

Appropriate Assessment of the Graiguenamanagh Local Area Plan in Relation to the River Barrow and River Nore Special Area of Conservation



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for Nicolas de Jong Associates

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Table of Contents

| | pg |
|---|----|
| EXECUTIVE SUMMARY | 3 |
| 1.0 INTRODUCTION | 6 |
| 1.1 Nature of the proposed plan | 6 |
| 1.2 The need for an Appropriate Assessment | 6 |
| 1.3 Methodology | 6 |
| 1.4 Zone of Influence | 6 |
| 1.5 Stakeholder and Consultees | 8 |
| 1.6 Existing legislation, plans and proposals | 9 |
| 1.7 Scoping of the study/Literature review | 10 |
| 1.8 Scope of the site survey | 13 |
| 2.0 BASELINE DATA | 15 |
| 2.1 Methodology | 15 |
| 2.2 Constraints | 15 |
| 2.3 Flora | 16 |
| 2.4 Fauna | 19 |
| 2.5 Water quality | 22 |
| 2.6 Determination of value | 24 |
| 2.7 Further study | 24 |
| 2.8 'Do-nothing' scenario | 24 |
| 3.0 IMPACT ASSESSMENT | 26 |
| 3.1 Impact prediction | 26 |
| 3.2 Nature of predicted impacts | 27 |
| 3.3 Scale and likelihood of predicted impacts | 27 |
| 3.4 Assessment of impact significance | 28 |
| 4.0 RECOMMENDATIONS FOR MITIGATION | 30 |
| 4.1 Impact mitigation | 30 |
| 4.2 Monitoring | 32 |
| 4.3 Conclusion | 33 |
| 5.0 REFERENCES | 34 |
| Appendix 1 – NPWS Site Synopsis for the River Barrow and River Nore SAC | 37 |
| Appendix 2 – Species lists for surveyed habitats | 43 |
| Appendix 3 – Q-Value assessments | 47 |

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) | <ol style="list-style-type: none"> 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 rivers Douske and Barrow 3. Increased boating activity could lead to loss of habitat, water pollution and erosion of river banks 4. Old or derelict buildings due for renovation may harbour populations of Bats |
| Set out the conservation objectives of the site | <p>Conservation objectives are not defined for the site but can be taken as:</p> <ol style="list-style-type: none"> 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. | <p>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:</p> <ol style="list-style-type: none"> 1. Designating areas of SAC as ‘open space’ could lead to direct loss of habitat (potentially either Riparian woodland or Wet grassland) 2. Ingress of pollutants, particularly nutrients, particulates and hydrocarbons could deteriorate water quality and impact upon water dependant species for which the site is designated. 3. Boating activity may lead to loss or degradation of habitat as well as pollution, which can lower the populations of key species. 4. Renovations of old buildings could lead to loss of bat roosting sites. |

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 or 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.
3. Boating activities can lead to cumulative pressures (e.g. water pollution) on water dependant species whose populations may decline.
4. Loss of roosting sites would lead to a lower of local bat populations.

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.

-
- Seven recommendations are made in total:
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 the boundary of the SAC as defined by NPWS is fully respected regardless of the perceived importance of features therein.
 4. Ensure that new or proposed wastewater treatment plant facilities are in place prior to opening of additional residential or business developments.
 5. Ensure that appropriate attenuation of pollution from surface water is integrated into all new developments that will discharge into the Douske or Barrow rivers, particularly availing of SUDS (sustainable drainage systems).
 6. Kilkenny county council should work with NPWS, SRFB and river users to ensure that pollution or damage of river banks does not occur as a result of boating activities. Any proposals for new piers or moorings must be subject to the Appropriate Assessment screening process.
 7. Prior to redeveloping old or derelict sites, carry out a Bat survey to determine the nature of the impact and recommend mitigation measures.
-

Results of Consultation

| Agency contacted | Response |
|-----------------------------------|--|
| NPWS | <p>Mr Jimi Conroy, Wildlife Ranger with NPWS was consulted from the early stages of the screening 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. There is a potential threat to the SAC as new amenity facilities attracts greater numbers of boat users on the Barrow. 5. 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 Graiguenamanagh 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 Special Area of Conservation (SAC) is situated within the boundary of the LAP. 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 rivers Barrow and Douske (a tributary of the Barrow that lies within the boundary of the SAC) 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 SAC is a large site, only a small part of which runs through Graiguenamanagh. While the water is

the main feature of the site, there is significant riparian vegetation that falls within the site boundary. Larger terrestrial areas of the site are to be found within the LAP area both along the banks of the Barrow and the Douske.

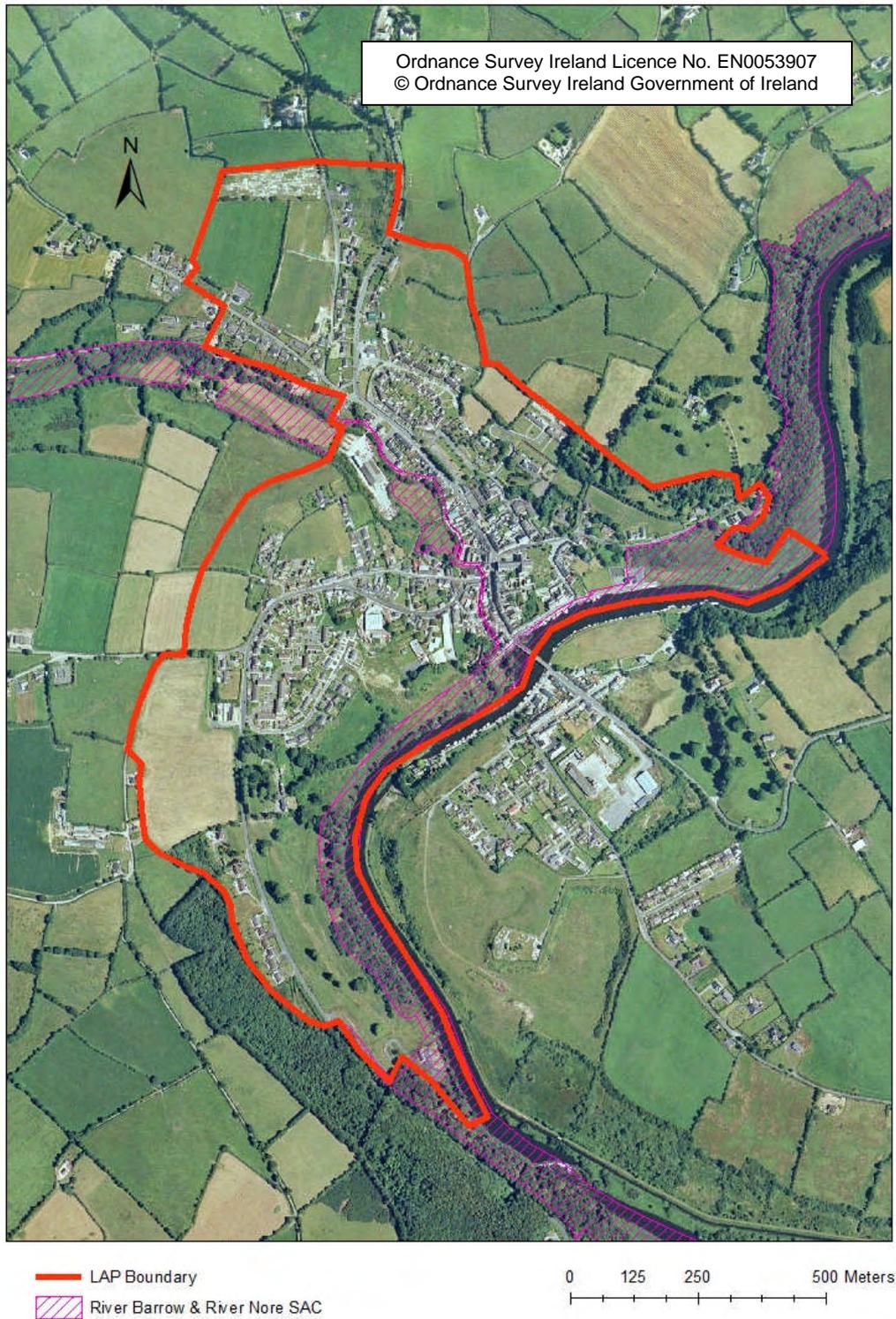


Figure 1 – Zone of Influence of the Graiguenamanagh LAP showing the location of the SAC

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 | Email/Telephone |
| 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.

This issue of invasive species was discussed in the context of actions that can be taken at the local level against what is a nationwide 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 Barrow catchment holds a population of the globally endangered Freshwater pearl mussel, Mr Conroy confirmed that these are located along a tributary of the Barrow upstream of Graiguenamanagh and so the LAP is not likely to impact on this important species.

It was also suggested that an increase in population, along with enhancement of amenity infrastructure in the town will encourage greater visitor numbers. While this is broadly desirable, there can be negative impacts from boating traffic in particular via sewage discharges and river bank erosion caused by excessive wave action. While encouraging more tourism to the area, action should be taken to avoid these negative impacts.

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 is a 'site synopsis' for the River Barrow and River Nore SAC (see Appendix 1) and there is a significant volume of published data on the distribution and status of protected species and, to a lesser extend, habitats.

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

1.7.1 NPWS Site Synopsis

Information regarding the site is available through a site synopsis report. This is reproduced as an appendix to this report. To date, a management plan has not been published for the River Barrow and River Nore 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.

Table 1 details the conservation aspects of the SAC.

The conservation objectives of the site 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 includes maintaining the area of important habitats, good water quality and the populations of important species.

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

| Aspect | Level of Protection | Relevant ¹ | Likelihood of potential impacts ² |
|--|-------------------------------------|-----------------------------|--|
| Alluvial wet woodland (code: 91E0) | Habitats Directive Annex I priority | Possible | Possible |
| Petrifying springs with tufa formation (code: 7220) | | Possible | Possible |
| Atlantic salt meadows (code: 1330) | Habitats Directive Annex I | No | None |
| Mediterranean salt meadows (code: 1410) | | No | None |
| Old oak woodlands (code: 91A0) | | Possible | Possible |
| Eutrophic tall herbs (code: 6430) | | Possible | Possible |
| Floating river vegetation (code: 3260) | | Possible | Possible |
| Estuary (code: 1130) | | No | None |
| Salicornia mudflats (code: 1310) | | No | None |
| Dry heath (code: 4030) | | Possible | Possible |
| Tidal mudflats (code: 1140) | | No | None |
| Sea Lamprey <i>Petromyzon marinus</i> | | Habitats Directive Annex II | Yes |
| 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>Austropotamobius 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 |
| Allis shad <i>Alosa alosa</i> | | Yes | Possible |

¹ Relevance is interpreted as meaning the likely presence of the habitat/species in the study area and is taken from relevant literature sources

² 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 ³ | Likelihood of potential impacts ⁴ |
|--|--|-----------------------|--|
| 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> | | Possible | 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 |

1.7.2 EPA Water Monitoring Database.

Figure 2 shows the results of river water monitoring in the Graiguenamanagh 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 of the Barrow.

³ Relevance is interpreted as meaning the likely presence of the habitat/species in the study area and is taken from relevant literature sources

⁴ The likelihood of impact is based on the potential presence of habitats from aerial photography and presence of suitable habitats for different species

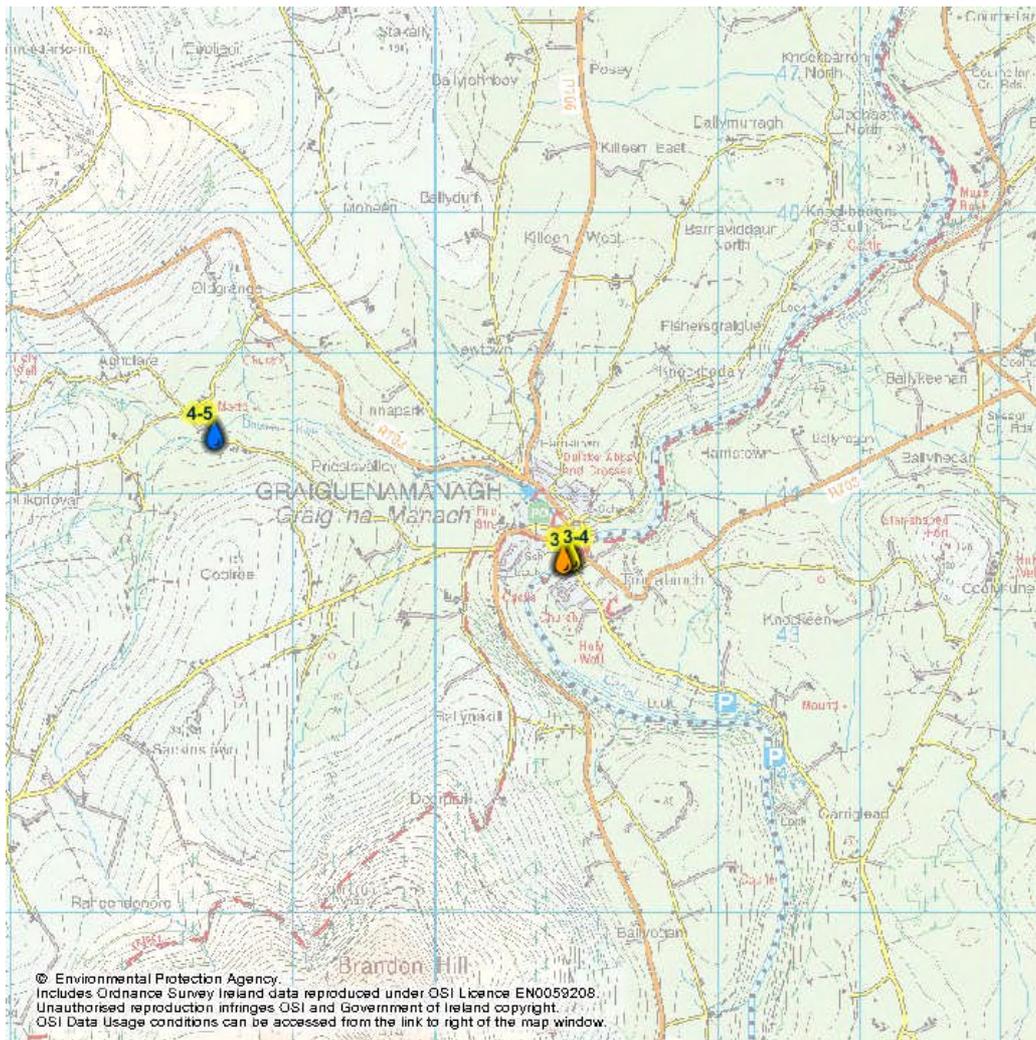


Figure 2 – EPA data showing river water quality in the Graiguenamanagh area. The numbers represent Q-Values: 4-5 (blue drop) indicates unpolluted river course; 3 (orange drop) indicates moderate pollution while 3-4 indicates slight pollution (Toner et al., 2005)

1.8 Scope of Site Survey

Figure 3 shows selected land use zonings from the Draft Graiguenamanagh LAP overlain with the extent of the River Barrow and River Nore 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' and 'Mixed Use'. In addition, land has been zoned for 'New Residential' that is directly adjacent to the SAC

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

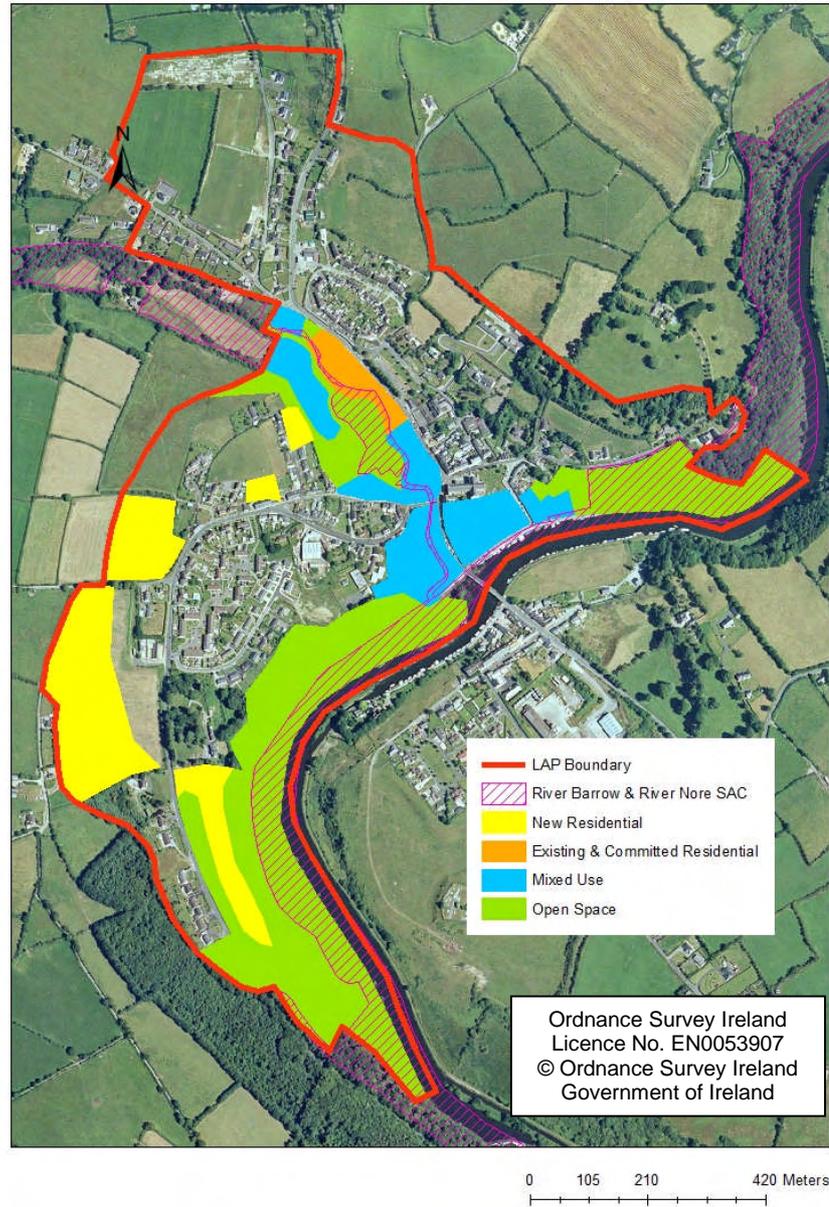


Figure 3 – Selected zonings from the Draft Graiguenamanagh LAP with potential impacts on the River Barrow and River Nore SAC.

2.0 BASELINE DATA

2.1 Methodology

A site visit was carried out on September 30th 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 samples were subsequently analysed following the EPA's Q-Value methodology (Toner et al., 2005).

2.2 Constraints

While the month of September lies within the optimal season for habitat survey (NRA, 2006) this was the last day of that month and it borders the sub-optimal period. 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) and while there was some light rain on the day, water levels were normal as there had been a dry period prior to this. Taking kick samples in the main channel of the Barrow 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 Barrow however presents an artificial riffle and a site that can be accessed in safety, a kick sample was therefore taken at this point.

Access to survey areas was not a problem.

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 2 to this report. In some cases, entirely man-made or artificial habitats are represented but in general these are excluded as they are of extremely low biodiversity value. Species lists therefore do not appear for these habitats (e.g. buildings).

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 principle feature of the SAC is the river Barrow which rises in the uplands of south county Laois. As it passes through Graiguenamanagh it is slow and meandering and deposits some of the silt and debris that it carried from further upstream. The river banks are variously vegetated with overhanging trees such as Alder *Alnus glutinosa* and narrow strips of tall reeds such as Common reed *Phragmites australis* and Reed canary-grass *Phalaris arundinacea*. The river at this point is very deep and no in-stream vegetation is apparent.

The river Douske enters the town from the north along two channels before joining together approximately 350 m prior to entering the main channel of the Barrow. While still two channels it is lined with trees including Alder, Willow *Salix sp.* and Hawthorn *Crataegus monogyna* as well as other typical hedgerow flora. The channels here are narrow and quite shallow and have some extensive in-stream vegetation, including Watercress *Nasturtium officinale* and Water-crowfoot *Ranunculus sp.* This latter feature is linked to the Habitats Directive Annex I habitat Floating River Vegetation (code: 3260).

2.3.2 Wet Grassland – GS4

This is a variable habitat type and can be of conservation value depending on the species composition and the site history. In Graiguenamanagh it comprises considerable areas of land adjacent to the river both to the north and the south. To the south it resembles rough grassland with a high proportion of grasses and rushes *Juncus sp.* and a fair to low diversity of broad-leaved species including Common and Greater bird's-foot-trefoil *Lotus corniculatus* and *L. uliginosus*, Common knapweed *Centaurea nigra*, Yellow iris *Pseudacorus iris* and Meadowsweet *Filipendula ulmaria*. The proportions of these species is variable depending how wet the soil is with Yellow iris dominating close to the Riparian woodland (see section 2.3.3) while further north Meadowsweet is predominant. It is likely that these areas are flooded periodically.

The area of Wet grassland to the south of the town is showing the signs of natural encroachment with numerous Alder and Willow saplings, indicating that it may return to Riparian woodland if left undisturbed.

In many places, but particularly in the sections to the south, there are heavy infestations of the alien invasive Indian (or Himalayan) balsam *Impatiens glandulifera*. This is a highly damaging weed that has recently been identified as one of the highest risk (most unwanted) alien invasive species in Ireland (Kelly et al., 2008). It blankets areas, particularly along river banks, to the exclusion of all other species and, as it dies back in winter, leaves banks exposed and vulnerable to erosion.

2.3.3 Riparian woodland – WN5

Riparian woodland is one of the rarest woodland types in Ireland (Little et al., 2008) and is a priority protected habitat under the EU Habitats Directive (Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*; code: 91E0).

This woodland type is represented by a small area just to the south of the bridge crossing the Barrow and is primarily composed of mature Willow and Alder although Ash *Fraxinus excelsior* and Sycamore *Acer pseudoplatanus* are also present. Depending on proximity to the river there are areas of muddy ground with dense areas of Common nettle *Urtica dioica* and Bramble *Rubus fruticosus*. The ecological value of this habitat is somewhat diminished due to the presence of the non-native tree species Lime *Tilia sp.* which is likely to have been planted in this location.

This area nevertheless represents an important habitat due to its rarity at a national level and its designation as a priority habitat under the Habitats Directive. For this reason it is encompassed within the boundary of the SAC.

2.3.4 (Mixed) Broadleaved Woodland – WD1

Woodland that is dominated by native Irish species is exceedingly rare in Ireland today. Broadleaved forests that have a high proportion of non-native trees have a lower conservation value but can nevertheless have a local importance for woodland species or for amenity purposes. The woodland to the south of Graiguenamanagh belongs to this classification as it is predominantly composed of non-native Sycamore and Beech *Fagus sylvatica*, although there is a good proportion of Oak *Quercus sp.* While there is a well developed understorey of Holly *Ilex aquifolium* and herbaceous species including Hart's tongue *Phyllitis scolopendrium*, Ivy *Hedera helix* and Wood sedge *Carex sylvatica*, the regeneration of sapling trees are almost exclusively those of Sycamore. In open areas Indian Balsam is much in evidence while there are also signs of encroachment by Rhododendron *Rhododendron ponticum* and Cherry laurel *Prunus laurocerasus*. There are also patches of Japanese knotweed *Reynoutria japonica*. These are all considered by the Invasive Species Forum as of greatest risk or most unwanted of alien invasive species in this country. (see www.invasivespeciesireland.com). Together they represent a major threat to the integrity of the SAC and to local biodiversity in general.

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

Linear woodlands are planted lines of trees and shrubs that have traditionally been planted in Ireland to mark field boundaries and keep in herds of

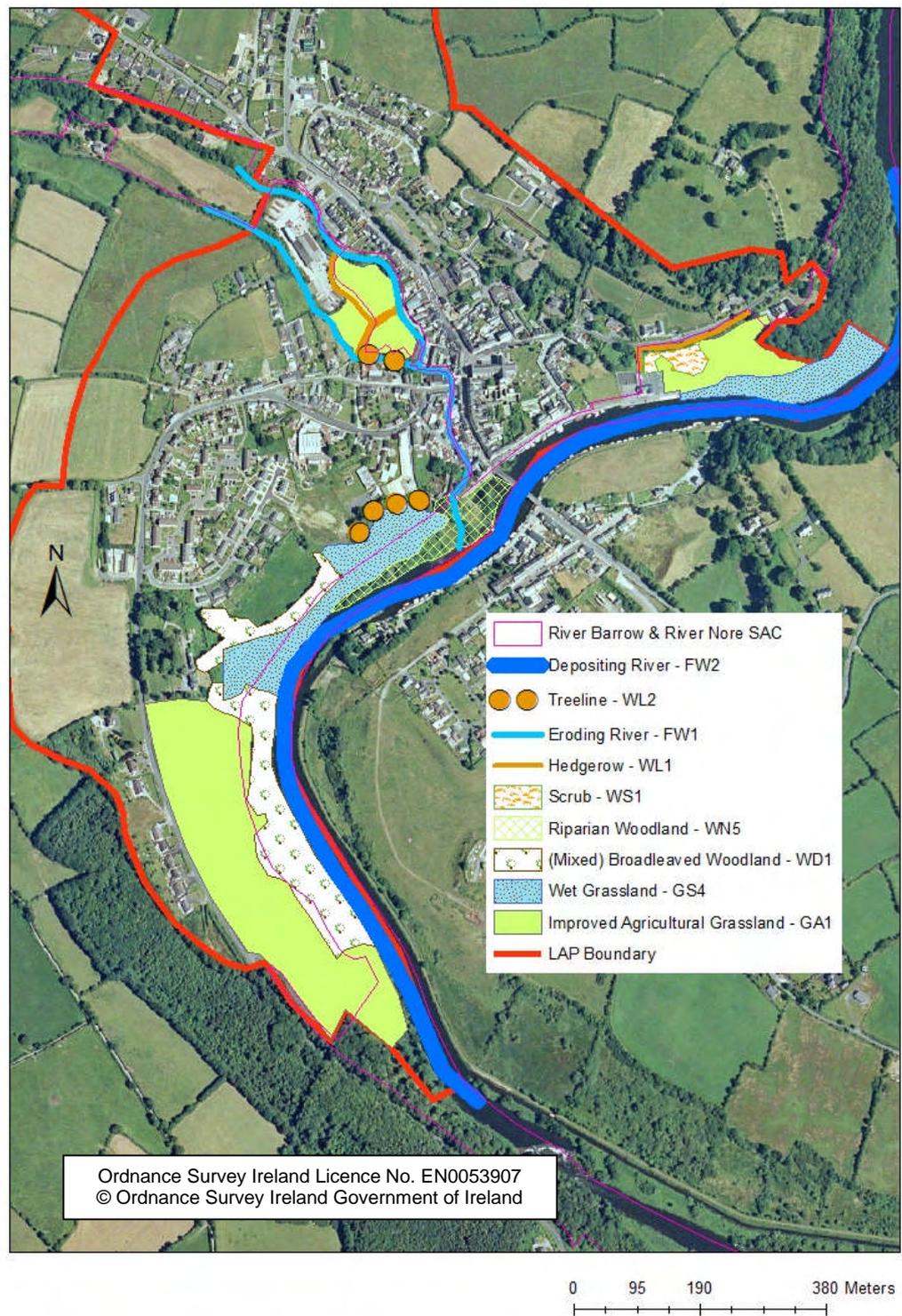


Figure 4 – Habitat map showing the distribution and classification of habitats that lie within the River Barrow and River Nore SAC and the Graiguenamanagh LAP boundary.

livestock. The 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'. Linear woodlands in Graiguenamanagh consist of both types and can be found within the designated SAC area. They are typically composed of the traditional Hawthorn hedge with other species such as Ash and Horse chestnut *Aesculus hippocastanum*.

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. Perennial rye grass *Lolium perenne* and a small number of tolerant plants such as Thistles *Cirsium sp.*, Dock *Rumex sp.*, Dandelion *Taraxacum sp.* and Creeping buttercup *Ranunculus repens*. These areas are included within the SAC because they are part of the river's floodplain.

2.3.7 Scrub – WS1

This is a small area to the north east that is bordering Improved Agricultural Grassland. It is dominated by Gorse *Ulex europaeus* and is probably advancing from the Hedgerow into the field below because of under-grazing. It is of low ecological importance due to the low species diversity, but it can be good habitat for breeding birds.

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 Barrow river although a search for spraint (droppings) did not reveal direct evidence.

The old derelict buildings along the water front 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.

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> | | |
| Irish hare <i>Lepus timidus hibernicus</i> | | Annex B Habitats Directive; Wildlife (Amendment) Act, 2000 |
| 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. There is no suitable habitat for birds listed in table 1, with the exception of Kingfisher *Alcedo atthis*.

While Kingfisher was not recorded during the survey, 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 | Common name | Conservation Status ⁵ |
|--------------------------------|-----------------|----------------------------------|
| <i>Ardea cinerea</i> | Grey heron | Green |
| <i>Anas platyrhynchos</i> | Mallard | Green |
| <i>Gallinula chloropus</i> | Moorhen | Green |
| <i>Columba palumbus</i> | Wood pigeon | - |
| <i>Parus caeruleus</i> | Blue tit | Green |
| <i>Erithacus rubecula</i> | Robin | Green |
| <i>Corvus frugilegus</i> | Rook | Green |
| <i>Troglodytes troglodytes</i> | Wren | Green |
| <i>Cygnus olor</i> | Mute swan | Amber |
| <i>Aegithalos caudatus</i> | Long-tailed tit | Green |
| <i>Turdus merula</i> | Blackbird | Green |
| <i>Clinclus cinclus</i> | Dipper | Green |
| <i>Motacilla cinerea</i> | Grey wagtail | 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 Barrow river catchment is known to provide habitat to species of conservation importance including Salmon *Salmo salar*, Sea Lamprey *Petromyzon marinus*, River lamprey *Lampetra fluviatilis* and 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 Graiguenamanagh.

⁵ According to BirdWatch Ireland's Birds of Conservation Concern in Ireland: Green = Low; Amber = Medium; Red = High

2.4.5 Invertebrates

A large number of insect species 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 particular significance in this catchment is the presence of the Freshwater pearl mussel *Margaritifera margaritifera* which is threatened globally and is now functionally extinct in Ireland since it has not bred since the 1970's (NPWS, 2008). This species is recorded from the square that passes through Graiguenamanagh (Moorkens, 1999) however the colony is located along a tributary of the Barrow upstream of the town. 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. 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 this 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 Graiguenamanagh where the river Barrow was most recently assessed as between Q3: Moderately polluted and Q3-4: Slightly polluted (2005). Meanwhile, well upstream of the town the Douske was assessed at Q4-5: Unpolluted (see figure 2).

For this study, four macro-invertebrate kick samples were taken and the location of these is shown in figure 4.

The flow of water in this figure is from north to south. As can be seen the quality of water is variable. The main channel of the Barrow was determined to be Q3: moderately polluted although the source of this pollution is not known. Many factors can contribute to pollution problems in lowland areas including agricultural run-off, as well as point sources from housing and industry.

Samples taken along the Douske reveal a different picture. While upstream of the town the Q-Values were Q4: unpolluted and Q3-4: slightly polluted, before it enters the Barrow it is Q3: moderately polluted. This indicates that polluted effluent is entering the Douske from within the town. It is not possible to be conclusive regarding the source of this pollution but a number of factors are likely contributors. These include surface water run-off from roads, gutters, car parks etc., and misconnected pipes from domestic sources that may be

sending sewage and cleaning wastewater into the surface water drainage system instead of to the municipal treatment plant.

It can therefore be concluded that water issues from the town of Graiguenamanagh are contributing to pollution in the Barrow. These issues are acting in combination with other point and diffuse sources in the catchment to result in poor ecological status of the river system.

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

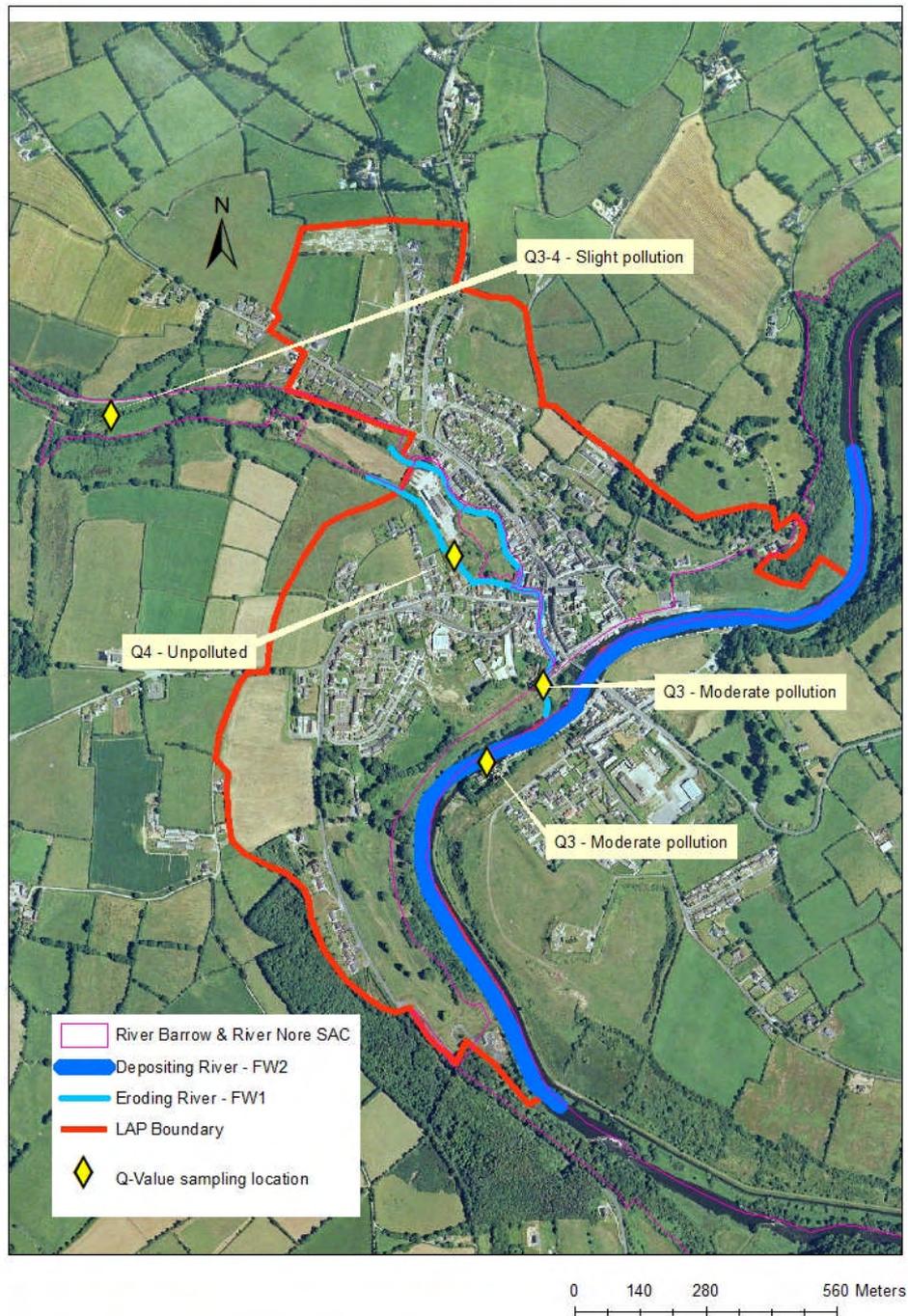


Figure 4 – Ecological water quality in the Graiguenamanagh area

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 3 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: WN5 – Riparian woodland FW1 – Eroding/upland river FW2 – Depositing/lowland river WD1 – (Mixed) broadleaved woodland GA1 – Improved Agricultural Grassland GS4 – Wet Grassland WL1 – Hedgerow WS1 - Scrub | A – Internationally important | Sites designated as SAC under the EU's Habitats Directive |
| WD1 – Mixed broad-leaved woodland | C – High value, locally important | Sites containing semi-natural habitat types with high biodiversity in a local context. |
| WL2 - Treeline | D – Moderate value, locally important | Sites containing some semi-natural habitat or locally important for wildlife. |

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, Freshwater pearl mussel 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 major impacts on the SAC in the Graiquenamanagh area. This is as a result of the infestation of the riparian zone with alien invasive species including Indian balsam, Japanese

knotweed, Rhododendron and Cherry laurel. Poor water quality is also having a detrimental impact on a species of global concern, the Freshwater pearl mussel, and without major intervention this species is likely to go extinct when the surviving individuals reach the end of their natural lives – albeit this is a catchment wide issue and not confined to Graiguenamanagh.

Elsewhere the agricultural grassland will remain the same so long as existing management practices continue while the scrub area is likely to expand in extent.

Water quality in the Barrow 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 including Riparian woodland, Wet grassland and (Mixed) broadleaved woodland. However, as these areas are threatened by invasive species, or may be of low ecological value (e.g. agricultural grassland) there is an equal opportunity to enhance habitats in these areas. These two impacts - the negative and the positive, are examined separately.

Of principle concern is the issue of water quality in the Barrow river which is at present moderately polluted (see section 2.5). 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 expansion occurs. Under this scenario there is considerable scope for further pollution of the Barrow.

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.

Indirect impacts may occur through the greater use of the Barrow by recreational boating. This can result in the removal of riparian vegetation to make way for moorings and impacts to water quality from discharges of foul sewage. Increased boat traffic can accelerate bank erosion through wave action, something that is not a normal feature of river systems.

In combination impacts may occur as LAPs are being drafted for other towns in the catchment: Thomastown, 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 Graiguenamanagh 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.

The redevelopment of old or derelict buildings both along the Barrow waterfront area and the mill race along the Douske river have the potential to impact negatively on Bat populations that may be roosting here.

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
- 5 Deterioration of water quality, habitat loss and bank erosion from increased recreational boat usage
- 6 Impacts to Bat populations within old or derelict buildings that may be renovated.

3.2 Nature of predicted impacts

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

| Impact | Direct/ Indirect | Cumulative | Permanent/ Temporary⁶ | 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 |
| 5 | Indirect | Yes | Permanent | Negative | No |
| 6 | Direct | No | Permanent | Negative | No |

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 whereby 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.

⁶ The NRA guidelines (2006) define 'permanent' as an impact lasting over 60 years

| Impact | Magnitude | As proportion of resource | Likelihood |
|----------------|--|--------------------------------|--|
| 1 | 9.7 ha of land has been zoned for 'open space' within the SAC | ~66% of SAC in the LAP area | Likely – depends on the specific plans |
| 2 | | | |
| 3 ⁷ | Under high scenario the population is expected to increase by 1,400 by 2020 | 34% increase on current levels | Possible – low scenario predicts increase of 20% |
| 4 | | | |
| 5 | Not possible to quantify due to lack of data on projected increase in boat numbers | - | Likely |
| 6 | Insufficient data to quantify this impact | - | Likely |

4.4 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 ⁸ , permanent impacts on an internationally important site |
| 4 | |
| 5 | Moderate negative – impacts on a small part of an internationally important site |
| 6 | Moderate negative – impacts on Annex IV listed species ⁹ |

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 Barrow river.

⁷ 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.

⁸ NRA guidelines (2006) define 'extensive' as an impact on a water course measurable more than 250m from the impact source

⁹ Bats are not identified as qualifying species for the River Barrow and River Nore SAC however they are assigned this importance because of their legal protection and their listing under Annex IV of the Habitats Directive

- **Moderate Negative** impacts may occur through the increase in boat traffic on the river and the reduction in Bat populations that may currently be roosting in old/derelict buildings.
- 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.

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 and two moderate negative (under the 'significant' threshold) impacts have been identified, as well as a major positive impact and it is proposed to address these through appropriate mitigation measures.

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 town that is within or adjacent to the SAC 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 Barrow river as a result of 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 and 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 Barrow 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 Barrow 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 *Deterioration of water quality, habitat loss and bank erosion from increase recreational boat usage.*

The scale of this impact is unknown as figures are not available for boat numbers using the Barrow. Nevertheless, the threats from these impacts are potentially important.

Recommendation 5:

The county council should work with the Southern Regional Fisheries Board (SRFB) and local boat users to ensure that pollution does not arise from this important recreational activity.

Speed limits should be set for boat users to prevent excess wave action that can lead to bank erosion. This should be done in consultation with the SRFB who are in a position to assess the potential for damage from this source.

Any new proposals to extend or create jetties, piers or moorings must be subject to Appropriate Assessment to ensure that such developments do not result in negative impacts to the SAC.

4.1.4 *Impacts to Bat populations during renovation to old or derelict buildings*

There is too few data available to determine the magnitude of this impact on local Bat populations. However, assessing such impacts is standard practice for renovating old buildings and so remedial measures are available.

Recommendation 6:

Prior to seeking planning permission for the renovation of old or derelict buildings either along the Barrow waterfront or the mill race along the Douske ensure that a qualified professional carries out a bat survey of the buildings. This should identify the species and number of Bats (if present), the nature of the site for the species (e.g. wintering or maternity roost) and recommend avoidance or mitigation measures as appropriate.

4.1.5 *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. Such measures would include removal of invasive species (Indian balsam, Japanese knotweed, Rhododendron and Cherry laurel), stabilisation of the river bank through re-vegetation with appropriate native species and highlighting the importance of the river for conservation among the town's inhabitants and visitors.

Recommendation 7:

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 SRFB.

Within these amenity areas, erect interpretive panels that will inform users of the fact that these rivers form 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

Monitoring may be required under individual Appropriate Assessments as part of planning permission applications that will be made under this LAP.

4.3 Conclusion

The Graiguenamanagh LAP is predicted to result in severe and moderate negative impacts on the integrity of the River Barrow and River Nore SAC. However there is also potential for major positive impacts. Seven 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 for the integrity of the site.

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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, Graiguenamanagh, New Ross, Inistioge, Thomastown, Callan, Bennettsbridge, Kilkenny and Durrrow. 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 sciuroides*. 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 Aughnabriskey, 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 Carrickcloney, 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 hederaceae*) and Greater Broomrape (*Orobanche rapum-genistae*). 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 daubentoni*), 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 – 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 ‘*’.

Riparian Woodland - WN5

| | |
|---------------------------------|---------------------------|
| <i>Buddleja davidii</i> * | Butterfly-bush |
| <i>Acer pseudoplatanus</i> * | Sycamore |
| <i>Alnus glutinosa</i> | Alder |
| <i>Calystegia sepium</i> | Hedge bindweed |
| <i>Cladophora sp.</i> | Green algae |
| <i>Dactylis glomerata</i> | Cock's-foot |
| <i>Epilobium hirsutum</i> | Great willowherb |
| <i>Equisetum sp.</i> | Horsetail |
| <i>Eupatorium cannabinum</i> | Hemp-agrimony |
| <i>Filipendula ulmaria</i> | Meadowsweet |
| <i>Fraxinus excelsior</i> | Ash |
| <i>Impatiens glandulifera</i> * | Indian (Himalayan) balsam |
| <i>Iris pseudacorus</i> | Yellow iris |
| <i>Juncus inflexus</i> | Hard rush |
| <i>Leucanthemum vulgare</i> | Oxeye daisy |
| <i>Phalaris arundinacea</i> | Reed canary-grass |
| <i>Prunus avium</i> | Wild cherry |
| <i>Prunus sp.</i> | Cherry |
| <i>Ranunculus repens</i> | Creeping buttercup |
| <i>Reynoutria japonica</i> * | Japanese knotweed |
| <i>Rosa sp.</i> | Rose |
| <i>Rubus fruticosus</i> | Bramble |
| <i>Rumex crispus</i> | Curled dock |
| <i>Salix sp.</i> | Willow |
| <i>Tilia cordata</i> * | Lime |
| <i>Ulex Europaeus</i> | Gorse |
| <i>Urtica dioica</i> | Common nettle |

Wet Grassland - GS4

| | |
|---------------------------------|-----------------------------|
| <i>Alnus glutinosa</i> | Alder |
| <i>Arrhenatherum elatius</i> | False oat-grass |
| <i>Calystegia sepium</i> | Hedge bindweed |
| <i>Carex pendula</i> | Pendulous sedge |
| <i>Centaurea nigra</i> | Common knapweed |
| <i>Cirsium arvense</i> | Creeping thistle |
| <i>Dactylis glomerata</i> | Cock's-foot |
| <i>Filipendula ulmaria</i> | Meadowsweet |
| <i>Holcus lanatus</i> | Yorkshire-fog |
| <i>Impatiens glandulifera</i> * | Indian (Himalayan) balsam |
| <i>Iris pseudacorus</i> | Yellow iris |
| <i>Juncus inflexus</i> | Hard rush |
| <i>Lotus corniculatus</i> | Common bird's-foot-trefoil |
| <i>Lotus uliginosus</i> | Greater bird's-foot-trefoil |
| <i>Phalaris arundinacea</i> | Reed canary-grass |
| <i>Phleum pratense</i> | Timothy |
| <i>Phragmites australis</i> | Common reed |
| <i>Plantago lanceolata</i> | Ribwort Plantain |
| <i>Polygonum amphibium</i> | Amphibious bistort |
| <i>Potentilla anserina</i> | Silverweed |
| <i>Ranunculus repens</i> | Creeping buttercup |
| <i>Reynoutria japonica</i> * | Japanese knotweed |
| <i>Rubus fruticosus</i> | Bramble |
| <i>Rumex crispus</i> | Curled dock |
| <i>Salix sp.</i> | Willow |
| <i>Senecio jacobaea</i> | Common ragwort |
| <i>Stellaria media</i> | Common chick-weed |
| <i>Trifolium pratense</i> | Red clover |
| <i>Urtica dioica</i> | Common nettle |
| <i>Vicia cracca</i> | Tufted vetch |

Treeline - WL2

| | |
|---------------------------------|-------------------|
| <i>Aesculus hippocastanum</i> * | Horse-chestnut |
| <i>Anthriscus sylvestris</i> | Cow parsley |
| <i>Athyrium filix-femina</i> | Lady-fern |
| <i>Crataegus monogyna</i> | Hawthorn |
| <i>Fagus sylvatica</i> * | Beech |
| <i>Geranium robertianum</i> | Herb-Robert |
| <i>Geum urbanum</i> | Wood avens |
| <i>Hedera helix</i> | Ivy |
| <i>Polypodium australe</i> | Southern polypody |
| <i>Polypodium vulgare</i> | Polypody |
| <i>Polystichum setiferum</i> | Soft shield-fern |
| <i>Rubus fruticosus</i> | Bramble |
| <i>Sambucus nigra</i> | Elder |
| <i>Stachys sylvatica</i> | Hedge woundwort |
| <i>Tilia cordata</i> * | Lime |

(Mixed) Broadleaved Woodland - WD1

| | |
|----------------------------------|-------------------|
| <i>Acer pseudoplatanus</i> * | Sycamore |
| <i>Agrostis capillaris</i> | Common bent |
| <i>Brachypodium sylvaticum</i> | False brome |
| <i>Carex sylvatica</i> | Wood sedge |
| <i>Cirsium palustre</i> | Marsh thistle |
| <i>Crataegus monogyna</i> | Hawthorn |
| <i>Fagus sylvatica</i> * | Beech |
| <i>Fraxinus excelsior</i> | Ash |
| <i>Geranium robertianum</i> | Herb-Robert |
| <i>Geum urbanum</i> | Wood avens |
| <i>Glechoma hederacea</i> | Ground ivy |
| <i>Hedera helix</i> | Ivy |
| <i>Hyacinthoides non-scripta</i> | Bluebell |
| <i>Ilex aquifolium</i> | Holly |
| <i>Oxalis acetosella</i> | Wood-sorrel |
| <i>Phyllitis scolopendrium</i> | Hart's tongue |
| <i>Pinus sylvestris</i> | Scots pine |
| <i>Polystichum setiferum</i> | Soft shield-fern |
| <i>Prunus laurocerasus</i> * | Cherry laurel |
| <i>Prunus spinosa</i> | Blackthorn |
| <i>Quercus sp.</i> | Oak |
| <i>Reynoutria japonica</i> * | Japanese knotweed |
| <i>Rhododendron ponticum</i> * | Rhododendron |
| <i>Rosa sp.</i> | Rose |
| <i>Rubus fruticosus</i> | Bramble |
| <i>Taxus baccata</i> | Yew |
| <i>Ulmus glabra</i> | Wych elm |
| <i>Viola riviniana</i> | Common dog-violet |

Depositing/Lowland River - FW2

| | |
|-----------------------------|-------------------|
| <i>Alnus glutinosa</i> | Alder |
| <i>Angelica sylvestris</i> | Wild angelica |
| <i>Carex pendula</i> | Pendulus sedge |
| <i>Phalaris arundinacea</i> | Reed canary-grass |
| <i>Phragmites australis</i> | Common reed |
| <i>Salix sp.</i> | Willow |
| <i>Scirpus lacustris</i> | Common club-rush |
| <i>Urtica dioica</i> | Common nettle |

Eroding/Upland River - FW1

| | |
|---------------------------------|---------------------------|
| <i>Aesculus hippocastanum</i> * | Horse-chestnut |
| <i>Alnus glutinosa</i> | Alder |
| <i>Calystegia sepium</i> | Hedge bindweed |
| <i>Crataegus monogyna</i> | Hawthorn |
| <i>Fagus sylvatica</i> * | Beech |
| <i>Fontinalis antipyretica</i> | River moss |
| <i>Ilex aquifolium</i> | Holly |
| <i>Impatiens glandulifera</i> * | Indian (Himalayan) balsam |
| <i>Nasturtium officinale</i> | Water-cress |
| <i>Pellia epiphylla</i> | Liverwort |
| <i>Ranunculus</i> sp. | Water-crowfoot |
| <i>Rubus fruticosus</i> | Bramble |
| <i>Rubus fruticosus</i> | Bramble |
| <i>Salix</i> sp. | Willow |
| <i>Urtica dioica</i> | Common nettle |

Hedgerow - WL1

| | |
|--------------------------------|-----------------------|
| <i>Asplenium trichomanes</i> | Maidenhair spleenwort |
| <i>Crataegus monogyna</i> | Hawthorn |
| <i>Filipendula ulmaria</i> | Meadowsweet |
| <i>Geranium robertianum</i> | Herb-Robert |
| <i>Hedera helix</i> | Ivy |
| <i>Lapsana communis</i> | Nipplewort |
| <i>Phyllitis scolopendrium</i> | Hart's tongue |
| <i>Polypodium australe</i> | Southern polypody |
| <i>Polystichum setiferum</i> | Soft shield-fern |
| <i>Ranunculus repens</i> | Creeping buttercup |
| <i>Rubus fruticosus</i> | Bramble |
| <i>Sambucus nigra</i> | Elder |
| <i>Taraxacum</i> sp. | Dandelion |
| <i>Umbilicus rupestris</i> | Navelwort |
| <i>Urtica dioica</i> | Common nettle |
| <i>Vicia sepium</i> | Buch vetch |

Improved Agricultural Grassland - GA1

| | |
|------------------------------------|--------------------|
| <i>Acer pseudoplatanus</i> * | Sycamore |
| <i>Achillea millefolium</i> Yarrow | Yarrow |
| <i>Arrhenatherum elatius</i> | False oat-grass |
| <i>Cirsium arvense</i> | Creeping thistle |
| <i>Cynosurus cristatus</i> | Crested dog's-tail |
| <i>Dactylis glomerata</i> | Cock's-foot |
| <i>Phleum pratense</i> | Timothy |
| <i>Ranunculus repens</i> | Creeping buttercup |
| <i>Rumex obtusifolius</i> | Broad-leaved dock |
| <i>Taraxacum</i> sp. | Dandelion |
| <i>Trifolium pratense</i> | Red clover |
| <i>Urtica dioica</i> | Common nettle |

Scrub - WS1

| | |
|-----------------------|-------|
| <i>Ulex Europaeus</i> | Gorse |
|-----------------------|-------|

Appendix 3 – Q-Value Assessments

| Location 1: On the weir across the Barrow | | | | | | | | | |
|---|---------|---|---------|--------------------------|---------|---------|--|-----------------------|--------------------|
| TAXA | Group A | TAXA | Group C | TAXA | Group D | | Total Numbers | Relative Abundance, % | Abundance Category |
| Plecoptera | | Ephemeroptera | | Megaloptera | | Group A | 0 | 0 | Absent |
| All except <i>Leuctra</i> spp. | | <i>Baetis rhodani</i> | 9 | Sialidae | | | | | |
| Ephemeroptera | | Caenidae | | Crustacea | | Group B | 0 | 0 | Absent |
| Heptageniidae | | Ephemerellidae | | Assellus sp. | 1 | | | | |
| Siphonuridae | | Trichoptera | | Crangonyx sp. | | Group C | 43 | 98 | Excessive |
| <i>Ephemera danica</i> | | Uncased spp. | 6 | Gastropoda | | | | | |
| Lamellibranchiata | | Hemiptera | | | | Group D | 1 | 2 | Present |
| <i>Margaritifera margaritifera</i> | | All except <i>A. aestivalis</i> | | <i>Lymnaea peregra</i> | | | | | |
| | | Coleoptera | 4 | Physa sp. | | | | | |
| TAXA | Group B | Diptera | | Lamellibranchiata | | Group E | 0 | 0 | Absent |
| Plecoptera | | Chironomidae (excl. Chironomus sp.) | 4 | Sphaeriidae | | | | | |
| <i>Leuctra</i> spp. | | Simuliidae | 7 | Hirudinea | | | | | |
| Ephemeroptera | | Tipulidae | | All except Piscicola sp. | 1 | | | | |
| Baetidae (excl. <i>B. rhodani</i>) | | Hydracarina | | TAXA | Group E | | | | |
| Leptophlebiidae | | Crustacea | | Diptera | | | | | |
| Trichoptera | | Gammarus spp. | 13 | Chironomus sp. | | | | | |
| Cased spp. | | <i>Austropotamobius pallipes</i> | | Eristalis sp. | | | | | |
| Hemiptera | | Gastropoda | | Oligochaeta | | | | | |
| <i>Aphelocheirus aestivalis</i> | | (all excl. <i>L. peregra</i> & Physa sp.) | | Tubificidae | | | | | |
| Odonata | | Lamellibranchiata | | | | | | | |
| | | Anodonta sp. | | | | | | | |
| | | Hirudinea | | | | | | | |
| | | Piscicola sp. | | | | | | | |
| | | Platyhelminthes | | | | | | | |
| | | | | | | | Q-Value Determination – Q3: Moderately Polluted | | |
| | | | | | | | Notes: Substrate made up of large rocks at artificial weir Light/Moderate siltation Abundant Cladophora sp. growth Moderate in-stream macrophyte growth including <i>Fontinalis antipyretica</i> Slime growths absent | | |

| Location 2: At the river Douske ~50m before entering the Barrow | | | | | | | | | |
|---|---------|---|---------|--------------------------|---------|---------|--|-----------------------|--------------------|
| TAXA | Group A | TAXA | Group C | TAXA | Group D | | Total Numbers | Relative Abundance, % | Abundance Category |
| Plecoptera | | Ephemeroptera | | Megaloptera | | Group A | 0 | 0 | Absent |
| All except <i>Leuctra</i> spp. | | <i>Baetis rhodani</i> | 375 | Sialidae | | | | | |
| Ephemeroptera | | Caenidae | | Crustacea | | Group B | 2 | 0.5 | Scarce/Few |
| Heptageniidae | | Ephemerellidae | | Assellus sp. | 1 | | | | |
| Siphonuridae | | Trichoptera | | Crangonyx sp. | | Group C | 395 | 99 | Excessive |
| <i>Ephemera danica</i> | | Uncased spp. | 5 | Gastropoda | | | | | |
| Lamellibranchiata | | Hemiptera | | | | Group D | 1 | 0.5 | Present |
| <i>Margaritifera margaritifera</i> | | All except <i>A. aestivalis</i> | | <i>Lymnaea peregra</i> | | | | | |
| | | Coleoptera | 3 | Physa sp. | | | | | |
| TAXA | Group B | Diptera | | Lamellibranchiata | | Group E | 0 | 0 | Absent |
| Plecoptera | | Chironomidae (excl. Chironomus sp.) | 2 | Sphaeriidae | | | | | |
| <i>Leuctra</i> spp. | | Simuliidae | 2 | Hirudinea | | | | | |
| Ephemeroptera | | Tipulidae | 4 | All except Piscicola sp. | | | | | |
| Baetidae (excl. <i>B. rhodani</i>) | | Hydracarina | | TAXA | Group E | | | | |
| Leptophlebiidae | | Crustacea | | Diptera | | | | | |
| Trichoptera | | Gammarus spp. | 4 | Chironomus sp. | | | | | |
| Cased spp. | 2 | <i>Austropotamobius pallipes</i> | | Eristalis sp. | | | | | |
| Hemiptera | | Gastropoda | | Oligochaeta | | | | | |
| <i>Aphelocheirus aestivalis</i> | | (all excl. <i>L. peregra</i> & Physa sp.) | | Tubificidae | | | | | |
| Odonata | | Lamellibranchiata | | | | | | | |
| | | Anodonta sp. | | | | | | | |
| | | Hirudinea | | | | | | | |
| | | Piscicola sp. | | | | | | | |
| | | Platyhelminthes | | | | | | | |
| | | | | | | | Q-Value Determination – Q3: Moderately Polluted | | |
| | | | | | | | Notes: Light siltation Good riffle sampling location Moderate Cladophora sp. growth No in-stream macrophyte growth Slime growths absent | | |

| Location 3: Tributary of the Douske upstream of the town | | | | | | | | | |
|--|---------|--|---------|---------------------------------|---------|---------|--|-----------------------|--------------------|
| TAXA | Group A | TAXA | Group C | TAXA | Group D | | Total Numbers | Relative Abundance, % | Abundance Category |
| Plecoptera | | Ephemeroptera | | Megaloptera | | Group A | 24 | 28 | Numerous |
| All except <i>Leuctra</i> spp. | 1 | <i>Baetis rhodani</i> | 5 | Sialidae | | | | | |
| Ephemeroptera | | Caenidae | | Crustacea | | Group B | 16 | 19 | Common |
| Heptageniidae | 23 | Ephemerellidae | | Assellus sp. | | | | | |
| Siphonuridae | | Trichoptera | | Crangonyx sp. | | Group C | 46 | 53 | Dominant |
| <i>Ephemera danica</i> | | Uncased spp. | 16 | Gastropoda | | | | | |
| Lamellibranchiata | | Hemiptera | | | | Group D | 0 | 0 | Absent |
| <i>Margaritifera margaritifera</i> | | All except <i>A. aestivalis</i> | | <i>Lymnaea peregra</i> | | | | | |
| | | Coleoptera | 12 | Physa sp. | | | | | |
| TAXA | Group B | Diptera | | Lamellibranchiata | | Group E | 0 | 0 | Absent |
| Plecoptera | | Chironomidae (excl. Chironomus sp.) | 2 | Sphaeriidae | | | | | |
| <i>Leuctra</i> spp. | 15 | Simuliidae | 11 | Hirudinea | | | | | |
| Ephemeroptera | | Tipulidae | | All except <i>Piscicola</i> sp. | | | | | |
| Baetidae (excl. <i>B. rhodani</i>) | | Hydracarina | | TAXA | Group E | | | | |
| Leptophlebiidae | | Crustacea | | Diptera | | | | | |
| Trichoptera | | Gammarus spp. | | Chironomus sp. | | | | | |
| Cased spp. | 1 | <i>Austropotamobius pallipes</i> | | Eristalis sp. | | | | | |
| Hemiptera | | Gastropoda | | Oligochaeta | | | | | |
| <i>Aphelocheirus aestivalis</i> | | (all excl. <i>L. peregra</i> & <i>Physa</i> sp.) | | Tubificidae | | | | | |
| Odonata | | Lamellibranchiata | | | | | | | |
| | | Anodonta sp. | | | | | | | |
| | | Hirudinea | | | | | | | |
| | | <i>Piscicola</i> sp. | | | | | | | |
| | | Platyhelminthes | | | | | | | |
| | | | | | | | Q-Value Determination – Q4: Unpolluted | | |
| | | | | | | | <p>Notes: Substrate made up of gravel and stones Very light siltation No <i>Cladophora</i> sp. growth Moderate in-stream macrophyte growth Slime growths absent Good riffle location, tunneling – possible canalised morphology</p> | | |

| Location 4: River Douske upstream of town | | | | | | | | | |
|---|---------|--|---------|---------------------------------|---------|---------|---------------|-----------------------|---|
| TAXA | Group A | TAXA | Group C | TAXA | Group D | | Total Numbers | Relative Abundance, % | Abundance Category |
| Plecoptera | | Ephemeroptera | | Megaloptera | | Group A | 2 | 2.5 | Small Numbers |
| All except <i>Leuctra</i> spp. | | <i>Baetis rhodani</i> | 43 | Sialidae | | | | | |
| Ephemeroptera | | Caenidae | | Crustacea | | Group B | 19 | 22.5 | Common/ Numerous |
| Heptageniidae | 2 | Ephemerellidae | 1 | Assellus sp. | | | | | |
| Siphonuridae | | Trichoptera | | Crangonyx sp. | | Group C | 64 | 75 | Dominant |
| <i>Ephemera danica</i> | | Uncased spp. | 3 | Gastropoda | | | | | |
| Lamellibranchiata | | Hemiptera | | | | Group D | 0 | 0 | Absent |
| <i>Margaritifera margaritifera</i> | | All except <i>A. aestivalis</i> | | <i>Lymnaea peregra</i> | | | | | |
| | | Coleoptera | 3 | Physa sp. | | | | | |
| TAXA | Group B | Diptera | | Lamellibranchiata | | Group E | 0 | 0 | Absent |
| Plecoptera | | Chironomidae (excl. Chironomus sp.) | | Sphaeriidae | | | | | |
| <i>Leuctra</i> spp. | 11 | Simuliidae | 13 | Hirudinea | | | | | |
| Ephemeroptera | | Tipulidae | | All except <i>Piscicola</i> sp. | | | | | |
| Baetidae (excl. <i>B. rhodani</i>) | | Hydracarina | | TAXA | Group E | | | | Q-Value Determination – Q3-4: Slightly Polluted |
| Leptophlebiidae | | Crustacea | | Diptera | | | | | |
| Trichoptera | | Gammarus spp. | 1 | Chironomus sp. | | | | | |
| Cased spp. | 8 | <i>Austropotamobius pallipes</i> | | Eristalis sp. | | | | | |
| Hemiptera | | Gastropoda | | Oligochaeta | | | | | |
| <i>Aphelocheirus aestivalis</i> | | (all excl. <i>L. peregra</i> & <i>Physa</i> sp.) | | Tubificidae | | | | | |
| Odonata | | Lamellibranchiata | | | | | | | |
| | | Anodonta sp. | | | | | | | |
| | | Hirudinea | | | | | | | |
| | | <i>Piscicola</i> sp. | | | | | | | |
| | | Platyhelminthes | | | | | | | |
| | | | | | | | | | Notes: Substrate made up of rocks and boulders Light siltation No <i>Cladophora</i> sp. growth Moderate macrophyte growth - mosses Slime growths absent Good riffle sampling location |