

Appropriate Assessment of the
Thomastown Local Area Plan
in relation to the
River Barrow and River Nore,
and Thomastown Quarry
Special Areas of Conservation



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for Nicolas de Jong Associates

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EXECUTIVE SUMMARY – as per Annex 2 of EU’s methodology (Oxford Brooke University, 2001)

Assessment of the effects of the project or plan on the integrity of the site

Describe the elements of the project or plan (alone or in combination with other projects or plans) that are likely to give rise to significant effects on the site (taken from the screening assessment)

1. Designating areas within the SAC as ‘open space’ could lead to direct loss of habitat but also presents opportunities for enhancement
2. Poorly treated domestic effluent and surface water run-off from new developments could contribute to water pollution in the river Nore

Set out the conservation objectives of the site

Conservation objectives are not defined for the site but can be taken as:

1. Maintain the area of key habitats within the sites
2. Maintain or achieve high standards of water quality
3. Maintain the populations of key species within the sites

Describe how the project or plan will effect key species and key habitats.
Acknowledge uncertainties and any gaps in information.

Impacts of the Local Area Plan are ultimately dependant on the design and location of developments that arise from it. The precautionary principle is therefore employed and these impacts represent the worst case scenario:

1. Designating areas of SAC as ‘open space’ could lead to direct loss of habitat (potentially Oak-Ash-Hazel woodland although the majority of this area is ecologically poor Improved Agricultural Grassland)
2. Enhancement of these areas could lead to control of invasive species and creation of habitat that could stabilise river banks and attenuate pollution
3. Ingress of pollutants, particularly nutrients, particulates and hydrocarbons could deteriorate water quality and impact upon water dependant species for which the site is designated.

Describe how the integrity of the site (determined by structure and function and conservation objectives) is likely to be affected by the project or plan (e.g. loss of habitat, disturbance, disruption, chemical changes, hydrological changes and geological changes, etc.). Acknowledge uncertainties and any gaps in information.

1. Loss of important habitats through built development within the SAC for amenity purposes, although the nature of this impact depends on the type, location, design and timing of any building works. There is also potential for enhancement works through such development.
 2. Pollution from domestic effluent and surface water run-off has cumulative impacts on water quality. Many aquatic species are pollution sensitive and their populations may decline, or fail to recover, because of this.
-

Five recommendations are made in total:

Describe what mitigation measures are to be introduced to avoid, reduce or remedy the adverse effects on the integrity of the site.
Acknowledge uncertainties and any gaps in information.

1. Designate all areas of SAC within the LAP boundary for 'biodiversity conservation' or some other similarly explicit title.
 2. Ensure that any specific project that may have an impact on the SAC is thoroughly screened through the Appropriate Assessment process.
 3. Ensure that new or upgraded wastewater treatment plant is in place and operational *prior* to the opening of new residential or business areas within the town.
 4. Ensure that appropriate attenuation of pollution from surface water is integrated into all new developments that will discharge into the Nore river, particularly SUDS (sustainable drainage systems).
 5. Ensure that the Appropriate Assessments that will be undertaken prior to the development of amenity areas suggests measures that will enhance the value of the site for conservation in consultation with NPWS and the SRFB.
-

Results of Consultation

Agency contacted	Response
NPWS	<p>Mr Jimi Conroy, Wildlife Ranger with NPWS was consulted from the early stages of the Appropriate Assessment process. He was particularly keen to make the following points:</p> <ol style="list-style-type: none"> 1. The SAC should stand out from the plan as an area of international conservation importance and not merely be included with other designated zonings. This does not preclude all development within the SAC. 2. An opportunity exists for the creation of wetland habitat that could effectively treat pollution from surface water run-off from a number of developments. This would avoid the need for separate attenuation measures for each individual project. 3. The issue of alien invasive species should be highlighted although acknowledging that the problem is nationwide. 4. It is a concern that promised wastewater treatment facilities are not being delivered prior to the building of new residential and business projects. This has lead to considerable pollution problems in the past.
Southern Regional Fisheries Board	no response

1.0 INTRODUCTION

1.1 The nature of the proposed plan

Nicolas de Jong Associates are currently preparing a Local Area Plan (LAP) for the Thomastown area for their client, Kilkenny county council. This plan provides for the proper planning of the region and the sustainable development of communities and the overall economy.

1.2 The need for an Appropriate Assessment

A section of the River Barrow and River Nore SAC (site code: 2162) is situated within the boundary of the LAP while the Thomastown Quarry SAC (site code: 2252) borders this boundary to the north west. SACs form part of the European Union's (EU) Natura 2000 network of conservation sites and are of international importance (NRA, 2006). These sites are designated under the EU's Habitats Directive (EC, 1992) and member states are required to maintain them in 'good conservation status'. Under Article 6 of its provisions, an Appropriate Assessment is required to be carried out by the competent authority where a plan or project may impact on the site's conservation status. The Appropriate Assessment must determine whether significant impacts on this status are likely, and if this is deemed to be the case, recommend avoidance or mitigation measures.

Step 1 of this process is a screening of the plan to determine, at an initial level, whether impacts are likely. However if it is already believed that such impacts are likely, then it is not necessary to carry out the screening study, but to move directly to the full Appropriate Assessment stage. Because of the central nature of the river Nore within the town, and the importance of good water quality to the conservation status of the SAC, the likelihood of impacts is high. It was therefore considered wise in this case to move straight to the full Appropriate Assessment.

1.3 Methodology

The assessment was carried out in accordance with the following methodologies and guidelines:

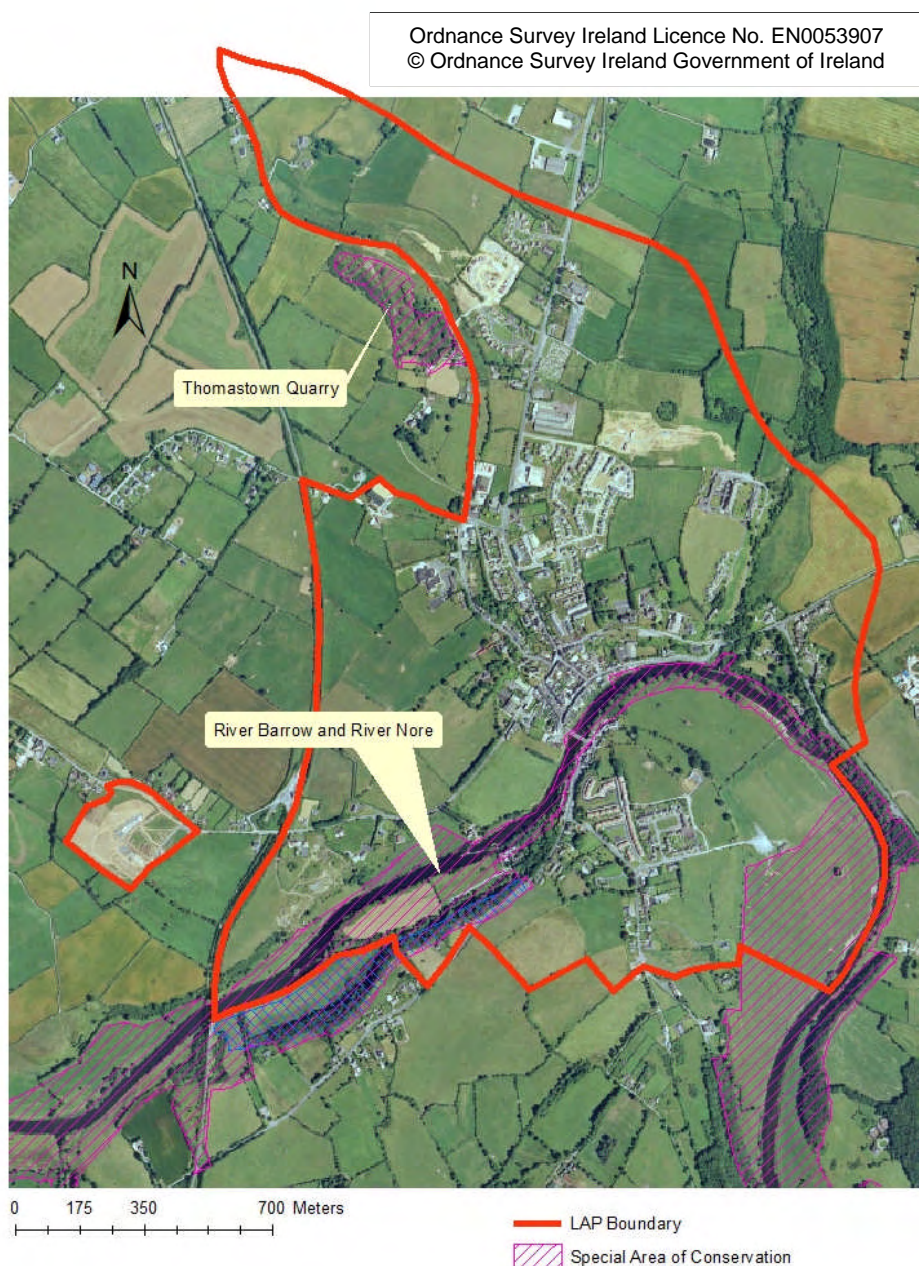
1. 'Assessment of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC'. Annex 2 of this document sets out an assessment template that is used in this report.
2. The 'Guidelines for Ecological Impact Assessment in the United Kingdom' by the Institute of Ecology and Environmental Management (IEEM, 2006).

1.4 Zone of Influence

The zone of influence of the LAP is shown in figure 1. The River Barrow and River Nore SAC is a large site, only a small part of which runs through

Thomastown. While the water is the main feature of the site, there is significant riparian vegetation and terrestrial portions that have also been designated and fall within the site boundary. While the Thomastown Quarry SAC is not located within the LAP boundary it lies directly adjacent to it. It is therefore appropriate, in line with the Precautionary Principle¹, to include this site within the zone of influence.

Figure 1 – Zone of Influence of the Thomastown LAP showing the location of the SACs



¹ This phrase was adopted at the world Earth conference in Rio in 1992 and states that where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation. (Cooney & Dickson, 2005)

1.5 Stakeholders and Consultees

1.5.1 Identification of Stakeholders

The primary stakeholders on this site were judged to be: the National Parks and Wildlife Service (NPWS) and the Southern Regional Fisheries Board.

Consultation was consequently sought from the following people:

	Stakeholder (name/organisation)	Form of Consultation
1	NPWS Development Application Unit	Letter
2	Southern Regional Fisheries Board	Letter/email
3	Jimi Conroy, Wildlife Ranger, NPWS	Phone conversation

1.5.2 Consultation outcomes

To date there has been no response from the Southern Regional Fisheries Board (10/10/08).

Mr Conroy of the NPWS expressed his concern that the installation or upgrading of wastewater treatment facilities should come before the building of new residential areas. In the past promised investment has been delayed or postponed so that poorly treated sewage effluent was being discharged into rivers.

The issue of invasive species was discussed in the context of actions that can be taken at the local level against what is a national problem. He suggested that while little can be done at this scale, the issue should nevertheless be highlighted.

The impacts of surface water run-off should not be underestimated as this can have a negative impact on fish and their habitats. Sustainable Drainage Systems (SUDS) should be applied where possible and he suggested that an opportunity exists to treat this effluent from whole areas with constructed wetlands. This would not only abate pollutants, but would create habitat and help to alleviate flood waters.

While the Nore holds a unique population of Nore freshwater pearl mussels, Mr Conroy confirmed that these are located well upstream from Thomastown and so the LAP is not likely to impact on this important species.

With regard to the Thomastown Quarry SAC Mr Conroy was of the view that impacts to the status of this site arising from the LAP are unlikely. This is due to the fact the no habitat loss will occur and where housing is planned nearby, this is located on higher ground. It is therefore unlikely to disrupt the hydrological flow of water at that SAC.

1.6 Existing legislation, plans and proposals

1.6.1 *Convention on Biological Diversity (CBD)*

The protection of biodiversity is enshrined in the CBD to which Ireland is a signatory. As part of its commitment to this international treaty Ireland, as part of a wider European Union initiative, is committed to the halt in loss of biodiversity by the year 2010. The National Biodiversity Plan (Dúchas, 2002), published in 2002, states that “each local authority [is] to prepare a local biodiversity action plan”. Kilkenny County Council is currently in the process of drawing up its first Biodiversity Action Plan. The contents of this document however are not available. In addition, the Department of the Environment, Heritage and Local Government is currently preparing the second National Biodiversity Plan.

1.6.2 *Kilkenny County Draft Development Plan 2008 – 2014 (KCC, 2008)*

Chapter 8 of the plan focuses on protection of the natural heritage. Section 8.2.1 and 8.2.2 discuss sites and species respectively that are designated under National and European legislation. Of particular relevance to this study is section 8.2.1 entitled ‘Designated Natural Heritage Sites of International and National Importance’. This discusses the role of the county council in protecting designated sites, in conjunction with NPWS. The following policy is stated:

- To protect natural heritage sites designated in National and European legislation. This includes sites proposed to be designated or designated as Special Areas of Conservation (SAC), Natural Heritage Areas (NHA), Nature Reserves and Wildfowl Sanctuaries. This protection will extend to any additions or alterations to sites that may arise during the lifetime of this plan.
- To assess all proposed developments (individually or in combination with other proposals, as appropriate) which are likely to impact on designated natural heritage sites or those sites proposed to be designated.
- To consult with the prescribed bodies and relevant government agencies when assessing developments which are likely to impact on designated natural heritage sites or those sites proposed to be designated.
- To ensure that any development in or near a designated natural heritage site will avoid any significant adverse impact on the features for which the site has been designated.
- To require an appropriate environmental assessment in respect of any proposed development likely to have an impact on a designated natural heritage site, or those sites proposed to be designated.

1.6.3 *National Sustainable Development Strategy*

The 2002 document: ‘Making Ireland’s Development Sustainable’ (DOEHLG, 2002) highlights “respect for ecological integrity and biodiversity” as a core

theme, while the associated principle is that: “the diversity of wildlife, habitats and species should be maintained and improved”. An update to this document was due in 2007 but is not expected until 2008.

1.6.4 Long-term Strategy of the Environmental Protection Agency (EPA)

In 2007 the EPA published ‘2020 Vision: Protecting and Improving Ireland’s Environment’ (EPA, 2007) and identified the protection of soil and biodiversity as one of six environmental goals.

1.6.5 South Eastern River Basin District Management Plan

Under the Water Framework Directive (Directive 2000/60/EC) all Irish waters must achieve ‘good ecological status’ by 2015. The South Eastern River Basin District encompasses all of county Kilkenny and the report, ‘Water Matters’ (SERBD, 2007) was recently published. In 2008 a program of measures will be published that will aim meet the targets of the Directive.

1.7 Scoping of the study/Literature Review

There is little site specific information regarding the area however there are ‘site synopsis’ for the River Barrow and River Nore and Thomastown Quarry SACs (see Appendices 1 & 2) and there is a significant volume of published data on the distribution and status of protected species and, to a lesser extent, habitats in this area.

The Environmental Protection Agency (EPA) maintain a nationwide biological water monitoring programme and information is available for the Nore catchment.

1.7.1 NPWS Site Synopsis

Information regarding the sites is available through site synopsis reports. These are reproduced as appendices to this report. To date, a management plan has not been published for either the River Barrow and River Nore SAC or Thomastown Quarry SAC.

The River Barrow and River Nore SAC (site code: 2162) is a large site consisting predominantly of river channel but also encompassing important areas of riparian and woodland habitats. These habitats support a number of species of conservation concern. Only a small portion of this site is contained within the boundary of the LAP.

The Thomastown Quarry SAC (site code: 2252), as its name suggests, is a disused quarry that has developed a number of important ecological features. These include petrifying springs with tufa formations, a priority listed habitat type under Annex I of the habitats directive (code: 7220). The calcareous nature of the geology has also provided suitable conditions for a number of specialist flora species, including Orchids, while ponds are home to both Common frog and Smooth newt.

Tables 1 and 2 detail the conservation aspects of the SACs.

Table 1 – Conservation aspects of the River Barrow and River Nore SAC

Aspect	Level of Protection	Relevant ²	Likelihood of potential impacts ³
Alluvial wet woodland (code: 91E0)	Habitats Directive Annex I priority	Yes	Possible
Petrifying springs with tufa formation (code: 7220)		Yes	Possible
Atlantic salt meadows (code: 1330)	Habitats Directive Annex I	No	None
Mediterranean salt meadows (code: 1410)		No	None
Old oak woodlands (code: 91A0)		No	None
Eutrophic tall herbs (code: 6430)		No	None
Floating river vegetation (code: 3260)		Yes	Possible
Estuary (code: 1130)		No	None
Salicornia mudflats (code: 1310)		No	None
Dry heath (code: 4030)		Yes	Possible
Tidal mudflats (code: 1140)		No	None
Sea Lamprey <i>Petromyzon marinus</i>	Habitats Directive Annex II	Yes	Possible
Brook Lamprey <i>Lampetra planeri</i>		Yes	Possible
Semi-aquatic snail <i>Vertigo moulinsiana</i>		No	None
River Lamprey <i>Lampetra fluviatilis</i>	Habitats Directive Annex II, V	Yes	Possible
Freshwater Pearl Mussel <i>Margaritifera margaritifera</i>		Yes	Possible
Freshwater Crayfish <i>Austropotamobium pallipes</i>		Yes	Possible
Twaite Shad <i>Alosa fallax fallax</i>		Yes	Possible
Atlantic Salmon <i>Salmo salar</i>		Yes	Possible
Otter <i>Lutra lutra</i>		Yes	Possible

² Relevance is interpreted as meaning the likely presence of the habitat/species in the study area and is taken from relevant literature sources

³ The likelihood of impact is based on the potential presence of habitats from aerial photography and presence of suitable habitats for different species

Aspect	Level of Protection	Relevant ⁴	Likelihood of potential impacts ⁵
Killarney fern <i>Trichomanes speciosum</i>	Habitats Directive Annex II, IV; Flora Protection Order, 1999	No	None
Daubenton's bat <i>Myotis daubentoni</i>	Habitats Directive Annex IV; Wildlife Act, 2000	Yes	Possible
Irish hare <i>Lepus timidus hibernicus</i>	Habitats Directive Annex V; Wildlife Act, 2000	Yes	Possible
Common frog <i>Rana temporaria</i>		Yes	Possible
Greenland white-fronted goose <i>Anser albifrons flavirostris</i>	Birds Directive Annex I; Wildlife Act 2000	No	None
Golden plover <i>Pluvialis apricaria</i>		Possible	Unlikely
Whooper swan <i>Cygnus cygnus</i>		Yes	Possible
Kingfisher <i>Alcedo atthis</i>		Yes	Possible
Perigrine <i>Falco perigrinus</i>		Possible	Possible
Bewick's swan <i>Cygnus columbianus bewickii</i>		No	None

Table 2 – Conservation aspects of the Thomastown Quarry SAC

Aspect	Level of Protection	Relevant	Likelihood of potential impacts
Petrifying springs with tufa formation (code: 7220)	Habitats Directive Annex I priority	Yes	Possible
Common frog <i>Rana temporaria</i>	Habitats Directive Annex V; Wildlife (Amendment) Act, 2000	Yes	Possible

The conservation objectives of these sites are not explicitly detailed through a management plan however it can be assumed that achieving, or maintaining, 'good ecological status' for each of the conservation aspects will be vital. This

⁴ Relevance is interpreted as meaning the likely presence of the habitat/species in the study area and is taken from relevant literature sources

⁵ The likelihood of impact is based on the potential presence of habitats from aerial photography and presence of suitable habitats for different species

includes maintaining the area of important habitats, good water quality and the populations of important species.

1.7.2 EPA Water Monitoring Database.

Figure 2 shows the results of river water monitoring in the Thomastown area. This indicates a possible deterioration of water quality downstream of the town. However these data are from 2003 and are inconclusive as to whether pollution problems arise within the town itself or from further upstream along the Barrow.

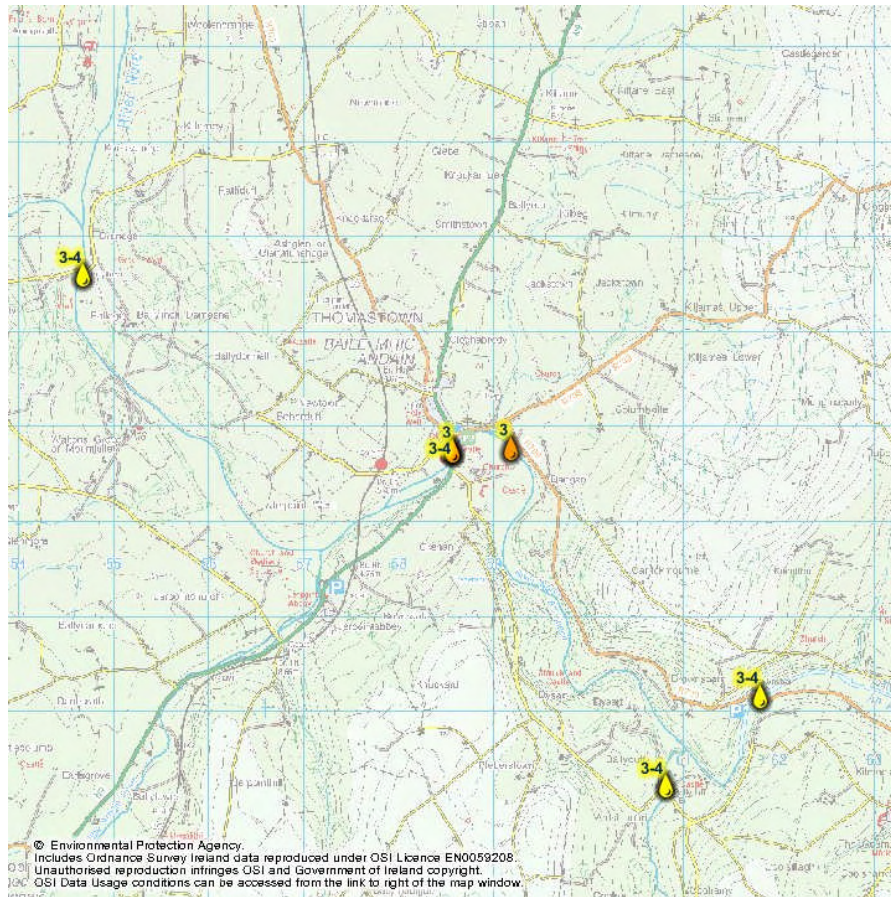


Figure 2 – EPA data showing river water quality in the Thomastown area. The numbers represent Q-Values: 3-4 (yellow drop) indicates slight pollution; 3 (orange drop) indicates moderate pollution (Toner et al., 2005)

1.8 Scope of Site Survey

Figure 3 shows selected land use zonings from the Draft Thomastown LAP overlain with the extent of the River Barrow and River Nore SAC and Thomastown Quarry SAC (these areas are either adjacent to the river or may have a direct impact upon it). This figure shows that significant areas of land designated as SAC have been zoned as 'Open Space'. In addition, land has been zoned for 'New Residential' that will increase the area of hard surfaces in the town and therefore may have implications for water quality.

The site survey was therefore focussed on areas of SAC that fell within the LAP area as well as potential wildlife corridors that are associated with it. In addition, macroinvertebrate samples were taken at locations along the river Nore and its tributaries to assess current water quality.

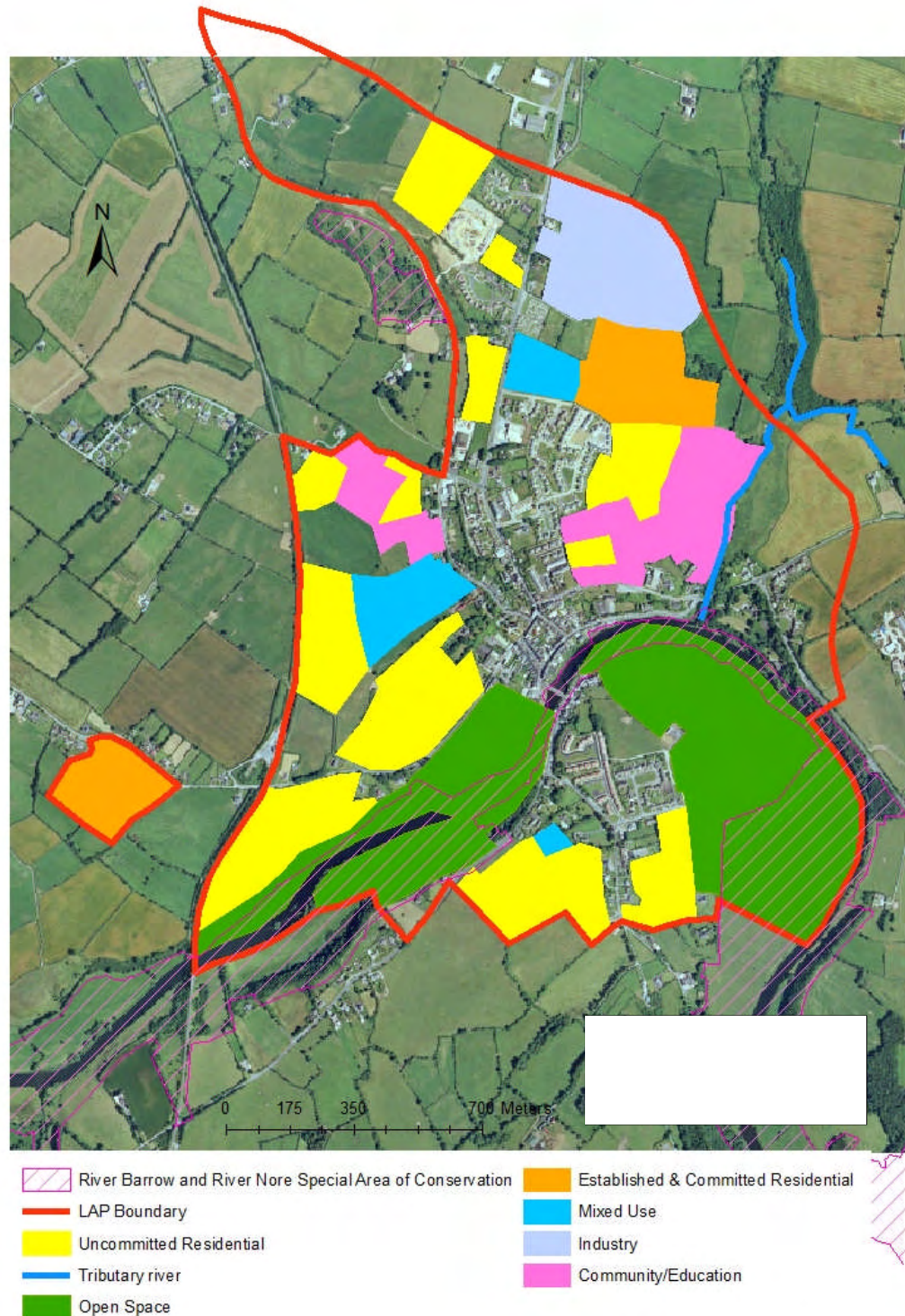


Figure 3 – Selected zonings from the Draft Thomastown LAP with potential impacts on the River Barrow and River Nore and Thomastown Quarry SACs.

Since no land take will occur at Thomastown Quarry SAC, and the hydrological flow is unlikely to be disrupted at the site as a result of nearby residential development, it was decided, in consultation with NPWS personnel, to scope this area out of the Appropriate Assessment study.

2.0 BASELINE DATA

2.1 Methodology

A site visit was carried out on October 7th 2008. The site was surveyed in accordance with the Heritage Council's draft Habitat Survey guidelines (Heritage Council, 2002) and the 'Guidelines for Baseline Ecological Assessment' from the Institute of Environmental Assessment (IEA, 1995). Habitats were identified in accordance with Fossitt's 'Guide to Habitats in Ireland' (Fossitt, 2000). A species list for each habitat was compiled and target notes were made. Targets notes and location information were taken with a *Garmin GPS 60*. Data were then uploaded to the *ArcView 9.2* GIS software suite.

The macroinvertebrate samples were taken in accordance with I.S. EN ISO 5667-3:2004: Water Quality – Sampling – Part 3: Guidance on the Preservation and Handling of Water Samples and ISO 7828: Water Quality – Methods of biological sampling – Guidance on Handnet sampling of aquatic benthic macro-invertebrates. A 2-minute kick sample was taken with stone washing and the sample was preserved in 70% iso-propanol. The sample was subsequently analysed following the EPA's Q-Value methodology (Toner et al., 2005).

2.2 Constraints

The month of October lies outside the optimal season for habitat survey (NRA, 2006) and it is therefore reasonable to expect that many floral species will not be apparent or will be difficult to identify.

It is important to note that a baseline survey does not attempt to catalogue all the species that are either present on the site or that may use the site for essential resources (foraging, roosting etc.). Whole groups of species such as invertebrates or bats may therefore go unrecorded. However, this need not be an obstacle to a full ecological assessment. A baseline survey uses a group of indicator species, vascular plants, to determine the extent and conservation status of individual land parcels. It is therefore not necessary to identify species of other taxonomic groups. Target notes are taken where important features are noted during the survey and where the presence of a protected species is revealed, further studies may be required.

Macroinvertebrate surveys were carried out within the optimal period which stretches from June – October (Toner et al., 2005) however heavy rain throughout the day resulted in swollen water levels. Taking kick samples in the main channel of the Nore is a challenge due to the river's depth and lack of riffle areas (these are highly oxygenated zones where the water surface is broken and are recommended sampling locations). The weir on the Nore however presents an artificial riffle and a site that can be accessed in safety, a kick sample was therefore taken at this point. While another suitable location was sampled on a tributary running alongside the health centre, other locations did not present themselves. The main Nore channel was too deep while a small tributary running through the centre of the town is entirely

culverted. There are consequently only two samples available and this limits the ability to predict pollution sources.

Access to survey areas was a problem at the woodland to the east of town as it is in private ownership and is surrounded by a high wall. While it was possible to identify tree species, the species list for this habitat is incomplete. However this area is outside the SAC and it is not anticipated that it will be impacted by plans under the LAP.

2.3 Flora

The full riparian zone running through the town and areas designated as SAC adjacent to it were surveyed. Habitats were classified and species lists for each are presented in Appendix 3 to this report.

The following habitats were found and are shown in figure 4 as a habitat map:

2.3.1 Rivers (*Eroding: FW1 and Depositing: FW2*)

The river Nore rises in the Slieve Bloom mountains and is joined by many other rivers before finally entering the sea at Waterford harbour. Upon entering Thomastown it has slowed and while erosion is still occurring in places, it is predominantly a depositing river. The typical course of a depositing river is meandering and this can be seen as it winds its way through the town, flowing north before turning in a wide arc to return to its course which is relentlessly southward. The river banks in this area are largely denuded of vegetation and this has accelerated the natural process of bank erosion. This can be seen as muddy cliffs along both sides of the river. To the south west the river splits in two briefly and it is not known whether this is an artificially dug channel or a natural phenomenon. The channel seems unnaturally straight and it is possible that it is a canalised stretch that once allowed a navigable passage around rapids. Along this section the river bank has much overhanging vegetation, particularly trees including Alder *Alnus glutinosa* and Willow *Salix* sp. but also some typical river flora such as Butterbur *Petasites hybridus*, Common nettle *Urtica dioica* and Pendulous sedge *Carex pendula*. The alien invasive Indian balsam *Impatiens glandulifera* is also present but in very low abundance. This plant was recently categorised as of the highest risk, or most unwanted of Ireland's invasive species (Kelly et al., 2008). It can blanket large areas, inhibiting the growth of native species, and upon dying back each winter it leaves land bare and prone to erosion.

There are at least two tributaries within the LAP area that flow into the Nore. One to the east flows past the regional health centre and is fast moving, shallow, and characterised by a riffle/glide sequence. These are features of an eroding river and represent a different habitat to the main channel of the Nore. This area is densely wooded with a mature stand of Alder, Willow and Sycamore *Acer pseudoplatanus*. There is little vegetation within the stream itself with the exception of river mosses that coat some of the larger rocks.

Another tributary enters the Nore just north of the main bridge however this is totally culverted and so has no ecological features of its own. This has

implications for water quality and a discoloured effluent was observed flowing into the Barrow as there was heavy rain on the day of survey.

2.3.2 Woodland

True native woodland, that is, woodland that is predominantly composed of native Irish species, is an exceedingly rare habitat type in Ireland (Fossitt, 2000). The great majority of broadleaved woodland today has been altered in some way or another and tend to be mostly composed of non-native species such as Sycamore and Beech *Fagus sylvatica*. The woodlands in Thomastown are therefore a mish-mash of habitat types that vary in their conservation importance on a national level. Because of its scarcity however, broadleaved woodland of any type is of local importance and can frequently harbour species of conservation significance.

To the west of the town, and to the north of the main N9 road to Waterford there is a steep embankment that falls into the river Nore. This is part of the SAC but is also designated as a Natural Heritage Area (Thomastown, site code: 410). The area was identified as of importance due to the presence of two legally protected plants: Meadow saffron *Colchicum autumnale* and Nettle-leaved bellflower *Campanula trachelium*. The lower reaches of this site were inaccessible but the wooded over-story appeared to be predominantly composed of Ash *Fraxinus excelsior* with occasional Oak *Quercus* sp., Sycamore and Hawthorn *Crataegus monogyna*. The greater proportion of native Irish trees means that this woodland can be characterised as Oak-Ash-Hazel woodland – WN2 and so is of high conservation significance. The under-storey, so far as it was visible, seemed to be characterised by Bracken *Pteridium aquilinum*, Bramble *Rubus fruticosus* and Ivy *Hedera helix*. There is some Cherry laurel *Prunus laurocerasus* and this is another highly invasive, ‘most-unwanted’ species that will ultimately destroy the forest in which it is found (Maguire et al., 2008).

The other wooded area within the LAP boundary occurs to the west of the town and to the south of the road to Inistioge. As mentioned in section 2.2 this forest was inaccessible and so a full survey did not take place. Mature tree species were identified from the road and included a large number of non-native Pine as well as some Oak, Ash and Sycamore. The proportion of native species here was well below 50% and so it is categorised by Fossitt as (Mixed) Broadleaved woodland – WD2. Other species that were identified were Elder *Sambucus nigra*, Ivy, Ground ivy *Glechoma hederacea* and Lady fern *Athyrium filix-femina*.

Where this woodland engulfs the eroding river that flows into the Barrow there are some features of Riparian woodland which is a separate habitat under the Fossitt scheme. Here the ground is evidently flooded periodically and this is characterised by bare, muddy ground and stands of Common nettle. There is also some Meadowsweet *Filipendula ulmaria* but overall the area is too small to map on its own.

2.3.3 Linear Woodland (Hedgerow: WL1 and Treeline: WL2)

Linear woodland is lines of trees and shrubs that have traditionally been planted in Ireland to mark field boundaries and keep in herds of livestock. The

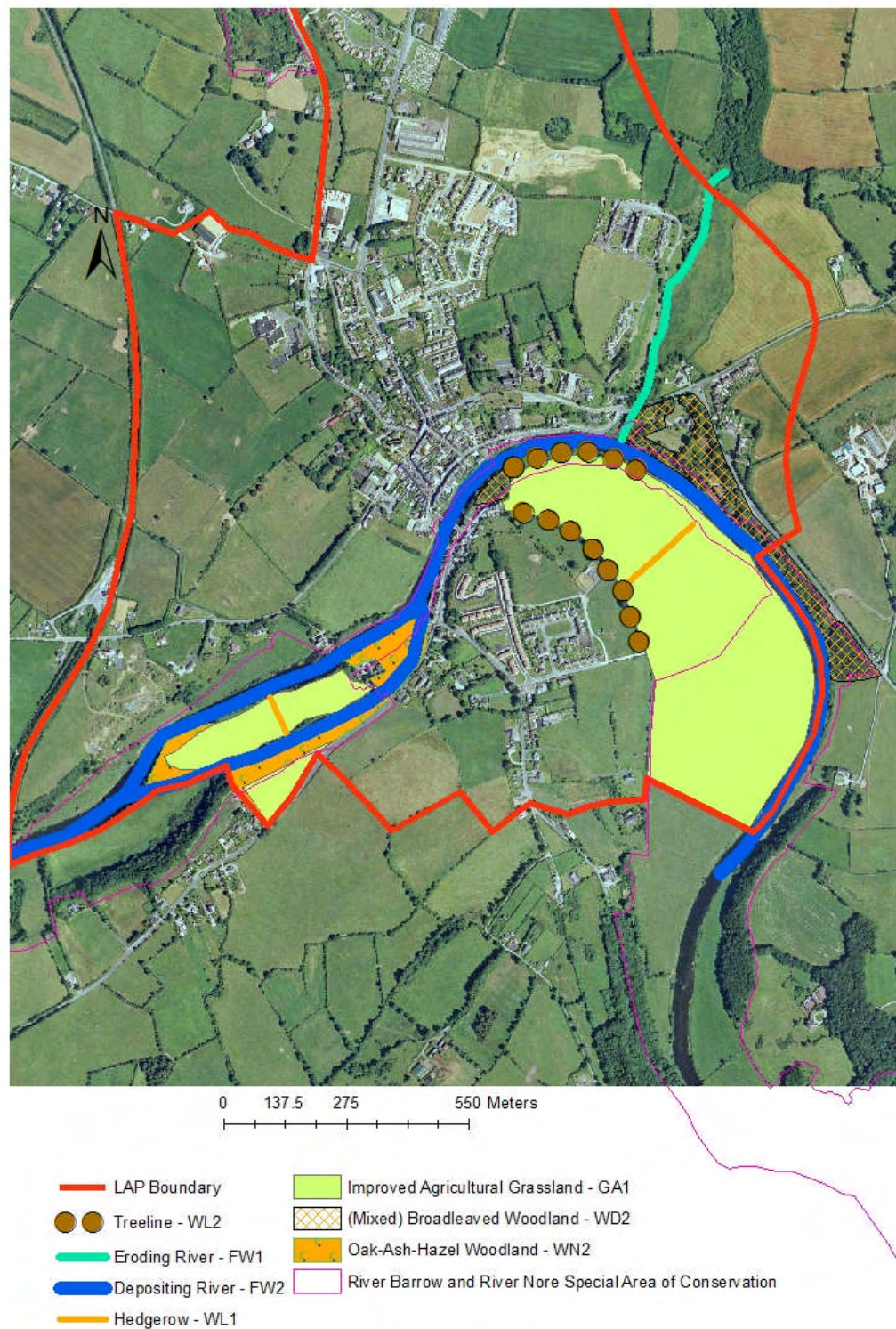


Figure 4 – Habitat map showing the distribution and classification of habitats that lie within the River Barrow and River Nore SAC and the Thomastown LAP boundary.

difference between a Treeline and a Hedgerow lies in the height of the trees. A Treeline consists of trees over 5 m in height and can vary from an 'avenue' style line of a single species to a Hedgerow that has ceased to be cut regularly and so the trees have grown to maturity. A Hedgerow meanwhile is

mostly less than 5 m and is densely vegetated at the bottom as it is maintained to be 'stock-proof'. Aerial photography shows that the Thomastown area has a low density of Hedgerows and this is rather typical of the larger field system that has traditionally existed in the fertile east of the country.

Within the SAC there are only short stretches of Treeline and Hedgerow and these are composed of typical broadleaved species such as Beech, Hawthorn and Horse chestnut *Aesculus hippocastanum*. They contain other species that are associated with woodlands such as Herb-Robert *Geranium robertianum*, Rose *Rosa sp.* and Hart's tongue *Phyllitis scolopendrium*.

Linear woodlands are vital features for wildlife in the Irish countryside for a number of reasons: they provide habitat for many woodland species where their traditional home has been removed; they act as corridors along which species can disperse and forage; and they enhance the health of important conservation areas by linking them with other areas of high biodiversity. They also provide a number of other benefits to the environment including adding soil fertility, attenuating floodwater run-off; helping to treat pollutants in air and water; and providing pollinators for crops (Hickie, 2004).

2.3.6 Improved Agricultural Grassland – GA1

Grassland that has been applied with industrial fertilisers is species poor and is therefore of low ecological value. Typical species include those grasses that have been sowed for grazing e.g. Cock's foot *Dactylis glomerata* and a small number of tolerant plants such as Thistles *Cirsium sp.*, Dock *Rumex sp.*, Common nettle, and in wet ground Rushes *Juncus sp.*

While these habitats are of little ecological significance on their own they have been included within the SAC because they form part of the floodplain of the river Nore.

2.4 Fauna

2.4.1 Mammals

Since a dedicated fauna survey was not carried out, the presence of various species is deduced from the existence of suitable habitat and this is shown in table 2. Otter *Lutra lutra* would be expected along the Nore river although a search for spraint (droppings) did not reveal direct evidence.

The old mill buildings along the river are likely to provide suitable habitat for bats, although it is not possible to determine which species without further study. All bat species are protected by law.

Badger *Meles meles* droppings were recorded in the grassy island adjacent to the mill race. While the Badger is protected under the Wildlife (Amendment) Act, 2000 it is not mentioned in the Habitats Directive.

Table 2 – Mammals known from the area and for which there is suitable habitat (Harris & Yalden, 2008)

Species	Level of Protection	Habitat
Otter <i>Lutra lutra</i>	Annex II & IV Habitats Directive; Wildlife (Amendment) Act, 2000	Rivers and wetlands
Whiskered bat <i>Myotis mystacinus</i>	Annex IV Habitats Directive; Wildlife (Amendment) Act, 2000	Gardens, parks and riparian habitats
Natterer's bat <i>Myotis nattereri</i>		Woodland
Leisler's bat <i>Nyctalus leisleri</i>		Open areas roosting in attics
Brown long-eared bat <i>Plecotus auritus</i>		Woodland
Leisler's bat <i>Nyctalus leisleri</i>		Woodlands and buildings
Common pipistrelle <i>Pipistrellus pipistrellus</i>		Farmland, woodland and urban areas
Soprano pipistrelle <i>Pipistrellus pygmaeus</i>		
Daubenton's bat <i>Myotis daubentonii</i>		Woodlands and bridges associated with open water
Irish hare <i>Lepus timidus hibernicus</i>	Annex B Habitats Directive; Wildlife (Amendment) Act, 2000	Wide range of habitats
Hedgehog <i>Erinaceus europaeus</i>	Wildlife (Amendment) Act, 2000	Woodlands and hedgerows
Pygmy shrew <i>Sorex minutus</i>		Woodlands, heathland, and wetlands
Red squirrel <i>Sciurus vulgaris</i>		Woodlands
Irish stoat <i>Mustela erminea hibernica</i>		Wide range of habitats
Badger <i>Meles meles</i>		Farmland, woodland and urban areas

2.4.2 Birds

Incidental recordings of birds were made and include many typical countryside species and these are detailed in table 3. No dedicated bird survey was carried out and so this list is far from exhaustive. Nearly all bird species and their nests are protected under the Wildlife (Amendment) Act, 2000. Poor weather on the day reduced the chances of casual encounters with birds and it is not believed that suitable habitat exists for bird species listed in table 1, with the exception of Kingfisher *Alcedo atthis*.

While Kingfisher was not recorded on the day, there is suitable habitat and its presence must be assumed. This species is listed under the Annex I of the Birds Directive.

Table 3 – Incidental records of birds

Scientific name	English name	⁶ Conservation Status
<i>Anas platyrhynchos</i>	Mallard	Green
<i>Ardea cinerea</i>	Grey heron	Green
<i>Corvus frugilegus</i>	Rook	Green
<i>Motacilla cinerea</i>	Grey wagtail	Green
<i>Phalacrocorax carbo</i>	Cormorant	Amber
<i>Turdus merula</i>	Blackbird	Green

2.4.3 Amphibians

Neither Common frog *Rana temporaria* nor Smooth newt *Triturus vulgaris* were recorded although they could breed in the marginal areas of the river where wetland vegetation has developed. Both are protected under the Wildlife (Amendment) Act, 2000 while the frog is also protected under Annex V of the Habitats Directive.

2.4.4 Fish

The Nore river catchment is known to provide habitat to species of conservation importance including Salmon *Salmo salar*, Sea Lamprey *Petromyzon marinus*, River lamprey *Lampetra fluviatilis*, Brook lamprey *L. planeri*, Allis shad *Alosa alosa* and Twaite shad *Alosa fallax fallax*, all of which are protected under Annex II of the Habitats Directive. These species require clean, well oxygenated gravel substrates for spawning (Hendry K & Cragg-Hine D, 2003; Maitland PS, 2003) and it is therefore not likely that spawning is occurring in the study area. Pollution barriers can be a problem but it is not known whether this is an issue in Thomastown.

During sampling for macroinvertebrates, an Eel *Anguilla anguilla* was captured. This species is currently not protected but concern has been expressed about dramatic declines across much of its range (Maitland, 2004)

⁶ Conservation status is derived from BirdWatch Ireland's list of Birds of Conservation Concern in Ireland (Lynas et al., 2007) where green = low concern; amber = medium concern; and red = high concern.

2.4.5 Invertebrates

A large number of insects are likely to be present in the area and all habitats present are suitable for a wide range of species. It is unlikely that protected species are present on the site but this is more to do with the limited number of protected insects in Ireland and a similarly poor level of data.

Of unique significance to the Nore is the presence of the Nore freshwater pearl mussel *Margaritifera durrovensis*, its only known world population. It is now functionally extinct since it has not bred since the 1970's (NPWS, 2008). A major factor in its decline has been the deterioration in water quality that has been experienced across Ireland in recent decades. If this species is to be rescued from the brink of extinction it is imperative that existing water quality issues be resolved while simultaneously preventing any further deterioration in quality. However the remaining mussels are located in the Nore headwaters, well upstream of Thomastown (Mookens, 1999).

Also present in these waters is the White-clawed crayfish *Austropotamobius pallipes* and while it is known to be relatively pollution tolerant (Toner et al., 2005) its status was recently assessed as being poor, with disease being highlighted as a particular threat (NPWS, 2008).

2.5 Water Quality

Water quality can be determined through analysing macro-invertebrates (i.e. those organisms that are visible to the naked eye) as these act as indicator species for the health of the river ecosystem. In Ireland, the EPA have developed a detailed methodology for this and it is known as the Q-Value. Q-Values vary from Q1: Seriously polluted, through to Q5: Unpolluted (Toner et al., 2005). The EPA conduct regular monitoring throughout the country and one monitoring station exists in Thomastown where the river Nore was most recently assessed as Q3: Moderately polluted (2004). This was a deterioration from Q3-4: Slightly polluted in 2001.

For this study, two macro-invertebrate kick samples were taken and the location of these is shown in figure 5.

The flow of water in this figure is from west to east. Two samples is rather few to be drawing conclusions but it can be seen the quality of water is variable. The main channel of the Nore remains Q3: moderately polluted since the last EPA sampling while the tributary flowing into it is only slightly better at Q3-4: slightly polluted. The assessment on the Barrow is upstream of the town and so pollution is occurring outside of the influence of this LAP. There are many possible contributors to this problem including agricultural run-off, poorly treated municipal wastewater, surface water run-off in towns and industrial point sources.

The culverted stream entering the Nore at the bridge was discoloured and slime growths were noted to be growing on the bare concrete. This may be an indication that pollutants are entering the river from the town at this point. While there is no evidence to assert this, it is not unusual for surface water run-off and misconnected piping in homes to be contributors to water pollution problems.

Full details of the Q-Value assessments are given in Appendix 4

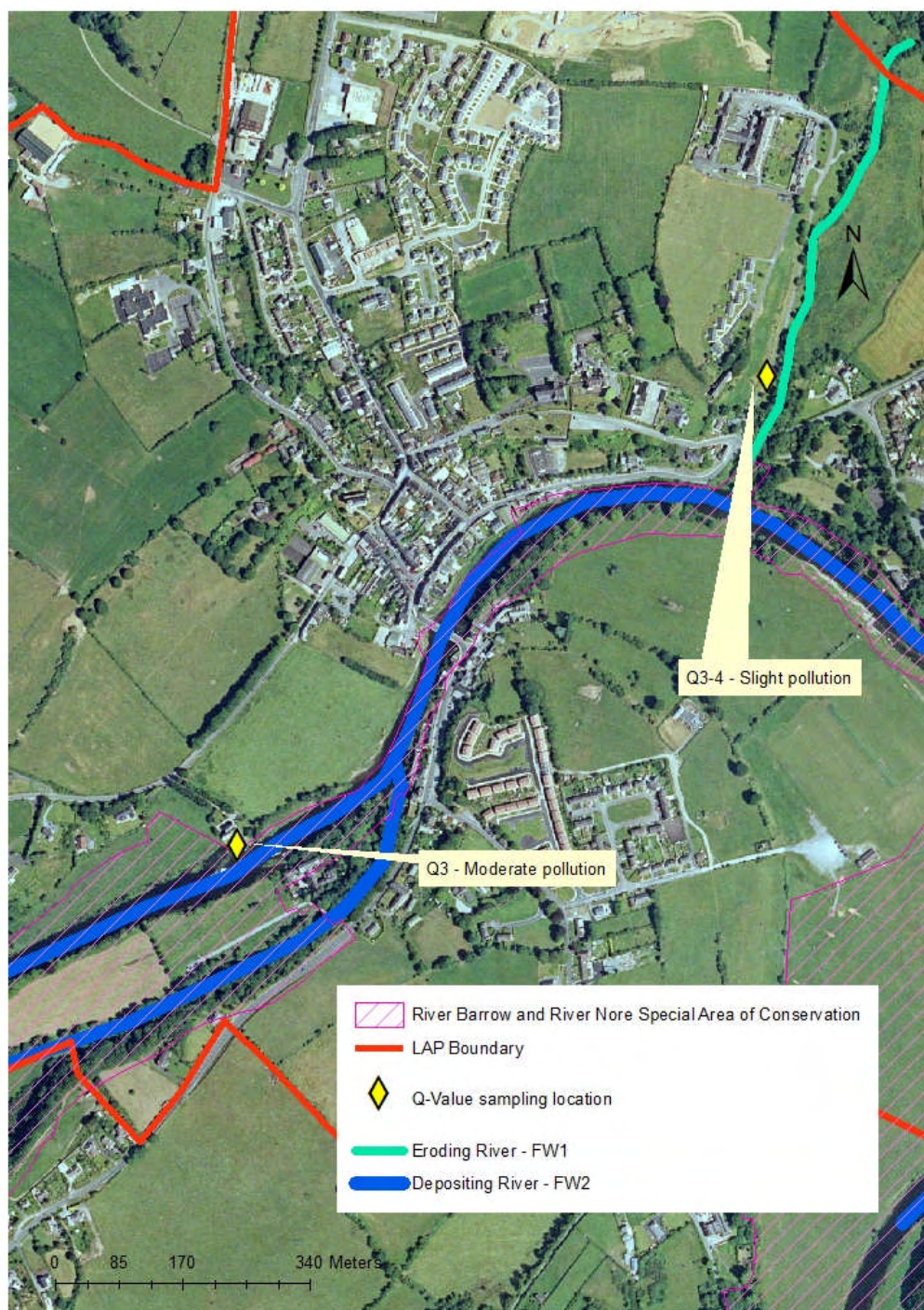


Figure 5 – Ecological water quality in the Thomastown area

2.6 Determination of Value

Appendix 3 of the NRA guidelines (NRA, 2006) outlines a 'site evaluation scheme' that is designed to assign value to ecological features.

Table 4 lists the habitats that were recorded and their associated value.

Table 4 – Valuation of habits with reference to Appendix 3 of the NRA guidance.

Habitat	Rating	Criteria
Any area within the SAC: FW2 – Depositing/lowland river WD1 – (Mixed) broadleaved woodland WN2 – Oak-Ash-Hazel woodland GA1 – Improved Agricultural Grassland WL1 – Hedgerow WL2 - Treeline	A – Internationally important	Sites designated as SAC under the EU's Habitats Directive
WD1 – Mixed broad-leaved woodland FW1 – Eroding/upland river	C – High value, locally important	Sites containing semi-natural habitat types with high biodiversity in a local context.

2.6 Further study

The 'Guidelines for Baseline Ecological Assessment' (IEA, 1995) recommends that further, more detailed study be carried out where the presence of species of conservation importance is highlighted through the literature review or site survey. Section 6.1 of the guidelines, *Mammals*, recommends further study where the baseline survey indicates the probable presence of species protected under...the Wildlife and Countryside Act [in Ireland the equivalent is the Wildlife (Amendment) Act 2000]".

This is particularly relevant as the presence of Bats, Otter, Kingfisher and White-clawed crayfish is likely within the zone of influence.

2.7 'Do-nothing' scenario

In the absence of this LAP there are likely to be impacts on the SAC in the Thomastown area through the advance of alien invasive species, particularly Cherry laurel and Indian balsam. While these species are not present in great abundance just yet, doing nothing will quickly change this state of affairs.

Other habitats are unlikely to undergo major changes assuming that current management practices continue. Hedgerows, where they exist, are likely to grow into Treelines if they are not being regularly trimmed.

Water quality in the Nore river may improve with the implementation of the Water Framework Directive and the installation of new wastewater treatment facilities. However continued built development within the town, and the

cumulative removal of biodiversity features such as hedgerows, diminishes the capacity of the land to treat pollutants in surface water run-off. This can lead to a decrease in overall river water quality.

3.0 IMPACT ASSESSMENT

3.1 Impact prediction

Here, impacts are discussed including direct, indirect, cumulative and in combination effects. Quantifying impacts at this point presents difficulties due to the scale of the plan and the fact that individual developments occur at different times while impacts are influenced by the layout and design features of each proposal.

Direct loss of habitat within the SAC may occur through the designation of protected areas as 'open space'. This may impact on habitats along the river bank particularly Oak-Ash-Hazel woodland to the south west of the town. However, large portions of these areas are of low ecological value (i.e.. agricultural grassland) and there is an equal opportunity to enhance habitats in these areas. These two impacts, the negative and the positive, are be examined separately.

Of principle concern is the issue of water quality in the Nore river which is at present poor. The expansion of built development and the population increases that that brings has the potential to further deteriorate water quality. This derives from two sources: foul wastewater (sewage); and surface run-off from paved surfaces. While a commitment has been given to expand and upgrade the local treatment plant facilities to accommodate the expected growth in population there is a concern that this will not be completed before this expansion occurs. Under this scenario there is considerable scope for pollution of the Nore.

The treatment of surface water run-off is not confined to flood control. This water can contain hydrocarbons and particulate matter which are damaging to fish and their habitats.

In combination impacts may occur as LAPs are being drafted for other towns in the catchment: Graiguenamanagh, Castlecomer, Callan, Kilkenny, Bennettsbridge and New Ross. These are all expected to result in an increase in local populations and business activity. This will result in a cumulative impact as the pressures on the water resource grows. The impacts to water quality in Thomastown can therefore be seen in the overall context of increasing population, increasing per capita water demand, and deteriorating water quality. This places the integrity of the SAC under increasing pressure and may result in a deterioration in the conservation status of key species and habitats listed in table 1.

Poor water quality diminishes the resources available to key species identified in table 1 and thereby undermines the integrity of the ecosystem on a catchment scale.

There is no predicted impact to populations of Freshwater pearl mussel as the existing population is located upstream of the town.

Specifically, there are six potential impacts from this development:

- 1 Loss of habitat within the SAC through designation of land as 'open space'.

- 2 Enhancement of habitat within the SAC through development of land for amenity use.
- 3 Deterioration of water quality through the discharge of poorly treated sewage effluent
- 4 Deterioration of water quality through the discharge of hydrocarbons and particulate matter in surface water run-off

3.2 Nature of predicted impacts

The nature of the impacts can be summarised in a table as follows:

Impact	Direct/ Indirect	Cumulative	Permanent/ Temporary ⁷	Positive/ Negative	Reversible?
1	Direct	No	Permanent	Negative	No
2	Direct	No	Permanent	Positive	No
3	Direct	Yes	Permanent	Negative	Yes
4	Direct	Yes	Permanent	Negative	Yes

3.3 Scale and likelihood of predicted impacts

Impacts are quantified where possible, both in absolute terms and as an impact of the whole resource. Quantifying impacts on this scale is difficult and has integral uncertainties associated with it. In many instances it also depends on decisions relating to planning design that have yet to be made. This uncertainty is acknowledged and therefore the precautionary principle is invoked and a worst case scenario presumed.

Impacts 1 and 2 are combined as they are related to one another, as are impacts 3 and 4.

Impacts to water quality are estimated using proxy indicators as an accurate assessment would require a degree of analysis that is beyond the scope of this report.

Impact	Magnitude	As proportion of resource	Likelihood
1	32.4 ha of land has been zoned for 'open space' within the SAC	~92% of SAC in the LAP area	Likely – depends on the specific plans
2			
3 ⁸	Under high scenario the population is expected to increase by 2,460 by 2020	34% increase on current levels	Possible – low scenario predicts increase of 20%
4			

⁷ The NRA guidelines (2006) define 'permanent' as an impact lasting over 60 years

⁸ It is not possible to accurately predict the actual increase in pollution concentrations without carrying out a detailed analysis and data collection exercise. Here, population is used as a proxy indicator to show the likely increase in pollution levels.

3.4 Assessment of impact significance

Appendix 4 of the NRA guidelines (NRA, 2006) provides guidance on assessing impact significance. This is done by combining the magnitude of the impact (from sections 3.2 and 3.3) with the value of the ecological resource as assessed in section 2.7. The 'site' that is referred to is the overall area and not necessarily the designated site.

Impact	Significance
1	Severe negative/Major positive – any permanent impacts on an internationally important site
2	
3	Severe negative – Extensive ⁹ , permanent impacts on an internationally important site
4	

Overall, the following statements can be made:

- **Severe Negative** impacts may occur as a result of 'open space' planning designations within the boundary of the SAC as well as from poorly treated domestic wastewater and untreated surface water run-off from developments that discharge into the Nore river.
- A **Major Positive** impact may occur through actions for conservation within areas that are proposed to be developed for amenity purposes.

Mitigation is required where significant negative impacts are predicted to the integrity of the SAC. The IEEM guidelines suggest that an impact is significant at a level of Major negative and over. However best practice also suggests that in the interests of sustainable development negative impacts should be mitigated and enhancement measures integrated in order to create an overall positive impact.

Mitigation is addressed in section 4.

⁹ NRA guidelines (2006) define 'extensive as an impact on a water course measurable more than 250m from the impact source

4.0 RECOMMENDATIONS FOR MITIGATION

According to accepted methodologies (EPA, 2003; IEEM, 2006) mitigation is required where there are likely, significant, negative impacts. Three significant negative impacts have been identified, as well as a major positive impact and it is proposed to address these through appropriate mitigation measures and recommendations for enhancement.

4.1 Impact Mitigation

4.1.1 *Loss of habitat within the SAC through 'open space' designations.*

An 'open space' designation within an SAC is inappropriate as it does not mark the site out as being of special conservation value. It also leads to ambiguity in relation to what actions may and may not be permissible on the site.

Recommendation 1:

Ensure that the boundary of the SAC is clearly marked on the LAP objectives map. Designate this area for 'biodiversity conservation' or other similar title that accurately conveys the purpose and importance of the site.

Recommendation 2:

Ensure that *any* development within the SAC, or which may have direct impacts upon its integrity is screened for impacts in accordance with the requirements for Appropriate Assessment under the Habitats Directive.

Only the Appropriate Assessment process can determine the value of features and land parcels within the SAC. A note to this effect should be included in the LAP to ensure it is clear to planners, developers and other interested parties.

These actions would reduce this **severe negative** impact to **neutral**.

4.1.2 *Discharge of pollutants into the Nore river as a result of the discharge of poorly treated sewage effluent*

It is acknowledged that within the draft LAP there is provision for the upgrading of the local wastewater treatment facility to accommodate the projected increase in population. However it is not clear that such a facility will be in place prior to the construction of new residential business areas within the town. It is imperative for the integrity of the SAC that adequate treatment facilities be in place *prior* to the construction of new homes and businesses.

Recommendation 3:

Ensure that new or upgraded wastewater treatment plant is in place and operational prior to the opening of new residential or business areas within the town.

4.1.3 *Discharge of pollutants in the Nore river as a result of surface-water run-off from new developments.*

This form of pollution has the potential to introduce contaminants that can damage fish and their habitats. Sustainable Drainage Systems (SUDS) have been developed in recent years that have a number of advantages. They can attenuate the flow of pollutants and especially particulate matter; alleviate pulse flows of water during flood periods; and can even create habitat in the form of wetlands.

Recommendation 4:

Ensure that all new developments that will be discharging surface water to the Nore river include appropriate abatement measures to ensure that final concentrations of pollutants will not result in a deterioration of water quality. This should be done by integrating SUDS within all such developments e.g. constructed wetlands, green roofs or permeable paving.

An innovative opportunity exists to provide an attenuation solution for all new developments at once through the creation of a constructed wetland. This is potentially more cost effective as it requires minimal maintenance, has excellent pollutant attenuation performance and can enhance the conservation objectives of the site through habitat creation.

Implementing this recommendation could reduce the magnitude of the impact from potentially **severe negative** to **neutral**.

4.1.3 *Enhancement of habitat within the SAC through the development of land for amenity use.*

There is considerable scope to enhance the current lands within the SAC that are proposed for amenity use. The current situation where river banks are devoid of vegetation is likely to be contributing to erosion. There is an opportunity therefore to establish buffer zones of appropriate, native Irish trees and shrubs that will stabilise river banks and provide habitat for wildlife.

Any plan for these areas should also include a strategy for the removal of alien invasive species, particularly Indian balsam and Cherry laurel. If tackled at an early stage this task could be relatively easy and cheap as levels of infestation are currently quite low.

Recommendation 5:

Ensure that the Appropriate Assessment that will be undertaken prior to the development of these amenity areas suggests measures that will enhance the value of the site for conservation as well as the amenity value for users. This should be done in consultation with NPWS and the Southern Regional Fisheries Board (SRFB).

Within these amenity areas, erect interpretive panels that will inform users of the fact that this river forms part of a Europe-wide network of sites for the conservation of nature.

4.2 Monitoring

Monitoring is required where there may be residual impacts despite implementation of mitigation measures. The EPA have a monitoring station in the town as part of their on-going programme of river data collection.

It is not considered necessary to propose further monitoring for the impacts highlighted in this report. However, monitoring may be necessary as part of Appropriate Assessments for individual developments in the future

4.3 Conclusion

The Thomastown LAP is predicted to result in severe negative impacts on the integrity of the River Barrow and River Nore SAC. However there is also potential for major positive impacts. Five recommendations have been made as avoidance mitigation and, if implemented, could ensure that the magnitude of these impacts is not only reduced to neutral but will be positive overall.

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Appendix 1 – NPWS Site Synopsis for River Barrow and River Nore SAC

SITE SYNOPSIS SITE NAME : RIVER BARROW AND RIVER NORE SITE CODE : 2162

This site consists of the freshwater stretches of the Barrow/Nore River catchments as far upstream as the Slieve Bloom Mountains and it also includes the tidal elements and estuary as far downstream as Creadun Head in Waterford. The site passes through eight counties – Offaly, Kildare, Laois, Carlow, Kilkenny, Tipperary, Wexford and Waterford.

Major towns along the edge of the site include Mountmellick, Portarlinton, Monasterevin, Stradbally, Athy, Carlow, Leighlinbridge, Thomastown, New Ross, Inistioge, Thomastown, Callan, Bennettsbridge, Kilkenny and Durrow. The larger of the many tributaries include the Lerr, Fushoge, Mountain, Aughavaud, Owenass, Boherbaun and Stradbally Rivers of the Barrow and the Delour, Dinin, Erkina, Owveg, Munster, Arrigle and King's Rivers on the Nore. Both rivers rise in the Old Red Sandstone of the Slieve Bloom Mountains before passing through a band of Carboniferous shales and sandstones. The Nore, for a large part of its course, traverses limestone plains and then

Old Red Sandstone for a short stretch below Thomastown. Before joining the Barrow it runs over intrusive rocks poor in silica. The upper reaches of the Barrow also runs through limestone. The middle reaches and many of the eastern tributaries, sourced in the Blackstairs Mountains, run through Leinster Granite. The southern end, like the Nore runs over intrusive rocks poor in silica. Waterford Harbour is a deep valley excavated by glacial floodwaters when the sea level was lower than today. The coast shelves quite rapidly along much of the shore.

The site is a candidate SAC selected for alluvial wet woodlands and petrifying springs, priority habitats on Annex I of the E.U. Habitats Directive. The site is also selected as a candidate SAC for old oak woodlands, floating river vegetation, estuary, tidal mudflats, *Salicornia* mudflats, Atlantic salt meadows, Mediterranean salt meadows, dry heath and eutrophic tall herbs, all habitats listed on Annex I of the E.U. Habitats Directive. The site is also selected for the following species listed on Annex II of the same directive – Sea Lamprey, River Lamprey, Brook Lamprey, Freshwater Pearl Mussel, Nore Freshwater Pearl Mussel, Crayfish, Twaite Shad, Atlantic Salmon, Otter, *Vertigo moulinsiana* and the plant Killarney Fern.

Good examples of Alluvial Forest are seen at Rathsnagadan, Murphy's of the River, in Abbeyleix estate and along other shorter stretches of both the tidal and freshwater elements of the site. Typical species seen include Almond Willow (*Salix triandra*), White Willow (*S. alba*), Grey Willow (*S. cinerea*), Crack Willow (*S. fragilis*), Osier (*S. viminalis*), with Iris (*Iris pseudacorus*), Hemlock Water-dropwort (*Oenanthe crocata*), Angelica (*Angelica sylvestris*), Thin-spiked Wood-sedge (*Carex strigosa*), Pendulous Sedge (*C. pendula*), Meadowsweet (*Filipendula ulmaria*), Valerian (*Valeriana officinalis*) and the Red Data Book species Nettle-leaved Bellflower (*Campanula trachelium*).

Three rare invertebrates have been recorded in this habitat at Murphy's of the River. These are: *Neoascia obliqua* (Diptera: Syrphidae), *Tetanocera freyi* (Diptera: Sciomyzidae) and *Dictya umbrarum* (Diptera: Sciomyzidae).

A good example of petrifying springs with tufa formations occurs at Dysart Wood along the Nore. This is a rare habitat in Ireland and one listed with priority status on Annex I of the EU Habitats Directive. These hard water springs are characterised by lime encrustations, often associated with small waterfalls. A rich bryophyte flora is typical of the habitat and two diagnostic species, *Cratoneuron commutatum* var. *commutatum* and *Eucladium verticillatum*, have been recorded.

The best examples of old Oak woodlands are seen in the ancient Park Hill woodland in the estate at Abbeyleix; at Kyleadohir, on the Delour, Forest Wood House, Kylecorragh and Brownstown Woods on the Nore; and at Cloghristic Wood, Drummond Wood and Borris Demesne on the Barrow, though other patches occur throughout the site.

Abbeyleix Woods is a large tract of mixed deciduous woodland which is one of the only remaining true ancient woodlands in Ireland. Historical records show that Park Hill has been continuously wooded since the sixteenth century and has the most complete written record of any woodland in the country. It supports a variety of woodland habitats and an exceptional diversity of species including 22 native trees, 44 bryophytes and 92 lichens. It also contains eight indicator species of ancient woodlands. Park Hill is also the site of two rare plants, Nettle-leaved Bellflower and the moss *Leucodon sciurioides*. It has a typical bird fauna including Jay, Long-eared Owl and Raven. A rare invertebrate, *Mitostoma chrysomelas*, occurs in Abbeyleix and only two other sites in the country.

Two flies *Chrysogaster virescens* and *Hybomitra muhlfeldi* also occur. The rare Myxomycete fungus, *Licea minima* has been recorded from woodland at Abbeyleix. Oak woodland covers parts of the valley side south of Woodstock and is well developed at Brownsford where the Nore takes several sharp bends. The steep valley side is covered by Oak (*Quercus* spp.), Holly (*Ilex aquifolium*), Hazel (*Corylus avellana*) and Birch (*Betula pubescens*) with some Beech (*Fagus sylvatica*) and Ash (*Fraxinus excelsior*). All the trees are regenerating through a cover of Bramble (*Rubus fruticosus* agg.), Foxglove (*Digitalis purpurea*) Wood Rush (*Luzula sylvatica*) and Broad Buckler-fern (*Dryopteris dilatata*).

On the steeply sloping banks of the River Nore about 5 km west of New Ross, in County Kilkenny, Kylecorragh Woods form a prominent feature in the landscape. This is an excellent example of a relatively undisturbed, relict Oak woodland with a very good tree canopy. The wood is quite damp and there is a rich and varied ground flora. At Brownstown a small, mature Oak-dominant woodland occurs on a steep slope. There is younger woodland to the north and east of it. Regeneration throughout is evident. The understorey is similar to the woods at Brownsford. The ground flora of this woodland is developed on acidic, brown earth type soil and comprises a thick carpet of Bilberry (*Vaccinium myrtillus*), Heather (*Calluna vulgaris*), Hard Fern (*Blechnum spicant*), Cowwheat (*Melampyrum* spp.) and Bracken (*Pteridium aquilinum*). Borris Demesne contains a very good example of a semi-natural broad-leaved woodland in very good condition. There is quite a high degree of natural re-generation of Oak and Ash through the woodland. At the northern end of the estate Oak species predominate.

Drummond Wood, also on the Barrow, consists of three blocks of deciduous woods situated on steep slopes above the river. The deciduous trees are mostly Oak species. The woods have a well established understorey of Holly (*Ilex aquifolium*), and the herb layer is varied, with Brambles abundant. Whitebeam (*Sorbus devoniensis*) has also been recorded.

Eutrophic tall herb vegetation occurs in association with the various areas of alluvial forest and elsewhere where the flood-plain of the river is intact. Characteristic species of the habitat include Meadowsweet (*Filipendula ulmaria*), Purple Loosestrife (*Lythrum salicaria*), Marsh Ragwort (*Senecio aquaticus*), Ground Ivy (*Glechoma hederacea*) and Hedge Bindweed (*Calystegia sepium*). Indian Balsam (*Impatiens glandulifera*), an introduced and invasive species, is abundant in places.

Floating River Vegetation is well represented in the Barrow and in the many tributaries of the site. In the Barrow the species found include Water Starworts (*Callitriche* spp.), Canadian Pondweed (*Elodea canadensis*), Bulbous Rush (*Juncus bulbosus*), Milfoil (*Myriophyllum* spp.), *Potamogeton x nitens*, Broad-leaved Pondweed (*P. natans*), Fennel Pondweed (*P. pectinatus*), Perfoliated Pondweed (*P. perfoliatus*) and Crowfoots (*Ranunculus* spp.). The water quality of the Barrow has improved since the vegetation survey was carried out (EPA, 1996).

Dry Heath at the site occurs in pockets along the steep valley sides of the rivers especially in the Barrow Valley and along the Barrow tributaries where they occur in the foothills of the Blackstairs Mountains. The dry heath vegetation along the slopes of the river bank consists of Bracken (*Pteridium aquilinum*) and Gorse (*Ulex europaeus*) species with patches of acidic grassland vegetation. Additional typical species include Heath Bedstraw (*Galium saxatile*), Foxglove (*Digitalis purpurea*), Common Sorrel (*Rumex acetosa*) and Bent Grass (*Agrostis stolonifera*). On the steep slopes above New Ross the Red Data Book species Greater Broomrape (*Orobanche rapum-genistae*) has been recorded.

Where rocky outcrops are shown on the maps Bilberry (*Vaccinium myrtillus*) and Wood Rush (*Luzula sylvatica*) are present. At Ballyhack a small area of dry heath is interspersed with patches of lowland dry grassland. These support a number of Clover species including the legally protected Clustered Clover (*Trifolium glomeratum*) – a species known from only one other site in Ireland. This grassland community is especially well developed on the west side of the mud-capped walls by the road. On the east of the cliffs a group of rock-dwelling species occur, i.e. English Stonecrop (*Sedum anglicum*), Sheep's-bit (*Jasione montana*) and Wild Madder (*Rubia peregrina*). These rocks also support good lichen and moss assemblages with *Ramalina subfarinacea* and *Hedwigia ciliata*.

Dry Heath at the site generally grades into wet woodland or wet swamp vegetation lower down the slopes on the river bank. Close to the Blackstairs Mountains, in the foothills associated with the Aughnabrisk, Aughavaud and Mountain Rivers there are small patches of wet heath dominated by Purple Moor-grass (*Molinia caerulea*) with Heather (*Calluna vulgaris*), Tormentil (*Potentilla erecta*), Carnation Sedge (*Carex panicea*) and Bell Heather (*Erica cinerea*).

Saltmeadows occur at the southern section of the site in old meadows where the embankment has been breached, along the tidal stretches of in-flowing rivers below Stokestown House, in a narrow band on the channel side of Common Reed (*Phragmites*) beds and in narrow fragmented strips along the open shoreline. In the larger areas of salt meadow, notably at Carrickloney, Ballinlaw Ferry and Rochestown on the west bank; Fisherstown, Alderton and Great Island to Dunbrody on the east bank, the Atlantic and Mediterranean sub types are generally intermixed. At the upper edge of the salt meadow in the narrow ecotonal areas bordering the grasslands where there is significant percolation of salt water, the legally protected species Borrer's Saltmarsh-grass (*Puccinellia fasciculata*) and Meadow Barley (*Hordeum secalinum*) (Flora Protection Order, 1987) are found. The very rare Divided Sedge (*Carex divisa*) is also found. Sea Rush (*Juncus maritimus*) is also

present. Other plants recorded and associated with salt meadows include Sea Aster (*Aster tripolium*), Sea Thrift (*Armeria maritima*), Sea Couch (*Elymus pycnanthus*), Spear-leaved Orache (*Atriplex prostrata*), Lesser Sea-spurrey (*Spergularia marina*), Sea Arrowgrass (*Triglochin maritima*) and Sea Plantain (*Plantago maritima*).

Salicornia and other annuals colonising mud and sand are found in the creeks of the saltmarshes and at the seaward edges of them. The habitat also occurs in small amounts on some stretches of the shore free of stones.

The estuary and the other Habitats Directive Annex I habitats within it form a large component of the site. Extensive areas of intertidal flats, comprised of substrates ranging from fine, silty mud to coarse sand with pebbles/stones are present. Good quality intertidal sand and mudflats have developed on a linear shelf on the western side of Waterford Harbour, extending for over 6 km from north to south between Passage East and Creadaun Head, and in places are over 1 km wide. The sediments are mostly firm sands, though grade into muddy sands towards the upper shore. They have a typical macro-invertebrate fauna, characterised by polychaetes and bivalves. Common species include *Arenicola marina*, *Nephtys hombergii*, *Scoloplos armiger*, *Lanice conchilega* and *Cerastoderma edule*.

The western shore of the harbour is generally stony and backed by low cliffs of glacial drift. At Woodstown there is a sandy beach, now much influenced by recreation pressure and erosion. Behind it a lagoonal marsh has been impounded which runs westwards from Gaultiere Lodge along the course of a slow stream. An extensive reedbed occurs here. At the edges is a tall fen dominated by sedges (*Carex* spp.), Meadowsweet, Willowherb (*Epilobium* spp.) and rushes (*Juncus* spp.). Wet woodland also occurs. This area supports populations of typical waterbirds including Mallard, Snipe, Sedge Warbler and Water Rail.

The dunes which fringe the strand at Duncannon are dominated by Marram grass (*Ammophila arenaria*) towards the sea. Other species present include Wild Sage (*Salvia verbenaca*), a rare Red Data Book species. The rocks around Duncannon ford have a rich flora of seaweeds typical of a moderately exposed shore and the cliffs themselves support a number of coastal species on ledges, including Thrift (*Armeria maritima*), Rock Samphire (*Crithmum maritimum*) and Buck's-horn Plantain (*Plantago coronopus*). Other habitats which occur throughout the site include wet grassland, marsh, reed swamp, improved grassland, arable land, quarries, coniferous plantations, deciduous woodland, scrub and ponds.

Seventeen Red Data Book plant species have been recorded within the site, most in the recent past. These are Killarney Fern (*Trichomanes speciosum*), Divided Sedge (*Carex divisa*), Clustered Clover (*Trifolium glomeratum*), Basil Thyme (*Acinos arvensis*), Hemp nettle (*Galeopsis angustifolia*), Borrer's Saltmarsh Grass (*Puccinellia fasciculata*), Meadow Barley (*Hordeum secalinum*), Opposite-leaved Pondweed (*Groenlandia densa*), Autumn Crocus (*Colchicum autumnale*), Wild Sage (*Salvia verbenaca*), Nettle-leaved Bellflower (*Campanula trachelium*), Saw-wort (*Serratula tinctoria*), Bird Cherry (*Prunus padus*), Blue Fleabane (*Erigeron acer*), Fly Orchid (*Ophrys insectifera*), Broomrape (*Orobanche hederæ*) and Greater Broomrape (*Orobanche rapum-genistæ*). Of these the first nine are protected under the Flora Protection Order 1999. Divided Sedge (*Carex divisa*) was thought to be extinct but has been found in a few locations in the site since 1990. In addition plants which do not have a very wide distribution in the country are found in the site including Thin-spiked Wood-sedge (*Carex strigosa*), Field Garlic (*Allium oleraceum*) and Summer Snowflake (*Leucojum aestivum*). Six rare lichens, indicators of ancient

woodland, are found including *Lobaria laetevirens* and *L. pulmonaria*. The rare moss *Leucodon sciuroides* also occurs.

The site is very important for the presence of a number of EU Habitats Directive Annex II animal species including Freshwater Pearl Mussel (*Margaritifera margaritifera* and *M. m. durrovensis*), Freshwater Crayfish (*Austropotamobius pallipes*), Salmon (*Salmo salar*), Twaite Shad (*Alosa fallax fallax*), three Lamprey species - Sea (*Petromyzon marinus*), Brook (*Lampetra planeri*) and River (*Lampetra fluviatilis*), the marsh snail *Vertigo moulinsiana* and Otter (*Lutra lutra*). This is the only site in the world for the hard water form of the Pearl Mussel *M. m. durrovensis* and one of only a handful of spawning grounds in the country for Twaite Shad. The freshwater stretches of the River Nore main channel is a designated salmonid river. The Barrow/Nore is mainly a grilse fishery though spring salmon fishing is good in the vicinity of Thomastown and Inistioge on the Nore. The upper stretches of the Barrow and Nore, particularly the Owenass River, are very important for spawning. The site supports many other important animal species. Those which are listed in the Irish Red Data Book include Daubenton's Bat (*Myotis daubentonii*), Badger (*Meles meles*), Irish Hare (*Lepus timidus hibernicus*) and Frog (*Rana temporaria*). The rare Red Data Book fish species Smelt (*Osmerus eperlanus*) occurs in estuarine stretches of the site. In addition to the Freshwater Pearl Mussel, the site also supports two other freshwater Mussel species, *Anodonta anatina* and *A. cygnea*.

The site is of ornithological importance for a number of E.U. Birds Directive Annex I species including Greenland White-fronted Goose, Whooper Swan, Bewick's Swan, Bartailed Godwit, Peregrine and Kingfisher. Nationally important numbers of Golden Plover and Bar-tailed Godwit are found during the winter. Wintering flocks of migratory birds are seen in Shanahoe Marsh and the Curragh and Goul Marsh, both in Co. Laois and also along the Barrow Estuary in Waterford Harbour. There is also an extensive autumnal roosting site in the reedbeds of the Barrow Estuary used by Swallows before they leave the country.

Landuse at the site consists mainly of agricultural activities – many intensive, principally grazing and silage production. Slurry is spread over much of this area. Arable crops are also grown. The spreading of slurry and fertiliser poses a threat to the water quality of the salmonid river and to the populations of Habitats Directive Annex II animal species within the site. Many of the woodlands along the rivers belong to old estates and support many non-native species. Little active woodland management occurs. Fishing is a main tourist attraction along stretches of the main rivers and their tributaries and there are a number of Angler Associations, some with a number of beats. Fishing stands and styles have been erected in places. Both commercial and leisure fishing takes place on the rivers. There is net fishing in the estuary and a mussel bed also. Other recreational activities such as boating, golfing and walking, particularly along the Barrow towpath are also popular. There is a golf course on the banks of the Nore at Mount Juliet and GAA pitches on the banks at Inistioge and Thomastown. There are active and disused sand and gravel pits throughout the site. Several industrial developments, which discharge into the river, border the site. New Ross is an important shipping port. Shipping to and from Waterford and Belview ports also passes through the estuary.

The main threats to the site and current damaging activities include high inputs of nutrients into the river system from agricultural run-off and several sewage plants, overgrazing within the woodland areas, and invasion by non-native species, for example Cherry Laurel and Rhododendron (*Rhododendron ponticum*). The water quality of the site remains vulnerable.

Good quality water is necessary to maintain the populations of the Annex II animal species listed above. Good quality is dependent on controlling fertilisation of the grasslands, particularly along the Nore. It also requires that sewage be properly treated before discharge. Drainage activities in the catchment can lead to flash floods which can damage the many Annex II species present.

Capital and maintenance dredging within the lower reaches of the system pose a threat to migrating fish species such as lamprey and shad. Land reclamation also poses a threat to the salt meadows and the populations of legally protected species therein.

Overall, the site is of considerable conservation significance for the occurrence of good examples of habitats and of populations of plant and animal species that are listed on Annexes I and II of the E.U. Habitats Directive respectively. Furthermore it is of high conservation value for the populations of bird species that use it. The occurrence of several Red Data Book plant species including three rare plants in the salt meadows and the population of the hard water form of the Pearl Mussel which is limited to a 10 km stretch of the Nore, add further interest to this site.

Appendix 2 – Site Synopsis report for the Thomastown Quarry SAC

SITE SYNOPSIS SITE NAME: THOMASTOWN QUARRY SITE CODE: 002252

Thomastown Quarry is situated along the R700 road about 1 km north of Thomastown, Co. Kilkenny. It comprises a disused limestone quarry in which an excellent diversity of calcareous habitat types has developed.

The site is a candidate SAC selected for petrifying springs, a habitat listed on Annex I of the E.U. Habitats Directive. Bare rock accounts for a significant area of the site, occurring both on cliff faces and the quarry floor. These rocky surfaces are well covered with lichens and mosses, and, particularly where there is shallow soil, also have species such as Biting Stonecrop (*Sedum acre*), White Stonecrop (*Sedum album*), Rue-leaved Saxifrage (*Saxifraga tridactylites*), Fairy Flax (*Linum catharticum*), Yellow Wort (*Blackstonia perfoliata*) and Blue Fleabane (*Erigeron acre*), the latter species being listed in the Irish Red Data Book. Ferns are frequent, with Rustyback fern (*Ceterach officinarum*) and Maidenhair Spleenwort (*Asplenium trichomanes*) amongst others. Where deeper calcareous soils occur on the dry rocky surfaces, species such as Red Fescue (*Festuca rubra*), Quaking Grass (*Briza media*), Lady's Bedstraw (*Galium verum*), Carline Thistle (*Carlina vulgaris*), Rest Harrow (*Ononis repens*), Blue Flax (*Linum bienne*) and Pyramidal Orchid (*Anacamptis pyramidalis*) are found.

Seepage lines or springs are a feature of the site and of particular importance is the presence of petrifying springs with tufa formations. This rare habitat is rich in bryophytes, most notably *Palustriella commutata* var. *commutata*, and *Cratoneuron filicinum*. Other species include *Calliergon giganteum*, *Campylium stellatum*, *Bryum pseudotriquetrum*, *Drepanocladus revolvens*, *Hylocomum splendens* and *Aneura pinguis*. Alkaline fen vegetation has developed over some of the seepage areas and also around the various ponds that occur on the quarry floor. The fen vegetation is quite species rich and includes Jointed Rush (*Juncus articulatus*), Toad Rush (*J. bufonius*), Common Spike-rush (*Eleocharis palustris*), various sedges (*Carex panicea*, *C. lepidocarpa*), Red Rattle (*Pedicularis palustris*), Brooklime (*Veronica beccabunga*),

Marsh Orchid (*Dactylorhiza incarnata*) and Fleabane (*Pulicaria dysenterica*). Bryophytes are frequent in the fen habitat. Wetland plants such as Water Plantain (*Alisma plantago-aquatica*), Bulrush (*Typha latifolia*), Water Horsetail (*Equisetum fluviatile*) and Common Cottongrass (*Eriophorum angustifolium*) occur at the margins of the ponds.

The ponds support populations of the Common Frog and Common Newt, both legally protected species. A limited survey of the aquatic invertebrates recorded the presence of two rare species for Ireland, the Coleopteran *Halipplus variegatus* and the Corixid *Hesperocorixa moesta*. Despite its small size, this site has an excellent diversity of calcareous habitats, including petrifying springs, a habitat with priority status on Annex I of the E.U. Habitats Directive.

26.11.2002

Appendix 3 – Species lists for surveyed habitats

The nomenclature for species in this Appendix, and throughout this report, is taken from *The Census Catalogue of the Flora of Ireland* by Scannell & Synnott (Stationary Office, 1987). Species that are recognised as non-native to Ireland are indicated with an asterisk ‘*’.

Oak-Ash-Hazel Woodland - WN2

<i>Acer pseudoplatanus</i> *	Sycamore
<i>Crataegus monogyna</i>	Hawthorn
<i>Fraxinus excelsior</i>	Ash
<i>Geranium robertianum</i>	Herb-Robert
<i>Hedera helix</i>	Ivy
<i>Ilex aquifolium</i>	Holly
<i>Phyllitis scolopendrium</i>	Hart's tongue
<i>Polypodium vulgare</i>	Polypody
<i>Prunus spinosa</i>	Blackthorn
<i>Pteridium aquilinum</i>	Bracken
<i>Quercus</i> sp.	Oak
<i>Rubus fruticosus</i>	Bramble
<i>Sambucus nigra</i>	Elder
<i>Urtica dioica</i>	Common nettle

(Mixed) Broadleaved Woodland - WD2

<i>Acer pseudoplatanus</i> *	Sycamore
<i>Alnus glutinosa</i>	Alder
<i>Athyrium filix-femina</i>	Lady-fern
<i>Filipendula ulmaria</i>	Meadowsweet
<i>Fraxinus excelsior</i>	Ash
<i>Glechoma hederacea</i>	Ground ivy
<i>Hedera helix</i>	Ivy
<i>Pinus</i> sp.	Non-native pine
<i>Pinus sylvestris</i>	Scots pine
<i>Quercus</i> sp.	Oak
<i>Rubus fruticosus</i>	Bramble
<i>Salix</i> sp.	Willow
<i>Sambucus nigra</i>	Elder
<i>Urtica dioica</i>	Common nettle

Treeline - WL2

<i>Aesculus hippocastanum</i> *	Horse-chestnut
<i>Crataegus monogyna</i>	Hawthorn
<i>Fagus sylvatica</i> *	Beech

Hedgerow - WL1

<i>Bromus ramosus</i>	Hairy-brome
<i>Calystegia sepium</i>	Hedge bindweed
<i>Crataegus monogyna</i>	Hawthorn
<i>Epilobium hirsutum</i>	Great willowherb
<i>Fraxinus excelsior</i>	Ash

<i>Rosa</i> sp.	Rose
<i>Rubus fruticosus</i>	Bramble
<i>Urtica dioica</i>	Common nettle

Depositng/Lowland river - FW2

<i>Alnus glutinosa</i>	Alder
<i>Carex pendula</i>	Pendulus sedge
<i>Filipendula ulmaria</i>	Meadowsweet
<i>Impatiens glandulifera</i> *	Indian (Himalayan) balsam
<i>Juncus inflexus</i>	Hard rush
<i>Petasites hybridus</i>	Butterbur
<i>Phalaris arundinacea</i>	Reed canary-grass
<i>Salix</i> sp.	Willow
<i>Scrophularia nodosa</i>	Common figwort
<i>Urtica dioica</i>	Common nettle

Improved Agricultural Grassland - GA1

<i>Cirsium arvense</i>	Creeping thistle
<i>Dactylis glomerata</i>	Cock's-foot
<i>Juncus inflexus</i>	Hard rush
<i>Lapsana communis</i>	Nipplewort
<i>Lolium perenne</i>	Perennial rye-grass
<i>Rumex crispus</i>	Curled dock
<i>Taraxacum</i> sp.	Dandelion
<i>Urtica dioica</i>	Common nettle

Appendix 4 – Q-Value Assessments

TAXA	Group A	TAXA	Group C	TAXA	Group D		Total Numbers	Relative Abundance, %	Abundance Category
All except <i>Leuctra</i> spp.	1	<i>Baetis rhodani</i>	23	Sialidae					
		Caenidae							
Heptageniidae	1	Ephemerellidae		Assellus sp.					
Siphonuridae				Crangonyx sp.					
<i>Ephemera danica</i>		Uncased spp.	7						
<i>Margaritifera margaritifera</i>		All except <i>A. aestivalis</i>		<i>Lymnaea peregra</i>					
		Coleoptera	3	Physa sp.					
TAXA	Group B								
		Chrionomidae (excl. Chironomus sp.)		Sphaeriidae					
<i>Leuctra</i> spp.	2	Simuliidae	8						
		Tipulidae	5	All except <i>Piscicola</i> sp.	1				
Baetidae (excl. <i>B. rhodani</i>)		Hydracarina		TAXA	Group E				
Leptophlebiidae						Notes: Substrate made up of rocks and stones Light siltation No <i>Cladophora</i> sp. growth Moderate in-stream macrophyte growth (mosses) Slime growths absent Good riffle sampling location			
		Gammarus spp.	71	Chrionomus sp.					
Cased spp.	4	<i>Austropotamobius pallipes</i>		Eristalis sp.					
<i>Aphelocheirus aestivalis</i>		(all excl. <i>L. peregra</i> & <i>Physa</i> sp.)	8	Tubificidae	1				
Odonata									
		Anodonta sp.							
		<i>Piscicola</i> sp.							
		Platyhelminthes							

TAXA	Group A	TAXA	Group C	TAXA	Group D		Total Numbers	Relative Abundance, %	Abundance Category
All except <i>Leuctra</i> spp.		<i>Baetis rhodani</i>	38	Sialidae					
		Caenidae							
Heptageniidae		Ephemerellidae		Assellus sp.	21				
Siphonuridae				Crangonyx sp.					
<i>Ephemera danica</i>		Uncased spp.							
<i>Margaritifera margaritifera</i>		All except <i>A. aestivalis</i>		<i>Lymnaea peregra</i>					
		Coleoptera	2	Physa sp.					
TAXA	Group B								
		Chironomidae (excl. Chironomus sp.)		Sphaeriidae					
<i>Leuctra</i> spp.	1	Simuliidae	8						
		Tipulidae		All except <i>Piscicola</i> sp.					
Baetidae (excl. <i>B. rhodani</i>)		Hydracarina		TAXA	Group E				
Leptophlebiidae									
		Gammarus spp.	21	Chironomus sp.					
Cased spp.		<i>Austropotamobius pallipes</i>		Eristalis sp.					
<i>Aphelocheirus aestivalis</i>		(all excl. <i>L. peregra</i> & <i>Physa</i> sp.)	1	Tubificidae					
Odonata									
		Anodonta sp.							
		<i>Piscicola</i> sp.	1						
		Platyhelminthes							

Notes:

Moderate siltation and extensive erosion of river banks
 No *Cladophora* sp. growth
 No in-stream macrophyte growth
 Slime growths absent
 Sample taken at artificial riffle (weir)