



# **Arterial Drainage Maintenance & High Risk Channel Designation**

**Programme 2011 – 2015**

**Environment Section  
Engineering Services  
Office of Public Works**

**December 2012**

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### **1. Introduction**

There is no statutory requirement under the Arterial Drainage Acts 1945 & 1995, for the production of a “Plan or Programme”, for Arterial Drainage Maintenance. Following Strategic Environmental Assessment (SEA) screening consultations with the Environmental Protection Agency (EPA), it was deemed appropriate for an SEA to be carried out, as Arterial Drainage Maintenance is an ongoing activity in the State. This Programme has been produced to facilitate the SEA process.

Where the Commissioners of Public Works have completed a drainage scheme under the Arterial Drainage Acts, 1945 and 1995, there is a statutory requirement to maintain the drainage works forming part of the Scheme. These drainage works include watercourses, embankments and other structures. Watercourses are subject to siltation and erosion, among other processes, while embankments are subject to settlement and erosion. Ongoing maintenance activities are of a cyclic nature which are to maintain the channel at a certain outfall datum and conveyance capacity by means of repetitive works. An annual programme of maintenance is compiled to maintain the drainage works which are prioritised based on the rate of deterioration and the risk arising. In any one year, approximately one-fifth of watercourses are maintained.

This Programme covers two sets of activities:

1. Arterial Drainage Maintenance
2. High Risk Channel Designation.

#### **1.1 Timescale**

The 2011 – 2015 timescale has been adopted to facilitate future more effective coordination with the River Basin Management Plans (RBMP) and Catchment Flood Risk Assessment and Management Studies (CFRAMS). Both these plans will be reviewed in 2015 in accordance with the Water Framework Directive (WFD) and Flood Directives respectively, and with both sets of plans being managed at an River Basin District (RBD) scale.

#### **1.2 Arterial Drainage Maintenance**

##### **1.2.1 Arterial Drainage Schemes**

The Office of Public Works is the body through which Central Government exercises its statutory responsibilities in respect of river drainage and flood relief. It derives its statutory authority from the Arterial Drainage Acts, 1945 and 1995 and the European Communities (Assessments and Management of Flood Risk) Regulations 2010.

**Table 1** OPW Schemes carried out under Arterial Drainage Acts 1945 & 1995

Scheme	Duration of Works	Areas Benefiting (hectares)
<b>Major Schemes (River Catchments over 100,000 acres in extent)</b>		
Brosna	1948 - 1955	34883
Glyde & Dee	1950 - 1957	10643
Feale	1951 - 1959	10724
Corrib-Clare	1954 - 1964	30310
Maine	1959 - 1963	4694
Inny	1960 - 1968	20234
Deel	1962 - 1968	4816
Moy	1960 - 1971	24685
Corrib-Headford	1967 - 1973	7851
Boyne	1969 - 1986	48157
Maigue	1973 - 1986	12343
Corrib-Mask-Robe	1979 - 1986	9712
Boyle	1982 - 1992	10845
Blackwater (Monaghan)	1984 - 1992	2367
<b>Minor Schemes (River Catchments 25,000 – 1000,000 acres)</b>		
Nenagh	1955 - 1960	2630
Ballyteige/Kilmore	1959 - 1961	931
Broadmeadow & Ward	1961 - 1964	2995
Killimor/Cappagh	1962 - 1968	5099
Bonet	1982 - 1992	1295
<b>Other Small Schemes (River Catchments less than 25,000 acres)</b>		
Clareen	1959 - 1961	445
Ouvane	1962 - 1963	162
Matt	1964 - 1965	202
Duff	1963 - 1965	1457
Brickey	1965 - 1967	405
Abbey	1964 - 1967	364
Knockcroghery	1967 - 1968	202
Creegh	1968 - 1969	405
Burnfoot/Skeoge	1968 - 1970	162

Kilcoo	1969 - 1971	162
Owenavorrach	1968 - 1970	1052
Carrigahorig	1968 - 1971	1538
Groody	1970 - 1973	1214
Deel and Swillyburn	1957 - 1961	1416
Cloonburn	1967 - 1968	162
<b>Estuarine Embankment Schemes</b>		
Shannon (Limerick)	1962 - 1971	4897
Shannon (Clare)	1958 - 1960	728
Fergus	1959 - 1963	2185
Owenogarney	1955 - 1959	850
Swilly etc.	1961 - 1968	1295
<b>Flood Relief Schemes</b>		<b>Completion Date</b>
Belclare, Clare River		1995
Bridge End, Co. Donegal		2000
Mulkear River, Cappaghmore, Co. Limerick		2000
Suir River, Carrick-on-Suir		2003
Lacken (Ardrahan), Co. Galway		1997
Nanny River, Duleek, Co. Meath		1998
Bandon River, Dunmanway, Co. Cork		2001
Gort Town, Co. Galway		1997
Shinkeen Stream, Hazelhatch, Co. Kildare		2001
River, Nore, Kilkenny		2006
Maam Valley, Co. Galway		2001
Mulkear River, Newport, Co. Tipperary		1998
Sixmilebridge, Co. Clare		1997

### 1.2.2 OPW's Roles and Responsibilities in Arterial Drainage Maintenance

Under Section 37 of the Arterial Drainage Act 1945, the OPW is statutorily obliged to maintain all rivers, embankments and urban flood defences on which it has executed works since the 1945 Act (**Table 1**) in “proper repair and effective condition”.

Maintenance referred to under the Arterial Drainage Act 1945 includes:

- The maintenance of river channels in a condition that ensures they are free-flowing, thus reducing flood risk and providing adequate outfall for land drainage.

- ii. The maintenance of river and coastal embankments, in a condition that protects benefiting lands to the extent defined in the Scheme, from risk of flooding.
- iii. The maintenance, repair and/or replacement of all structures forming part of a Scheme, including accommodation bridges, weirs, sluice barrages, sluices, pumping stations and tidal flap gates.

The Act uses the terms “*proper repair and effective condition*”. The performance criteria relate to the design standard of the original Scheme works, its condition and performance of the various watercourses, embankments etc.

Failure to comply with these obligations would be contrary to the Drainage Acts and could lead to a “writ of mandamus” or an award of compensation arising from claims for damage to the benefiting lands. All of the completed Arterial Drainage and Estuarine Embankment Schemes are now maintained under the statutory obligation.

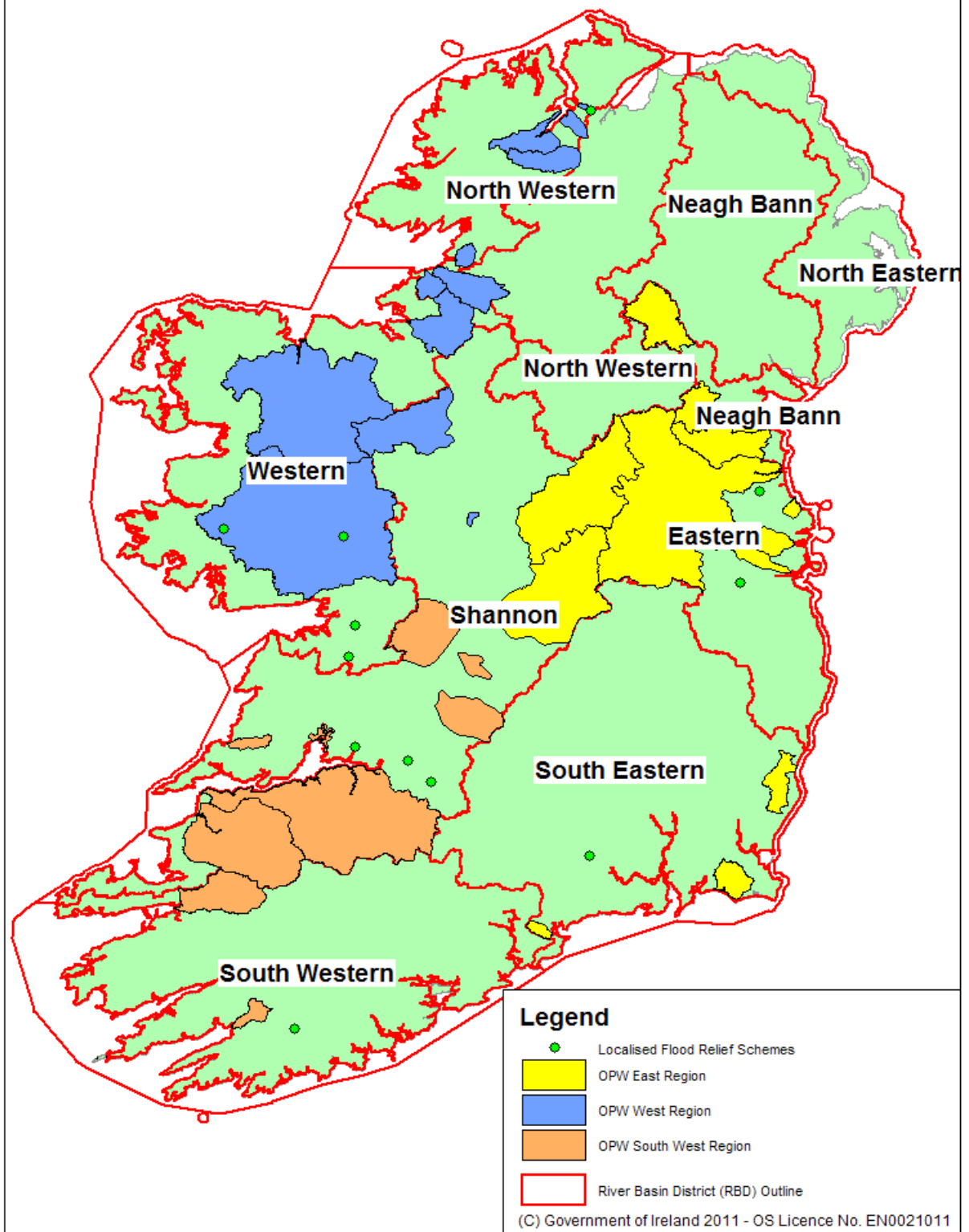
### 1.2.3 Extent of Operations

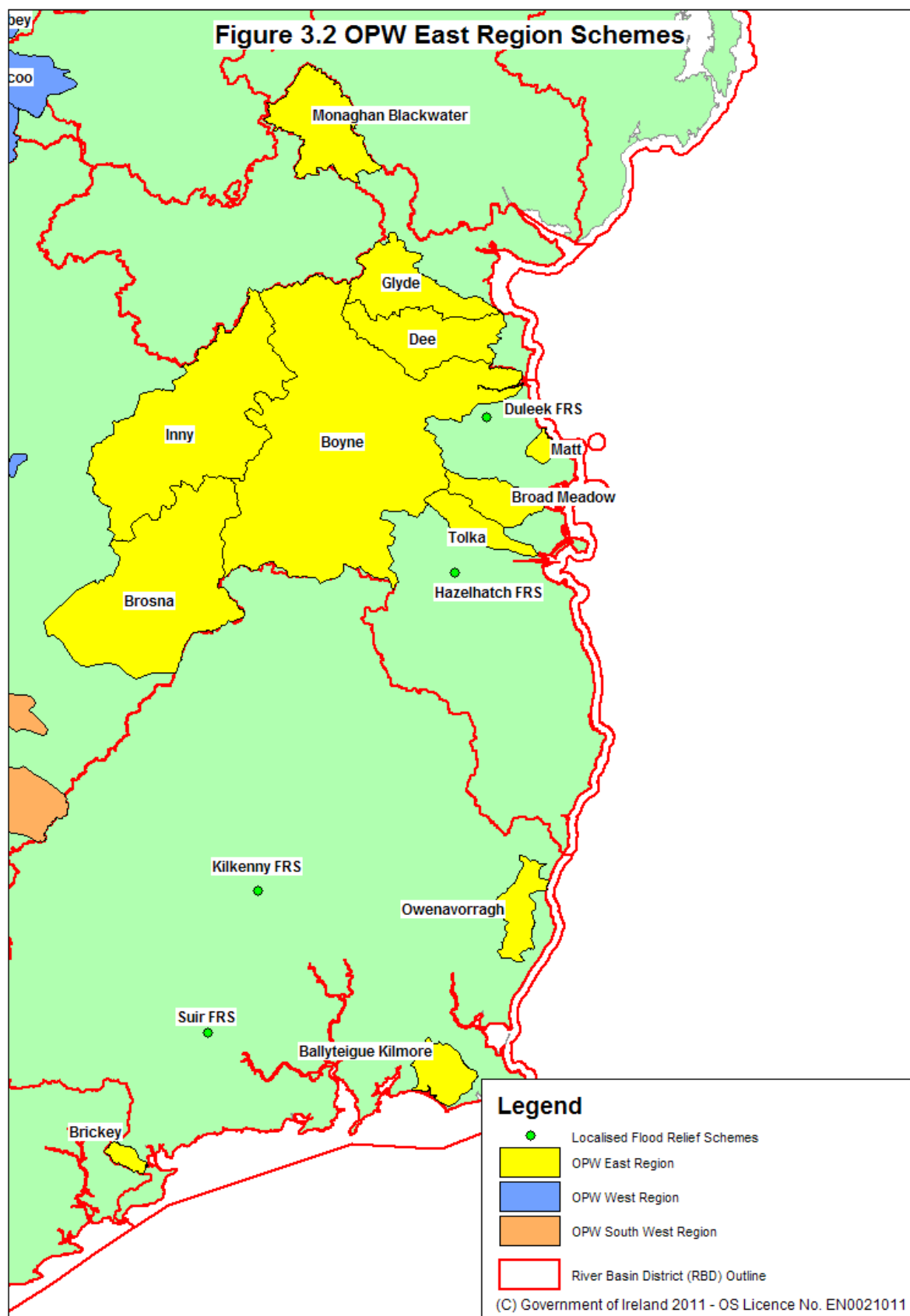
OPW Head Office is based in Trim, Co Meath. The maintenance function is divided into three regions for the purpose of programming and executing the work, **Table 2**. Each region has a main regional office with at least one sub office. The annual maintenance budget is circa €17 Million. The OPW maintain their own transport and excavator fleet and other specialised equipment such as weed cutting boats. The operations are carried out by a trained direct labour work force numbering circa 300. OPW direct labour staff uses a fleet of approximately seventy hydraulic excavators nationwide to execute the maintenance programme.

**Table 2** OPW Drainage Maintenance Office Locations

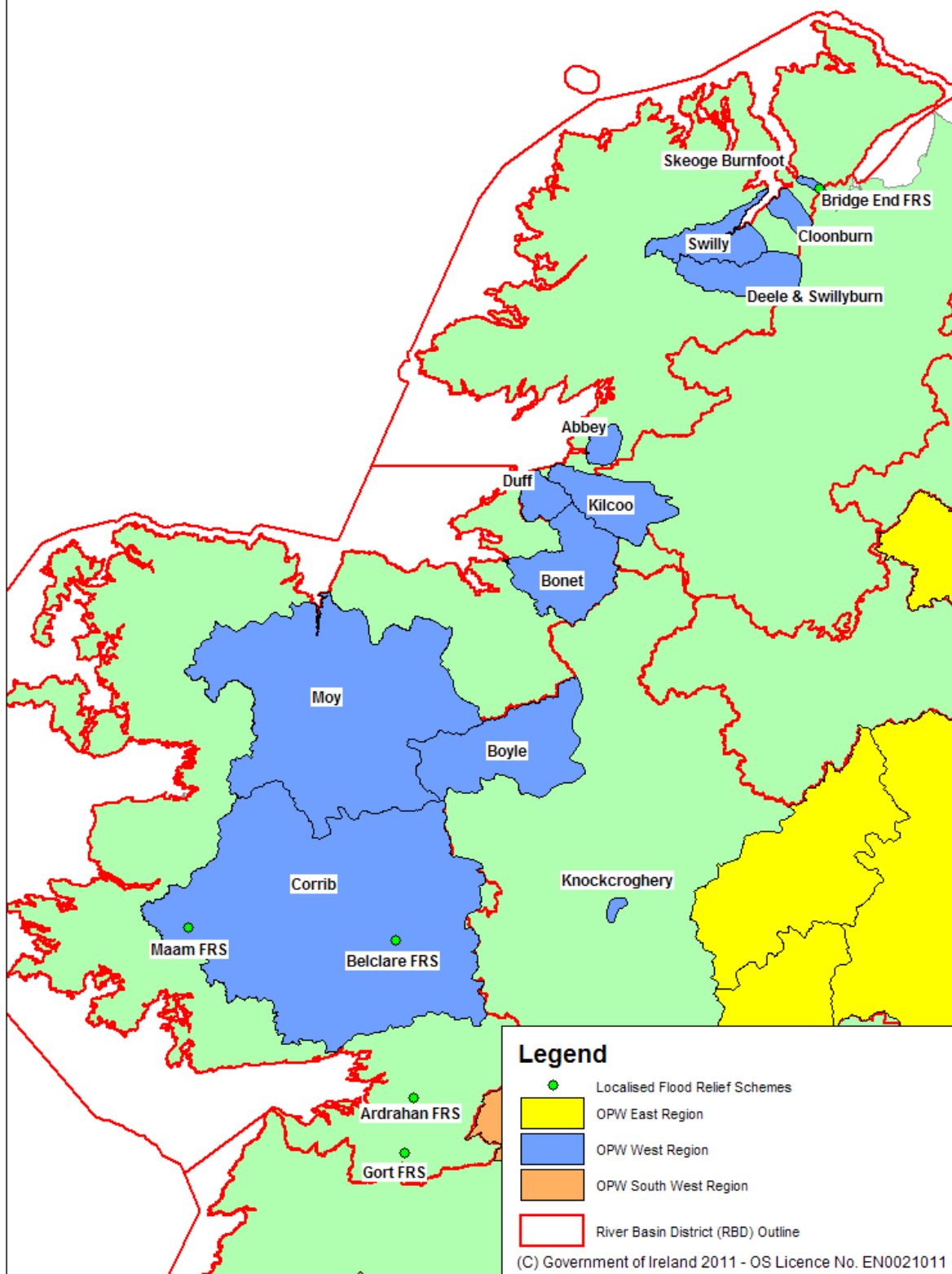
Region	Main Regional Office	Sub-Office(s)
<b>East</b>	Newtown, Trim, Co. Meath	Ardee, Monaghan, Mullingar & Wexford
<b>South West</b>	Templemungret, Co. Limerick	Listowel & Portumna
<b>West</b>	Headford, Co. Galway	Ballina & Lifford

**Figure 3.1 OPW Regions and River Basin Districts**

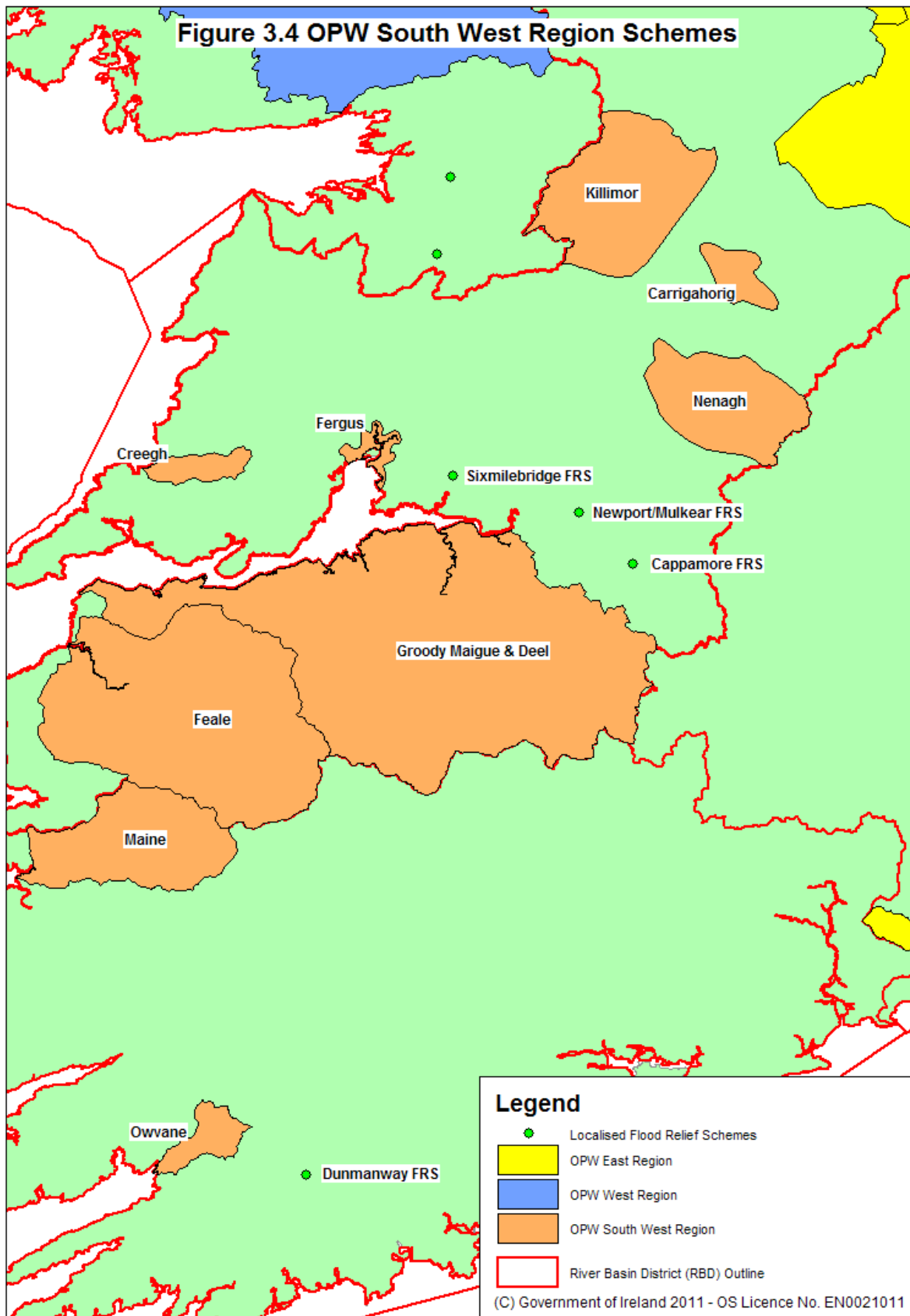




**Figure 3.3 OPW West Region Schemes**







## **2.0 Programme Activities**

This Programme covers two sets of activities:

1. Arterial Drainage Maintenance
2. High Risk Channel Designation.

### **2.1 Part 1 - Arterial Drainage Maintenance 2011 – 2015**

Statutory Arterial Drainage Maintenance entails the maintenance of completed Arterial Drainage Schemes and completed Flood Relief Schemes. The OPW are responsible for the maintenance of 11,500km of channel, 730km of embankments, some 18,500 bridges and 750 ancillary structures such as sluice gates, pumping stations and tidal barrages.

The majority of Arterial Drainage Maintenance works is on channel maintenance with the average channel requiring maintenance every four to six years. While this varies, with some channels requiring maintenance annually and others only requiring maintenance every twenty years, circa 2000km of channels are maintained annually and nearly all of the 11,500km of channels will have been maintained at least once over the Programme cycle of five years. Of the 750km of embankments, the frequency of maintenance tends to be more variable than that for channels with embankments scheduled for maintenance works as the need arises. To date there have been thirteen Flood Relief Schemes carried by the OPW and statutory arterial drainage maintenance includes the maintenance of these schemes. In respect of the various bridges and structures, a relatively small number are maintained annually i.e. circa 170 bridges and 30 other structures which are restricted to the most critical structures. Note that a portion of the 18,500 bridges are road bridges where the Local Authorities are responsible for the structural integrity, hence OPW maintenance operations typically exclude bridge deck or arch repair works on road bridges.

#### **2.1.1 Part 1.1 - Scheme Channel Maintenance Works 2011 – 2015**

Channel maintenance operations normally involves removing the build up of foreign or natural material that impedes the free flow of water. Predominately this consists of the removal of water-entrained silt and associated 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 in the 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.

Some channels are steep and fast flowing, which 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 in-stream 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 four to six years. Channels with prolific weed growth may require maintenance annually, particularly where downstream bridges are at risk of being blocked due to a flow of decaying vegetation in autumn. Conversely, some channels may only require maintenance every twenty years due to the self-cleaning characteristics of the channel.

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. Weed cutting boats are engaged in these cases, or where a particular channel requires to be cleared of vegetation but it is not deemed necessary to remove silt or other heavy material. In all, approximately 90km 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.

Historical databases have been built up in all regions. From these are extracted a base line list of channels which are due for cleaning. Critical sections of these channels are inspected and a work programme developed. This takes account of requests from the general public and potential flooding risk to roads, properties, urban areas and sewage works.

In developing the works programme, special consideration is given to potential impacts on fisheries, Natura 2000 Sites and the environment. This includes assessment of all works for their potential to impact on Natura 2000 sites by an external ecological consultants, specific timing of certain works, and consultation with both Inland Fisheries Ireland and National Parks and Wildlife Service

In general, scheme channel maintenance work is carried out by trained OPW drivers, using a hydraulic excavator. The material removed is normally spread along the bank or on top of existing spoil heaps where present.

### **2.1.2 Part 1.2 - Maintenance of Scheme Structures 2011 – 2015**

During the course of the original Arterial Drainage Scheme excavations following the 1945 Act, circa 18,500 accommodation bridges were modified or replaced as required. These bridges provide riparian farmers with farm vehicular/foot access. The type of bridge provided depended on the width, depth and required flow capacity, and ranged from concrete piped culverts to larger concrete or masonry spanned bridges.

In general, as channel maintenance work proceeds, the bridges are inspected by supervisory industrial staff, and if required repairs/replacements are programmed. On many occasions, it is not necessary to totally replace the structure, and repairs such as under-pinning foundations or replacement of wing walls, parapets or deck are carried out to extend the bridge life.

Currently all Scheme structure maintenance work is carried out by the direct labour gangs. Approximately 170 bridges are repaired/replaced each year. Ancillary structures such as sluice gates, tidal barrages and pumping stations are repaired or replaced as necessary to maintain their respective operating function.

### **2.1.3 Part 1.3 - Scheme Embankment Maintenance 2011 – 2015**

Most Embankment Schemes are tidal in nature hence they tend to be located at estuaries. The foremost inland Embankment Scheme is the Annagh Embankments, on the Inny Arterial Drainage Scheme. During the period between 1987-1993 the financial resources for drainage maintenance were reduced resulting in a reduction in staff numbers and in the capability of OPW to carry out necessary work. By 1994 the deteriorating condition of the embankments, which at some critical locations had been eroded to less than half their original volume, gave cause for great concern, especially in Kerry, Wexford and Donegal. A programme of embankment strengthening was put in place to redress this.

Currently, programming of maintenance work consists of regular inspections of sections of embankments, which are known from experience to be at risk, together with additional inspections after a storm at sea, or a high tidal/flood event in the case of tidal embankments. Embankments are scheduled for works when it is deemed that the structure is in need of repair to maintain an effective condition. Repair works normally take the form of topping up clay embankments to design height and structural strengthening by importing rock/soil material or utilising in-situ material.

In addition, the programme extends to the refurbishment of the deteriorated embankments in Kerry, Wexford and Donegal. The Shannon Embankments are also undergoing refurbishment works, due to their importance to flood defence for Limerick and Shannon Town. The refurbishment of the embankments is carried out by contract or by direct labour.

### **2.1.4 Part 1.4 - Flood Relief Scheme Maintenance 2011 – 2015**

Flood Relief Schemes completed since the Arterial Drainage (Amendment) Act, 1995 also have a statutory maintenance requirement. The requirement for maintenance is identified at regional level on an annual basis, and included in the Annual Arterial Drainage Maintenance Programme. Maintenance cycles vary depending on the characteristics of the Flood Relief Scheme. Original scheme works that included durable structural works such as new embankments, retaining walls or hard bank reinforcement typically require little or no maintenance while some flood relief scheme channels require periodic silt removal or riparian vegetation management, to maintain the designed channel capacity.

## **2.2 Part 2 - High Risk Channel Designation 2011 – 2015**

### **2.2 High Risk Channel Designation**

The Report of the Flood Policy Review Group identified, among other things, that:

- There are a substantial number of watercourses for which no State authority has legislative responsibility for flood management.
- The lack of maintenance of watercourses and their associated defences and structures is a potential major cause of flooding on influence on flood processes.

The report recommended that a system be put in place to “designate” high-risk channels and give permissive powers of maintenance to the central authority (OPW). The general objective of ‘Designation’ is to ensure that potentially high-risk channels

or defences are maintained to reduce the flood risk that may otherwise arise. This system is intended however, only to be applicable to channels or defences that pose a significant risk, or that are of strategic importance. The report also recommended that an asset register be developed to aid in identifying and prioritising watercourses and structures for 'Designation'.

The Commissioners have introduced a funding mechanism to Local Authorities for localised works to alleviate flooding where the following conditions are satisfied:

- There is a technically viable option to mitigate or eliminate flooding.
- A legal mechanism is available to carry out the option and the necessary consents, agreements and licenses are in place. Some of these mechanisms are identified below.
- The option is cost effective and government requirements for assessing costs and benefits have been met. A simple method of assessing benefits is used for less expensive proposals, and full cost benefit analysis may be used for more expensive options.

Typically this means that works that do not require an Environmental Impact Statement (EIS) and cost less than €0.5 million are funded under this mechanism.

No legal mechanism is yet in place to allow the Commissioners to designate particular channels or other structures. In many cases minor works in excess of maintenance are required to address specific issues. The minor works funding mechanism has proved effective in addressing this type of issue. In addition, there are complex responsibilities, rights and interests in the management of watercourses. As a result, careful consideration of the incentives that arise for the various stakeholders is necessary to ensure that appropriate action is taken.

Existing legislation provides a number of mechanisms for carrying out watercourse improvement and maintenance works. A number of issues must be addressed for each mechanism, including:

- Authority to carry out works;
- Consultation;
- Environmental protection;
- Interference with owners and occupiers.

In addition to the specific maintenance powers of the Commissioners, Local Authorities and Drainage Boards, the following mechanisms provide a means of dealing with the issues identified above:

- Maintenance works by a person on their own land are exempted development under the Planning and Development Act, 2000, although there are some restrictions and licensing requirements designed to protect the environment.
- The Commissioners of Public Works can promote a scheme under the Arterial Drainage Acts, 1945 and 1995 to prevent or substantially reduce flooding or to improve drainage of land. This legislation provides the necessary means to promote a scheme, subject to an EIS.

- The Commissioners of Public Works can carry out a scheme by agreement with other persons under the Commissioners of Public Works (Functions and Powers) Act, 1996. This act provides only an outline of functions and powers and does not identify a mechanism for delivering a scheme.
- A Local Authority may carry out works under the Local Authorities (Works) Act, 1949 for a number of purposes including to prevent or repair damage from flooding.
- A Local Authority may carry out works or development in its functional area under Part XI of the Planning and Development Act, 2000 and Part VIII of the Planning and Development Regulations 2001. These acts provide authority and a mechanism for granting planning permission where an EIS is not required. Powers of entry and compensation are not covered in the planning acts.
- A Local Authority may carry out works in its functional area, where an EIS is required, under the Planning and Development Act, 2000 as amended by the Strategic Infrastructure Act, 2006. An Bord Pleanála determines the mechanism to be adopted and, if appropriate, whether planning permission may be given for works under this legislation.
- A Local Authority may direct that works be included as part of a development as a condition under the Planning and Development Act, 2000. Different sections apply if the works are necessary for the development to proceed or if they are in excess of the needs of the development.
- A Local Authority may, by zoning in the county development plan, or a variation, promote or prevent development to reduce the risk of flooding.

Directive 2007/60/EC on the assessment and management of flood risks entered into force on 26 November 2007. This Directive now requires Member States to assess if all water courses and coast lines are at risk from flooding, to map the flood extent and assets and humans at risk in these areas and to take adequate and coordinated measures to reduce this flood risk

This Directive along with the Report on the Flood Policy Review Group resulted in the introduction of Statutory Instrument (S.I.) 122/2010 – European Communities (Assessment and Management of Flood Risks) Regulations 2010. The S.I. addresses items such as “The preparation of schemes of flood risk management works and measures”, “Designation Orders”, “Powers of the Minister” and “the costs of flood risk management”. This legislation is relatively recent and it will take some time before all components are fully implemented.

### **Roles & Responsibilities**

The key feature of a ‘Designation’ process is that it coordinates actions by a variety of stakeholders to provide a greater benefit than could be achieved by the stakeholders on their own, particularly taking the tendency toward negative behaviour into account. The key players are the riparian owners, the riparian community and

statutory bodies, together with other parties with property related rights and beneficial use related rights or interests. The OPW also has a key role to play.

The fact that stakeholders have overlapping responsibilities tends to dilute the incentive to perform them, even though the benefits to be achieved may be clear. All stakeholders have responsibilities for cooperation with other stakeholders and responsibilities to take appropriate actions and refrain from inappropriate action.

***Riparian Owners:***

Riparian owners have control over access to the watercourse and are also responsible for maintenance under the common law. They are also likely to suffer damage as a result of flooding.

***OPW:***

The OPW, as lead agency in Flood Risk Management, has a role in coordinating the activities of statutory stakeholders and as a service provider to citizens.

***Local Authorities:***

Local authorities have a number of complementary functions in relation to 'Designation'. They can collect and assess information on the need for 'Designation'. They have powers to carry out some maintenance and other works. They provide emergency services. They are also the primary democratic organ at the local level.

***Communities:***

Riparian communities, in addition to being riparian owners, can organise and coordinate riparian owners and benefit from improved amenity, environmental and heritage resources. They are also likely to be called on for emergencies and to share in the economic effects of floods. Riparian communities often act through the Local Authority, but they also act in a self-organised or ad-hoc manner.

***Beneficial Users:***

Beneficial Users have property related rights, or rights or interests in beneficial uses of a watercourse, including power generation, fishing, watering animals, recreational use etc. Beneficial Users benefit from the maintenance of watercourses, and can reasonably be expected to contribute to their maintenance.

***Statutory Regulators:***

Statutory Regulators have a role in the management of watercourses from a variety of legislation including protecting water quality, natural environments, and natural resources.

***Statutory Undertakers:***

Statutory Undertakers have responsibilities for the provision of water related services, including water supply, wastewater treatment, power-generation, navigation, and resource management. They generally have some statutory powers to enable them to perform these duties.

## **2.4 Programme Exclusions**

This Programme does not include the following activities:

- New Arterial Drainage Schemes.

- Catchment Flood Risk Assessment & Management Studies (CFRAMS).
- New Flood Relief Schemes – carried out under the Arterial Drainage Acts 1945-1995, which entail aspects such as public exhibition and Ministerial approval. Modern Flood Relief Schemes typically involve relatively large-scale engineering construction, generally within the confines of an urban area and designed to specific criteria such as 1 in 100 year flood protection.
- Drainage Districts – channel maintenance works on the various Drainage Districts by Local Authorities or Drainage Boards.



## **3.0 Environmental Management**

All maintenance operations are carried out in accordance with OPW's Environmental Management Protocols and Standard Operating Procedures.

### **3.1 OPW Environmental Management Protocols**

#### **Communications - Statutory Stakeholders**

- By the end of September of each year, each Drainage Region to forward a draft copy of its Annual Works Programme for the coming year to OPW's Environment Section, and to the Inland Fisheries Ireland (IFI) EREP Project Manager who will review it for appropriate sites and study locations for the Environmental River Enhancement Programme 2008 -2012.
- By end of November of each year, each Drainage Region to forward the relevant sections of the Finalised Annual Maintenance Programme for the coming year with a copy of appropriate scheme maps, to the National Parks & Wildlife Services (NPWS) Regional Managers and the IFI Directors.
- When compiling the programme the type of works proposed should be indicated for each channel under the headings A-F to facilitate the Screening for Appropriate Assessment (AA).
  - A – Silt & Vegetation Management
  - B – Aquatic Vegetation Cutting
  - C – Bank Protection
  - D – Bush Cutting/Branch Trimming
  - E – Tree Cutting
  - F – Bridge/ Structure Repairs
- Ideally, approximate timing (season/month) and approximate duration of works should be included for each channel.
- Works that fall within Special Areas of Conservation (SAC), Special Protection Areas (SPA) or Natural Heritage Areas (NHA) are to be highlighted on the programme.
- As a follow up, the Drainage Regions offer the opportunity for a meeting with the stakeholders to discuss the programme and where a meeting is requested, preferable for this to take place as early as possible in the year.
- Prior to entry onto a channel contained wholly or partly within an SAC, SPA or NHA, three weeks notice in advance of entry, and for SAC & SPA an AA Screening Statement/Conclusion Statement must be completed and forwarded through the NPWS District Conservation Officer (DCO).

#### **Interim Stakeholders Meetings**

- In addition to the start of the year stakeholder meeting to overview the Annual Works Programme, Regional Offices will offer and facilitate a schedule of more frequent and catchment focused meetings.
- The need and the frequency of these meetings will be determined on a regional basis in partnership with the relevant stakeholders.
- Typically a frequency of every 2-3 months to discuss the following 2-3 months work on the catchment, identifying any further environmental sensitivities, appropriate mitigating measures, follow up joint site visits where deemed

beneficial and flagging any opportunities for added benefit in proposed River Enhancement works.

- Typical attendance includes a range of OPW Management Staff, i.e. Engineer, Technician and/or Foreman, NPWS Rangers and/or DCO and IFI Officers.
- OPW Engineer will compile minutes of the meeting to record attendance and a brief account of main decisions and follow up actions.
- Any channel specific information resulting from these meetings, such as timing requests should be entered into the Records Database in accordance with the National Recording Process.
- Fruitful consultations with statutory stakeholders such as NPWS and IFI are of critical importance to continuously improving environmental performance. However, in the interest of maximising the efficiency of stakeholders input, Management Staff are as far as practical, to plan their consultative requirements and address a range of aspects in any one discussion forum. Interim Stakeholder Meetings or similar forums offer good opportunities to maximise consultation efficiencies.

### **Correspondence**

- All Environment related correspondence/complaints should be logged on the Engineering Services Correspondence Database as per normal protocol. Complaints received should be forwarded to the Environment Section should assistance be required.

### **Walkover Surveys**

- As a component to the EREP Project, on a number of channels, EREP team will request for Walkover Surveys as an opportunity to discuss in detail on site the environmental options for a particular channel with a range of relevant stakeholders.
- Typical attendance will be an IFI EREP representative, a range of OPW Management Staff and relevant Operational Crew if deemed beneficial, local IFI Officer and/or NPWS Ranger or DCO.
- OPW Management Staff to liaise with EREP team and coordinate the site visit with local IFI and NPWS to facilitate their participation if these stakeholders wish to attend.
- Environmental procedures as agreed on-site will be recorded by IFI EREP team and issued to the OPW Engineer as part of the design guidance for the particular enhanced maintenance works.
- Regional Management Staff to ensure that Operational Staff carry out the works in accordance with the agreed procedures.

### **Natura 2000 Site Assessments**

- All scheduled maintenance operations in the vicinity of a Natura 2000 Site i.e. an SAC or SPA, will require Screening for Appropriate Assessment and Stage II Appropriate Assessment where required.
- By the end of September of each year, each Drainage Region to forward a draft copy of its Annual Works Programme for the coming year to OPW's Environment Section to facilitate this process.

- Environment Section will procure the Ecological Consultant, collate all the channel lists and issue completed AA Screening Statements/Conclusion Statements to the respective OPW engineers as completed.
- The Ecological Consultant will consult with OPW management to define the precise extents of proposed works in each Natura 2000 Site.
- In addition, the Ecological Consultant will be carrying out walkover surveys for pre and post maintenance works for a representative number of the sites and OPW Management will be required to facilitate the same.
- OPW Management Staff will issue the relevant completed Assessments directly to the NPWS District Conservation Officer. In addition, Environment Section will issue all of the Assessments to the Development Applications Unit, Department of Arts, Heritage and the Gaeltacht, Newtown Road, Wexford.
- Preferably for the Assessments to be forwarded to the DCO as soon as it is completed, but in any case with a minimum of three weeks notice before commencement of the works.
- Management Staff to implement all prescribed mitigating measures and ensure that Operational Staff are made aware of all relevant site specific mitigating measures.

#### **Environmental River Enhancement Programme (EREP)**

- After reviewing the draft Annual Works Programme, IFI EREP team will revert to the respective Regional Office and request follow up meetings as required to discuss aspects of the programme in relation to the EREP.
- Enhancement sites require ground truthing to ensure they are technically feasible as envisaged. This is to be coordinated by the IFI EREP team with local IFI and OPW personnel as required.
- Sites shortlisted by IFI EREP team for capital enhancement works are emanating from a screening process of technical feasibility in terms of gradient and water quality. In the future, sites selected will increasingly be resulting from other requirements such as the Water Framework Directive Programme Of Measures under Morphology.
- IFI EREP team in consultation with the local IFI and OPW, will prioritise sites on a basis of best return for investment. IFI EREP team will liaise with the Regional Offices to assist in identifying channels deemed suitable for capital enhancement which should be integrated with the following years work programme. In some cases, a situation may arise where the site selected is not overlapping with the current Annual Works Programme but where feasible and subject to any third party agreement, OPW will accommodate these works.
- Similarly for enhanced maintenance works, IFI EREP team in consultation with the local IFI and OPW, will select sites again that are technically feasible and offer best return for investment. These sites will normally be from channels on the current Annual Works Programme.
- IFI EREP team will coordinate all the scientific monitoring works, provide the enhancement design details and guidance to OPW Management Staff and maintain a reasonable level of site supervision, proportional to the complexity of the works and the experience of the OPW Staff involved.

- Consultations with local IFI through the interim stakeholder meetings are encouraged to identify sites suitable for enhancement works and in some cases the local IFI may also be in a position to produce an enhancement design. All enhancement designs and works are to be coordinated through the IFI EREP team to facilitate formal recording into the national EREP project and allow for biodiversity and/or hydromorphology monitoring if required. Local IFI may coordinate with IFI EREP team or alternatively OPW Regional Staff coordinate directly with the EREP team.
- A small portion of channels have more infrequent maintenance cycles and these cases can offer particularly good opportunities for enhanced maintenance type works. Channels programmed where maintenance works have not being carried out for in excess of 10 years, to be flagged to IFI EREP team for possible walkover surveys and guidance on appropriate Environmental Drainage Maintenance (EDM) procedures.
- Management Staff to ensure that as far as practical, all Operational crews have an opportunity to get experience on these projects.
- Each Regional Engineer is to make provision in the Annual Works Programme for Plant & Labour resources in addition to provisions in the Annual Budget for materials subject to expenditure constraints. Typical resources are as follows:

#### **Capital Enhancement**

<b>Region</b>	<b>Target (Km)</b>	<b>Capital Costs</b>	<b>Machine Weeks</b>	<b>Man Weeks</b>
East Region	20	€200,000	30	60
South West Region	14	€140,000	21	42
West Region	16	€160,000	24	48
	<b>50</b>	<b>€500,000</b>	<b>75</b>	<b>150</b>

#### **Enhanced Maintenance** *(in conjunction with routine maintenance)*

<b>Region</b>	<b>Target (Km)</b>	<b>Capital Costs</b>	<b>Machine Weeks</b>	<b>Man Weeks</b>
East Region	20		15	0
South West Region	14		11	0
West Region	16		12	0
	<b>50</b>		<b>38</b>	<b>0</b>

- Progress targets for EREP to be shown on monthly production reports.
- OPW are the primary contact point for liaison with landowners including the organising of access and egress for machinery and materials. Brochures on EREP are available in all Regional Offices. Additional copies can be obtained through OPW Environment Section.
- Management Staff are encouraged to maximise the use of all available on-site materials such as stone from historical spoil heaps as opposed to importing materials at a higher cost.
- In addition, Management Staff are encouraged to maximise synergies with other funding sources such as Fisheries Development grants attained by local

Angling Clubs, which could be combined with OPW plant and labour to supply materials.

- In all cases, Inland Fisheries Ireland is the statutory authority to give design guidance to OPW. Angling Clubs or other sectoral funding sources to liaise with the Fisheries authorities in respect of all design and environmental monitoring requirements.
- As-Built plans are to be completed by the IFI EREP team for all enhancement works. This will entail a site visit by IFI and relevant OPW Staff where requested. These will be retained by IFI as well as any relevant design information.
- IFI EREP team will forward a copy of the as-built plans to Environment Section who will upload the same to Socialtext for access to the information by all Staff.
- At the end of the year, IFI EREP team will forward Environment Section a GIS layer of that year's works for uploading to OPWs GIS records.

### **National Recording Process**

- Weekly Record Cards can contain information on Lamprey, Crayfish, Kingfisher, Mussels, Otter and other site specific environmental information as arises.
- Environmental information on Cards will be recorded onto the Records Database by each Drainage office. The latest Records Database has been revised to integrate environmental records.
- On an interim basis, a copy of all Cards with environmental information to be copied and forwarded to Environment Section by each Drainage Office. This is to allow Environment Section to review the detail of information being recorded, feedback to the Operational crews through the Management Staff and attain a national consistency in the style of information being recorded.
- All relevant information to be uploaded to GIS by Environment Section.
- All other relevant environmental information sourced by Management Staff whether from direct observations or through stakeholder consultations, should be entered into the Records Database.
- Relevant environmental information sourced through the EREP project and related research will be forwarded by IFI EREP team to Environment Section directly for centralised GIS uploading.
- On an annual basis, Environment Section will compile an update of Weekly Records Cards species records and make available to all Staff via Socialtext to assist in tracking progress.
- On an ongoing basis, Environment Section will make available the various OPW compiled species records to other authorities to assist in contributing to any appropriate national conservation knowledge.
- As described above, each drainage office will upload onto the Records Database all environmental information from the Weekly Record Cards and all other broader environmental information attained by Management Staff. Within a few years, it's envisaged that multiple regional Staff will be able to use the new Records Database, and then environmental information from all sources will be uploaded directly by a whole host of Staff. Typically this will include any mitigating agreements for particular channels agreed with stakeholders or any

other individuals observation such as protected species presence noted during a separate site visit.

### **Salmonids**

- As far as practicable, the maintenance works are to be scheduled to accommodate salmonid (Salmon & Trout) spawning areas, as is in place across all regions for many years. This is a widespread measure on many catchments and is most applicable to medium gradient channels with gravel substrate.
- Prior to works commencing, consult with local IFI. Ideally, consultations to be conducted through Interim Stakeholder Meetings or alternatively, direct contact in respect of the specific site.
- Maintenance operations on salmonid spawning beds typically carried out between July and September but timing subject to adjustment due to local knowledge of IFI.
- Raking of spawning gravels to improve spawning capacity also typically carried out between July and September.
- River enhancement works to enhance both the fisheries and the broader ecology of the drainage channel are covered under the EREP project.
- In the future, as the extent of completed enhancement works increases, there is a risk of damage to structures due to future maintenance. All channels scheduled for maintenance to be checked against GIS records for presence of previous enhancement works. Where a presence is indicated, carry out a site visit as appropriate and in consultation with IFI, devise on-site procedures to protect or enhance existing instream structures.

### **Lamprey (Brook, River & Sea) & Crayfish**

- All channels scheduled for maintenance to be checked against GIS records for presence of Lamprey or Crayfish.
- In accordance with the SOPs, Operational Staff will closely observe the spoil three times daily and report to the Foreman any Lamprey or Crayfish located.
- Mitigating procedures to apply when:
  - GIS records indicate species presence, or
  - Operational Staff locate Lamprey or Crayfish during operations, or
  - Where particularly suitable habitat is identified by an environmental stakeholder.
- If significant populations are encountered, notify IFI EREP team and facilitate scientific studies if site deemed suitable by IFI.
- If significant populations are encountered, notify NPWS Ranger and local IFI Officer and conduct site visit as necessary.
- Combination of Mitigating Measures to be selected as applicable to the site while balancing the Flood Risk Management requirements and a sustainable approach to the conservation of Lamprey and/or Crayfish.
- Identify extent of channel applicable and the mitigating measures to apply.
- Inform Operational Staff of mitigating requirements.

## ***Suite of relevant Mitigating Measures as follows:***

### ***On site measures***

- Skip sections to retain intact habitat either in one long reach or multiple short reaches.
- Maintenance in an upstream direction to avoid secondary disturbance of a species moving downstream. Balance with the advantage of maintenance in a downstream direction where instream vegetation minimises siltation.
- Confine maintenance to 2/3 of channel width leaving marginal vegetation and silt intact.
- Maximise use of weed cutting bucket particularly where aquatic vegetation removal is the primary objective. This is effective for Lamprey juveniles as they are in the silt. For Crayfish, cutting of “Flaggers” type vegetation is effective but cutting of “water celery” mat type vegetation is less effective as it can result in Crayfish being removed within the weed mass.

### ***Forward planning measures***

- Annual maintenance of the channel in shorter segments sequentially completing the same over a number of years. Balance with maintaining reasonably operational efficiency in terms of machinery moving, transport, access and egress.
- Longer time periods between maintenance cycles e.g. move from 4-6 years to 7 to 8 years. Balance with overall river ecology as longer maintenance cycles will lead to more heavy-scale works.
- Timing of maintenance to accommodate Lamprey spawning. Stakeholder consultations between OPW and local IFI for salmonid mitigating purposes, to include consideration of Lamprey spawning. This is to be applied to channels where Lamprey spawning habitat is known as informed by IFI or other stakeholder. For River & Brook Lamprey, no works on relevant spawning channel from end March to start of June subject to adjustment due to local knowledge of IFI. For Sea Lamprey, as they spawn during the summer months, restrictions from late April to early July are required. To be applied to channels where Sea Lamprey spawning is known as informed by IFI or other stakeholder and timing subject to adjustment due to local knowledge of IFI. Note that Sea Lamprey are much less widespread so envisaged that the scale of this mitigation will be very limited.
- Loosening spawning bed gravels. Stakeholder consultations between OPW and IFI for salmonid gravel loosening purposes, now to include consideration of Lamprey spawning as above.
- Enhance channel profile such as skewed cross section and promote deposition of silt along margins. Integrate with IFI discussions on planning the EREP to avail of enhancement opportunities particularly for channels where Lamprey or Crayfish presence is recorded.
- Modification of OPW structures which impede upstream migration. Identification of weirs as barriers to be as informed by IFI or other stakeholder. Where modification designs required, liaison with IFI EREP team to integrate the improvement works into the EREP project. Identification of a bridge apron step attained through ongoing site inspections by OPW Management Staff or other stakeholder. In consultation with IFI, steps at bridges to be modified by a

rock armour type ramp or similar. Envisaged that these measures will be of a limited scale on drained channels.

***GIS Records:***

- Where Lamprey or Crayfish are discovered, Operational Staff will have recorded the same on the Weekly Record Cards. Cards with species location information will be uploaded to the Records Database as stated in the National Recording Process.
- All new Lamprey spawning location information attained through stakeholder consultation to be recorded on the Records Database in accordance with the National Recording Process.
- All database records of species location will be uploaded to GIS by Environment Section.
- IFI EREP team conducting ongoing research on Lamprey & Crayfish as a component of the EREP works. Scientific data calculating species density for some sites will be developed and to be supplied by IFI to OPW and uploaded to GIS by Environment Section.

***Otter***

- Research to date indicates that Otters are widespread across all sizes of drainage channels nationally, hence it is prudent to assume that Otter use any particular site.
- In accordance with the Otter SOP, Operational Staff will walkover the works area one week in advance in conjunction with the Health & Safety assessment noting dense cover with access directly to the water that is to be avoided where feasible.
- In addition, any recognisable signs of Otter presence observed such as Spraints, Footprints or suspected Holts, will be recorded on the Weekly Record Cards. These signs were identified in Otter Awareness Training carried out across all regions in 2008.
- While holts are usually well concealed, where Operational Staff observe a suspected holt such as a burrow opening, in consultation with Management Staff, subject to flood risk management functions, no works to within a 50m buffer each side.

***Bridge mammal crossing enhancement***

- As a component of ongoing consultations with NPWS and other stakeholders, evidence may arise from time to time as to a particular spot for Otter road kill. Typically this can arise where the Otter always traverses the roadway as opposed to going through the bridge. While this scenario is not known to be a widespread issue in Ireland, the highest risk locations are on the National Primary Roads which have the heaviest traffic volumes.
- There are 170 National Primary Road bridges on OPW channels as listed in the table referenced below and Management Staff are to have particular regard to these locations if evidence arises on a possible road kill “hot spot”.
- Enhancement works will typically take the form of a bolt-on wildlife ledge or similar. Design and configuration is to be carried out in consultation with NPWS and relevant Local Authority.



- On an annual basis, Environment Section will review the national website [www.biology.ie](http://www.biology.ie) which records Otter road kill reports from the public. Any road kill location which overlaps with an OPW channel will be flagged by Environment Section to the relevant Management Staff.
- Current understanding is that Otter road kill is not a significant issue in Ireland. It's envisaged that while the justification for bridge mammal crossing works may arise for some scenarios, these measures will be of a limited scale on drained channels.

### **Freshwater Pearl Mussel**

- GIS records from NPWS show the locations of the 91 known FWPM populations in Ireland.
- The following OPW channels have been identified as containing FWPM:

Channel	Scheme	Location	Most Recent Record
CH9	Corrib Headford	Oughterard	2009
C1/21/3	Moy	Approx 500yds from outfall to into L. Cullin	2004
C1 Sect M&N	Moy	Ballygallagart	2004
C1/21/14	Moy	Crossmolina	2008
C1	Dunmanway FRS	d/s of the Long Bridge	2003
C1	Owvane	Approx 1400 yds from outfall	2002
C1	Feale	d/s Listowel near Scartleigh cemetary	2006
**Owenaher	Moy	u/s of C1/54	1996
**Brown Flesk River	Maine	Trib of C1 Maine near Farranfore	1987
** Galey River	Feale	Approx 1400yds u/s of C1/18 near Ahavoher Br.	1950
**River Liffey	Ryewater	(Lucan) Approx 3.5km d/s C1 Ryewater outfall	1894

*\*\* Although not on OPW channels - these channels may or may not contain populations of FWPM. Works in the vicinity which could impact on a possible population need to be considered in close consultation with local NPWS knowledge.*

- While highly unlikely to have instream works in a FWPM habitat, if a new population located by Operational Staff during operations, works to cease.
- Notify NPWS and in consultation with NPWS, area to be skipped or non in-stream works carried out as agreed for the specific site.
- For operations in the vicinity of known populations, mitigating procedures to apply:
- Consult with NPWS and local IFI and conduct site visit as necessary.
  - Typically only selective non in-stream works adjoining the population.
  - Works such as removal of a fallen tree is to be completed by lifting clear of the channel to minimise any channel bed disturbance due to the branches being dragged.
  - Assess need for silt management procedures for works upstream of the population and implement in consultation with NPWS.

### **Swan & Duck Mussels**

- Swan and Duck Mussels are not strictly a protected species, however they are of conservation interest.
- Both species are similar in appearance and habitat requirements and distinguishing between them is not necessary unless local environmental stakeholders can identify the exact species.
- As the Mussel SOP, if Operational Staff locate the same, Management Staff will be notified.
- Where significant populations are encountered notify NPWS Ranger and local IFI Officer, and where they are interested in visiting the site, facilitate a site visit as necessary.
- Identify extent of channel applicable and the mitigating measures to apply.
- Typical Mitigating Measures include:
- Operational Staff to observe spoil and return any Mussels to the channel whom are expected to recolonise the channel bed.
- Maximise use of weed cutting bucket particularly where aquatic vegetation removal is the primary objective.
- Skip sections to retain intact habitat either in one long reach or multiple short reaches.
- Confine maintenance to 2/3 of channel width leaving marginal vegetation and silt intact.
- Record species presence on the Weekly Record Cards which will be recorded on the Records Database.

### **Kingfisher**

- Avoid disturbing nesting sites in banks.
- Visual sightings of Kingfisher by Operational Staff to be recorded on the Weekly Record Cards.
- Sightings by Management Staff to be recorded on the Weekly Record Cards where works in progress or on other occasions, record by separate map or channel reference format.
- All sightings to be recorded on the Records Database in accordance with the National Recording Process.
- All database records of species location will be uploaded to GIS by Environment Section.
- On an annual basis, Environment Section will issue the records to Birdwatch Ireland whom will add to the national Kingfisher database.

### **Birds**

- Removal of any abnormally dense layer of vegetation is to be executed between September and February (inclusive) to minimise impacts on nesting birds unless there are other overriding requirements such as Health & Safety.
- For SPAs containing important over-wintering bird populations, in consultation with the NPWS, regard to be given to timing or phasing of the works to minimise potential disturbance.

## **Bats**

- While the removal of large mature trees is not typically a requirement of maintenance works, where the case arises, in consultation with NPWS, regard to be given to the likelihood of bat roosting habitat.
- Typical mitigating measure would be to leave tree in fallen position for 24hrs to allow any bats vacate.
- Masonry bridges offer niches and crevices suitable for bat roosts and where masonry bridges are scheduled for maintenance works, regard to be given to the likelihood of bat roosting habitat. Typical maintenance works at low level such as wing wall repair or underpinning foundations have limited potential to impact on bat roosts. Where the case arises that repair works are to be above the high water level such as the upper arch, in consultation with NPWS, assess the potential for the works impacting on bat roosts.
- Typical mitigating measure would be to contract a bat specialist to survey for bat presence before works commence, to avoid entombment of any bats.

## **Wetlands - Bogs, Fens & Turloughs**

- All channels scheduled for maintenance which overlap SAC designations to be checked against the list of channels that impinge on Raised Bog, Fen habitat or Turloughs and have regard to any NPWS agreements noted \*.
- OPW Management Staff to consult with NPWS for expert opinion as to any evidence of ongoing ecological decline of the Bog, Fen or Turlough and judgement on, if the drainage datum set by the Drainage Scheme and its maintenance is an ongoing contributing factor by affecting the hydrological regime of the same.
- Where a likely impact is identified, conduct site visit as necessary and in consultation with NPWS, mitigating measures to be selected such as:
- Skipping the channel in question while taking cognisance of the flood risk management requirements.
- Maximise use of weed cutting bucket particularly where aquatic vegetation removal is the primary objective.
- Inspection by OPW line management to assess the possibility of over digging the channel below the original design datum. Presence of an existing water level control such as a bridge floor to be established and alternative reference datum to be installed if deemed warranted.

*\* Environment Section currently developing a list of channels which overlap with Raised Bog, Fen habitat and Turloughs within SACs. Channels that are subject to a previous NPWS agreement /understanding of the extent of maintenance will be recorded.*

## **Invasive Species – Plants**

- Multiple invasive plant species are widespread nationally as described in the SOP and prudent to assume that one or more of these plants can be present on any works site.
- At present the OPW does not have any direct responsibility for the management of Invasive species. However to ensure OPW operations are not a vector for these invasives, measures are required to reduce the risk of spread.

- Ensure machine washing equipment transported to site for all appropriate machinery movements as described in the Invasive Species SOP.
- Ongoing EDM site audits by Environment Section will include confirmation that machine washing was executed in accordance with the SOP for the last applicable machine transfer.
- In some cases, OPW will assist other authorities in the control of invasive species. In these projects, the works are typically carried out in partnership between a number of authorities such as IFI, NPWS and relevant Local Authority. As scenarios arise where OPW are requested to assist in an invasive species control project, Management Staff are encouraged to support the multi-authority partnership model which will maximise resource efficiencies for all parties while still achieving a broader environmental good.

### **Invasive Species – Zebra Mussel**

- Zebra Mussels are present in the River Shannon, Grand Canal and are in many lakes such as L Derg, L Ree, L Garra, L Key, L Derragh, Derravaragh, L Sheelin and L Corrib. This species is spreading and it is prudent to assume that works in any large sluggish river or near a lake has potential to contain Zebra Mussel.
- For any proposed works in the vicinity of potential Zebra Mussel waters, flag for Operational Staff and ensure particular attention to cleaning procedures for all equipment prior to removal from site.
- Any new location of Zebra Mussel uncovered during operations, notify NPWS and IFI for their information.
- Record on Weekly Record Sheet which will be uploaded on the Records Database in accordance with the National Recording Process.
- On an annual basis, Environment Section will collate the records nationally and issue to any relevant authorities to assist in tracking the species spread.

### **Tree Management**

- A small portion of channels have more infrequent maintenance cycles typically where self cleaning gradients are present. These sites can entail abnormally dense tree cover which may be required to be managed for conveyance or fisheries purposes. Removal of any abnormally dense layer of vegetation is to be executed between September and February (inclusive) to minimise impacts on nesting birds unless there are other overriding requirements.
- IFI requests to reduce “tunnelling” on drainage channels to be accommodated where feasible. OPW Management Staff to facilitate a site visit with the IFI Officer as required and devise a selective approach to the tree removal so as to retain a dappling of shade along the channel length.
- Excess woody vegetation to be collected and utilised by the following in order of preference:
  - Reused by adjoining landowner for domestic firewood.
  - Subject to landowners agreement, stockpile excess to form natural cover and niche habitat, preferably with some connection of cover to the channel e.g. along a hedge leading to the water.
  - Shred and spread along the adjoining top of bank allowing the material to degrade rapidly and recolonisation of the underlying vegetation.

### **Environmental Drainage Maintenance (EDM) Guidelines**

- A portion of operational crews will be audited annually for implementation of the EDM Guidelines and other standard environmental procedures as adopted.
- Auditing will be carried out separately by both IFI and OPW Environment Section on a rotational basis to ensure all operational crews are audited at least once every three years.
- Audit results will be recorded on a standard format with the following feedback:
  - All audit results will be forwarded to the relevant Engineer for that Drainage Scheme within two working weeks.
  - In the event of an audit showing elements of unreasonable non-compliance with procedures, the relevant Engineer will be notified within one working day.
  - Audit results will be forwarded to OPW Systems Co-ordinator for inclusion in monthly regional benchmarking reports.
  - IFI EREP team will compile an overall summary of their findings in their end of year report under the EREP project.
- Design for Enhanced Maintenance works under EREP will include a design element for full scale implementation of the EDM Guidelines such as Boulder Replacement and Excavating Pools.
- Management Staff to ensure that as far as practical, all Operational crews have an opportunity to get experience on these projects.

### **3.2 OPW Standard Operating Procedures (SOPs)**

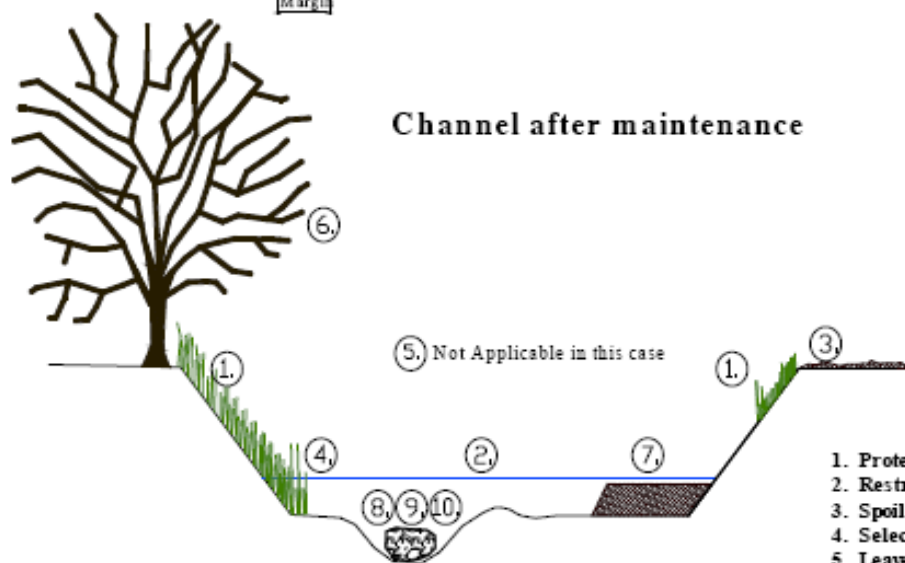
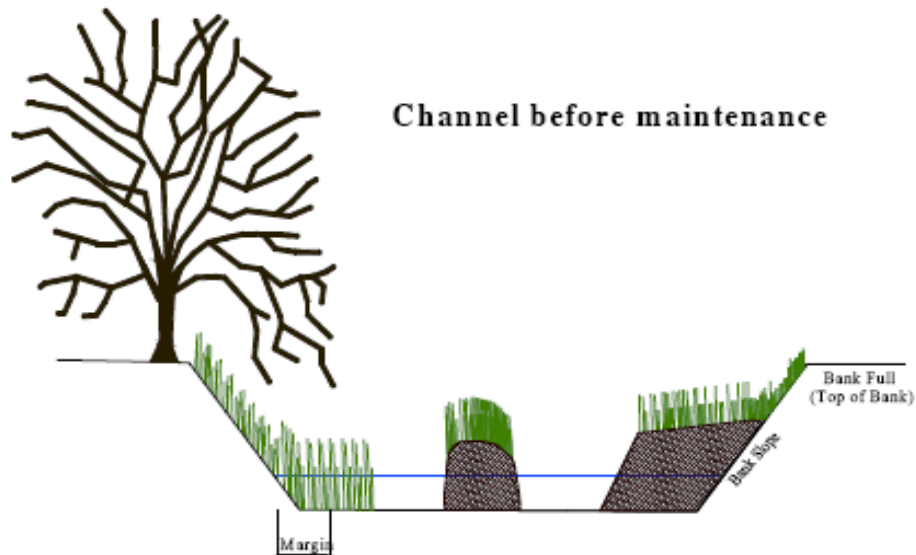
A total of 7 No. Standard Operating Procedures are applied during operational works. These SOPs set out actions designed to eliminate, or substantially reduce impacts to identified species and their associated habitats. These include:

- Environmental Drainage Maintenance Guidance Notes (10 Steps to Environmentally Friendly Maintenance)
- Lamprey SOP
- Crayfish SOP
- Otter SOP
- Mussel SOP
- Invasive Species SOP
- Zebra Mussel SOP

# Environmental Drainage Maintenance Guidance Notes



## 10 Steps to Environmentally Friendly Maintenance



1. Protect bank slopes
2. Restrict maintenance to channel
3. Spoil management
4. Selective vegetation removal
5. Leave section untouched
6. Management of trees
7. Manage berm to form two stage channel
8. Replace stones and boulders
9. Loosen gravel beds
10. Re-profile channel bed

### 1. Protect bank slopes

- 1.1 Do not disturb the non-working bank slope
- 1.2 Minimise any effect on working bank
- 1.3 Leave margin of vegetation at foot of each bank slope



### 2. Restrict maintenance to channel

- 2.1 Remove only necessary silt – no new diggings
- 2.2 Remove instream material only
- 2.3 Retain marginal vegetation
- 2.4 Check spoil regularly. *See Lamprey & Crayfish SOPs*

### 3. Spoil Management

- 3.1 Maximise spoil placement on bank full line or spoil heaps **and**
- 3.2 Minimise spoil placement on bank slopes
- 3.3 Spread spoil as thinly as possible
- 3.4 Allow water to drain out of bucket over the water – lets small fish, lamprey and crayfish escape





## Environmental Strategies for Channel Maintenance



### 4. Selective Vegetation Removal

- 4.1 Retain a band of vegetation on both sides at water's edge
- 4.2 Selectively manage instream vegetation
- 4.3 Maximise use of weed-cutting bucket
- 4.4 Avoid maintenance in coarse fish channels from 1<sup>st</sup> April to 1<sup>st</sup> July



- 4.5 Retain 1/3 to 1/2 of instream floating type vegetation, such as *Ranunculus* (water crowfoot) – see photo to right



### 5. Leave sections untouched

- 5.1 If channel capacity is not affected, leave section alone





### 6. Management of Trees

- 6.1 Remove trees that are blocking the flow
- 6.2 Tree-cutting window 1<sup>st</sup> September to 28<sup>th</sup> February



- 6.3 Remove overhanging branches to known flood level

- 6.4 Use saw secateurs for removal, not excavator bucket

- 6.5 Manage Trees to reduce very heavy shading
- 6.6 Manage briars and scrub.  
*See Otter SOP*



### 7. Manage berms to form two-stage channels

- 7.1 Retain berm where channel capacity is not affected
- 7.2 Remove top of berms to low flow levels
- 7.2 Remove vegetation and soil from gravel berms
- 7.3 Replace sod to the berm where feasible
- 7.4 Only narrow berms if 'excessively' wide for the channel (i.e. greater than a third of the channel width)



### 8. Replace stone and boulders

- 8.1 Reinstate boulders and gravels as removed by maintenance operations
- 8.2 Reinstate suitably sized boulders into channel from spoil heaps where feasible
- 8.3 Boulders should be placed at or below low flow level and spaced out

### 9. Work in gravel bed channels

- 9.1 Loosen or toss bed gravels to wash out fines
- 9.2 Only considered between 1st July and 30th September
- 9.3 No work in gravel bed / spawning channels in fisheries 'closed season'  
*Note:* This varies locally check with local IFI





## Environmental Strategies for Channel Maintenance



**10.1** Excavate bed to form deeper pool areas and shallow riffles



**10.2** Overdeepen the channel along one side and place spoil on opposite side –particularly on curves and bends

**10.3** Use existing boulders to form simple low-level structures



**10.4** Record where such works are carried out

## BROOK, RIVER & SEA LAMPREY STANDARD OPERATING PROCEDURE - ARTERIAL DRAINAGE MAINTENANCE

### **Actions during Maintenance Operations**

- Machine gangs to closely observe the spoil three times daily for Lamprey (and Crayfish).
- Where Lamprey encountered:
  - Contact area Foreman immediately.
  - Foreman to contact Engineering Staff in line with the Environmental Management Protocols.
  - Record the location and abundance of Lamprey on the time card.

### **Measures as directed by Foreman to minimise impact may include:**

- Skip a defined stretch of channel.
- Confine maintenance to 2/3 of channel width leaving marginal vegetation and silt intact.
- Maximise use of weed cutting bucket particularly where aquatic vegetation removal is the primary objective.



*Lamprey in the spoil*



## RIVER, BROOK & SEA LAMPREY IDENTIFICATION CARD



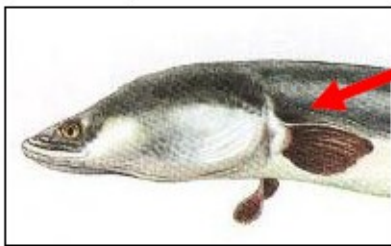
Gill Pores



Lamprey and young eels can look very similar. These key identifying features can be used to distinguish the two species

### Lamprey:

- Gill Pores (Holes)
- No Fins
- No Jaw
- Average length 8 to 15cm (3 to 6 inches)



No Gill pores

### Eels: No Gill Pores

Paired Fins

Jawed Mouth

Average length 65cm (26 inches)

### Juvenile Lamprey:

- Juvenile Lampreys live in the sediment.
- It is in this juvenile phase that they can be removed from the sediment during maintenance.



### Adult Lamprey:

- Largest is the Sea Lamprey species.
- Also are River and Brook Lamprey
- Length from 30 to 60cm (12 to 24 inches).



## WHITE-CLAWED CRAYFISH STANDARD OPERATING PROCEDURE - ARTERIAL DRAINAGE MAINTENANCE

### **Actions during Maintenance Operations**

- Machine gangs to closely observe the spoil three times daily for Crayfish (and Lamprey).
- Where Crayfish encountered:
  - Contact area Foreman immediately.
  - Foreman to contact Engineering Staff in line with the Environmental Management Protocols.
  - Record the location and abundance of Crayfish on the time card.

### **Measures as directed by Foreman to minimise impact may include:**

- Skip a defined stretch of channel.
- Confine maintenance to 2/3 of channel width leaving marginal vegetation and silt intact.
- Maximise use of weed cutting bucket particularly where aquatic vegetation removal is the primary objective.



*Crayfish in the spoil*



## WHITE-CLAWED CRAYFISH

### Identification

- Resemble small lobsters.
- Colour varies from light to dark green-brown, with large front claws.
- Adults typically 7cm - 10cm (3" - 4") long.
- Juveniles can be as small as 2cm (1") long.
- Prefer channels with
  - dense weed cover (flaggers / watercelery) or
  - with a mixture of rocks / gravels that provide crevices for cover.



## **OTTER**

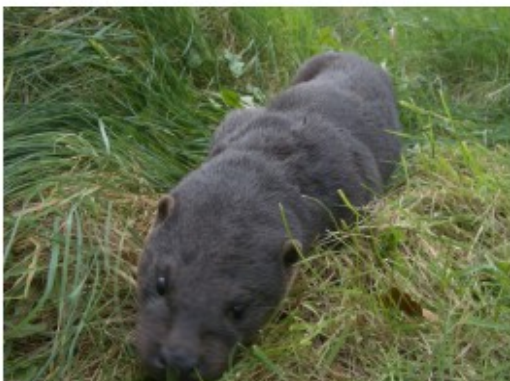
### **STANDARD OPERATING PROCEDURE - ARTERIAL DRAINAGE MAINTENANCE**

#### **Week before Maintenance Operations begin:**

- Operational staff will walkover works area one week in advance in conjunction with the PRA noting areas of dense cover with access directly to the water. (As identified during Otter Awareness Training)
- These areas of suitable cover should be avoided where feasible during maintenance.
- Suspected presence of an Otter holt to be reported immediately to area Foreman, who will contact Engineering Staff in line with the Environmental Management Protocols.
- Signs of Otter presence observed such as Spraints, Footprints or suspected Holts, to be recorded on the Weekly Record Cards.

#### **Measures to minimise disturbance may include:**

- Retain suitable cover where possible.
- Areas of dense scrub to be avoided by large plant.
- Skip stretch of channel in proximity of suspected holt.



#### **Otters**

- Widespread presence on OPW channels.
- Shy animals and not normally seen.
- Adults 1 metre long and weigh 10kg.
- Streamlined profile.



# OTTER

## Holts

- Usually well concealed.
- Typically burrows, or spaces under banks, tree roots or dense cover.



## Spraints

- Found on rocks, paths, channel junctions.
- Dark, oily, sweet smelling.

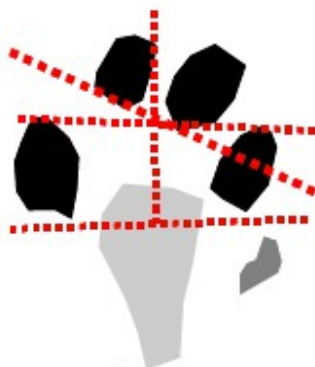


## Suitable areas of cover

Dense bankside vegetation, particularly where there is direct covered access to the water.  
Any isolated clumps of dense vegetation giving cover along an open length of channel.

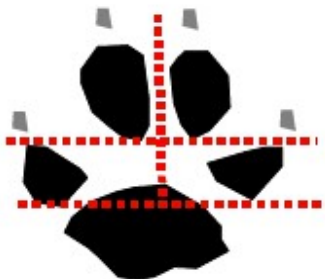


## Foot-prints



**Otter**

(Non-symmetrical toes)



**Dog**

(Symmetrical toes)



**Fox**



**Badger**



**Mink**

## **MUSSELS**

### **STANDARD OPERATING PROCEDURE - ARTERIAL DRAINAGE MAINTENANCE**

## **FRESH WATER PEARL MUSSELS**

### **Before Maintenance Operations begin:**

- Maintenance must not commence where a known population of Fresh Water Pearl Mussel exists (as listed in the Environmental Management Protocols).
- In the unlikely event of new population of Fresh Water Pearl Mussel being encountered during maintenance,
  - **All works must cease immediately.**
  - Contact area Foreman.
  - Record the location of Mussels on the time card.

### **Measures to minimise disturbance may include:**

- Placing of straw bales to prevent movement of silt.
- Any exceptional / emergency works to be carried out in close consultation with the NPWS.
- For exceptional / emergency works e.g. fallen tree obstruction – these to be lifted clear of the channel to prevent disturbing the channel bed.



## MUSSELS



### Fresh Water Pearl Mussels (*Margaritifera margaritifera*)

- Shells very thick & heavy – shaped like a kidney.
- Shell colour is dark-brown – black, to blue & black.
- Adults range in length from approx. 6 cm – 12 cm (2.5 – 5 inches) and can live for over 100 years.
- Suitable rivers are reasonably fast flowing, with very clean, good quality water, gravel bed, preferably with large cobbles.



### **Not to be confused with Duck & Swan Mussel**

- Egg-shaped shells 12 -16cm (5-6 inches) long.
- Thin shiny shells, usually brownish yellow with traces of green.
- Found in slow moving water.
- If encountered, contact area Foreman and return Mussels to channel.
- Record location of Mussels on time card



## **INVASIVE SPECIES STANDARD OPERATING PROCEDURE – ARTERIAL DRAINAGE MAINTENANCE**

### **Measures to reduce the risk of spread of invasive species**

**All excavators, weed cutting boats, tractors, dumpers & other machinery employed on maintenance must be thoroughly cleaned down using a power washer unit prior to being;**

- (a) transported by Low- Loader**
- (b) moving to another catchment within the Region**
- (c) moving to another Region.**

**Notify your supervisor immediately if you see any of the invasive species listed.**

*Full details of all species are available in the CFB's  
Field guide to the Identification of Aquatic Invasive Species*





## Giant Hogweed

Found on the banks of many rivers throughout Ireland.

Can grow to a height of 4 metres.

Seeds are carried by water and spread very quickly.

!!!Avoid contact with the sap of this plant as it can cause extensive lesions or blistering of the skin.



## Japanese Knotweed

Grows up to 2-3m in height along roadsides and river corridors throughout the country.

Even a tiny piece of this plant can produce a new plant.

Leaves are heart-shaped with a pale stripe down the centre.

In Summer cream flowers arise from the tips of the red-flecked stems.



## Himalayan Balsam

Grows in dense strands up to 3m high, and is found widespread across Ireland along banks of rivers.

Seed pods explode scattering seeds.

Dies back in Autumn exposing bare banksides to erosion.

White or pink flowers, smooth hollow stem, oval shaped pointed leaves with jagged edges.



## Curly waterweed – *Lagarosiphon major*

Found in lakes and slow flowing waterways up to 6m deep.

Spread by fragmentation from one watercourse to another on boat hulls, trailers, outboard motors or angling equipment.

Significant weed stands located in Lough Corrib.



## Zebra Mussels

Distinctive stripy shell, very small (1-3cm).

Attach in clusters to hard surfaces – boats, pipes, buoys.

Refer to the [Zebra Mussel Standard Operating Procedure](#).

*All photographs courtesy of Central Fisheries Board*

**Actions for Maintenance Operations****1) Zebra Mussels detected on site**

- Where Zebra Mussels are found, remark on the extent of Mussels on the Weekly Report Card and notify the Foreman/Technician.
- Technicians/Engineers to notify Environment Section of location and grid reference.
- Environment Section to update the National Database.

**2) Maintenance close to R. Shannon or infested lakes**

- Where a machine is working close to the R. Shannon or an infested lake, ensure that prior to the machine transferring to a new site, buckets and tracks are thoroughly cleaned of any material such as silt or vegetation.
- Ganger / Driver to visually inspect the bucket, tracks and any equipment that was in the water to ensure no Mussels are present.

**3) Maintenance close to outlets/inlets of any lakes**

- Where a machine is working close to any lake, ensure that prior to machine transferring to a new site, buckets are clean of any material such as silt or vegetation.
- Ganger / Driver to visually inspect the bucket and other equipment that was in the water to ensure no Mussels are present.

**4) Boats and other equipment**

- Boats or other water based equipment that is to be transferred between river catchments should be thoroughly cleaned on the outside, drained of any bilge water and inspected for the presence of Mussels.
- If it's suspected that the equipment was in contact with Zebra Mussel waters, steam clean the hull and trailer and leave the boat or equipment out of water for four weeks prior to moving.

**OPW Role**

Although it is a relatively low risk, OPW could spread Zebra Mussels if aquatic vegetation or excavated material containing Mussels is inadvertently transported to another non-infested channel. Adult Mussels can survive for up to four weeks out of water hence its critical not to transport the same. Larvae are tiny and barely visible but will not survive on a machine bucket if there is no silt, stones or vegetation to shelter it.

**Environmental Threat**

Zebra Mussels are thumbnail-sized black & orange striped shellfish. They grow into dense clusters and attach to any underwater hard surface. They are an invasive species that damage the natural ecology of the infested waters. They expand into catchments through been transported by man's activities e.g. transferring fishing boats. Once in a particular lake or river, if conditions are favourable, they will multiply and spread with the currents. It is envisaged that they will keep expanding their territory unless man makes a concerted effort to prevent transport of the Mussels into non-infested waters.



## **4.0 Mitigation and Monitoring**

### **4.1 Environmental Management System**

All works carried out as part of this Programme are done in accordance with OPW's Environmental Management Protocols and Standard Operating Procedures.

#### **Environmental River Enhancement Programme 2008-2012**

The Arterial Drainage Maintenance Service of Engineering Services, OPW is carrying out a five year Environmental River Enhancement Programme (EREP). The enhancement works consist of both capital enhancement and enhanced maintenance. These works focus on river corridor improvements to salmonid channels with specific actions on 100 kilometres of Scheme channel per annum, with pre and post measurement of biodiversity taking place on the channels in the relevant sub-catchments scheduled to benefit from these works. The identification of these channels, the carrying out of biodiversity assessments, the preparation of a five year programme of work and post biodiversity change assessments forms part of the work programme to be delivered by the service provider i.e. Inland Fisheries Ireland. It also involves making the assessment data available in a form that will allow completion of hydromorphological assessments.

The enhancement works are being carried out using OPW staff and machinery with the IFI's staff working alongside OPW supervisory staff. All materials required for the construction of in-stream structures, gravel and fencing is being supplied by OPW.

#### **Environmental Training**

Environmental training of all staff is an ongoing process. Technical and Operational Staff have completed formal training in environmental river maintenance in 2004, and again in 2010 which contained the more recent environmental practice. This training was developed and delivered by Inland Fisheries Ireland as part of the EREP. The training programme delivered included presentations in river corridor ecology, maintenance strategies involving both 'enhanced maintenance' and 'capital enhancement', and OPW's Environmental Management Protocols and SOPs.

The formal approach to EREP Training is complimented with on-site training. Regular site visits from IFI and OPW's Environment Section provide further guidance and advice to operational staff. Auditing of operational staff on the implementation of the Environmental Drainage Maintenance Guidance Notes (Ten Steps to Environmentally Friendly Maintenance) is also carried out under EREP.

In addition, other environmental training takes place as deemed beneficial, e.g. in 2008, the majority of operational staff were trained in Otter Awareness. This course, provided by the Department of Zoology, Trinity College Dublin, included presentations on otter ecology, and on-site identification of otter signs and suitable habitat.

#### **Geographical Information Systems (GIS)**

GIS systems are now a significant tool to manage both the existing and future environmental information and to this effect, the Drainage Maintenance Service has recently digitised the original Drainage Scheme maps. GIS systems allow the rapid and accurate transfer of geographical environmental data and it is hoped to contain

all maintenance work programmes, fishery information such as spawning reaches, environmentally designated areas e.g. SACs, other sensitive sites such as habitats of protected species and general habitat information in this format

### **Ecological Assessments**

The Arterial Drainage Maintenance Annual Works Programme is screened for potential impacts on Natura 2000 Sites. Channels identified as having the potential to impact on a Natura 2000 Sites are subject to Appropriate Assessment under Article 6(3) of the Habitats Directive. These Appropriate Assessments are carried out by external Ecological Consultants.

The High Risk Channel Designation process is at development stage, and while there have been no formal 'Designations' under this approach, there are a number of localised flood alleviation projects completed or underway which would be of a similar nature as envisaged for 'Designation'. Recent practice for any new localised flood alleviation projects is to carry out an Appropriate Assessment if the works overlap with a Natura 2000 Site or an ecological assessment if the works are not within a Natura 2000 Site but still need to have regard to the broader protected habitats and species such as Annex IV species, Wildlife Acts or Flora Protection Order.

### **Environmental Impact Assessments**

European Communities (Environmental Impact Assessment) Regulations, 1989 to 2006 transposes the EIA requirements with recent further changes to the EIA thresholds been introduced through the Planning and Development (Amendment) (No. 2) Regulations 2011. The most applicable class of development relevant to drainage maintenance and 'Designation' projects is in respect of Canalisation. The thresholds are where canalisation and flood relief works, where the immediate contributing sub-catchment would exceed 500 hectares or where more than 2 hectares of wetland would be affected or where the length of river channel on which works are proposed would be greater than 2 km.

Arterial drainage maintenance works are considered to be sub-Environmental Impact Assessment threshold as the operations are maintaining the river corridor but are not canalising any new lengths.

For 'Designation' projects, it is foreseen that the size and scale of the works will be sub-threshold EIA. However, proposed 'Designation' projects will consider the EIA thresholds and any project exceeding qualifying will be subject to an EIA. In the absence of an EIA, an ecological assessment will be carried out as described above.

### **Planning & Development**

While there is an extensive range of Planning and Development legislation, the most applicable current legislation is the Planning and Development Regulations, 2001 and the Planning & Development Acts 2000 to 2010. This legislation exempts from planning permission, works under an Arterial Drainage Scheme. These drainage works and the associated maintenance, forming part of a scheme have been confirmed by a Minister and have gone through a public exhibition process in accordance with the Arterial Drainage Acts 1945 and 1995.



For proposed High Risk Channel Designation projects, each specific project will require consideration of the requirements for compliance with the Planning and Development Acts and associated Regulations. Pending changes to legislation, 'Designation' projects of an urgent nature may be carried out on a once-off basis by agreement with affected landowners and statutory stakeholders or under the provisions of Part VIII of the Planning and Development Regulations, 2001 and the Local Authorities (Works) Act, 1949. Works using Part VIII procedures must be under the threshold for an EIS, as works above the threshold would fall under the Strategic Infrastructure Act, 2006.

It is the intent of the Flood Policy that Designation would lead to ongoing maintenance and it envisaged that works carried out by agreement will involve upkeep, maintenance and repair only. Therefore, further legislative changes are necessary, and future Designation would be made under new legislative powers, including absorption of prior works.

## **4.2 Monitoring Programme**

Monitoring of this Programme is made up of two components. The first addresses the on-site implementation of OPW's Environmental Management Protocols and Standard Operating Procedures. The second is a scientific monitoring programme, carried out under the EREP, assessing the impacts of routine maintenance and 'capital enhancement' projects on the river corridor biodiversity.

### **Auditing**

External auditing of operational staff, on the implementation of the Environmental Drainage Maintenance (EDM) Guidance Notes (Ten Steps to Environmentally Friendly Maintenance), is carried out by Inland Fisheries Ireland, as part of the EREP. These audits inform the OPW of the level of compliance with the Environmental Management Protocols and Standard Operating Procedures, with particular focus on the EDM Guidance Notes. External auditing covers approximately one-third of OPW drainage machine crews annually.

Auditing (both internal and external) provides an opportunity to assess the level of compliance with Environmental Management Protocols and SOPs. It also allows for discussion on any difficulties encountered and experimental works that could be applied. The OPW Foreman is present throughout the audit along with the entire machine gang. A section of recently maintained channel is examined along with the next section to be maintained. This gives a good idea of pre-maintenance conditions and enables recommendations to be made about maintenance should proceed, should changes be required. The audit form is forwarded to the relevant Engineer.

A rating system was developed and is recorded in OPW's Internal Management System. Ratings are monitored by both IFI and OPW to identify any issues with particular machine crews, or any difficulties with particular aspects environmental maintenance.

### *Audit Ratings*

<b>Rating %</b>	<b>Category</b>
0-49	Unacceptable
50-59	Poor
60-70	Acceptable
71-84	Good
85-100	Very Good

Audit results are reported to OPW Management Staff throughout the year and presented in the IFI's Annual EREP report. Presentations are delivered on the auditing and recommended improvements at an annual meeting had with IFI's EREP Team and OPW's Engineers, Technicians and Foremen.

Internal auditing is carried out by OPW's Environment Section. A number of OPW/IFI audits are carried out in tandem annually for standardisation purposes. A standard audit form is used by both IFI and OPW's Environment Section (**OPW Site Audit Form**).

## OPW Site Audit Form

**Region:** \_\_\_\_\_ **CDS:** \_\_\_\_\_  
**Channel (name & code):** \_\_\_\_\_ **Section (chg – chg):** \_\_\_\_\_  
**Foreman:** \_\_\_\_\_ **Driver(s):** \_\_\_\_\_  
**Auditor:** \_\_\_\_\_ **Date:** \_\_\_\_\_  
**Site surveyed from-** working bank: ☐ non-working bank: ☐  
**GPS Reference:** \_\_\_\_\_ **Photographs:** Yes ☐ No ☐  
**Weather Conditions:** \_\_\_\_\_ **Water levels:** \_\_\_\_\_  
**Wetted/Base width:** 0-3m ☐ 3-6m ☐ 6-10m ☐ 10-15m ☐ >15m ☐  
**Velocity Rating:** Slow ☐ Moderate ☐ Fast ☐ Torrential ☐  
**Bed Type:** \_\_\_\_\_ **Machine Number:** \_\_\_\_\_

### OPW SOP AWARENESS / COMPLIANCE

**Invasive Species SOP:** Poor / Fair / Good / Excellent  
**Protected Species SOP's:** Poor / Fair / Good / Excellent  
**Spill Kit Present:** YES / NO

### Environmental Drainage Maintenance Constraints

Maintenance Constraints		Working Bank	Non Working Bank
Ownership:	Woodland		
Ownership:	Tillage		
Ownership:	Position of Fencing		
Availability of suitable stone			
Placement of spoil			
Time of year:	Tree cutting		
Time of year:	Wildlife		
Time of year:	Fisheries		
Potential Habitat for Annex II Species	Lamprey		
	Crayfish		
	Otter		
	Pearl mussel		
	Salmon		

### Comments on Audit Findings

Maintenance Strategies Achieved - (based on section recently maintained)							
Maintenance Options		Working Bank		Non-working Bank		Instream Channel	
		Suitability	Compliance*	Suitability	Compliance*	Suitability	Compliance*
<b>Protect Bank Slopes</b>							
1	Non-working bank left intact						
	Protect working bank slope						
<b>Restrict Maintenance to Channel</b>							
2	Restrict maintenance to open channel						
	Use of SOPs for lamprey and crayfish						
<b>Spoil Management</b>							
3	Best practice placement of spoil						
	Spread spoil thinly						
	Let water drain from bucket over channel						
<b>Selective Vegetation Removal</b>							
4	Manage instream vegetation (Attn SOPs)						
	Retain marginal vegetation both sides						
	Potential for weed cutting bucket						
	Outside coarse fish spawning (April 1 <sup>st</sup> to July 1 <sup>st</sup> )						
<b>Leave Sections Intact</b>							
5	Sections skipped						
<b>Management of Trees</b>							
6	Remove trees blocking flow						
	Observe tree cutting window						
	Remove low hanging branches to known flood level						
	Use chainsaw/secutors for tree removal or thinning						
	Tree thinning management						
	Manage scrub - Otter & Birds SOP						
<b>Manage Berms to form 2 Stage Channels</b>							
7	Retain berms (no maintenance)						
	Top berm to just over summer water flow						
	Re-sod berms where suitable						
	Only narrow berms if OVER-WIDE						
<b>Replace Stone &amp; Boulders</b>							
8	Replace stone and gravel coming out in digging bucket (No New Diggings)						
	Replace large stones/boulders into channel from old spoil						
<b>Working in Gravel Bed Channels</b>							
9	Loosen/toss gravels (between July 1 <sup>st</sup> & Sept. 30 <sup>th</sup> )						
	No instream works outside of Fisheries Window (between July 1 <sup>st</sup> & Sept. 30 <sup>th</sup> )						
	Use of silt barriers in winter/spring						
<b>Re-profile Channel Bed</b>							
10	Dig pool - riffle sequences						
	Reprofile cross-section						
	Use existing stone to create 'simple' instream structures						

\*based on rating system: 0-10, with 0=no compliance and 10=full compliance

Total Compliance (%)

OVERALL COMPLIANCE (%)

### **Scientific Monitoring**

The EREP biological monitoring programme assesses the impacts of routine maintenance and 'capital enhancement' projects on the river corridor biodiversity. Fish, flora, birds, macro-invertebrates, lamprey and crayfish are monitored across a selection of sites. The physical changes in the channels are also monitored. Monitoring of these aspects have been ongoing since the commencement of the EREP in 2008. The results of this 5-year monitoring programme will be examined in 2012, with a view to identifying areas where further information is deemed necessary.

### **River Corridor Biodiversity**

EREP monitoring to date has indicated that often changes seen across the whole site can be interlinked. Enhancement of the physical regime can greatly improve channel diversity, through the creation of riffle/glide/pool sequences, addition of spawning gravels and bank protection.

Physical changes to the channel often result in changes in the floral communities, as a more diverse bed material is available. Species such as *Ranunculus* and *Scirpus* tend to favour gravely bed material will softer sediment attracts species like *Sparganium*.

Changes to the aquatic, marginal and riparian vegetation can often result in changes to the invertebrate communities. Increased vegetation cover and diversity often correspond with increased invertebrate diversity and abundance.

### **Physical Monitoring**

Physical monitoring includes pre and post works monitoring of a number of variables. Variables measured include bank-full width, wetted width, channel length, depth velocity and canopy cover.

The Water Framework Directive (WFD) requires information on hydromorphological conditions, along with biological quality and physico-chemical conditions, in order to determine the ecological status of any given water-body. A classification of 'High Ecological Status' cannot be assigned to a water-body unless the hydromorphological conditions are high also. If the hydromorphological condition of a water-body has not been determined and the system has been subject to drainage, then that catchment is deemed to be "probably at risk". Therefore the EREP has included monitoring of hydromorphology in its monitoring programme.

The River Hydromorphology Assessment Technique (RHAT) monitoring system has been approved as the appropriate method to determine hydromorphological status of a channel and is being used for WFD monitoring.

RHAT is used to monitor hydromorphological condition of a selection of channels under EREP. The data collected will feed back to the Environmental Protection Agency (EPA) and contribute to the overall national assessments on channel morphology.

### **Floral Monitoring**

Three vegetation types are surveyed under the floral monitoring programme. These include:

- Aquatic (in-channel) vegetation
- Marginal vegetation
- Riparian vegetation

A walkover survey of the entire site is used to compile a species inventory of riparian and in-stream species. Quantitative assessments are also carried out within the sites. Tree surveys also form part of this monitoring process and include information of composition and abundance of tree cover.

### **Macro-invertebrate Monitoring**

The macro-invertebrate communities of a river respond quickly to change and are a good reflection of conditions in the short term. Their assemblages reflect changes in habitat as well as changes in water quality, as most species have a preference for either fast or slow flowing water, sheltered or exposes areas and silt or cobbles. Sampling is carried out at both experimental and control sites, and a species inventory list compiled.

### **Fish Sampling**

While the primary focus for the EREP fish stock survey is on salmon and brown trout, data from all species encountered during surveys are recorded. Data collected provides information on population, distribution, age-structure for any species encountered.

### **Bird Population Studies**

Bird surveys are carried out a selection of sites, using standard survey methods used by Bird Watch Ireland and other relevant agencies. The key objectives of the bird studies are to:

- Record the abundance, species richness and distribution of bird species in OPW channels, and
- Assess the impacts of drainage and drainage maintenance on bird species based on this data.

To this end, surveying is conducted on:

- Various habitat types within the river corridor.
- Sites pre and post maintenance.
- Non-drained channels and drained channels

### **Lamprey & Crayfish Studies**

OPW funded studies to examine the effects of Arterial Drainage Maintenance operations on lamprey and white-clawed crayfish have been ongoing since 2006. Ecological Impact Assessments (EclA) were carried out on both species, by the then Central Fisheries Board. Further research was recommended in these EclAs, which resulted in the continuation of studies of both species as part of the EREP. Surveying of both species includes monitoring of population size and age structure, prior to, and in a series of years post maintenance.