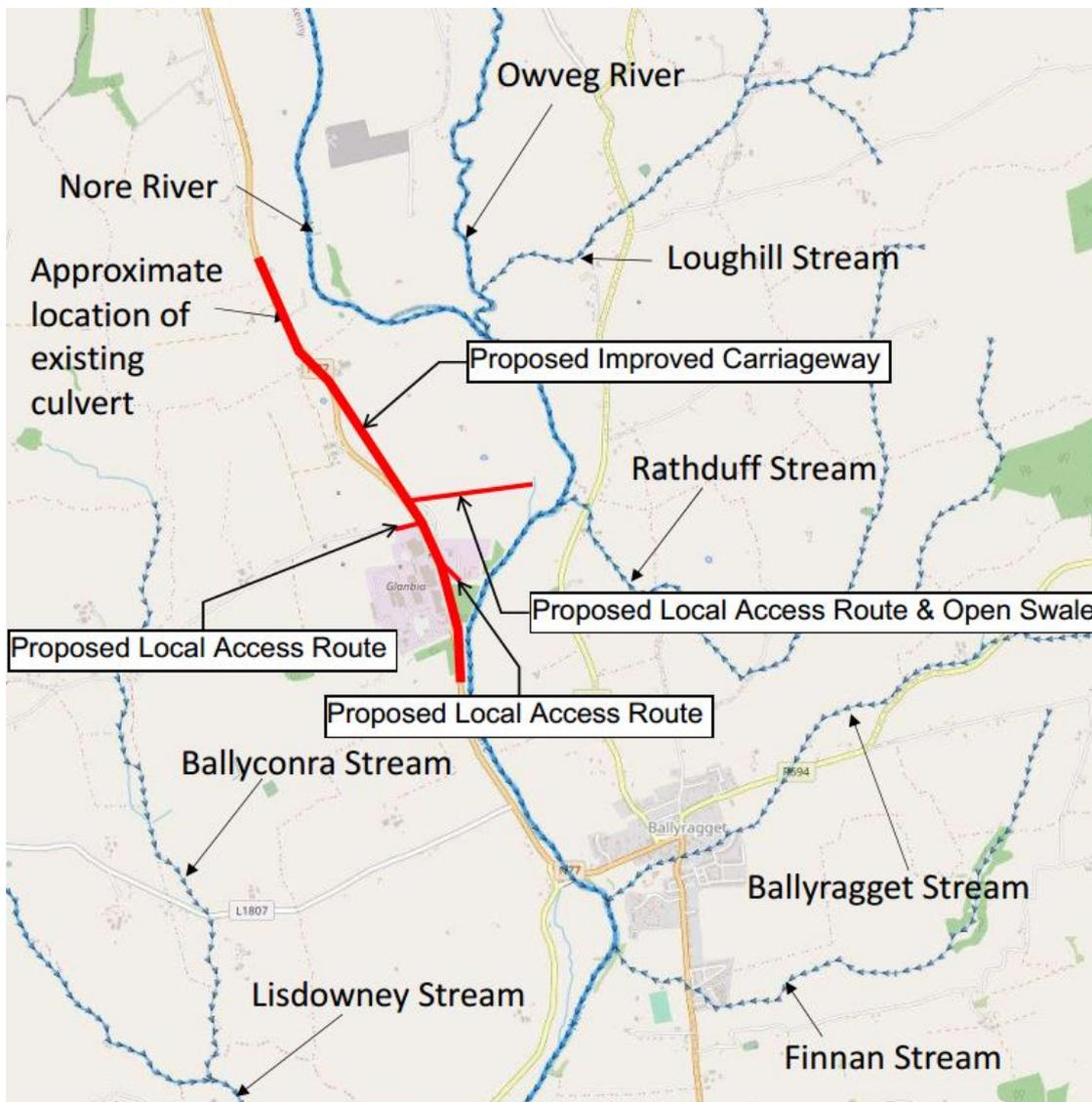


Figure 2-2 - Local Topography (GeoHive Viewer)

### 2.4. Local Hydrology

The River Nore (IE\_SE\_15N011400) flows in a southerly direction to the eastern extent of the proposed scheme. The watercourse originates in Clonakenny, Co Tipperary approximately 55km upstream of Ballyragget Village. The River Nore's catchment upstream of the proposed road improvement extents is 1,059km<sup>2</sup>, refer to Appendix A for further catchment characteristics, downloaded from the online Environmental Protection Agency's (EPA) Hydrometric Data System Tool (<http://watermaps.wfdireland.ie/HydroTool/Default.aspx>). From Ballyragget Village the river continues in a southerly direction for approximately 65km before discharging to the River Barrow.

Figure 2-3 below displays the local hydrology surrounding the proposed scheme extracted from the Envision website which is the EPA's interactive map viewer. Due to the alignment of the watercourse its proximity to the existing carriageway varies from approximately 900m at the middle section to 35m at the southern scheme extent.



**Figure 2-3 - Local Hydrology (EPA Envision)**

The Drainage Layout Drawings, submitted as part of the planning application, indicate the presence of an existing damaged culvert approximately 390m south of the northern tie in point. This existing channel was identified during site investigations and is not noted within the Ordnance Survey Historic Maps (6-inch or 25-inch).

Figure 2-4 below displays the upstream end of the culvert taken in early 2020 following a period of heavy rainfall. Initial site investigations estimate the upstream section of the box culvert as approximately 450/550mm wide X 400mm high. Downstream, the culvert has been extended with a 450mm diameter concrete pipe. Further site investigations, including a subsurface utility and a CCTV survey, are scheduled to confirm the existing culvert arrangement.



**Figure 2-4 - Existing Damaged Culvert**

## 2.5. Geology

A review of the Geological Survey of Ireland (GSI) online maps has identified that the scheme extents are underlain by gravels derived from Limestones and fall within a regionally important gravel aquifer.

## 2.6. Proposed Development

### 2.6.1. Road Improvement Works

This existing stretch of N77 is limited because of its cross-sections and sub-standard alignment, which contribute to the absence of overtaking opportunities and inconsistent traffic flow regimes on the route. The proposed improvement works will provide safe overtaking opportunities, increase overall consistency and efficiency of the route and provide safer and more time efficient journeys. The proposed works will also provide safer access for Vulnerable Road Users (VRUs).

KCC proposes to improve the N77 route between Ballyragget Village and Ballynaslee in Co. Kilkenny, a single carriageway road with a 100kph speed limit. The proposed development will consist of the N77 Ballyragget Village to Ballynaslee Road Improvement Scheme, north of Ballyragget Village, in the townlands of Ballyconra and Ballynaslee, in County Kilkenny. The proposed development will consist of the realignment of a 2.44km section of the N77 to remove a bend immediately to the north of the Glanbia plant at Ballyragget, County Kilkenny. The proposed development will commence c. 250m south of the Glanbia plant at Ballyragget and extend northwards to tie in to the recently completed N77 Ballynaslee Realignment Scheme. The works will consist of 1740m of online realignment and 700m of offline realignment works, with associated drainage, including attenuation pond and swales; fencing; safety barriers; kerb line; signage; and all site development and landscaping works.

The overall aim of this scheme is to improve the consistency, accessibility and safety of the existing stretch of this route, and the relevant objectives are as follows (N77 Ballyragget Village to Ballynaslee Improvement Scheme Preliminary Design Report -Tramore House Regional Design Office THRDO, 2020);

- To provide a suitable structural pavement to cater for existing and future traffic needs, including the anticipated increase in heavy vehicle trips as indicated within the Transport Infrastructure Ireland (TII) National Transport Model NTpM;
- To improve the existing access arrangement at the Glanbia Plant having regard to the current TII DMRB and the volume of heavy vehicle trip movements to and from the plant; and,
- To provide safer and more efficient accessibility to the N77 route to the local community and all VRUs.

This proposed route is in accordance with an objective of Kilkenny County Council Development Plan 2014-2020 as follows:

To develop and agree an appropriately planned policy response to access for Glanbia and the Leggetsrath roundabout in conjunction with the National Roads Authority (KCC, 2014).’

The type of road proposed to be constructed is a Type 1 Single Carriageway cross-section, all-purpose road with a 3.65m carriageway, a 2.5m hard shoulder and 3m grass verge in each direction constructed to the geometric standards of TII Publication DN-GEO-03031 (Rural Road Link Design). The cross section is identified in Figure 2-5 below.

The proposed geometric alignment of the scheme has been designed in accordance with TII Design Manual for Roads and Bridges and in particular DN-GEO-03030, DN-GEO-03031 and DN-GEO-03060.

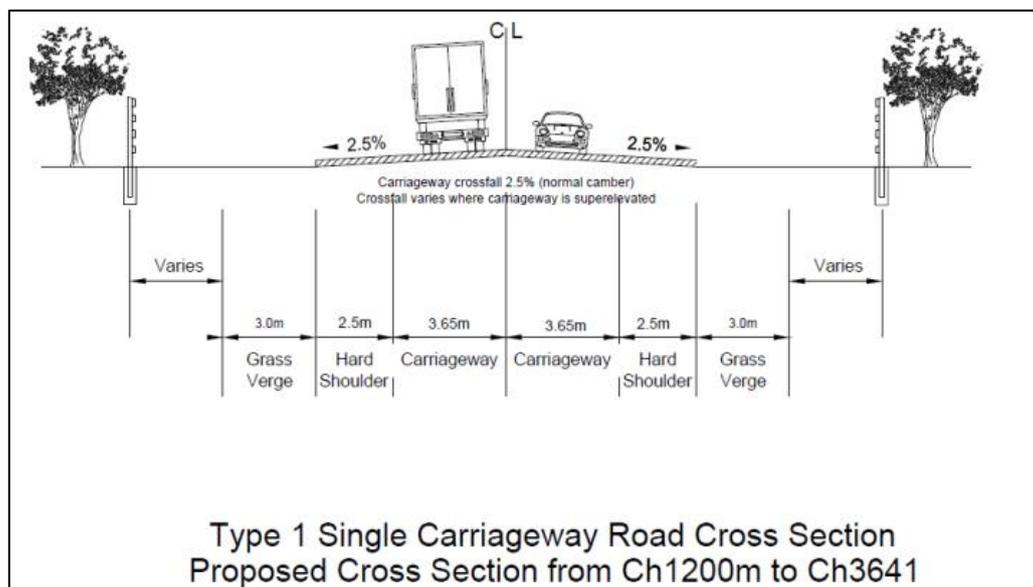


Figure 2-5 – TII Type 1 Single Carriageway

## 2.6.2. Drainage Design

A full preliminary surface water drainage design has been undertaken by Tramore House Regional Design Office to accompany the planning application. The drainage design includes discharging sections of the proposed upgraded road to existing networks to the north and south of the scheme, provision of bypass petrol interceptors, filter drains, conventional gully to closed network systems, attenuation pond to cater for the 1 in 100-year event, an infiltration trench, spillway and open swale. Ground investigations including infiltration testing, groundwater analysis and standpipe installation were undertaken to inform the drainage design. Full details of the drainage design can be found in the Drainage Layout Drawings and Preliminary Design Report.

With regards to the existing damaged culvert, it is noted within the Drainage Layout Drawings that the existing culvert will be replaced with a new 1m wide X 1m high box culvert.

# 3. Flood Risk Identification

## 3.1. Flood Risk Investigation

In accordance with the planning guidelines, a *Stage 1 Flood Risk Identification* is required to be undertaken to identify if there are any flooding or surface water management issues related to the proposed development that may warrant further investigation. Initially, the following possible flood mechanisms for the N77 Ballyragget Village to Ballynaslee Road Improvement Scheme have been identified:

Table 3-1 Possible Flooding Mechanisms

Source/Pathway	Significant?	Comment/Reason
Coastal flooding	No	The proposed road improvement scheme is not located in a coastal area.
Overland flow	No	The immediate surrounding topography is relatively shallow and consists largely of greenfield agricultural areas.

Source/Pathway	Significant?	Comment/Reason
River flooding	Yes	The proposed road improvement scheme is adjacent to the River Nore.
Flooding from artificial drainage systems	No	There are no significant urban drainage infrastructure elements in the immediate vicinity of the proposed road improvement scheme. The existing surface water drainage network within the southern extent of the scheme is not deemed to be significant. A full preliminary drainage design has been undertaken (by others) for the proposed scheme which has been informed by on-site ground investigations. Therefore, the risk of flooding from the proposed new artificial drainage system is also not deemed significant.
Groundwater flooding	No	There are no significant springs or groundwater discharges recorded in the immediate vicinity of the proposed road improvement scheme.
Estuarial flooding	No	The proposed road improvement scheme is not located in an estuarial area.
Failure of infrastructure	No	One hydraulic structure has been identified in the direct vicinity of the proposed road improvement scheme – the existing damaged culvert, see Section 2.4 for further details. It is noted in the Drainage Layout Drawings that the existing damaged culvert will be replaced with a new 1m wide X 1m high box culvert. The culvert (which has been designed by others) has been sized accordingly to convey the Q100 + climate change flow, therefore the risk of flooding from failure of infrastructure is not deemed to be significant.

Table 3-1 above demonstrates that the proposed road improvement scheme is potentially at risk of fluvial flooding from the River Nore.

### 3.1.1. Office of Public Works Flood Maps

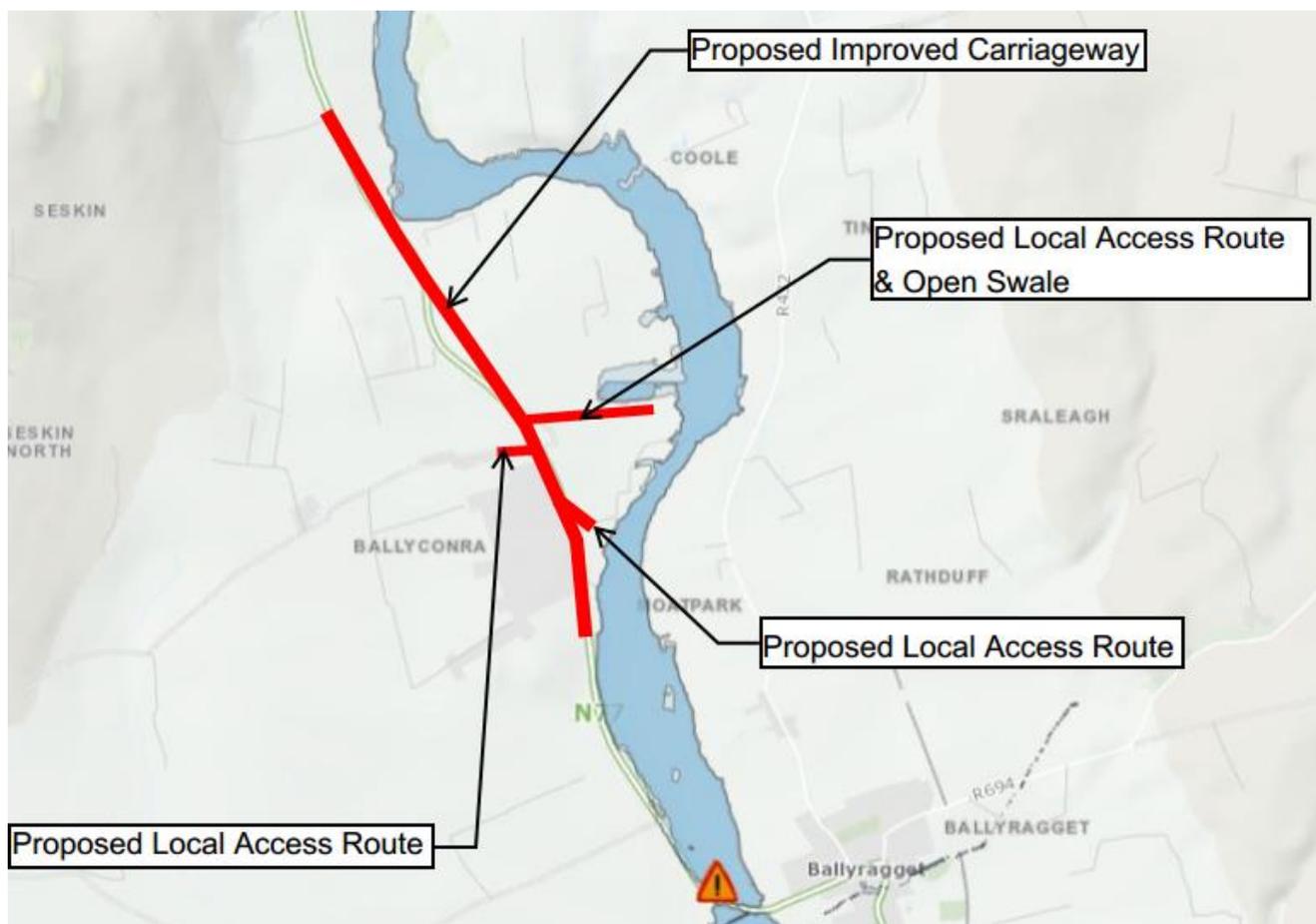
The Office of Public Works (OPW) has launched an interactive map viewer (<http://www.floodinfo.ie/map/floodmaps/>) which displays the predicted flood extents for both rivers and coastal areas over various return periods. The viewer was consulted in relation to the N77 Ballyragget Village to Ballynaslee Road Improvement Scheme. Detailed flood maps are available for the Ballyragget Village area which extend to the southernmost section of the proposed scheme. The fluvial map specific to the site (O15BAT\_EXFCD\_F0\_08) has been included in Appendix B of this report.

From review of the detailed fluvial map it is evident that there are sections of the existing carriageway to the south of the scheme (extents shown in red) which are at risk from flooding.

As noted within the flood map, survey point “15NORE06694” is located approximately 300m south of the tie in location and predicts a 1 in 100-year flood level of 63.98mOD and a 1 in 1000-year flood level of 64.31mOD. From review of a contour survey provided by the Client, the road level adjacent to the node location is 68.00mOD.

As discussed in Section 2.3 above, the existing road level at the southern extents tie in point is 66.610mOD, which is 2.3m above the downstream 1 in 1000-year flood level of 64.31mOD. As the local topography across the southern section of the scheme is relatively shallow and as indicated in the flood maps, it is concluded that the southern section of the scheme is suitably elevated from the flood plain and hence does not lie within the 1 in 100-year or 1 in 1000-year fluvial flood plain of the River Nore.

There are no detailed flood maps available for the remainder of the proposed road improvement scheme, therefore the online map viewer was consulted to review the predicted River Nore fluvial flood plain. Figure 3-1 below displays the extents of the 1 in 100-year (dark blue) and 1 in 1000- year (light blue) fluvial flood plain from the River Nore.



**Figure 3-1 – OPW Flood Map Viewer**

It is noted that an isolated area of flooding is predicted within proximity to the eastern branch of the scheme. This branch is noted within the General Arrangement and Drainage Layout Drawings to incorporate 200m of access road and 350m of a spillway and open swale. The proposed swale extents run parallel to this isolated area of flooding.

Finally, towards the northern section it is evident that flooding is predicted within proximity to the proposed road improvement scheme extents. The proposed road level at this location is 75.772mOD. From review of a contour survey provided by the Client and the figure above, the flood plain of the River Nore extends approximately 350m from the main channel at this location into a low-lying field. The 70.00mOD contour line aligns with the extents of the flood plain shown above. Furthermore, a site review confirms that the existing road is significantly elevated at this location in comparison to the adjacent low-lying field.

In summary, from review of the map viewer and the available detailed flood map it is apparent that the proposed road improvement scheme is outside of the River Nore fluvial flood plain for a 1 in 100-year and 1 in 1000-year return period and is therefore classified as being in Flood Zone 'C'.

### 3.1.2. OPW Flood Hazard Website

The OPW Flood Hazard Mapping website ([www.floodmaps.ie](http://www.floodmaps.ie)) was consulted in relation to available historical or anecdotal information on any flooding incidences or occurrences in the vicinity of the proposed scheme. This information is also now available on the OPW's interactive map viewer and Figure 3-1 indicates a recorded reoccurring flood event south of the scheme within Ballyragget Village. Two reports are available for this recorded location, one of which dates to 1948 and primarily discusses flooding in Thomastown, Kilkenny City, Threecastles and Jenkinstown. The second report, which is a letter drafted by a Kilkenny Council Engineer on 9th November 2000, is included within Appendix C. The letter states that between the 5<sup>th</sup> and 7<sup>th</sup> of November 2000 several roads, including the N77, were closed due to flooding from the River Nore. The letter does not provide any further information on the extents or locations where the N77 was flooded.

### 3.1.3. OPW/EPA/Local Authority Hydrometric Data

The OPW, EPA and Local Authority hydrometric data stations were reviewed on the EPA HydroNet website. The closest station to the scheme was identified as an active OPW station (No. 15012) located 300m to the south within the River Nore. The location of the station aligns with the OPW Flood Map Node discussed in Section 3.1.1 (15NORE06694). The complete daily mean recordings were reviewed which date back to the 3<sup>rd</sup> November 1988. The records show the highest recorded flood level as 64.155mOD which occurred on 31<sup>st</sup> December 2015. This date aligns with a series of storms (Desmond, Eva & Frank) which occurred over the winter of 2015. Furthermore, throughout the course of the 32-year period, the flood level of 64.00mOD was exceeded ten times.

### 3.1.4. Ordnance Survey Historic Mapping

The GeoHive map viewer (<http://map.geohive.ie/mapviewer.html>) was consulted to review available historic mapping for the proposed scheme which can contain evidence of historical flooding incidences or occurrences. The maps consulted were the pre-1900's historic 6-inch colour and 25-inch maps. The flood maps layer was also consulted to identify any potential flood plains within the environs of the site.

From review of the 6-inch and 25-inch maps there are no watercourses identified which cross the proposed road improvement scheme. However, as noted within Section 2.4 above, site investigations confirmed the presence of an existing damaged culvert which will be replaced as part of this project. The flood maps layer indicates high level flooding extents as displayed in Figure 3-2 below.



Figure 3-2 – GeoHive Flood Maps Layer (GeoHive Viewer)

### 3.1.5. OPW Flood Plans

The OPW's Flood Risk Management Plan for the Nore River Basin, published in February 2018, was reviewed to obtain any further information relating to the flood risk to the Ballyragget area. The report notes that *"Ballyragget is at low risk of flooding during a 1% AEP fluvial event with no properties or key receptors at risk of flooding during such an event"*. The plan also notes that there is no structural flood relief scheme currently proposed for Ballyragget.

## 3.2. Conclusion of Flood Risk Identification

The purpose of *the Stage 1 Flood risk identification* process is to establish whether a flood risk issue currently exists or may exist in the future. If a potential flood risk issue is identified the risk will be investigated in further detail by undertaking a Stage 2 – Initial flood risk assessment. However, if no potential flood risk is identified then the overall assessment can conclude at this point.

In relation to the N77 Ballyragget Village to Ballynaslee Road Improvement Scheme based on the *Stage 1 - Flood risk identification* findings discussed above the flood risk study has identified that the section of the N77 proposed for road improvements is not at risk of fluvial flooding from the River Nore.

As a result, the report shall be concluded at this point. Section 4 below includes an overview of the report findings and further recommendations.

## 4. Conclusion & Recommendations

### 4.1. Conclusion

The proposed road improvement scheme is located over a 2.44km section of the existing N77 carriageway between Ballyragget Village and Ballynaslee, Co. Kilkenny. The purpose of the scheme is to improve and upgrade this existing section of carriageway which is proposed to be achieved by road widening and partial offline realignment. The proposed works will also include the provision of surface water drainage, an attenuation pond, fencing, safety barriers and kerb line along with all associated ancillary works.

The various information sources reviewed as part of this flood risk assessment have confirmed that the section of N77 under review for this road improvement scheme is not at risk from fluvial flooding from the River Nore for a 1 in 100-year or 1 in 1000-year flood event. Therefore, in accordance with the planning guidelines, the scheme extents are classified to fall within Flood Zone 'C'. It is noted however, that sections of the existing N77 to the south of the proposed scheme on approach to Ballyragget Village are at risk from fluvial flooding.

### 4.2. Recommendations

The following recommendations are to be taken into consideration for the detailed design and construction of the proposed scheme:

- Suitable Sustainable Urban Drainage systems (SuDS) are to be utilised within the proposed road improvement scheme to reduce surface water runoff and should be designed in accordance with TII Document Reference DN-DNG-03022.
- The proposed discharge of surface water drainage to existing networks and to ground, via infiltration, should be designed in accordance with best practice including the provision of pollution interceptors and sufficient treatment and be set at a maximum discharge rate of QBAR or 2 l/s/ha, whichever is the greater.
- A maintenance regime for the SuDS systems are required and are to be considered as part of the overall drainage design for the proposed road improvement scheme. This will ensure both the design life of the SuDS systems, ongoing improved water quality and reduction of peak water runoff.
- An application for consent under Section 50 of the Arterial Drainage Act, 1945 should be undertaken and submitted to the Office of Public Works (OPW) for approval with regards to the construction or alteration of any new or proposed bridges and/or culverts, where applicable.

# Appendices

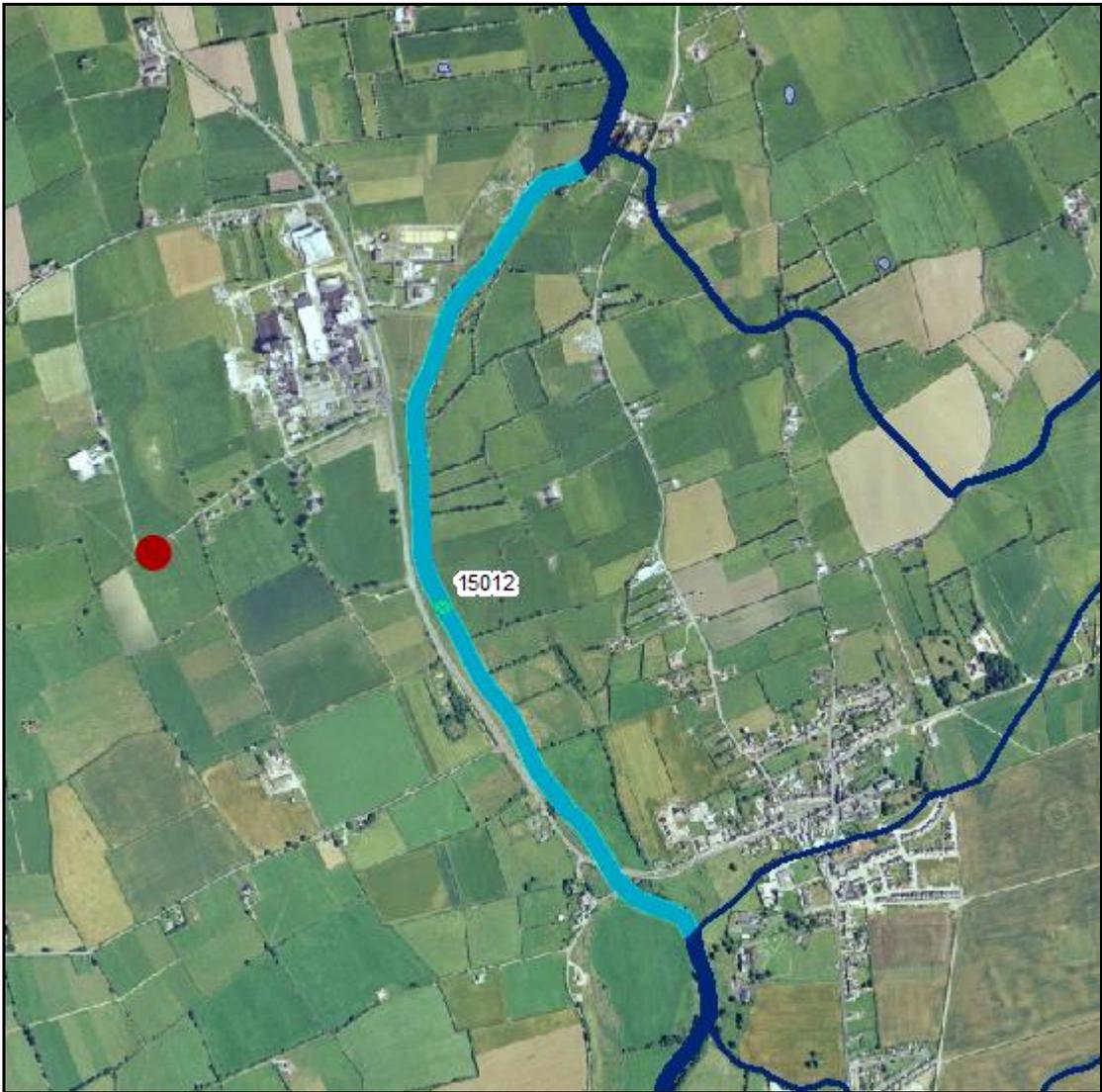


# Appendix A. EPA Hydrometric Data – River Nore



River Name	Nore(15_140)
XY Location	243977,172107 (ING)

**River Segment Map**



**Disclaimer**

The source hydrometric data used to estimate the flow duration curve ordinates for ungauged catchments was obtained from (1) water level data and (2) the rating curve(s) generated for each hydrometric station. The Environmental Protection Agency and the Office of Public Works used these data, respectively, to calculate daily mean flows. The daily mean flows were then used by the Environmental Protection Agency to prepare flow duration curves for each station. Neither body accepts any liability for the subsequent handling of the data.



## Disclaimer

The source of hydrometric data used to estimate the flow duration curve ordinates for ungauged catchments was obtained from (1) water level data and (2) the rating curve(s) generated for each hydrometric station. The Environmental Protection Agency and the Office of Public Works used these data, respectively, to calculate daily mean flows. The daily mean flows were then used by the Environmental Protection Agency to prepare flow duration curves for each station. Neither body accepts any liability for the subsequent handling of the data.

The user should familiarise himself/herself with the catchment being studied and confirm that the ungauged site is in a natural catchment where flows conditions are suitable for the use of the model.

It is strongly recommended that the user examine the catchment descriptors contained in the report produced and confirm that the percentages of the various constituent elements are comparable to a natural catchment.

If the flow in a catchment is not entirely natural, the estimation of flows using the model in these catchments could be affected due to:

- existence of local conduit karst within the catchment;
- the selected location itself is on local conduit karst;
- regulation of the river flow on the river channel (e.g. power station, sluice gates etc)
- impacts of abstractions upstream of the selected location or the impact of the discharge associated with the abstraction into the same/different catchment;
- estimates of flow being sought at locations effected by storage effects at, or near, lake outfalls;
- lack of similar catchments with observed flows, ie where catchment descriptors lie outside the range of available gauging station catchments (e.g. the catchment area is under 5 km<sup>2</sup>);
- any other special circumstances that may affect river flows.

Expert judgement will be required to ensure that the estimate of flow is not unduly affected by any of these influences.

Please note that the model does not provide estimates of flood peaks and, specifically, should not be used for that purpose.

The EPA has also prepared estimates of DWF and long term 95 percentile flows which are also presented on the EPA web site. These data are presented at <http://www.epa.ie/whatwedo/monitoring/water/hydrometrics/data/>

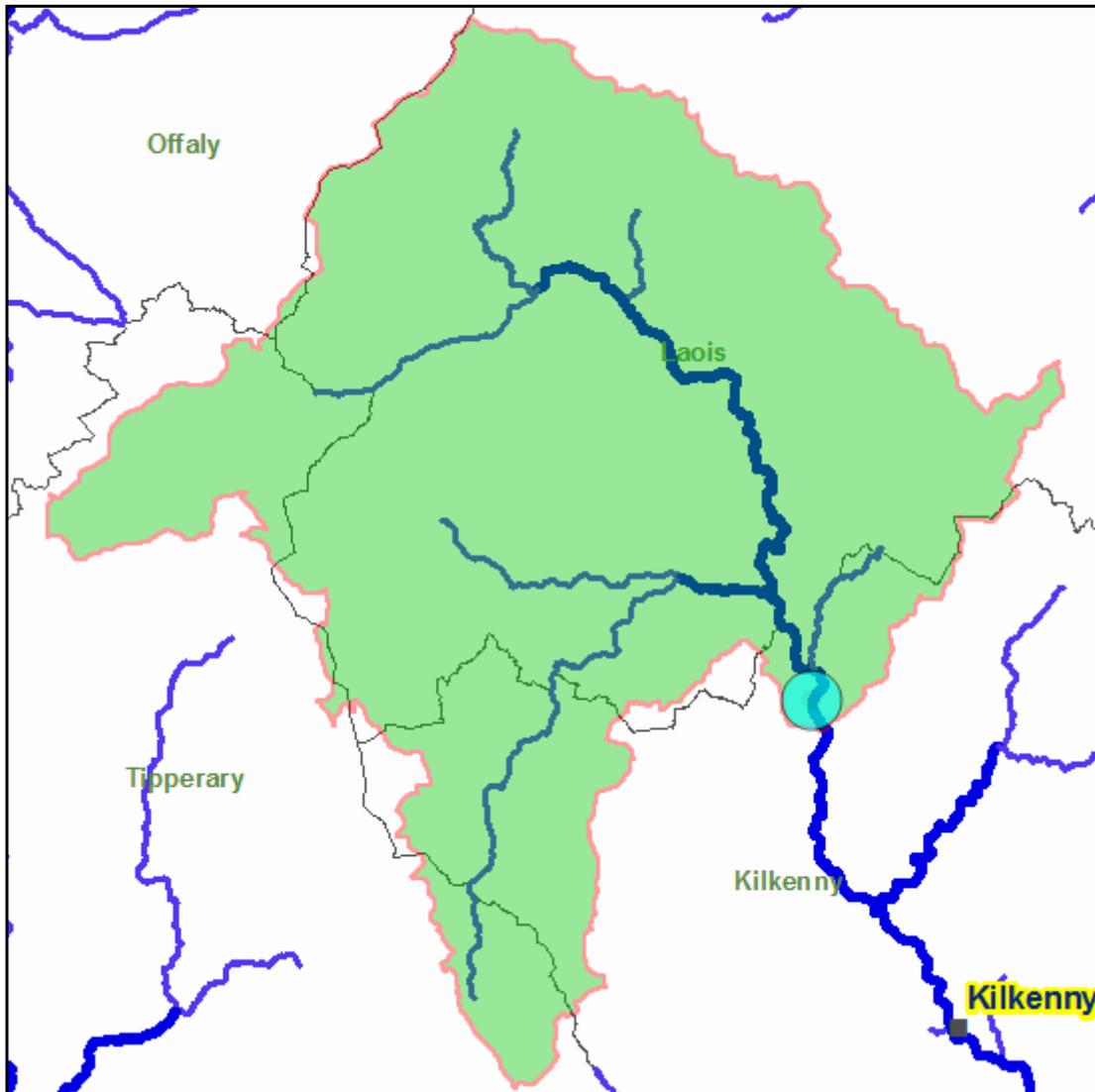
The data produced by the model for specific stations should be compared to the data contained in this file of DWF and long term 95percentile flows.

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XY Location	243977,172107 (ING)

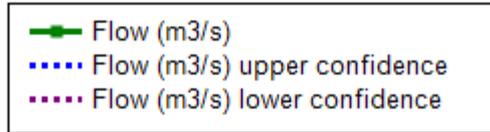
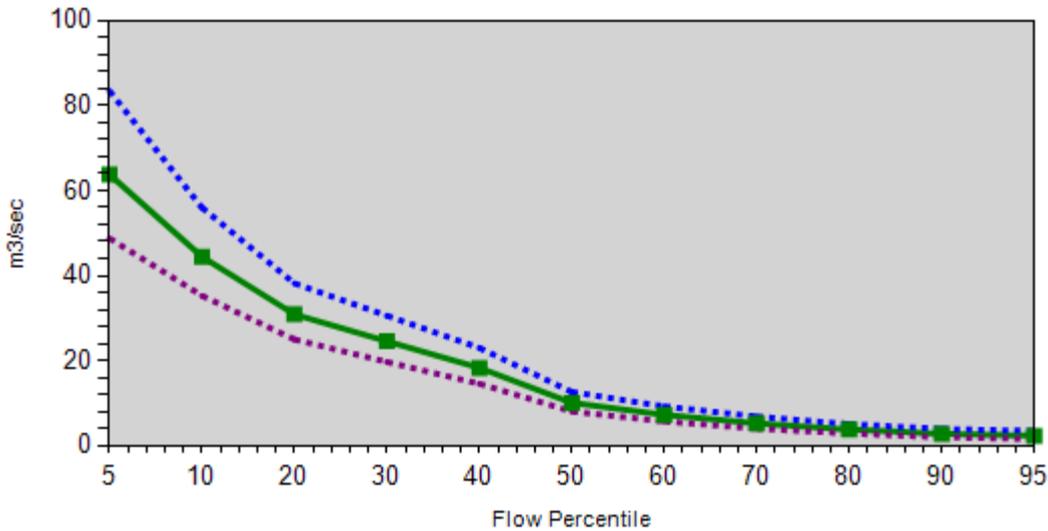
**Nested Catchment Map**



**Disclaimer**  
The source hydrometric data used to estimate the flow duration curve ordinates for ungauged catchments was obtained from (1) water level data and (2) the rating curve(s) generated for each hydrometric station. The Environmental Protection Agency and the Office of Public Works used these data, respectively, to calculate daily mean flows. The daily mean flows were then used by the Environmental Protection Agency to prepare flow duration curves for each station. Neither body accepts any liability for the subsequent handling of the data.



**Flow Duration Curve (Flow in m3/sec)**



%ile	flow(m3/sec)	upper 95% confidence limit m3/sec	lower 95% confidence limit m3/sec
5	63.791	83.439	48.77
10	44.429	55.981	35.261
20	30.872	38.158	24.978
30	24.53	30.564	19.687
40	18.288	22.989	14.549
50	10.067	12.614	8.034
60	7.248	9.227	5.694
70	5.235	6.842	4.005
80	3.792	5.062	2.84
90	2.785	3.933	1.973
95	2.315	3.473	1.544

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Catchment Descriptors		
General		
Descriptor	Unit	Value
Area	sq km	1059
Average Annual Rainfall (61-90)	mm/yr	963
Stream Length	km	966.5
Drainage Density	Channel length (km)/catchment area (sqkm)	0.9
Slope	Percent Slope	4
FARL	Index (range 0:1)	1

Soil	
Code	% of Catchment
Poorly Drained	30.5
Well Drained	48.2
Alluvmin	4.8
Peat	15.9
Water	0
Made	0.5

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Subsoil Permeability		
Code	Explanation	% of Catchment
H	High	6.4
M	Moderate	47.8
L	Low	10.8
ML	Moderate/Low	5.8
NA	No Subsoil/Bare Rock	29.2

Aquifer		
Code	Explanation	% of Catchment
LG_RG	LG: Locally important sand-gravel aquifer RG: Regionally important sand-gravel aquifer	13.8
LL	Locally important aquifer which is moderately productive only in local zones	46.4
LM_RF	LM: Locally important aquifer which is generally moderately productive RF: Regionally important fissured bedrock aquifer	11.6
PU_PL	PU: Poor aquifer which is generally unproductive PL: Poor aquifer which is generally unproductive except for local zones	15
RKC_RK	Regionally important karstified aquifer dominated by conduit flow	0
RKD_LK	Regionally important karstified aquifer dominated by diffuse flow	13.2

Stations in Pooling group			
%ile Flow	Station 1	Station 2	Station 3
5	24008	25001	26007
10	24008	25001	26021
20	24008	25001	26021
30	24008	25001	26007
40	24008	26007	25001
50	15006	14014	15001
60	15006	14014	15001
70	15006	14014	15001
80	15006	14014	11001

**Disclaimer**

The source hydrometric data used to estimate the flow duration curve ordinates for ungauged catchments was obtained from (1) water level data and (2) the rating curve(s) generated for each hydrometric station. The Environmental Protection Agency and the Office of Public Works used these data, respectively, to calculate daily mean flows. The daily mean flows were then used by the Environmental Protection Agency to prepare flow duration curves for each station. Neither body accepts any liability for the subsequent handling of the data.



## Estimation of Flow Duration Curve for Ungauged Catchment

Environmental Protection Agency

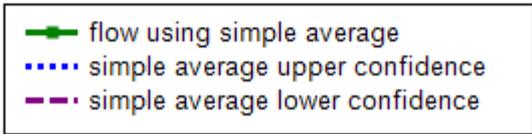
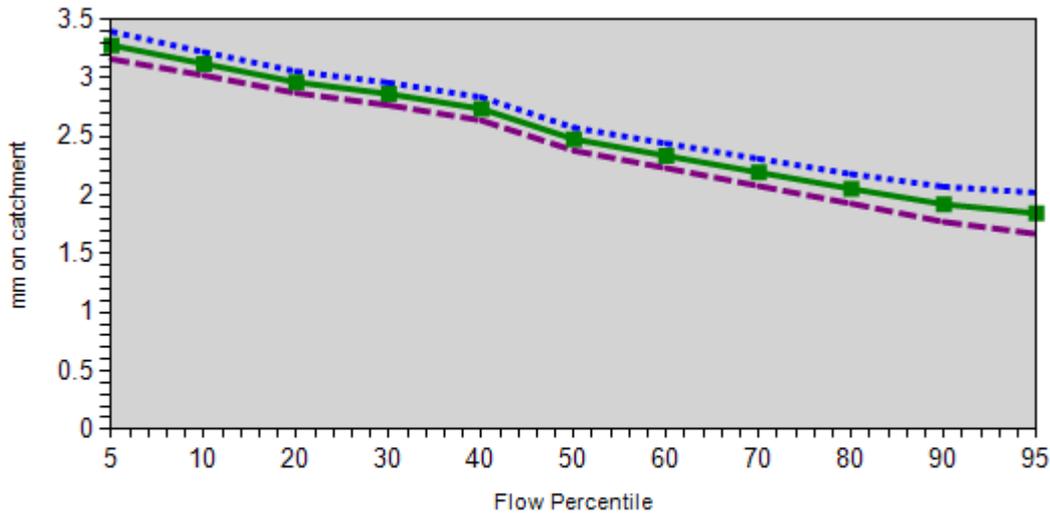
90	15006	14014	11001
95	15006	14014	11001

### Disclaimer

The source hydrometric data used to estimate the flow duration curve ordinates for ungauged catchments was obtained from (1) water level data and (2) the rating curve(s) generated for each hydrometric station. The Environmental Protection Agency and the Office of Public Works used these data, respectively, to calculate daily mean flows. The daily mean flows were then used by the Environmental Protection Agency to prepare flow duration curves for each station. Neither body accepts any liability for the subsequent handling of the data.



**Flow Duration Curve (mm on catchment)**



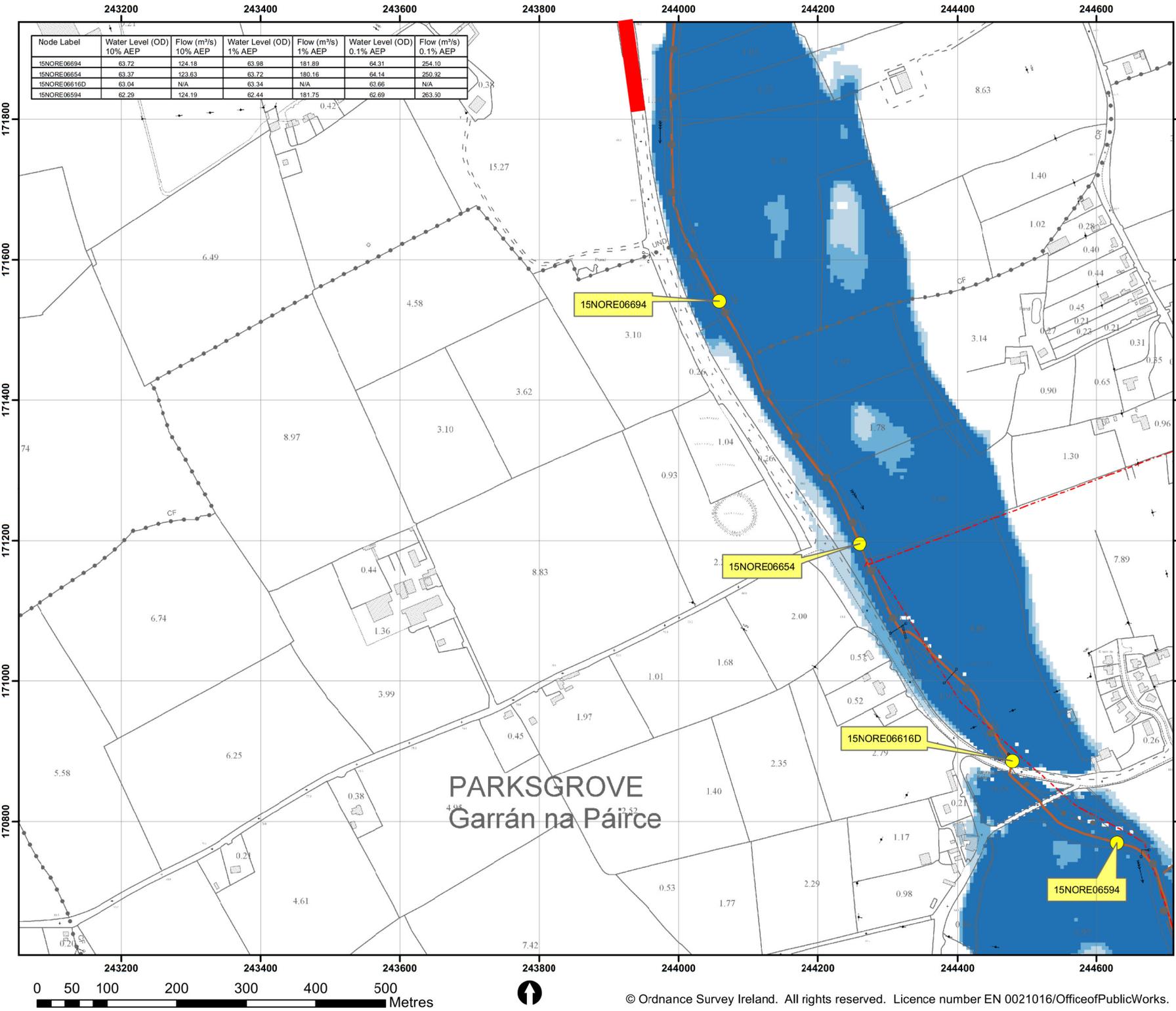
Log Flow (mm on catchment)			
%ile	mm	upper 95% confidence limit	lower 95% confidence limit
5	3.279	3.396	3.162
10	3.122	3.222	3.022
20	2.964	3.056	2.872
30	2.864	2.96	2.768
40	2.737	2.836	2.638
50	2.478	2.576	2.38
60	2.336	2.441	2.231
70	2.194	2.31	2.078
80	2.054	2.18	1.928
90	1.922	2.072	1.772
95	1.845	2.021	1.669

**Disclaimer**

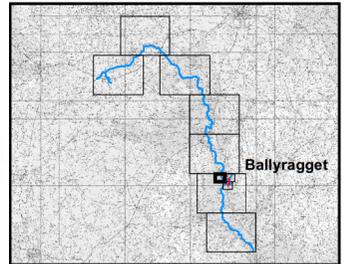
The source hydrometric data used to estimate the flow duration curve ordinates for ungauged catchments was obtained from (1) water level data and (2) the rating curve(s) generated for each hydrometric station. The Environmental Protection Agency and the Office of Public Works used these data, respectively, to calculate daily mean flows. The daily mean flows were then used by the Environmental Protection Agency to prepare flow duration curves for each station. Neither body accepts any liability for the subsequent handling of the data.

# Appendix B. OPW Flood Map

## B.1. O15BAT\_EXFCD\_F0\_08



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
15NORE06694	63.72	124.18	63.98	181.89	64.31	254.10
15NORE06654	63.37	123.63	63.72	180.16	64.14	250.92
15NORE06616D	63.04	N/A	63.34	N/A	63.66	N/A
15NORE06594	62.29	124.19	62.44	181.75	62.69	263.50



**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 Label

FINAL

REV:	NOTE:	DATE:
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The Office of Public Works  
Jonathan Swift Street  
Trim  
Co Meath

Elmwood House  
74 Boucher Road  
Belfast  
BT12 6RZ

T +44(0) 28 90 667914  
F +44(0) 28 90 680286  
W www.rpsgroup.com  
E ireland@rpsgroup.com

<b>Map:</b> Ballyragget Fluvial Flood Extents	
<b>Map Type:</b> EXTENT	
<b>Source:</b> FLUVIAL	
<b>Map Area:</b> HPW	
<b>Scenario:</b> CURRENT	
<b>Drawn By :</b> C.C.	<b>Date :</b> 20 July 2016
<b>Checked By :</b> J.M.	<b>Date :</b> 20 July 2016
<b>Approved By :</b> G.G.	<b>Date :</b> 20 July 2016
Drawing No.:	
O15BAT_EXFCD_F0_08	
Map Series : Page 08 of 10	
Drawing Scale : 1:5,000 @ A3	



# Appendix C. OPW Flood Hazard Report

**Kilkenny County Council**

County Hall, John Street, Kilkenny

Tel: 056-52699 Fax: 056-64316

**Chomhairle Chontae Chill Chainnigh**

Halla an Chontae, Sraid Eoin, Cill Chainnigh

E-mail: [coengin@kilkennycoco.ie](mailto:coengin@kilkennycoco.ie)

9<sup>th</sup> November, 2000

County Engineer

County Secretary

Re: DOE Circular Letter EP 2/00 – Assessment Reports on Severe Flooding

A Chara,

I refer to the above circular and wish to advise as follows:

- **Chronology of events**

Severe weather warnings were received from the Meteorological Office on Friday, 3<sup>rd</sup> November, 2000. These warnings were distributed to all relevant staff, including all Area Engineers, Senior Executive Engineers, Chief Fire Officer and the County Engineer. Arrangements were made to alert emergency crews to the possibility of call-out during the coming weekend.

There was no rainfall on Saturday, 4<sup>th</sup> November and, consequently, no response was necessary. Heavy rainfall was encountered early on Sunday, 5<sup>th</sup>, and approximately at 11 a.m., The County Engineer alerted the County Manager to the possibility of severe flooding, and confirmed that he had activated regular monitoring of the river levels and flood prediction system. He also advised that he would be available to co-ordinate any necessary emergency response.

At approximately 6 p.m. on Sunday, 5<sup>th</sup> November, the County Engineer was contacted by \_\_\_\_\_, Asst. Chief Fire Officer, the Senior Officer on duty for the weekend, who advised that there was substantial flooding throughout the county and that several fire brigades had responded to emergency call-outs. The County Engineer apprised the Mayor of Kilkenny and the Chairman of the Council on the situation and updated them on a regular basis during the emergency period. Arrangements were also made to call out both Kilkenny Corporation and County Council crews. These crews responded to many incidents throughout the county during Sunday, 5<sup>th</sup> & Monday 6<sup>th</sup> November.

In Kilkenny City, the River Nore did not break its banks until early in the morning of Monday, 6<sup>th</sup>. Corporation crews worked throughout the night to close the affected road to traffic and secure private property against flood damage.

Fire and road crews worked throughout Monday, 6<sup>th</sup> and the remaining crews were stood down at approximately 11 p.m. on Monday, 7<sup>th</sup>.

- **Emergency Plan**

It was no necessary to activate the Major Emergency Plan.

- **Services Involved**

All of the fire brigades in the County were involved, as were the road crews in each of the area engineers' area, i.e. 7 No. fire brigades and 13 No. road crews. In addition, the road crews of Kilkenny Corporation were deployed in the City area.

- **Contribution of each service**

**Fire Service**

The Fire Service responded to emergency calls as received, engaging in the protection of property from flood damage, pumping out of flooded property, and relieving road flooding. The Fire Service also provided emergency signage on some flooded roads.

**Road Crews**

Each road crew worked to relieve road flooding where roads were blocked, or partially blocked. Where flooding could not be relieved, emergency signs and lights were provided. The road crews also helped to secure private property against flood damage and assisted in distribution of sandbags throughout the county.

- **Road Closures**

Many roads throughout the county were closed at the peak of the flood. These included the National Primary N9 at Ballyhale & Mullinavat; National Primary N24 at Piltown; National Secondary N78 at Ballyhemmin, **and the National Secondary N77 at Ballyragget**. A full schedule of road closures will be prepared and forwarded to the Department in due course. **All of the above roads were closed as a result of river flooding and could only be re-opened when river levels had subsided**. The last National Road to be re-opened was the N24 at Piltown, at approximately 10.30 p.m. on Tuesday, 7<sup>th</sup> November. The Council has not yet prepared an accurate register of flooded property, and it is difficult to be definitive regarding the exact amount. Based on the reports which have been received from the Fire Service and from each overseer's area, the best estimate is that approximately 100 premises were flooded, and that approximately 25% of these were commercial premises.

- **Residential Properties Evacuated**

Approximately 24 properties were evacuated by their owners or occupiers during the flood period. None of these evacuations were ordered by the emergency services. However, the service did provide help and assistance to those evacuating their houses. In all cases the evacuees made their own arrangements for emergency accommodation and none was sought from or provided by the Council or Corporation. In Kilkenny city, a number of private businesses provided emergency meals etc. to the evacuees and others affected by the flooding.

- **Number of People Evacuated**

The Council does not have a record of the number of evacuees. However, it is likely that between 70 and 100 were affected. In all instances, private properties only were affected. There is no report of a local authority house having been flooded.

- **Alternative Accommodation Provided**

The Council did not provide any accommodation to evacuees. In each case the evacuees made their own arrangements for accommodation which, in the main, was provided by relatives. The Council has since received one request for accommodation.

Flood levels have now receded in all areas. However, it will be sometime before all the properties are dried out and fit for habitation. Each individual family is making its own arrangements. The Council is not in a position to indicate the likely duration of continued evacuation. No special arrangements were necessary to evacuate elderly or disabled persons.

- **Sanitary Infrastructure**

There was not any substantial adverse affect on water supply schemes throughout the county and, while in many instances sewerage schemes had to deal with increased quantities of rainwater, there was no significant environmental impact.

A summary log prepared by the Fire Service indicating the major events during the emergency is attached. A full Fire Brigade log is available on request.

Mise, le meas,

County Engineer

Ailis Corrigan  
**WS Atkins Ireland Limited**  
Atkins House  
150 Airside Business Park  
Swords  
Co. Dublin  
K67 K5W4

Tel: +353 1 810 8000  
ailis.corrigan@atkinsglobal.com

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