

**SERIES OF ECOLOGICAL ASSESSMENTS  
ON ARTERIAL DRAINAGE MAINTENANCE  
No 7**

**Ecological Impact Assessment (EcIA) of  
the Effects of Statutory Arterial Drainage  
Maintenance Activities on  
Freshwater Pearl Mussels  
(*Margaritifera margaritifera* &  
*M.m. durrovensis*)**



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## **Foreword**

This Ecological Impact Assessment follows on from the strategic approach outlined in

**"Series of Ecological Assessment on Arterial Drainage Maintenance No. 1: Screening of NATURA 2000 Sites for Impacts of Arterial Drainage Maintenance Operations."**

It examines the impacts of statutory arterial drainage maintenance activities on ....., outlines measures to mitigate any negative impacts, and possible enhancement opportunities.

## **Environment Section**

## GLOSSARY

<b>Biodiversity</b>	The diversity and variety of all life.
<b>Connectivity</b>	How habitats are linked to one another to provide routes of travel/dispersal for wildlife.
<b>Duration</b>	An impact assessment term; refers to the length of time an impact may last.
<b>Ecological Impact Assessment (EcIA)</b>	The formal process by which the significance of potential impacts on ecological factors are assessed.
<b>Eco-phenotype</b>	Visible physical or behavioural characteristics that are a result of the surrounding environment
<b>Ecosystem</b>	The flora and fauna within a given area and how they interact with each other.
<b>Encystment</b>	The stage when glochidia become attached to the gills of host fish.
<b>Enhancement</b>	With reference to habitats and species, enhancement describes any improvement for biodiversity over and above any mitigation measures employed.
<b>European Sites</b>	Sites identified for protection under the EU Habitats and Birds Directives.
<b>Eutrophic</b>	A water body with a high nutrient status, rich in nutrients.
<b>Extent</b>	An impact assessment term referring to the area over which an impact may occur.
<b>Fragmentation</b>	A term given to the isolation of habitat by removal of vegetation or other means.
<b>Frequency</b>	An impact assessment term referring to how often an impact may occur.
<b>Glochidia</b>	The early life stage of freshwater pearl mussels.
<b>Habitat</b>	The range of environments where a given species occurs.
<b>Host</b>	A species that nourishes and supports another species.
<b>IEEM</b>	The Institute of Ecology and Environmental Management.
<b>Impact</b>	An effect on an ecological receptor.
<b>Integrity</b>	The sustainability or wholeness of a site or feature.
<b>IUCN</b>	International Union for the Conservation of Nature.
<b>Keystone Species</b>	A species whose inclusion in an ecosystem has a major effect on other species and habitats present.
<b>Linked</b>	With reference to habitats or species, linked reflects a relationship between the subject species and another species or habitat.
<b>Magnitude</b>	An impact assessment term referring to size or amount of an impact.
<b><i>M. margaritifera</i></b>	The scientific name for the freshwater pearl mussel.
<b>Mesotrophic</b>	Water bodies of intermediate nutrient status.
<b>Mitigation</b>	Measures taken to avoid or reduce negative impacts.
<b>National Parks and Wildlife Service (NPWS)</b>	The statutory nature conservation organisation in Ireland.
<b>Natura 2000 Network</b>	Refers to the collection of European designated conservation sites; i.e. SACs and SPAs.
<b>Oligotrophic</b>	Water bodies of low nutrient or nutrient poor status.
<b>OPW</b>	The Office of Public Works.
<b>Probability</b>	An impact assessment term referring to the likelihood that an impact may occur.
<b>Receptor</b>	An element (species or habitat) in the environment affected by a development impact.
<b>Reversibility</b>	An impact assessment term referring to whether an impact may be undone.
<b>Riparian</b>	Pertaining to the river bank.
<b>Salmonid</b>	Members of the salmon family, including brown/sea trout and Atlantic salmon.
<b>Severance</b>	The process by which fragmentation of habitat occurs.
<b>Significance</b>	An impact assessment term referring to whether an impact will have a large enough effect to require mitigation.
<b>Special Area of Conservation (SAC)</b>	A designation under the EU Habitat Directive. A constituent of The Natura 2000 Network.
<b>Special Protection Area (SPA)</b>	A designation under the EU Birds Directive. A constituent of The Natura 2000 Network.
<b>Unionid</b>	Freshwater mussels

## 1. TERMS OF REFERENCE

This Ecological Impact Assessment (EcIA) report was commissioned by the Office of Public Works (OPW). The report assesses the effects of statutory arterial drainage maintenance activities on the freshwater pearl mussel (*Margaritifera margaritifera* and *M. durrovensis*) in Ireland.

The aim of the EcIA was to assess the potential impacts, both positive and negative, of the statutory arterial drainage maintenance activities on the freshwater pearl mussel. The freshwater pearl mussel is a qualifying interest of five Special Areas of Conservation (SACs) in Ireland, within which maintenance activities are undertaken by OPW.

The aim has been achieved through the following objectives:

- Case studies of four SAC systems and one further river system with pearl mussels present;
- Identification and research of maintenance activities; and
- Impact assessment following Institute of Ecology and Environmental Management (IEEM) guidelines for Ecological Impact Assessment (EcIA) (2006).

## **2. NON-TECHNICAL SUMMARY**

The EcIA of impacts from arterial drainage maintenance activities on the freshwater pearl mussel was based on consultation with relevant parties, site visits and interpretation of reported OPW maintenance activities, within four SAC systems and one further river system with pearl mussels present.

Predictive assessments were then applied to the known baseline conditions, potential impacts identified, mitigation measures proposed as appropriate, and residual impacts assessed using IEEM guidance.

The potential impacts and mitigation measures were identified and assessed as follows:

- Direct habitat loss;
- Severance;
- Loss of life;
- Habitat creation, and
- Enhanced mitigation measures

Mitigation suggested to address these impacts include:

- Establish a clear understanding of the needs of freshwater pearl mussels and the relevance of different maintenance activities upon those needs;
- Train front-line staff in the survey techniques of freshwater pearl mussel and/or use specially trained professional consultants where necessary;
- Implement freshwater pearl mussel surveys of potentially suitable water bodies to investigate the extent of the species range within SACs;
- Adhere, develop and regularly assess the Environmental Drainage Maintenance (EDM) work practices;
- Where possible, mature trees, natural riparian habitats and in-stream boulders should be retained (or planted) within areas known to hold freshwater pearl mussels;
- There should be no use of heavy plant machinery within rivers where freshwater pearl mussels are known to be present (informed by survey work);
- Communicate regularly and share information with relevant nature conservation organisations, fisheries boards and rangers;
- For future design, construction and maintenance of small bridges and culverts refer to the Design Manual for Roads and Bridges (DMRB); and
- Raise awareness and train OPW staff to help with monitoring, surveillance and protection of freshwater pearl mussels.

Using IEEM guidelines an assessment was carried out of the potential impacts of maintenance activities on freshwater pearl mussels. The assessment concluded that the overall mitigated impact from the maintenance activities can be judged to range from a moderate significant impact (loss of life), to a significant positive impact (habitat creation and enhanced mitigation measures).

### **3. INTRODUCTION**

#### **3.1 Historical Background and Functions of Statutory Arterial Drainage**

##### ***3.1.1 Historical background***

Drainage works have a long history in Ireland stretching back to the mid 19th century. Ireland is liable to flooding and drainage problems principally due to the fact that the country has high rainfall and a relatively low-lying interior surrounded by coastal highlands.

A large scale programme of catchment wide arterial drainage schemes was carried out by the State between 1945 and 1995 and, following the 1995 Amendment to the 1945 Arterial Drainage Act, a number of flood relief schemes have been undertaken to mitigate, in the main, urban flooding.

There is a statutory obligation on the State to maintain these schemes "in proper repair and effective condition". The State exercises this responsibility through the Office of Public Works (OPW 2007) which is now the State's lead agency in relation to flood management.

In recent years the OPW has become aware of the effects of its activities on the natural environment. The OPW recognises the need to fully understand the impacts of drainage maintenance operations with the aim of both minimising negative impacts and focusing through studies and research on identifying future positive impacts (OPW, 2007).

##### ***3.1.2 Functions of statutory arterial drainage***

The main functions of the statutory arterial drainage schemes are to provide flood alleviation (freshwater and estuarine) and outfall for land drainage.

In total over 260,000 hectares of land has benefited from the 1945 Arterial Drainage Act schemes (OPW, 2007).

#### **3.2 Legal and Policy Context for this Ecological Impact Assessment**

To ensure compliance with the EC Habitats Directive (Council Directive 92/43/EEC) transposed into Irish law through the European (Natural Habitats) Regulations (1997) the OPW is required to carry out environmental assessments for European sites (Natura 2000 network) which overlap with drainage operations. European sites under the Habitats Directive include Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).

In accordance with Section 31 of the EC (Natural Habitats) Regulations (1997), where an operation or activity is carried out by the State that is likely to have a significant effect on a European site, an appropriate assessment should be carried out on the implications for that site, in view of its conservation objectives. The operation or activity shall only be undertaken when it is ascertained that it will not adversely affect the integrity of the site and then, having regard to conclusions from the assessment (OPW, 2007).

This assessment addresses those potential impacts which may affect freshwater pearl mussels in the sites investigated.

It is important to note that the designation process of SACs and SPAs commenced in Ireland after the arterial drainage schemes. The designation process commenced in the mid 1990's and 1980's respectively and the national programmes of arterial drainage schemes commenced in 1948 and finished in 1995. Therefore, all Natura designations are based on conservation factors in a post drainage scheme environment (OPW, 2007).

### 3.3 Objectives and Scope of Study

This study has been designed to assess the potential impacts of arterial drainage maintenance activities on the freshwater pearl mussel. As such, the scope of the study has necessarily included an understanding and, where possible, an observation of all activities associated with maintenance. These activities are discussed further in Chapter 5 of this report.

During the development of the scope of the study, an understanding of the volume of data required was addressed. It was considered by the OPW that a representative selection of study areas, or case studies, would provide sufficient data. The rationale behind this included:

- That maintenance activities across the country are standardised;
- That complete studies of each SAC and associated drainage channels and tributaries would be extremely time-consuming and costly; and
- That the data gathered and EcIAs produced through complete surveys of each SAC, their drainage channels and tributaries would quickly become dated and irrelevant given that maintenance works are often carried out at intervals of up to a decade.

This understanding led to a scope which included an assessment of the four SAC systems and one further river system where freshwater pearl mussels were noted as a feature and maintenance activities have been or were currently being undertaken.

The selected SACs and river system are detailed in Table 3.1, and are illustrated in Maps 1-6 in Appendix A of this report. Map 1 shows the SAC and river system locations. Maps 2-5 show SAC boundaries and OPW scheme channels, while map 6 shows the location of recent works on the River Lee.

**Table 3.1: SAC Assessment Sites**

Site	SAC Code/River Name	OPW Channel Reference
1	River Bandon SAC (002171)	C1, C2, C3, C3/1, C4
2	River Nore and River Barrow SAC (002162)	C9, C10, C3
3	River Lee	No channel number assigned
4	Lower River Shannon SAC (002165)	Over 30
5	Lough Corrib SAC (00297)	Over 30

Note that the Lower River Suir SAC (002137) had originally been identified as an assessment site for this study. However, preliminary research identified that, although OPW has a statutory Maintenance duty for this channel, in practice OPW work within this SAC was limited to an Urban Flood Relief Scheme. This Scheme involved structural engineering in an urban setting and it is considered that no further maintenance will be required in the future.

In its place, the non-SAC River Lee at Inchigeelagh was assessed. Maintenance works at Inchigeelagh entailed modern works in close proximity to pearl mussels and whilst not designated an SAC, this river presented a better opportunity to assess Drainage Maintenance impacts on the species.

### **3.4 Methodology**

#### **3.4.1 Fieldwork**

As part of this study, OPW engineers for each of the study sites were consulted as to the current maintenance activities undertaken and if there are any future plans for proposed work. Due to the high levels of rainfall during the summer months it was considered to be unsafe to carry out any surveys within each of the study areas. Previous survey results and reports were obtained from the National Parks and Wildlife Service (NPWS) as to the known locations of *M. margaritifera* throughout the channels within the SACs.

Relevant individuals were contacted and consulted regarding *M. margaritifera* surveys and OPW activities; these can be found in Appendix A.

#### **3.4.2 Assessment methodology**

The assessment has been undertaken following the guidelines produced by the IEEM as described in the Terms of Reference section of this report. These guidelines reflect current legislation and best practice relating to EcIA and species protection.

## 4. FRESHWATER PEARL MUSSELS

### 4.1 Description of the Species

#### 4.1.1 *Species background*

During the past 100 years, the freshwater pearl mussel has declined throughout its Holarctic range to such an extent that it is now listed as an endangered species (IUCN, 1991). Great Britain and Ireland are major European and global strongholds for *M. margaritifera*, with recent estimates suggesting that Scotland alone holds perhaps half of the world's known remaining viable populations (Cosgrove *et al.*, 2000a; Young *et al.*, 2001). Full assessment of the importance of all Ireland's populations has not yet occurred. However, the species has declined in GB and Ireland and a number of factors have been implicated e.g. industrial and agricultural pollution, over-exploitation by pearl fishermen, decline in salmonid host stocks (the short parasitic larval stage of freshwater pearl mussel is entirely dependent upon salmon and trout fry) and physical river bed habitat degradation due to hydro-electric operations and small-scale river engineering works (Cosgrove *et al.*, 2000a).

#### 4.1.2 *Distribution and status in Ireland*

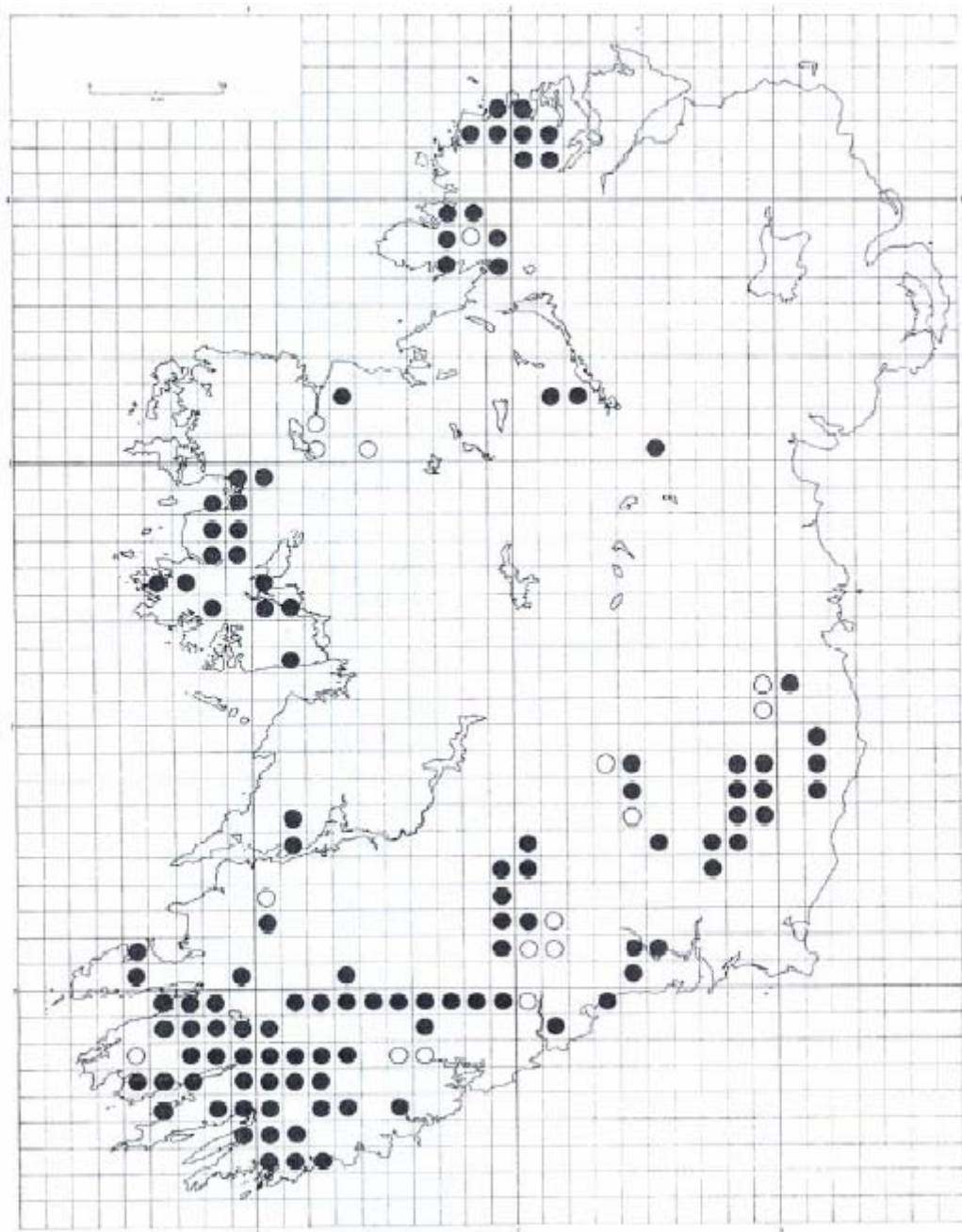
Ireland has long been considered to hold one of the most important freshwater pearl mussel populations remaining in Western Europe, following a rapid and widespread decline throughout its range during the last few decades. Consequently, several studies have been undertaken in Ireland and the following description is based around these published accounts. In Ireland, literature records of freshwater pearl mussels stretch back over at least a thousand years, with for example, pearls from County Tyrone being sent to the Archbishop of Canterbury in 1094 (Ross, 1992). Since then, several published accounts over the centuries have summarised known occurrence in various parts of the country. Originally, *M. margaritifera* was found throughout most of Eire, except for the central area and the eastern coastal section around Dublin (Young *et al.*, 2001).

In 1993, Lucey carried out a study into the distribution of *M. margaritifera* in southern Irish rivers and streams. 1800 sites on almost 400 rivers and streams were examined of which 8.1% and 14.6% respectively held freshwater pearl mussels. The study concluded that although the species was widespread across the region and that its true distribution was hitherto poorly recorded, a decline of its former sites was nonetheless apparent.

Freshwater pearl mussel populations have declined in Ireland despite legislation designed to protect the species and its habitat. Beasley and Roberts (1996) carried out surveys on rivers in County Donegal, NW Ireland, to determine current distribution, size and densities of populations as well as threats. The survey revealed freshwater pearl mussels to be widespread, but with densities of mussels at most sites low. Mussels were absent from a number of sites from which they had been previously recorded. Evidence gathered suggested that destructive pearl fishing was adversely affecting all sites surveyed. Maintaining high water quality was also a key finding of the study, along with enforcement of existing protective legislation.



The most recent distribution map (Figure 1) shows that pearl mussels are widespread in Ireland, but the status of these populations is not healthy. In a study of 32 living populations of *M. margaritifera*, it was found that only 8 had juvenile mussels present (Moorkens, 1996). In some of these populations, the last successful recruitment of juveniles dated back to the 1960s or early 1970s.



**Figure 4.1.2** Distribution of *M. margaritifera* in Ireland (inc. *M. durrovensis*) since 1987. Data from Beasley and Roberts (1996), Lucey (1993), Moorkens *et al.* (1992), Moorkens (1996) and Duchas. Open/white circles = dead shells only, black/closed circles = living mussels.

There is one known population in Ireland from hard water, which is known as *Margaritifera (m) durrovensis*. This population is the source of scientific and taxonomic interest and debate; it is

regarded by some specialists as a separate species and by others as simply a form of *M. margaritifera*. Regardless of taxonomic status, the population is highly endangered.

Costello *et al.* (1998) reported that *M. margaritifera durrovensis* only occurred in a 20km stretch of the River Nore, whereas Chesney *et al.* (1993) estimated a population of 5000 in 1988/1989 and 2500 in 1990, and Costello *et al.* (1998) estimated 2000, 1000, 800, 500 and 360 overall in 1991-1995, respectively. However, they noted that the number found was very much dependent upon good viewing conditions.

No *M. margaritifera durrovensis* of less than 20 years old were found in recent surveys and the population is considered senescent. Lucey (1993) commented that juvenile *M. margaritifera* were rarely encountered in southern Eire, although it was not clear whether a specific search was made for them. Beasley and Roberts (1996) found no young juvenile mussels (below 15mm in length) and only 26 (15-35mm) at 11 sites in four rivers, despite regular searches for them. As a result of these findings, Young *et al.* (2001) concluded that few Irish populations were recruiting successfully.

Pearl fishing has been reported commonly across Ireland and this remains a serious threat. However, Lucey (1993) and Beasley and Roberts (1996) agree that nutrient enrichment from farming and sewage disposal represents the main threat and that this problem is widespread. In local areas, river engineering, resulting in direct mortality and habitat modification, has also had a detrimental impact (Young *et al.*, 2001). Costello *et al.* (1998) found direct evidence of fouling due to cattle wastes and agricultural fertilizer use and regarded this as the primary problems in the River Nore.

#### **4.1.3 Freshwater pearl mussel habitat requirements**

Freshwater pearl mussels are found in clean, fast flowing rivers, with detailed studies on Scottish freshwater pearl mussel populations suggesting that optimum water depths of 0.3-0.4m and optimum current velocities of  $0.25-0.75\text{ms}^{-1}$  at intermediate water levels are most suitable (Hastie *et al.*, 2000). River bed substratum characteristics appear to be the best physical parameters for describing freshwater pearl mussel habitat. Freshwater pearl mussels prefer stable cobble/boulder dominated substrate with some fine substrate that allows the mussels to burrow (Cosgrove *et al.*, 2000b). Adult and juvenile mussels tend to have similar habitat 'preferences', although adults are found over a wider range of physical conditions and juveniles appear to be more exacting in their requirements and sensitivity to environmental disturbance (Hastie *et al.*, 2000).

Freshwater pearl mussels live buried or partly buried in the beds of clean, fast-flowing unpolluted streams and rivers and subsist by inhaling and filtering for the minute organic particles on which they feed (Cosgrove *et al.*, 2000b). Of specific importance to freshwater pearl mussel survival are levels of silt, suspended solids, calcium and chemical compounds generally associated with enrichment (eutrophication) i.e. nitrate, phosphate and biological oxygen demand (Bauer, 1983). Juvenile mussels require fine stable sediments, particularly clean sand and gravel. Within these fine sediments, oxygen can move freely to the juvenile mussels, which are usually buried. If this substrate becomes clogged or blocked with silt, oxygen cannot reach the juvenile mussels and

they can die (Buddensiek *et al.*, 1993). If large quantities of silt accumulate on the river bed, or if the bed becomes coated in filamentous algae, no juveniles will survive and adults also become stressed, clam their shells shut, and begin to waste away and die (Moorkens, 1996).

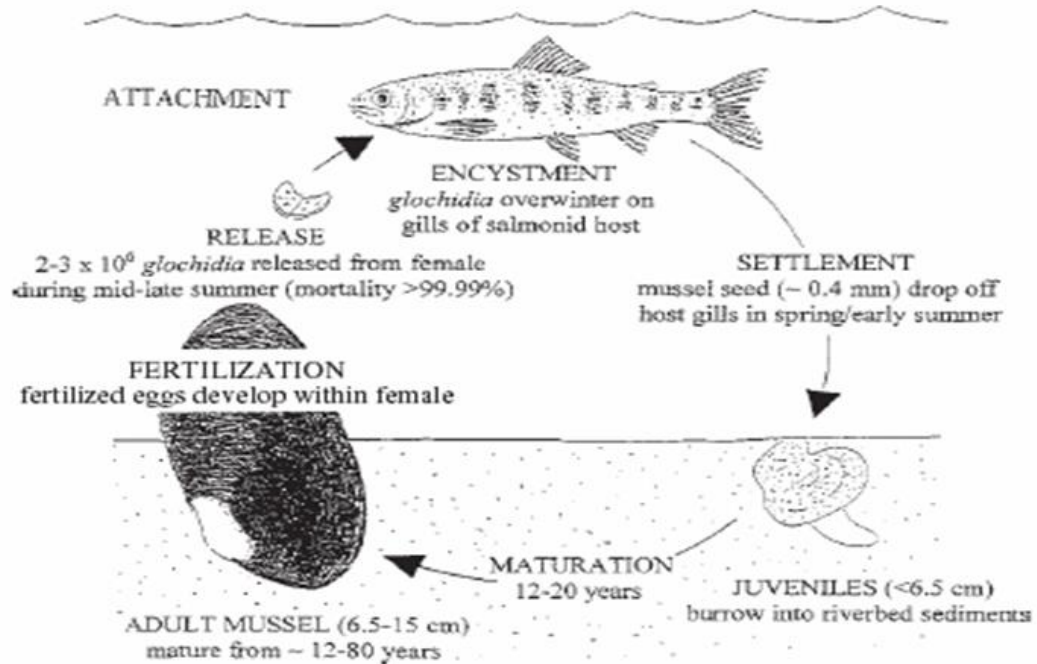
There is no scientific agreement about what constitutes a 'functional' or 'viable' freshwater pearl mussel population in terms of the numbers of juvenile mussels present, although a working figure of at least 30% under adult age is often used. Nevertheless, by any definition, very few functioning pearl mussel populations remain in Britain and Ireland. This is the most worrying feature of all, for there is a general lack of juvenile mussels in almost every population recently studied (Hastie *et al.*, 2000, Cosgrove *et al.*, 2000a). At first sight many populations may look healthy based on the number of adults present, but the adults can linger for many years after recruitment has failed and unless threats are removed, such populations are ultimately doomed.

Moorkens (2000) reported that in her various river studies of *M. margaritifera*, juvenile mussels were only found in eight populations. Conditions in these rivers were generally good, with low numbers having silted conditions. Rivers with mussels had significantly more gravel, and less silt, erosion and canalisation. Sites with older mussels had significantly more over-hanging trees than sites with no mussels, and sites with young mussels present had significantly less algae than former sites with no mussels. Rivers with healthy populations of mussels had consistently lower ortho-phosphate and oxidised nitrogen levels than rivers with poor mussel populations in the historical water chemistry comparisons. Irish mussel populations with large numbers of individuals and juveniles occur more frequently in rivers with low nutrient levels and unsilted gravel. Moorkens' conclusions suggest that stricter water quality standards are needed for waters where pearl mussels are to be conserved than are currently used for protecting salmonids.

#### **4.1.4 Freshwater pearl mussel host requirements**

Freshwater pearl mussels have a unique lifecycle that includes a short parasitic larval phase on the gills of suitable host fish (Figure 4.1). The larvae (glochidia) of *M. margaritifera* are very host-specific and can only complete their development (ensystem) on Atlantic salmon *Salmo salar* or brown/sea trout *Salmo trutta*. Usually juvenile fish (fry and parr) are utilised (Young and Williams, 1984). The presence of freshwater pearl mussels in any river therefore depends on salmonid host fish availability. It is usually considered necessary for migratory salmonids to be present within a catchment for freshwater pearl mussels to be present. This is typically the case, however occasionally, where historical river captures have occurred, pearl mussel populations are sometimes isolated from present day migratory salmonids e.g. by impassable waterfalls, and have survived this isolation by utilising resident brown trout hosts. Thus, all sites with suitable habitat capable of containing native salmonids can potentially hold freshwater pearl mussel populations

Figure 4.1.4 Lifecycle of the freshwater pearl mussel (from Hastie and Cosgrove 2001)



#### 4.1.5 Legislation

As a result of the widespread decline in freshwater pearl mussel populations and the possible continued threats to the species from pearl fishing, habitat loss, river engineering and pollution, the species is protected in Ireland.

*Margaritifera margaritifera* is one of two European species of pearl mussel which are now on the International Union for the Conservation of Nature (IUCN) red data list (the other being *M. auricularia*). The same species have Council of Europe protection under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention). The EC Directive on the Conservation of Natural and Semi-Natural Habitats and of Wild Fauna and Flora (Habitats Directive) lists *M. margaritifera* under Annex II (species whose conservation requires the designation of special conservation areas) and Annex V (species whose taking in the wild and exploitation may be subject to management measures), and *M. auricularia* under Annex IV (species of community interest in need of strict protection).

Under Irish law, it is illegal to interfere with *M. margaritifera* (Statutory Instrument No. 112, 1990); thus pearl fishing is currently outlawed in the country. **For legal purposes, the hard water form of pearl mussel *Margaritifera (m) durrovensis* is treated as within the taxon *M. margaritifera*. Thus, it enjoys the same level of legal protection as the latter under Irish and European law (Moorkens, 1999).**

The effect of these legislative provisions is to give protection to both the animal and its habitat. One consequence is that any action that might have an adverse effect upon the pearl mussel can only be carried out under licence (NPWS, 2004).

## 4.2 Threats

The predominant threats to the freshwater pearl mussel in Britain and Ireland have traditionally been considered to be destructive pearl fishing and/or pollution. However, recent research has highlighted a number of additional threats to freshwater pearl mussels in Britain and Ireland. In 1999, the Heritage Service commissioned a review of the species in Ireland (<http://www.npws.ie/media/Media,4582,en.pdf>; Moorkens, 1999) and much of the following section is taken directly from this review. To assess the main threats to freshwater pearl mussels, it is important to consider their very specific habitat/lifecycle requirements. Anything that directly or indirectly interferes with their requirements would constitute a potential threat to *M. margaritifera*.

### 4.2.1 Nutrient enrichment

Use of artificial fertilisers, spreading of slurry, untreated sewage and industrial waste with a high biological oxygen demand (BOD), even when at low levels, combine to increase nutrient levels within a river system to an extent which can in time change the river's nutrient status from oligotrophic to mesotrophic to eutrophic. Initial negative effects may be stress on the filter feeding mechanism within adult mussels, adapted for systems where nutrients are low (adults "clam-up" in the presence of high suspended solids). Excessive nutrients encourage filamentous algal growth, which then coats the bed of the river, leading to oxygen deprivation in the substratum spaces, making it uninhabitable for juvenile mussels. As the alga dies, it decomposes into fine organic silt which reaches deeper into the interstices of the gravel, causing long term clogging and less chance of fresh oxygenated water reaching the substratum (Moorkens, 1999).

### 4.2.2 Point source pollution

Severe single pollution events, such as slurry, silage, sheep dip or industrial spills, can cause large fish kills. In a pearl mussel river, the effects of such an incident can range from loss of host salmonid fish which are essential to the mussel's life cycle, long term stress and death of adult and young mussels from oxygen deprivation, to immediate death of the entire mussel population from toxic poisoning, as has happened following the release of sheep-dip (Moorkens, 1999).

### 4.2.3 River bank erosion

Erosion of riverbanks is caused at sites where cattle enter the river to drink, or is the result of removal of bank side vegetation. Whatever the cause, the effects are similar, the eroded banks fall into the water and are reduced to silt by the force of the current, to be deposited on downstream mussels and the river bed. The banks are then unstable and are vulnerable to further episodes of erosion by the same causal factors and at times of flood (Moorkens,

1999). An associated problem is with excessive grazing, particularly on hillsides, where exposed soil and silt can be carried by rain into the rivers below.

#### **4.2.4 Forest management practices**

In preparing areas for forestry, the ground is sometimes ploughed and ditched, following which a series of drills are cut and considerable quantities of artificial fertiliser are applied. The consequent runoff of soil and nutrients to nearby rivers causes the nutrient enrichment problems outlined above. If the forestry is on a steep slope in the river valley, and on poorly buffered acidic land with peaty soil, both of which are often the case in *Margaritifera* catchments, the problem becomes more extreme, with large quantities of peat silt entering the river. If the forestry is coniferous, the problems can continue as the trees mature and cause acidification of the river. Harvesting the crop later can cause another high influx of silt, due to soil exposure and run-off accompanying clear-felling activities (Moorkens, 1999).

#### **4.2.5 Road/track building**

The development of poorly planned road/track or building works close to a watercourse can result in silt runoff, leading to problems for mussels identified above (Moorkens, 1999).

#### **4.2.6 Bog drainage and artificial drainage schemes**

Drainage of bogs in the upland regions of river catchments can lead to large quantities of peat silt being carried into the river. This silt is fine and large quantities can be carried long distances downstream and fill in the smallest interstices in the substratum. Widespread drainage of farmland changes the flow regime within a river and can cause bank erosion and erosion of the substrate within the riverbed (Moorkens, 1999).

#### **4.2.7 Decline in host salmonid stocks**

Pearl mussels require healthy stocks of native host salmonids. Recent changes in the status of native salmonids in Britain and Ireland may pose a serious new threat to the long-term survival of *M. margaritifera*. For example, in the NW of Scotland, many migratory salmonid stocks have recently collapsed. Since more than 90% of Scotland's viable pearl mussel populations occur in this area (ca. half of the world's known viable populations) it is important to determine the cause(s) of these declines, which have coincided with current recruitment problems in Scottish pearl mussel populations (Hastie and Cosgrove, 2001). Declines in Irish migratory salmonids have also occurred, but it is not yet known if these have impacted upon already stressed mussel populations.

#### **4.2.8 Pearl fishing**

There is recent evidence that destructive pearl fishing has occurred at practically every British and Irish river, including both remote and accessible sites. The availability of cars to most households and a good road network since the 1970's has meant that even remote sites are now accessible to illegal pearl fishers. As the number of rivers with pearl mussel populations decreases, the illegal pearl fishing effort is redirected and concentrated to the ever decreasing

sites that remain (Cosgrove *et al.*, 2000b). Thus, an increasingly important issue has arisen in relation to (a) enforcement of existing legislation, and (b) safeguarding site information. A general policy of not disclosing important pearl mussel site information in the public domain has developed and even resulted in the ruling of the Information Commissioner to with-hold detailed site information for conservation purposes under the Freedom of Information Act (Case 020207; reported on 25/07/02).

#### **4.2.9 River engineering/modification**

Canalisation of a river changes its flow regime and sediment budget. An Irish study found a strong negative correlation between rivers that had been canalised and the presence of pearl mussels (Moorkens, 1996). Other modifications that could damage a pearl mussel river are the building of large weirs or dams which would create a barrier to the movement of either mussels or salmonids. The clearing of vegetation from riverbanks, especially the removal of trees, is also detrimental. Algal growth is promoted in the absence of shading trees, and the river water quality suffers when the filtration effect of the roots of river-edge trees is removed and nutrients run directly to the river. Removal of riparian vegetation can also create riverbank instability, leading to bank collapse and subsequent siltation (Moorkens, 1999).

River engineering work has historically been responsible for the decline and extinction of a number of freshwater pearl mussel populations and potentially remains a significant threat. The impact of different types of engineering activity (e.g. pipe laying, bridge maintenance, hydro-electric work, channel realignment and fisheries management) varies and can impact on pearl mussels in many different ways. Cosgrove and Hastie (2001) examined and reviewed the scale, nature and impacts of different river engineering activities on mussels across the species' range and went on to discuss how river managers should try to integrate ecological and socio-economic factors when considering the impact of proposed activities.

#### **4.2.10 Water abstraction**

Abstraction of river water close to pearl mussels can lead to a lowering of water quality and a rise in water temperature which could adversely affect mussel populations. This has been identified as a pressure within Scottish *M. margaritifera* SACs. This is particularly a problem when periods of low rainfall lead to reduced flows in river channels.

#### **4.2.11 Introduction of non-native species**

The stocking of *Margaritifera* rivers with non-native fish species has been found to be detrimental to pearl mussel reproduction, because glochidial encystment cannot take place, and the non-native fish may out compete native fish, making the problem for pearl mussels worse over time (Valovirta, 1998). There are also risks associated with disease, virus and parasite transfers associated with fish stocking. The zebra mussel *Dreissena polymorpha* has reached Ireland and spread to a number of linked waterways. Serious infestations of unionid mussels by *Dreissena* in North America has led to their decline in populations where both taxa are present (Schloesser and Kovalak, 1991). The zebra mussel is often spread by attaching itself to the hulls of boats and while most pearl mussel rivers are not within the

navigable catchments, there is a strong possibility that zebra mussels will make their way to the Barrow navigation, and possibly to the river Nore, or the Barrow and Suir tributaries, some of which do have pearl mussels (Moorkens *et al.*, 1992). However, the requirement of zebra mussels for a higher calcium content in water than that normally tolerated by *Margaritifera* should ensure that negative interactions between these species are localised and do not affect the vast majority of remaining Irish *Margaritifera* populations (Moorkens, 1999).

#### **4.2.12 Climate change**

Changes in climate are now known to be happening around the world and the effects on ecosystems will vary, depending upon the extent and nature of these changes. In NW Europe experts predict that annual rainfall will increase significantly, along with dramatic storm events and flooding in the next 50-100 years and these may threaten many pearl mussel populations. For example, formerly rare events such as large floods have been shown to adversely affect mussels and these events are predicted to become much more common. Mussel populations may also be affected by a number of other factors, including predicted changes in temperature, sea level, habitat availability, host fish stocks and human activities in response to climate change e.g. increases in river engineering activities (Hastie *et al.*, 2003a).

### **4.3 Site Designation and Evaluation**

#### **4.3.1 Site Value**

Site evaluation is an important aspect of any EcIA as it places in context the nature conservation value of the site concerned. Following guidance provided by the IEEM on the determination of site value; any site currently designated as a SAC is of international value.

Please note that some of the SAC citations provided by NPWS describe the freshwater pearl mussel populations as of national importance. This may be the case, but given that freshwater pearl mussels are a qualifying feature of the SACs in question, each site assessed in this document and indeed each SAC with freshwater pearl mussel interests is of **international** value. This evaluation of value will be important in the forthcoming assessment of impacts.

#### **4.3.2 Background Information**

In the interest of completeness, this section describes the background in terms of biology, geology, geography and land use of the SACs selected as part of this study. The known occurrence of freshwater pearl mussels is summarised from reports/maps supplied by OPW and NPWS.

##### **4.3.2.1 River Bandon SAC (002171)**

The site consists of relatively short adjoining stretches of the Bandon and Caha Rivers. These rivers flow in a southerly direction to the east of Dunmanway, County Cork. Towards the southern end of the site the Bandon takes an easterly course. The predominant rock



formations are Old Red Sandstone to the north and Carboniferous Slate stretching south of Dunmanway. Soils in the northern section consist of peats, podzols and skeletal soils. The southern section consists of alluvial soils and brown podzolics. The east-west exposure of Old Red Sandstone to the north of Dunmanway displays distinct ridgelines of bare rock with poor pasture and scrub. In this area around Lovers Leap the Bandon River cuts a narrow channel southwards, cascading over a series of rock steps through a narrow valley. Below this and above Long Bridge the river widens and meanders through a fertile floodplain. Immediately south of the Long Bridge the reduced flow gradient and broad, flat valley permit the main channel to split and extend into a network of braided streams forming islands. The site is important for a number of reasons. It contains a small though very important example of the Annex I priority habitat alluvial forest as well as good examples of another Annex I habitat - floating river vegetation. The Annex II animal species otter, Atlantic salmon, brook lamprey (*Lampetra planeri*) and freshwater pearl mussel occur (NPWS, 2007).

Wet broadleaved semi-natural woodland is found in an undisturbed area of braided river channels and islands below Dunmanway. The river channels are well defined and the islands appear solid. Canopy dominants are hazel (*Corylus avellana*) (multi-stemmed) and sessile oak (*Quercus petraea*), with scattered downy birch (*Betula pubescens*), ash (*Fraxinus excelsior*), rusty willow (*Salix cinerea* subsp. *oleifolia*) and alder (*Alnus glutinosa*). There is a very sparse understorey composed of hawthorn (*Crataegus monogyna*), holly (*Ilex aquifolium*) and saplings of hazel and sessile oak. Epiphytes are abundant on trees: ivy (*Hedera helix*), honeysuckle (*Lonicera periclymenum*) and bryophyte species such as *Isoetecium myosuroides*. The ground flora is dominated by ramsons (*Allium ursinum*), wood anemone (*Anemone nemorosa*), ivy with abundant/scattered lesser celandine (*Ranunculus ficaria*), wood sedge (*Carex remota*) and Irish spurge (*Euphorbia hyberna*). Goldilocks buttercup (*Ranunculus auricomus*), a very rare plant in Co. Cork, has been recently recorded from this woodland (NPWS, 2007).

Freshwater pearl mussel surveys have been carried out on the main stem of the Bandon River and its tributaries. Tributaries with mussels present are:

- Bealanascartane (River Code 20/B/08) (John Lucey; Environmental Protection Agency river monitoring, 2006);
- Blackwater (Bandon) (River Code 20/B/04) Grid Ref: W 319 535 (NPWS, 2004);
- Cullenagh Lake Stream (River Code 20/C/04) Grid Ref: W 168 558. NPWS report stated that population of Freshwater Pearl Mussels was not within SAC (John Lucey; EPA river monitoring, post 2003); and
- Caha (River Code 20/C/01) Grid Ref: W 241 558 (NPWS Stage 2 Survey).

A map received from OPW shows location of FWPM on main stem of the river between Knockduff and Demesne.

#### 4.3.2.2 River Nore and River Barrow SAC (002162)

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 Durrow. The larger of the many tributaries include the Lerr, Fushoge, Mountain, Aughavaud, Owenass, Boherbaun and Stradbally Rivers of the Barrow and the Delour, Dinin, Erkina, Owveg, Munster, Arrigle and King's Rivers on the Nore. Both rivers rise in the Old Red Sandstone of the Slieve Bloom Mountains before passing through a band of Carboniferous shales and sandstones. The Nore, for a large part of its course, traverses limestone plains and then Old Red Sandstone for a short stretch below Thomastown. Before joining the Barrow it runs over intrusive rocks poor in silica. The upper reaches of the Barrow also run 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 it is today (NPWS, 2007).

The site is an SAC selected for alluvial wet woodlands and petrifying springs, priority habitats on Annex I of the EC Habitats Directive. The site is also selected as an 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 EC 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, white-clawed crayfish, twaite shad, Atlantic salmon, otter, *Vertigo moulinsiana* and the plant Killarney fern (NPWS, 2007).

The Nore has 24 tributaries varying in length from 8km to 58km. All have been surveyed for pearl mussels (Moorkens, 1996). FWPM have been found on the main stem of the River Nore (River Code 15/N/01) along 24 historically surveyed sections (Moorkens and Costello 1994). *M. durrovensis* is/was found mainly between Poorman's Bridge and Ballyragget.

A report from the NPWS indicates that FWPM have been found in the following tributaries of the River Barrow (John Lucey; EPA river monitoring, post 2003; Moorkens and Costello 2004):

- Aughavaud (River Code 14/A/04);
- Aughnabrisk (River Code 14/A/05);
- Ballymurphy; and
- Mountain (14/M/01) (Ross, 2006).

#### 4.3.2.3 River Lee

The River Lee is situated to the southwest of Ireland and is considered to be one of the largest rivers along the southwest coast, with a catchment area of approximately 2000 km<sup>2</sup>. It rises in the Shehy Mountains on the western border of County Cork and flows eastwards through Cork city and flows into the sea at Cork Harbour on Ireland's south coast.

The Gearagh SAC (000108) is located on the River Lee in County Cork, extending westwards and southwards from the Lee Bridge, where it extends for about 7km of the river (NPWS, 2007).

A report received from the NPWS shows that the main stem of the River Lee (River Code 19/L/03) contains pearl mussels and the following tributaries of the River Lee have pearl mussels present (John Lucey; EPA river monitoring, post 2003):

- Lough Lua;
- Foherish (River Code 19/F/02);
- Laney (River Code 19/L/01);
- Sullane (River Code 19/S/02);
- Toon (River Code 19/T/02); and
- Bealaphadeen.

#### 4.3.2.4 Lough Corrib SAC (000297)

Lough Corrib is situated to the north of Galway city and is the second largest lake in Ireland with an area of approximately 18,240 ha (the entire site is 20,556 ha). The lake can be divided into two parts: a relatively shallow basin, underlain by Carboniferous limestone, in the south and a larger, deeper basin, underlain by more acidic granite, schists, shales and sandstones, to the north. The surrounding lands are mostly pastoral farmland to the south and east, and bog and heath to the west and north. Rivers, mainly to the east of the site, are included within the SAC as they are important for Atlantic salmon. These rivers include the Clare, Grange, Abbert, Sinking, Dalgan and Black to the east, as well as the Cong, Bealanabrack, Failmore, Cornamona, Drimneen and Owenriff to the west. In addition to the rivers and lake basin, adjoining areas of conservation interest, including raised bog, woodland, grassland and limestone pavement, have been incorporated into the site. This site is of major conservation importance and includes 14 habitats listed on Annex I of the EC Habitats Directive. Six of these are priority habitats - petrifying springs, *Cladium* fen, active raised bog, limestone pavement, bog woodland and orchid-rich calcareous grassland. The other annexed habitats present include hard water lakes, lowland oligotrophic lakes, floating river vegetation, alkaline fens, degraded raised bogs, rhynchosporion vegetation, *Molinia* meadows and old oak woodlands. Species present on the site that are listed on Annex II of this directive are sea lamprey, brook lamprey, Atlantic salmon, white-clawed crayfish, freshwater pearl mussel, otter, lesser horseshoe bat, slender naiad and the moss *Drepanocladus vernicosus* (NPWS, 2007).

FWPM surveys have been carried out on the following tributaries (Moorkens, 2004a, 2005c, 2006c):

- Owenriff (River Code 30/O/02)
  - Glenawbeg (tributary of Owenriff)

A report produced by Moorkens (1996) indicates that the Owenriff River falls into a rare category of being one of the few remaining breeding populations in the EU and the world for freshwater pearl mussels, and is therefore of the utmost international importance. It was also established that the population was actively breeding within this river in the vicinity of Oughterard.

#### 4.3.2.5 Lower River Shannon SAC (002165)

The Lower River Shannon SAC (002165) is a very large site that stretches along the Shannon valley from Killaloe to Loop Head/Kerry Head, a distance of some 120 km. The site thus encompasses the Shannon, Feale, Mulkear and Fergus estuaries, the freshwater lower reaches of the River Shannon (between Killaloe and Limerick), the freshwater stretches of much of the Feale and Mulkear catchments and the marine area between Loop Head and Kerry Head. Rivers within the sub-catchment of the Mulkear include the Killeenagarraff, Annagh, Newport, the Dead River, the Bilboa, Glashacloonaraveela, Gortnageragh and Cahernahallia (NPWS, 2005).

There are a wide range of land uses within the site. The most common use of the terrestrial area is grazing by cattle and some areas have been damaged through over-grazing and poaching (NPWS, 2005).

The site is an SAC selected for lagoons and alluvial wet woodlands, both habitats listed on Annex I of the EC Habitats Directive. The site is also selected for floating river vegetation, *Molinia* meadows, estuaries, tidal mudflats, Atlantic salt meadows, Mediterranean salt meadows, *Salicornia* mudflats, sand banks, perennial vegetation of stony banks, sea cliffs, reefs and large shallow inlets and bays, all habitats listed on Annex I of the EC Habitats Directive. The site is also selected for the following species listed on Annex II of the same Directive: bottle-nosed dolphin (*Tursiops truncatus*), sea lamprey (*Petromyzon marinus*), river lamprey (*Lampetra fluviatilis*), brook lamprey, freshwater pearl mussel, and Atlantic salmon (NPWS, 2007).

The following tributaries of the Lower River Shannon have been previously surveyed and are known to contain populations of the FWPM:

- Cloon (River Code 27/C/02) (NPWS);
- Feale (River Code 23/F/01) (Ross, 2005j);
- Galey (River Code 23/G/01) (NPWS Stage 1 Survey (also J. Lucey post 2003); and
- Fergus (River Code 27/F/01) (NPWS).

## 4.4 Site Integrity

Under the European (Natural Habitat) Regulations (1997) in relation to SACs, works shall not normally be permitted when they will negatively affect the 'integrity' of the site. The 'integrity' of a site refers to an approach which deals with the whole ecosystem. 'Integrity' is best described as,

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*'...the coherence of [the site's] ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified.'*

Conservation objectives for SACs usually include the following:

- To avoid deterioration of the habitats of qualifying species, or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for the qualifying feature; and
- To ensure for the qualifying species that the following are maintained in the long-term:
  1. Population of the species as a viable component of the site;
  2. Distribution of the species within the site;
  3. Distribution and extent of habitats supporting species;
  4. Structure, function and supporting processes of habitats supporting the species; and
  5. No significant disturbance of the species.

To ensure that the obligations of the Directive are met, there should not be deterioration or significant disturbance of the qualifying feature from its condition at the time the site is first given formal Ministerial approval.

## **5. MAINTENANCE ACTIVITIES CARRIED OUT BY THE OPW**

### **5.1 Outline of Maintenance Activities**

#### **5.1.1 Historical scheme works**

##### **5.1.1.1 Scheme works**

Construction of the original arterial drainage schemes required major hard engineering. Typically it involved widening and deepening the existing channel with some localised straightening and, in a few cases, the opening of a new channel reach. Using draglines, works entailed excavation of all soil types such as peat, clays and gravel while rock was normally blasted. The channel cross section was excavated to a trapezoidal form, channel width was standardised, longitudinal gradients were made more uniform and cross sectional bed levels were made even. All in-stream and riparian vegetation and soils were removed and access for construction plant was made along the channel banks. In schemes prior to circa 1973, excavated material was stockpiled in spoil heaps set back parallel to the channel. Post 1973, the spoil was levelled out on riparian lands and damaged lands were top-soiled and reseeded (OPW, 2007). It should be noted that many weirs and obstacles were removed as part of the original Drainage scheme works and that new weirs or large impoundment structures have not been inserted into rivers by statutory Drainage Maintenance (Nathy Gilligan, OPW *pers. comm.* 2007).

##### **5.1.1.2 Scheme hydrological change**

Typically the riparian water table would have been dropped by circa 1 metre although this value would vary widely depending on a number of characteristics such as soils, geology, topography, catchment hydrology and critical design factors. Arterially drained channels differ from more natural channels in that the waterway has significantly more uniform flow velocities, more constant depth/width ratios, a reduction in connectivity to floodplains but with more in-stream storage (OPW, 2007).

#### **5.1.2 OPW maintenance works**

The purpose of arterial drainage maintenance is simply to retain the scheme channel's design capacity to convey water in an effective manner. Maintenance works are carried out following OPW environmental work practices through which ecological disturbance is minimised and habitat enhancement is common. Following the scheme works, the channel capacity gradually reduces over time as both silt and vegetation levels increase and other obstructions develop, necessitating maintenance to return the channel capacity to its design condition. This is achieved by removal of the silt and vegetation, repairing bank damage or slippage and removal of obstructions such as trees encroaching at low levels on the banks. No excavations of virgin ground are necessary and generally the majority of the riparian vegetation is left intact.

Maintenance works restore the hydraulic capacity of the channel to that originally designed. As a rule, medium to high gradient channels have limited build up of silt, and maintenance work consists of removing obstructions, repairing damaged banks and removal of dense instream vegetation.

Low gradient channels requiring maintenance would normally have a reduced capacity due primarily to siltation and instream vegetation. Maintenance operations will reinstate the original design datum.

This ongoing process of maintenance ensures that the level of drainage provided to the riparian lands and the flood protection originally provided is retained.

#### 5.1.2.1 Channel works

As stated above, channel maintenance operations normally involve removing the build up of foreign or natural materials that impede the free flow of water. Predominately this consists of the removal of silt and vegetation from the bed of the channel by suitably rigged hydraulic excavators. Restrictions in channels due to bank slippage or damage would be re-graded to the original profile. Channel breaches due to bank erosion would be resolved by re-profiling the bank in-situ or in some cases by importing protection material such as rock armour or log poles. In addition, other larger vegetation such as trees, which impinge on channel capacity, are either removed in whole or impingement is reduced by selective removal of lower branches. The material removed during maintenance operations is normally spread along the bank or on top of existing spoil heaps where present. In most cases no alterations to the bank are required and in some cases the channel is not disturbed at all if no build up of material is present (OPW, 2007).

Some channels that are steep and fast flowing are subject to flash floods, bank erosion and rapid movement of bed gravel. However, 60-70% of scheme channels are of gentle longitudinal gradient and subject to relatively rapid deposition of silt, especially those that are subject to prolific growth of instream vegetation. The steeper sections of channel normally require relatively little maintenance works. The majority of maintenance works are on smaller lower lying channels with 90% of works in channels with a base width of less than three metres. The average channel requires maintenance every 4-6 years. Channels with prolific weed growth may require maintenance annually, particularly where downstream urban bridges are at risk of being blocked due to a flow of decaying vegetation in the autumn. Conversely, some channels may only require maintenance every 20 years due to the self cleaning characteristics of the channel (OPW, 2007).

#### 5.1.2.2 Weed cutting

A number of channels have an annual prolific growth of aquatic plants but are too wide or the bank conditions are too unstable to allow maintenance by way of excavators, even those designed for low ground pressure and long reach. Weed cutting boats are engaged in these cases. In all, ~90 km of channel are cleaned annually by four weed cutting boats, operating on a seasonal basis, with the majority of the works concentrated in the West of Ireland (OPW, 2007).

#### 5.1.2.3 Embankments

Most embankment schemes occur in areas that are tidal in nature hence they tend to be located at estuaries. The foremost inland embankment scheme is the Annagh Embankments on the

Inny Drainage Scheme. The frequency of maintenance for embankments tends to be more variable than that for channels. Embankments are scheduled for works when it is deemed that the structure is in need of repair to maintain an effective condition. Repair work normally takes the form of topping up clay embankments to design height and structural strengthening by importing rock/soil material or utilising in-situ material that has been eroded from the original embankment (OPW, 2007).

#### 5.1.2.4 Other works

Included within the 18,500 bridges in Ireland on maintainable arterial drainage schemes are structures ranging from concrete pipe culverts, timber bog access ramparts through to concrete or masonry abutments, either with a similar decking material or steel girders with concrete or timber decking. Repair/replacement works are carried out on ~ 170 bridges per annum and are restricted to the most critical structures. Repair works are normally carried out with a similar material as that of the structure in question with the exception of the wooden structures that tend to be substantially deteriorated and are replaced by concrete structures (OPW, 2007).

Ancillary structures such as sluice gates, tidal barrages and pumping stations are repaired or replaced as necessary to maintain their respective operating function (OPW, 2007).



## 5.2 OPW Maintenance Works Within Selected Sites

The following tables provide information on those OPW maintenance activities carried out within the four freshwater pearl mussel SACs and one additional river system.

**River System Name:** River Lee

**OPW contact:** South Western Regional Office, Mungret

<b>Current activities</b>	Work was carried out along the River Lee at Inchigeelagh. This section of the river is not normally within the remit of OPW, however maintenance works were requested by the Irish Ministers as a response to a potential flood threat.  Works carried out by OPW included a two year work phase which involved a river clean and development of a flood path. These works have now been completed and comprised largely of vegetation and silt removal using bank-side plant with long-reach buckets.
<b>Future activities</b> <b>planned</b>	Works carried out on this section of the river were one off. There are no future works planned for this area as it is not currently included in the OPW remit.

**SAC Name:** River Bandon

**OPW contact:** South Western Regional Office, Mungret

<b>Current activities</b>	There is ongoing vegetation removal work on the banks of the River Bandon. There is no in-stream vegetation removal planned as the system is relatively self-regulating.  According to the map supplied by the OPW the channel works undertaken along this stretch of the river are located downstream from an <u>approximate</u> location of freshwater pearl mussel at Dunmanway. There has been a request received to carry out works upstream at Caha Bridge and Ardcahan Bridge to alleviate flooding in the area. Reports from the NPWS suggest that there are pearl mussels in the River Caha.  Silt removal activities have been undertaken in the River Bandon which includes the employ of a long reach excavator situated on the bank using a bucket to remove build up of silt.  Bank protection works have taken place on the Ovan River.
<b>Future activities</b> <b>planned</b>	There is a proposed flood relief scheme on the River Blackwater and possible works at Caha Bridge. These activities will include instream vegetation removal, from the bankside where possible, and embankment works.

**SAC Name:** River Nore and River Barrow

**OPW contact:** Eastern Regional Office, Trim

<b>Current activities</b>	There are no maintenance activities planned within the River Nore and River Barrow SAC in the 2007 works schedule.
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	The Killkenny Scheme, a drainage scheme carried out on the Nore and completed last year, included extensive in-channel works extending to the widening and deepening of the river, canalisation in several areas, the inclusion of a fish pass and the development of four weirs. All works were carried out downstream of known mussel populations.
<b>Future planned activities</b>	Although no works are planned for 2007, maintenance activities may be required in the future to ensure the efficacy of the Killkenny Scheme. Activities will include removing blockages for weirs using a boat and winch, silt removal using bank-side excavators with buckets and removal of instream vegetation.

**SAC Name:** River Shannon

**OPW contact:** South Western Regional Office, Mungret

<b>Current activities</b>	<p>Works planned for 2007 include the raising of embankments at Bunratty, Coonagh and Rineanna where tributaries of the Shannon flow. It is expected that materials in front of the current embankments will be excavated.</p> <p>There are no instream works planned for the River Fergus, however there are maintenance works occurring adjacent to the river which involve vegetation clearance within back drains that feed into sluices. The back drains are largely stagnant water bodies, unsuitable for pearl mussels. Vegetation is cleared from these using bank-side excavators with buckets, however OPW is currently investigating the efficacy of employing weed cutters in this type of activity.</p> <p>There were previous flood protection embankment works carried out along tidal areas of the river. Obvious silt build up was removed using an excavator with a bucket. Vegetation was removed from one side of the river only.</p> <p>Ongoing maintenance works include vegetation removal along the banks of the rivers within the Lower Shannon catchment. Other maintenance activities include silt removal and the raising of embankments as a method of flood defence. Previous works along the River Galey included removal of silt using a bank-side excavator with a bucket.</p> <p>Maintenance operations on the River Feale include bank protection works which involves drilling locally sourced wooden stakes 3-4m into the bank and back-filling with imported soils. These works are carried out utilising a vibrating pile driver which is located on the riverbank.</p>
<b>Future planned activities</b>	Ongoing maintenance operations every 5-6 years. There may be future silt removal on the River Galey.

**SAC Name:** Lough Corrib

**OPW contact:** Western Regional Office, Headford

<b>Current activities</b>	There are no works planned for the main channel of the Owenriff. It should be noted, however, that a single tree removal event was required close to a known pearl mussel population on the Owenriff at Oughterard after a large tree fell into the watercourse. Removal works were carried out under the guidance and supervision of NPWS.  Other works undertaken on channels within the SAC included vegetation removal, drain clearance and bridge maintenance.  Bales of straw are used to catch any silt moving downstream of any works.
<b>Future planned activities</b>	Ongoing maintenance activities to include weed cutting and vegetation removal from back-drains.

### 5.3 Duration and Timing of Maintenance Activities

The extent of interference from maintenance activities is dependent on the type and frequency of maintenance activities required. The duration and timing of drainage maintenance activities is dependent on what works are required and site specific characteristics.

As discussed in section 5.1, maintenance activities carried out by the OPW include scheme works, channel works, weed cutting, embankment works, and repairs to bridges and culverts. From the complex nature and different methodologies required to undertake these activities, it is clear that the duration and timing of works will vary. As discussed, the average channel requires maintenance every 4-6 years, channels with prolific weed growth may require annual maintenance, and some self cleaning channels only require maintenance every 20 years (OPW, 2007).

As with extent, 'duration', 'location' and 'timing' are factors which require formal consideration within the impact assessment. These factors have been addressed in further chapters of this report. The occurrence of a maintenance activity within an SAC may or may not be within an area where freshwater pearl mussels are present.

### 5.4 Impacts on Receptors

The term 'receptor' is used commonly throughout the EcIA process and is usually defined as an element in the environment affected by a development. The term 'impact' is also used commonly throughout the EcIA process and is usually defined as a change experienced by a receptor, in this case freshwater pearl mussel; impacts can be positive, neutral or negative. The term 'effect' is used commonly throughout the EcIA process and is usually defined as the consequences for the receptor of an impact.

An important aspect of an EcIA is also to highlight where positive impacts are predicted or are already being undertaken. As such, it is considered that the habitat creation and enhancement

associated with maintenance activities can have a potentially indirect positive impact on freshwater pearl mussels. Based on a sound understanding of the maintenance activities required on drainage channels, coupled with knowledge of freshwater pearl mussel ecology, the following impacts are predicted as a result of maintenance activities (Table 5.1):

**Table 5.1: The Potential Negative Impact of OPW Maintenance Activities on Freshwater Pearl Mussels.**

Maintenance activity	Potential impact if receptor present	Potential effects on receptor
Channel works: removal of instream vegetation	Mechanical weed cutting may result in a temporary release of silt	Silt may smother substrate habitat and/or kill juvenile & adult mussels; May remove habitat suitable for host fish;
Channel works: removal of silt by hydraulic excavators	Removal of silt may cause temporary release of silt to downstream areas	Presence of silt detrimental to mussels, so removal may be beneficial to mussels if downstream release of silt caused by works can be avoided;
Channel works: repair of eroded banks	Repair to banks may cause silt or soil to get washed downstream or it may stop or reduce input of eroded materials including silt to downstream areas. Operating machinery may cause temporary release of silt to downstream areas	Presence of silt detrimental to mussels, so repair of eroded banks may be beneficial to mussels if downstream release of silt caused by works can be avoided. However, this would depend upon the nature of the repair work as within stream works can kill mussels if present in work area;
Channel works: removal of riparian trees & vegetation	May cause release of soil/silt downstream and removes beneficial habitat	Degradation of riparian habitat may reduce suitability of in-stream habitat for host fish and mussels;
Embankment repairs	May impact on tidal/estuary reaches of river	Low, few pearl mussels present in tidal reaches of most rivers;
Bridge repairs	Localised river bed disturbance; Inert materials need to be used in repairs to avoid causing downstream toxic pollution	Would depend upon the nature of the repair work as within stream works, could potentially kill mussels
Ancillary structure repairs: sluice gates, tidal barrages and pumping stations	Localised river bed disturbance	Would depend upon the nature of the repair work as within stream works can kill mussels

## 6. EFFECTS OF THE MAINTENANCE OPERATIONS

### 6.1 Impact Assessment

This section of the report details an assessment of the impacts identified in section 5.4 above. This assessment has been based on IEEM guidance from the recently published Guidelines for Ecological Impact Assessment in the United Kingdom (2006). Although this text has not been prepared specifically for Ireland, it provides details of best practice and current thinking which relates directly to the assessment of flora and fauna in Ireland.

Please refer to Chapter 4 of these guidelines for further information regarding the assessment of ecological impacts.

#### 6.1.1 Direct habitat loss

Direct habitat loss describes the removal or destruction of any suitable substrate used by the freshwater pearl mussel.

With regard to the maintenance works undertaken by the OPW, there may be some loss of riparian habitat, which provides shading for freshwater pearl mussels. According to OPW, land reclamation activities which were once widespread, are no longer conducted as part of Drainage Maintenance operations and so are not considered a current threat, however some channels require bank protection/re-profiling which involves driving wooden stakes into the river channel and back-filling with infill material.

This loss of riparian habitat will be a **negative** impact on freshwater pearl mussel populations, the likelihood of which is **possible/probable**. The **magnitude** and **extent** of the impact is difficult to assess without population data for all sites, however it is likely that if direct habitat loss occurs it will affect the available habitat occupied by the freshwater pearl mussel, which will have ramifications on population dynamics throughout the SAC systems.

The **duration** of activities which lead to habitat loss, in terms of the actual activity, is generally limited and may only last a few hours to a few days. For larger catchments, several channels may be worked on throughout the year so consequently the cumulative duration of required activities is extended. Under these circumstances the resultant impact of the habitat loss will have a much longer duration, for example it may impact on the recruitment success of the freshwater pearl mussel which has lost a suitable host or substrate site as a result of activities.

If habitat loss occurs, it is considered to be **permanent** and **irreversible** due to the long timescales associated with maintenance activities.

As described above, the **frequency** of habitat loss is varied and intermittent.

It should also be considered that maintenance activities are already managed with ecological interests in mind, and have been adapted to address these features where possible. Other

maintenance activities carried out on OPW channels involve the removal of silt build-up which may have a **positive** impact on freshwater pearl mussel habitats. The removal of silt will help create spawning grounds for salmon (an important host for glochidia) and also potentially suitable habitat areas for the pearl mussel. It should be noted that OPW maintenance works have been designed to limit damage to banks and, as such, now operate from one bank only, thus leaving vegetation on the opposite bank intact.

Given that four of the sites studied were SACs and that freshwater pearl mussels are qualifying interests for each, it is assessed that direct habitat loss is of **moderate significance**.

It should be noted that any works that will directly disturb freshwater pearl mussel populations will require a licence under the European (Natural Habitat) Regulations (1997).

### 6.1.2 Severance

Severance describes the loss of connectivity between habitats, which ultimately results in the isolation of discrete populations of pearl mussels. Such isolation would result in an impact on the structure and function of a population.

Severance of freshwater pearl mussel populations would be caused by engineering works such as the installation and maintenance of weirs as this may impede the movement and velocity of the river, which could have a dramatic effect on the survival of freshwater pearl mussels. Another loss of connectivity between habitats for the freshwater pearl mussel could be the reduction in the movement of host fish for glochidia. However, new weirs or large impoundment structures have not been inserted into rivers by statutory Drainage Maintenance (Nathy Gilligan, OPW *pers. comm.* 2007) and so are considered to be **unlikely** impacts.

If severance occurs it will be a **negative** impact. **Magnitude** and **extent** are potentially widespread but difficult to assess without detail of the nature of the planned work. The **duration** of this impact would likely be long-term given that hard engineering structures will have long-term impacts on the velocity and flow of a river.

An assessment such as this should consider current practices. It notes that OPW do not carry out any maintenance work on rivers during the spawning season. Hard engineering works are not carried out on rivers that are known to contain populations of freshwater pearl mussels. Hard engineering structures, once created may cause **irreversible** damage to the freshwater pearl mussel habitat. It has consequently been assessed that severance is of **low significance** with regard to pearl mussels.

### 6.1.3 Loss of Life

Loss of life refers to death of freshwater pearl mussels attributable directly to the maintenance works.

With regard to OPW maintenance activities, loss of life would be likely to occur during the undertaking of maintenance works, operation of plant, and through improper design, construction and maintenance of small bridges and culverts.

Loss of life can occur due to a decrease in water quality caused by pollution from machinery fuel tanks that is being utilised within or close to the channel. As described in previous sections a decrease in water quality due to pollution would likely lead to either a toxic wash downstream or nutrient enrichment and an increase in algal blooms along the bed of the river, these blooms then have the potential to cover any downstream populations of freshwater pearl mussels which could then lead to their death.

Occasionally, materials used in construction and maintenance activities e.g. wet concrete around bridge supports, may wash into a river and cause toxic materials to wash downstream and kill either host fish for pearl mussels.

The use of heavy machinery in channels where pearl mussels are present would have a negative impact on the pearl mussel and also lead to their death.

Engineering staff located on Lough Corrib ensure that when maintenance activities are carried out there is adequate silt protection in place to ensure that silt is not carried downstream by the current and covers the river bed which may be a suitable habitat for the freshwater pearl mussel. Although silt defences are not placed on any of the other SACs. It should be noted that OPW activities are limited when dealing with channels that are known to contain freshwater pearl mussels.

If present, the loss of life would be a **negative** impact. Given that those populations potentially impacted by OPW maintenance activities are small, localised and not currently known to be recruiting, this potential impact may have a large **magnitude**. The **extent** of the impact would be widespread (potentially upon the whole population if downstream of a damaging activity), based on the assumption that maintenance will be undertaken on all river systems where pearl mussels have been identified.

Although the activity leading to the loss of life of an individual or population of pearl mussels may be of short duration, the overall **duration** of this potential impact would be long term due to the recruitment difficulties facing existing pearl mussel populations. Loss of life is also considered to be **irreversible** in terms of the structure and function of the population due to the long life-cycle and recruitment difficulties experienced by the species.

Consequently, loss of life has been assessed as being of **moderate-high significance**. This impact is considered to be **probable/possible**, largely dependent upon the location of the mussel population in relation to a planned maintenance activity.

#### **6.1.4 Habitat creation**

The maintenance activities, although potentially resulting in the negative impacts identified above, may also result in the improvement of habitats suitable for salmon and trout (hosts for

glochidia) and pearl mussels. The careful removal of silt and excessive weed growth can be potentially beneficial for host fish and pearl mussels. It should be noted that OPW are not aware of any locations where excessive weed growth coincides with *Margaritifera* habitat.

This is a **positive** impact with an **extent** and **magnitude** equivalent to the size of the area of the drainage network where work is carried out. It is also an impact of long-term **duration**. The continued management of these physical factors leads to a **probable** impact.

## 6.2 Site Integrity

The integrity of each SAC; River Nore and River Barrow, Lough Corrib, Lower River Shannon, River Bandon and River Lee, applies to the conservation features for each site (freshwater pearl mussel in this assessment). For the conservation objectives of the SAC to be met, the following ecological parameters must be considered: (i) population of the freshwater pearl mussel must remain as a viable component of the site; (ii) distribution of the pearl mussel must remain within the site; (iii) distribution and extent of habitats supporting pearl mussels must remain; (iv) the structure, function and supporting processes of habitats supporting the pearl mussel must remain; and (v) there must be no significant disturbance of the freshwater pearl mussel.

The impacts of OPW's activities in terms of (i) Habitat Loss, (ii) Severance, (iii) Loss of Life, (iv) Physical Disturbance, and (v) Habitat Creation must be considered against the conservation objectives above. Adoption of the mitigation measures outlined in Section 7 should ensure that integrity is not affected. However, failure to adopt the outlined mitigation measures means that site integrity cannot be guaranteed.



## 7. MITIGATION MEASURES

### 7.1 Avoidance Measures

Previous sections have identified that some maintenance activities undertaken by the OPW have a potentially significant (detrimental) impact on freshwater pearl mussel populations, whilst others may have potentially significant (beneficial) impacts on these populations. Crucial to this consideration is the location (presence/absence) of pearl mussels. If mussels are absent from an area (as they are from many parts of an SAC) then OPW's activities may not impact on pearl mussels whatsoever.

The habitat requirements of freshwater pearl mussels are well known and described in section 4.1.3. It should be noted that freshwater pearl mussels can and do occur in a variety of river habitats. The habitats used can vary from medium/high channel gradients, typified by upper river sections, through slower, meandering low gradient sections to the tidal and brackish reaches of some larger rivers. The potential presence of mussels in all these river reaches means that it is not usually possible to dismiss or discount an area as unsuitable and unlikely to contain pearl mussels. Certain habitat 'preferences' have been established e.g. positive relationships between mussel occurrence and stable, clean mixed sized substrates and broadleaved riparian woodland and negative relationships between mussel occurrence and muddy substrate and reed lined banks (Hastie *et al.* 2003b). These provide general guidance as to likelihood of mussel occurrence, but as river habitats are not generally homogenous, changes in habitat suitability can rapidly occur, sometimes confounding expectations.

#### 7.1.1 Direct habitat loss

Mitigation to avoid direct pearl mussel habitat loss includes:

- Training of front-line staff in the identification of suitable freshwater pearl mussel habitats, or the use of professional specialists, in all potentially suitable reaches at applicable sites. Surveys ahead of proposed work areas should be undertaken ca. two weeks prior to work commencing to assess the need for disturbance licences if avoidance is impossible, and to ensure that freshwater pearl mussel surveys are conducted during periods of suitable weather when it is considered safe. If surveys are carried out after a period of heavy rain and during high water levels, pearl mussels may not be visible and surveyors may inadvertently produce 'false-negative' searches, potentially leaving freshwater pearl mussel populations vulnerable and operators inadvertently open to legal challenge;
- Prior to embankment protection works being undertaken the area should be surveyed to ensure that there are no freshwater pearl mussels present that may be affected by these works;
- Species and/or habitat surveys should be conducted following maintenance activities, where appropriate, to investigate the effects on any freshwater pearl mussel present in the vicinity of the works. This practice would allow for the testing of mitigation measures and for new protocols to be developed where necessary;

- Adhere, develop and regularly assess the EDM Work Practices (developed by OPW and detailed below). For direct habitat loss this specifically refers to EDM steps 1, 2, 4 and 5, as described in section 7.2.;
- Where possible, mature trees within the river corridor near pearl mussels should be retained. Similarly, suitable substrate should be retained where possible;
- Silt protection measures should be put in place to help prevent habitats becoming sub-optimal. In back-drains and minor tributaries, straw bales can be used to prevent silt being washed in to pearl mussel rivers. It should be borne in mind that even small quantities of silt can impact on downstream or adjacent pearl mussel populations;
- No works should be undertaken in known freshwater pearl mussel locations without contacting relevant NPWS staff, and all site workers should be made aware of the site's sensitivity and the impacts that the maintenance works may have;
- No use of heavy plant equipment in the channel where mussels are present; and
- Regular communication should be maintained with NPWS with whom survey data should be shared. Regular contact with NPWS rangers will ensure the requirements of pearl mussels and all interested parties are being met.

### **7.1.2 Severance**

Mitigation to avoid severance includes:

- Training of front-line staff in the identification of suitable freshwater pearl mussel habitats, or the use of specially trained consultants, in all potentially suitable reaches at applicable sites. Surveys ahead of proposed work areas should be undertaken ca. two weeks prior to work commencing to assess the need for disturbance licences and to ensure that pearl mussel surveys are conducted during periods of suitable weather when it is considered safe. If surveys are carried out after a period of heavy rain and during high water levels, pearl mussels may not be visible and surveyors may inadvertently produce 'false-negative' searches, potentially leaving the freshwater pearl mussel in harm's way and operators inadvertently open to legal challenge;
- Adhere, develop and regularly assess the EDM Work Practices (developed by OPW and detailed below). For severance this specifically refers to EDM steps 1, 2, 3 and 4 as described in section 7.2.;
- Where possible, mature trees within the river corridor near pearl mussels should be retained. Similarly, suitable substrate should be retained where possible; and
- Regular communication should be maintained with the relevant nature conservation organisations, fisheries boards and countryside ranger teams who should review the annual works programme.

### **7.1.3 Loss of life**

Mitigation to avoid loss of life includes:

- Training of front-line staff in the identification of suitable freshwater pearl mussel habitats, or use specially trained professional consultants, in all potentially suitable reaches at applicable sites. Surveys ahead of proposed work areas should be

undertaken ca. two weeks prior to work commencing to assess the need for disturbance licences and to ensure that freshwater pearl mussel surveys are conducted during periods of suitable weather when it is considered safe to undertake the surveys. If surveys are carried out after a period of heavy rain and during high water levels, pearl mussels will not be visible and surveyors may inadvertently produce 'false-negative' searches, potentially leaving freshwater pearl mussels in harms way and operators inadvertently open to legal challenge.

- Adhere, develop and regularly assess the EDM Work Practices (developed by OPW and detailed below). For loss of life this specifically refers to EDM step 4, as described in section 7.2.;
- No use of heavy plant equipment in the channel with ruptured tank protocols established;
- Regular communication should be maintained with the relevant nature conservation organisations, fisheries boards and countryside ranger teams who should review the annual works programme; and
- For future design, construction and maintenance of small bridges and culverts refer to the Design Manual for Roads and Bridges (DMRB)<sup>1</sup>. This manual sets out key issues relating to best practice engineering methods with regards to limit ecological impacts.

It is considered that following those mitigation measures relating to silt control will be the most effective means of safeguarding pearl mussels during maintenance activities. The removal of silt as a standard maintenance activity is beneficial to pearl mussels, however this positive impact may be confounded by the release of silts into water bodies where it may smother sensitive mussel populations. It is recommended that OPW analyses and where possible improve their silt control measures as part of the ongoing development of the EDM.

## **7.2 Influence of EDM Work Practices**

The EDM Work Practices were produced in July 2003 to ensure that the general environment is protected during maintenance activities.

An important feature of these Work Practices was the production of a Guidance Note, issued to all ground staff. The Guidance Note details "10 Steps to Environmentally Friendly Maintenance". Six of these steps significantly lessen the potential impacts of maintenance activities on the freshwater pearl mussel.

These include:

1. Protect bank slopes (retain vegetation on non working bank and minimise scraping of bank slope on working bank) - this will ensure that riparian habitat is permanently available for host fish, thus providing potential breeding and sheltering opportunities;
2. Deposit spoil on bank full (maximise spoil deposition on bank full or spoil heaps and minimise spoil deposition on bank slopes) – spoil should not re-enter water body as this will potentially damage habitats for pearl mussels;

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<sup>1</sup> Design manual for roads and bridges (DMRB). Volume 10, Section 4 Environmental Design and Management Nature Conservation. Part 4 ha81/99 Nature conservation advice in relation to Otters.

3. Leave section untouched (if channel capacity is not affected, then leave intact and only maintain if environmental works are required) - this will ensure that unnecessary impacts are avoided, and overall potential impacts on freshwater pearl mussels will be minimised;
4. Management of trees (leave intact if no reduction in channel capacity is caused, remove overhanging branches to flood level and use a saw or secateurs for removal, not an excavator) – any removal of overhanging branches may prove detrimental to pearl mussels, thus in areas where pearl mussels have been confirmed, overhanging branches should be left intact unless they pose a health and safety risk;
5. Replace boulders (reinstate boulders and gravels as removed by maintenance operations, reinstate boulders into channel from spoil heaps, and place boulders below low flow level and staggered) – the removal of instream habitat from pearl mussel areas may result in the death of pearl mussels and has associated legal implications. No stable substratum should be removed from pearl mussel sections of rivers in SACs; and
6. Steps to enhance fisheries (but not necessarily fish populations) e.g. loosen bed gravels and if channel bed is composed of suitable material, excavate pools and create riffles, may result in loss of life, if pearl mussels are present. As such, instream habitat creation should not be undertaken in pearl mussel areas. Furthermore, works involving habitat creation should ensure sufficient sediment control is in place.

### **7.3 Specific Extra Mitigation Measures Identified**

It is important that prior to any channel maintenance works in pearl mussel rivers, surveys are carried out on the main stem of the channel and downstream for the presence of freshwater pearl mussels, and any populations of these found should be dealt with appropriately, to stay within the obligations of relevant legislation (as described in preceding sections).

**Figure 7.3 A healthy freshwater pearl mussel population profile showing a variety of age sizes © Peter Cosgrove**



Where a freshwater pearl mussel habitat is identified by a suitably trained surveyor, work should not commence until NPWS have been consulted for advice on the requirement for a licence to proceed. The most important factor potentially detrimentally affecting freshwater pearl mussels as a result of OPW maintenance operations is the transport of silt down river. Mitigation must be put in place to ensure that silt is not released and carried downstream where it may affect freshwater pearl mussel populations. The removal of silt build-up ensures that there are suitable spawning grounds for salmon, with potential benefits to host fish populations.

## **7.4 Opportunities for Enhancement or Compensatory Measures**

This section deals with measures, which may be undertaken as part of a habitat enhancement scheme, to increase the value of the drainage network for biodiversity and specifically for freshwater pearl mussels.

### ***7.4.1 Plant bank side trees and scrub***

These are an important feature and they provide shelter for host fish. They also significantly add to the availability of invertebrate prey for fish populations, which in turn will be of benefit to freshwater pearl mussels.

### ***7.4.2 Create buffer zones and margins***

These will protect river banks against erosion, by binding the soil with plant and tree roots, reduce land run-off by increasing infiltration, trap sediment, absorb nutrients, improve fisheries and diversify the river corridor.

### ***7.4.3 Block any drains***

Block any artificial drains found to be depositing silt into pearl mussel rivers.

### ***7.4.4 Site monitoring, surveillance and protection***

OPW staff can look out for pearl mussels and threats, such as pearl fishing signs and pass information on to NPWS. This would be a powerful addition to general conservation efforts as many OPW staff are working on rivers across Ireland (not just SAC sites). OPW staff could easily become valued protectors of pearl mussels if given the right training and advice, perhaps through NPWS. For example, it is suggested that all OPW field staff should be aware of what live and dead pearl mussel shells look like (Figures 7.4.4 i and 7.4.4 ii) and the where and who to report such sightings. The threats posed by pollution and pearl fishing can only be tackled effectively if incidents are reported to the appropriate authorities quickly and OPW field staff are in a unique to do this.

**Figure 7.4.4 i) Live freshwater pearl mussels in situ amongst mixed stable substrate**  
Photo © EnviroCentre



**Figure 7.4.4 ii) Illegal pearl fishing kill.** The numbers killed can vary from tens to hundreds.  
© Peter Cosgrove



## 8. CONCLUSION AND SUMMARY

### 8.1 Level of Significance of the Likely Impact

The level of significance of the likely impacts is presented in Table 8.1 below. With reference to Table 8.1 it is clear that the main impacts addressed in this assessment can be mitigated to reduce their significance. Following the successful implementation of mitigation and enhancement, it is predicted that the potential impact significance will range from a **moderate – high significant negative impact** to a **significant positive impact**.

Crucial to understanding, interpreting and attributing value to significance is the likely probability of an impact occurring and its subsequent effect. Actual freshwater pearl mussel loss of life and habitat loss within an SAC related to OPW activities would necessarily have to be considered of moderate or moderate-high significance (depending on the scale of effect). However, OPW are not planning to kill or harm mussels or damage their habitat in any way within SACs, so the likelihood or probability of this occurring is considered low if OPW carry out their activities in ways which avoid harming mussels (e.g. follow the suggested mitigation measures outlined in this report).

There are many potential impacts discussed within this report and these have been assessed individually and vary considerably. The conclusions summarise this range of assessment values from potentially '*moderate-high significant impacts*' (e.g. if OPW kill mussels or damage mussel habitat) to '*significant positive impacts*' (if OPW implement all suggested mitigation measures). This does not mean that both significant negative and positive impacts will necessarily occur, merely that a range of possible scenarios exist which could occur. At the assessment stage the assessors do not know how the planned activities will actually be implemented. Thus, it is not possible to give a degree of certainty to the assessment of potential significant impact. The ideal 'residual significance' would be for all OPW activities to be beneficial and for OPW to become champions for the species across Ireland. It is the assessors understanding, that OPW will strive to achieve this positive residual significance through their future work programmes and efforts.

### 8.2 Likely Success of Proposed Mitigating and Enhancement Measures

The proposed mitigation measures described in previous sections of this report will provide pragmatic and realistic means by which the negative impacts of drainage maintenance activities can be reduced and the positive impacts enhanced.

OPW has shown considerable commitment to the environment through the creation of its environmental team and the production of the EDM guidelines. This commitment, coupled with the mitigation and enhancement opportunities provided in this document, is likely to lead to successful management for freshwater pearl mussels along Ireland's drainage channels. New opportunities have been identified for OPW staff to become effective protectors and champions for the pearl mussel across Ireland.



### **8.3 Information Relevant to Future Biodiversity and Heritage Impact Assessments**

The information provided in this report bears relevance not only to freshwater pearl mussels, but should be considered as a part of a wider biodiversity issue. Freshwater pearl mussels are a keystone species which means they provide a significant role in the aquatic ecosystem across Ireland, not just in designated sites.

Any future impact assessments should consider not only the species or habitat they address, but also how these features relate to and affect other ecological interests. For example, an important aspect of freshwater pearl mussel ecology is the species' habitat requirements, which relates directly to appropriate fisheries management interests.

It is recommended, therefore, that any further assessments, and the consequent mitigation measures undertaken, are not prepared in isolation but pay due regard to other relevant ecological impact assessments.



**Table 8.1: Potential Impacts, Mitigation and Residual Significance**

Description of Feature	Proposed OPW Activity	Characterisation of unmitigated impact on the feature	Mitigation	Residual significance
<b>Direct Habitat Loss</b>				
Freshwater pearl mussel.	(1) Clearance of riparian vegetation including scrub vegetation and mature trees. (2) Embankment and in-channel works e.g. removal of silt. (3) Bank protection/re-profiling including stake-driving and back-filling.	<p><b>Negative Impact.</b></p> <p><b>Magnitude and Extent</b> – All areas maintained and complete loss of habitat.</p> <p><b>Duration</b> – Short term disturbance with long term implications for freshwater pearl mussel habitat.</p> <p><b>Reversibility</b> – Permanent loss of habitat</p> <p><b>Frequency</b> – Intermittent.</p> <p><b>Likelihood</b> – Possible/probable if mussels present</p>	<p>Training of front-line staff or use specially trained professional consultants to properly survey ahead of scheduled work.</p> <p>Conduct surveys post maintenance activities (site use and recovery period).</p> <p>Adhere, develop and regularly assess EDM work practices.</p> <p>No works to be undertaken in pearl mussel locations without prior notification of NPWS.</p> <p>Rigorous silt control measures to be designed and implemented.</p> <p>Retain mature trees and suitable substrate.</p> <p>No use of heavy plant equipment in-stream.</p> <p>Maintain regular communication with relevant nature conservation organisations, fisheries boards and rangers.</p>	<b>Moderate significant negative impact</b>

Description of Feature	Proposed Activity	Characterisation of unmitigated impact on the feature	Mitigation	Residual significance
<b>Severance</b>				
Freshwater pearl mussel.	Destruction of connectivity between suitable habitats through: (1) Engineering works resulting in damaged or sub-optimal substrata.	<p><b>Negative Impact.</b></p> <p><b>Magnitude and Extent</b> – Low with all areas maintained potentially suffering from some loss of connectivity.</p> <p><b>Duration</b> – Long term.</p> <p><b>Reversibility</b> – Irreversible</p> <p><b>Likelihood</b> – Unlikely even if mussels present</p>	<p>Training of front-line staff or use specially trained professional consultants to properly survey ahead of scheduled work.</p> <p>Adhere, develop and regularly assess EDM work practices.</p> <p>Retain mature trees and suitable substrate.</p> <p>Maintain regular communication with relevant nature conservation organisations, fisheries boards and rangers.</p>	<b>Low significant negative impact</b>

Description of Feature	Proposed Activity	Characterisation of unmitigated impact on the feature	Mitigation	Residual significance
<b>Loss of life</b>				
Freshwater pearl mussel.	(1) Point source pollution caused by ruptured or leaking fuel tanks. (2) Presence of plant machinery in the river channel. (3) Release of silt into the river channel. (4) Potentially toxic materials used in construction and maintenance activities (5) Physical removal	<p><b>Negative Impact.</b></p> <p><b>Magnitude and Extent</b> – Large magnitude with widespread extent.</p> <p><b>Duration</b> – Long term implications for breeding success of species.</p> <p><b>Reversibility</b> – Irreversible.</p> <p><b>Likelihood</b> – Likely if mussels present downstream of pollution event</p>	<p>Training of front-line staff or use specially trained professional consultants to properly survey ahead of scheduled work.</p> <p>Adhere, develop and regularly assess EDM work practices.</p> <p>No use of heavy plant equipment in the river channel with ruptured tank protocols in place.</p> <p>Maintain regular communication with relevant nature conservation organisations, fisheries boards and rangers.</p> <p>For future design, construction and maintenance of small bridges and culverts refer to the DMRB.</p>	<b>Moderate-high significant negative impact.</b>

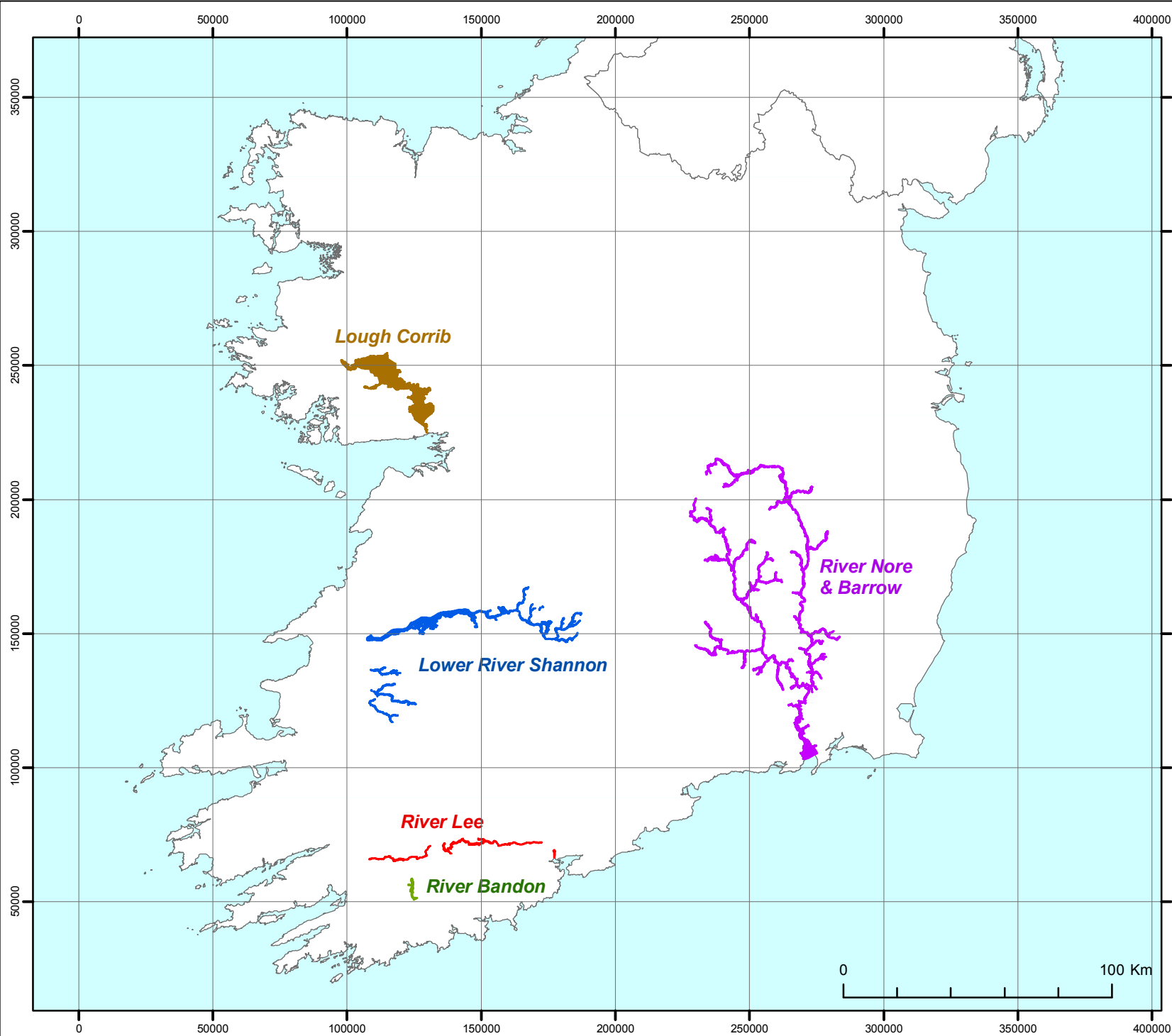
Description of Feature	Proposed Activity	Characterisation of unmitigated impact on the feature	Mitigation	Residual significance
<b>Habitat creation</b>				
Freshwater pearl mussel.	(1) Maintenance of waterways and habitat suitable for freshwater pearl mussel and host fish. (2) Removal of silt build-up.	<b>Positive Impact.</b>  <b>Magnitude and Extent</b> – All areas require maintenance where freshwater pearl mussels are known to be present.  <b>Duration</b> – Long term.  <b>Likelihood</b> – Likely if mussels present	n/a	<b>Significant positive impact.</b>

Description of Feature	Proposed Activity	Characterisation of unmitigated impact on the feature	Mitigation	Residual significance
<i>Enhanced mitigation measures</i>				
Freshwater pearl mussel	(1) Plant bankside trees (2) Create buffer zones and margins (3) Block drains (4) Site monitoring, surveillance and protections	<p><b>Positive Impact.</b></p> <p><b>Magnitude and Extent</b> – Targeted areas where freshwater pearl mussels are known to be present.</p> <p><b>Duration</b> – Long term.</p> <p><b>Likelihood</b> – Likely if mussels present</p>	<p>Target denuded areas of river bank with pearl mussels for enhanced riparian planting</p> <p>Encourage management measures that will reduce erosion and run-off</p> <p>Block drains that are emptying silt into rivers</p> <p>Staff training and awareness raising to know what to look for in terms of live and dead pearl mussel shells, evidence of pollution events and pearl fishing kills. Ensure all staff know how and who to report information to in NPWS</p>	<b>Significant positive impact.</b>

## **Appendix A – Maps**


## **Map 1:**


# **Relevant SACs and River System Locations**





Notes


Legend

 River Bandon SAC

 River Nore & Barrow SAC


 River Lee

 Lower River Shannon SAC

 Lough Corrib SAC

Do not scale this drawing

Rev	Date	Amendment	Initial
Status			
Client			
OPW			
Project			
OPW FWPM			
Title			
SACs and River Systems			
Drawing No.			Revision
20409j/Appendix A Map 1			
Scale at A4		Date	
1:2,000,000		14/11/07	
Drawn	Checked	Approved	
SBW			



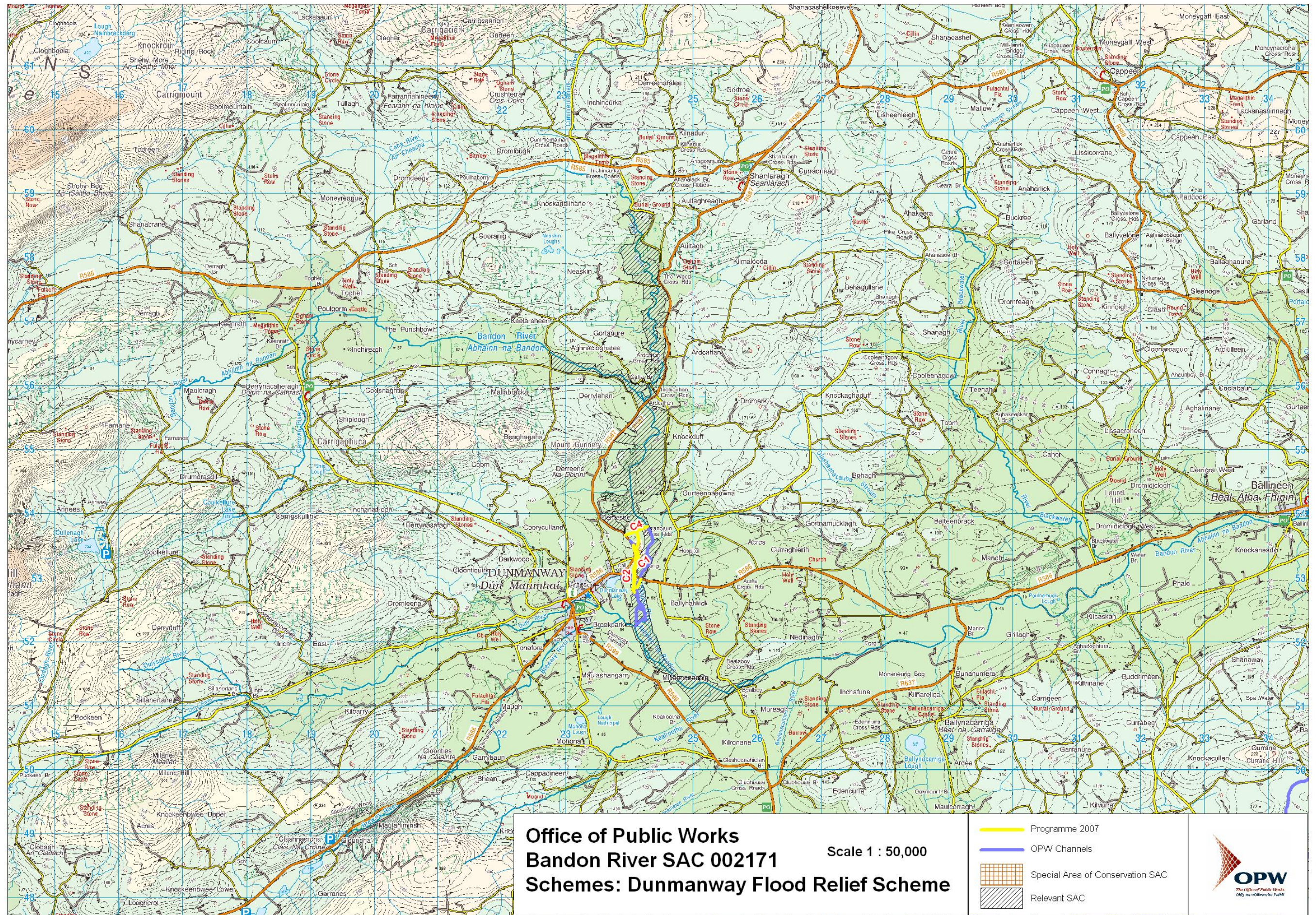
Craighall Business Park  
Eagle St.  
Glasgow  
G4 9XA  
Tel: 0141 341 5040  
Fax: 0141 341 5045



## **Map 2:**

# **River Bandon SAC Boundary and OPW Scheme Channels**



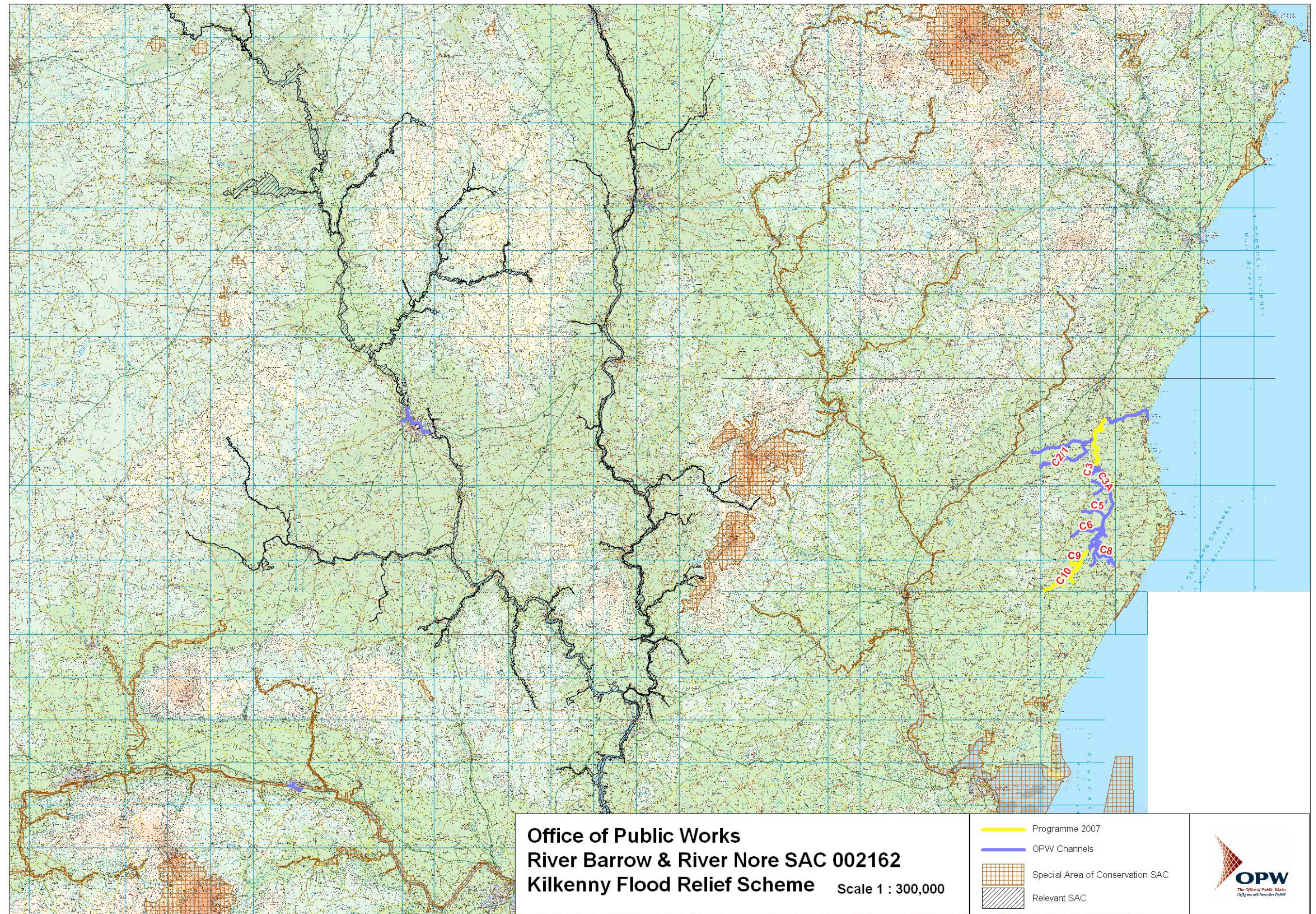




## **Map 3:**

# **River Nore and River Barrow SAC Boundary and OPW Scheme Channels**



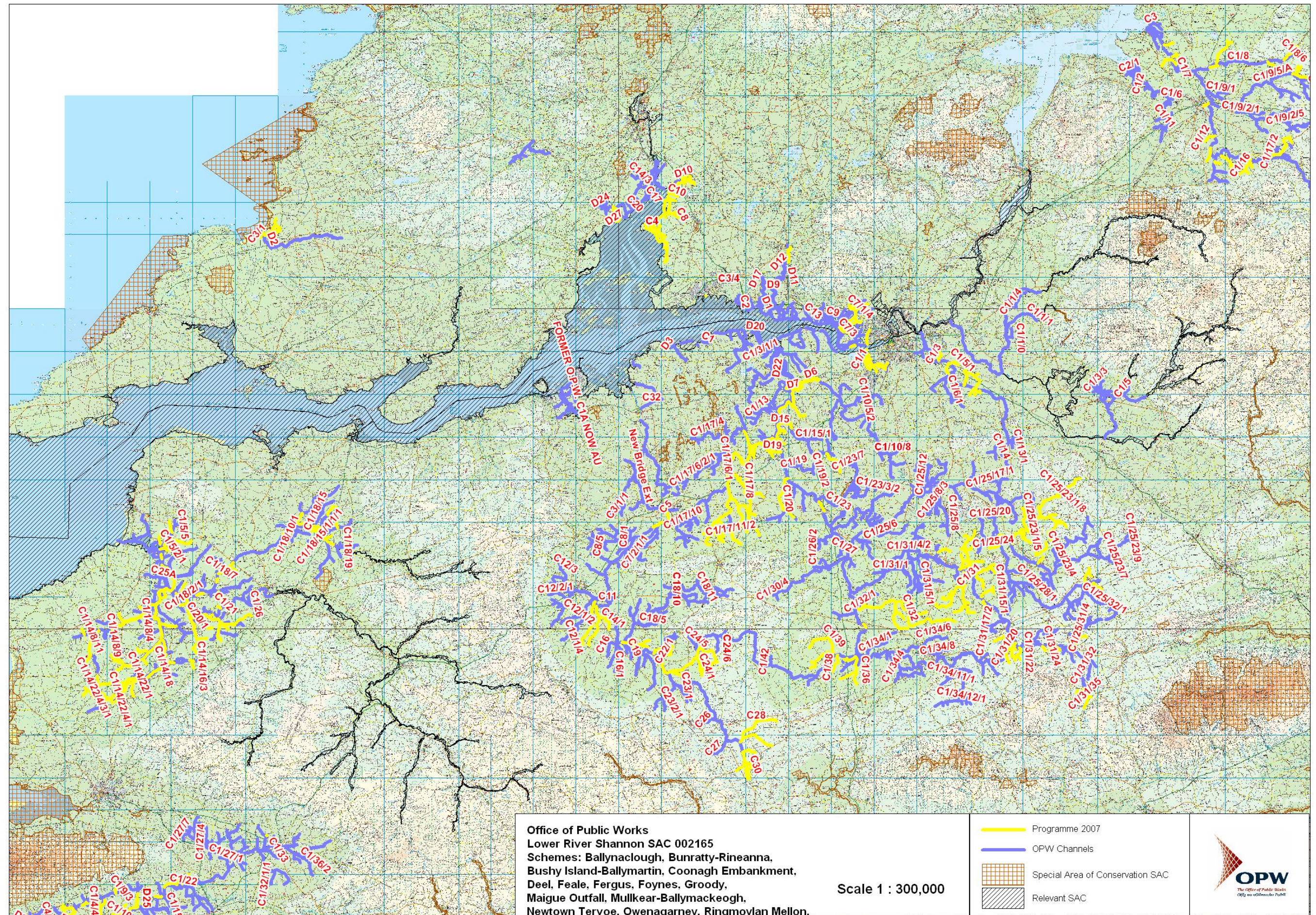




## **Map 4:**

# **Lower River Shannon SAC Boundary and OPW Scheme Channels**



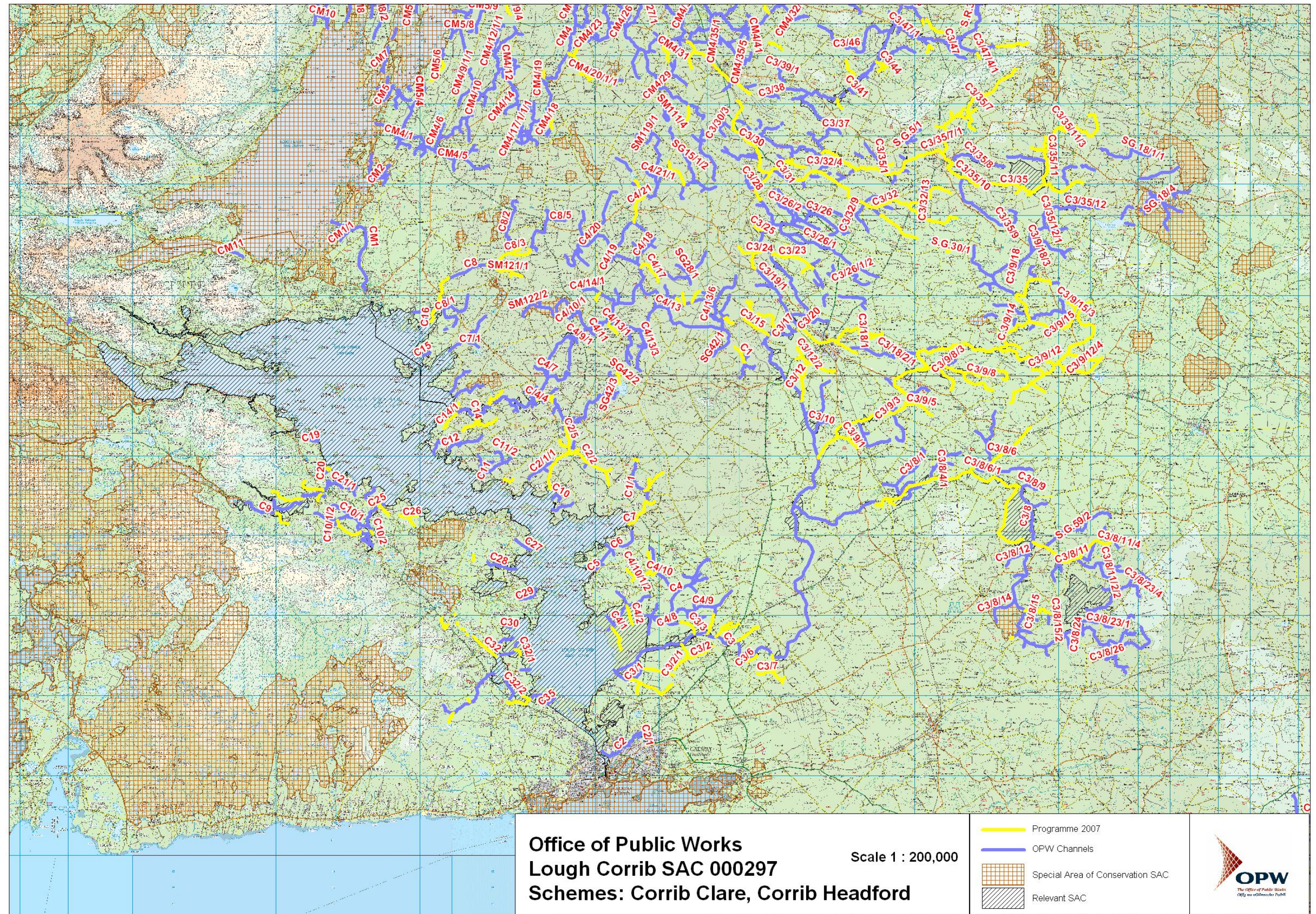




## **Map 5:**

# **Lough Corrib SAC Boundary and OPW Scheme Channels**







## **Map 6:**

### **Location of Works on the River Lee**







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## PLATES



Photograph 1: Photograph showing equipment used for vegetation clearance along OPW channels. The long reach arm ensures that works take place on one side of the bank only, minimising disturbance and habitat destruction.



Photograph 2: Photograph showing bank protection methods incorporated along OPW channels. Stakes are driven into the bank to ensure protection against erosion.





Photograph 3: Photograph showing a section along the Bandon River. A programme of works was scheduled for 2007 along this river. This picture shows suitable habitat for Freshwater Pearl Mussels.



Photograph 4: Photograph showing a channel section on the Owenriff River. This river is known to have an established population of Freshwater Pearl Mussels. Note the high incidence of algal bloom caused by point source pollution of unknown origin. Pollution causes the bed of the river to become covered by algae, subsequently causing a high mortality rate among the Mussel population.

## CONTACT INFORMATION

Individuals contacted for background information on baseline pearl mussel survey data or OPW operational activities

Contact	Date
<b>NPWS</b>	
Aine O'Connor	July 2007
Julie Fossitt	July 2007 (no response)
<b>OWP</b>	
Mark Noonan	August-Sept 2007
Noel Fitzpatrick	August-Sept 2007
Charlie O'Sullivan	August-Sept 2007
John Murphy	August-Sept 2007
<b>Independent consultant</b>	
Evelyn Moorekens	August 2007