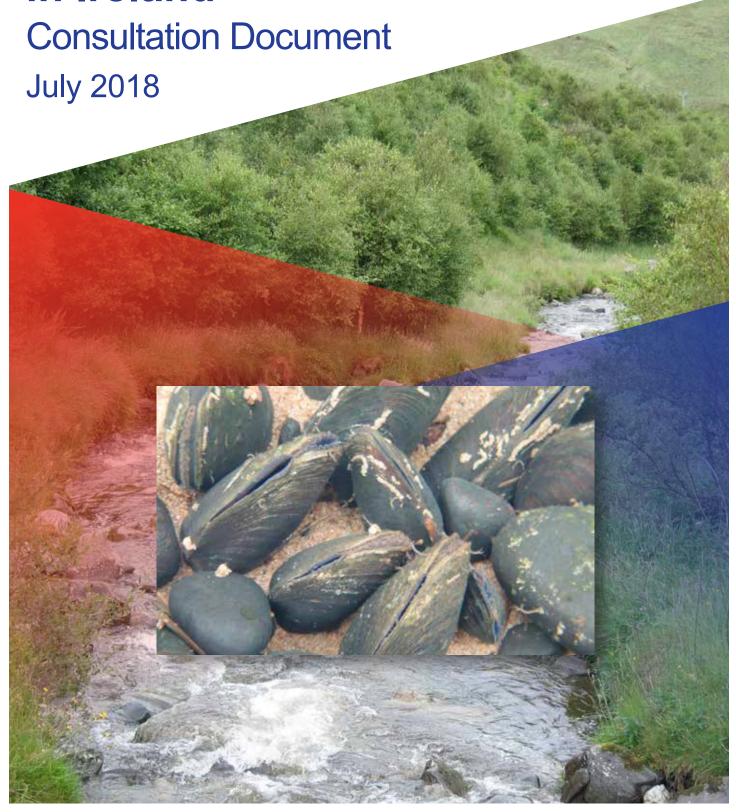


DRAFT Plan for Forests & Freshwater Pearl Mussel in Ireland



The Department of Agriculture, Food & the Marine (DAFM) is responsible for ensuring the development of forestry within Ireland in a manner and to a scale that maximise its contribution to national socio-economic well-being on a sustainable basis compatible with the protection of the environment. Its strategic objectives are to:

- > foster the efficient and sustainable development of forestry
- > increase quality planting
- > promote the planting of diverse tree species
- > improve the level of farmer participation in forestry
- promote research and training in the sector
- encourage increased employment in the sector

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Contents

Executive Summary	iii.
Section 1: Introduction	
1.1 Overview	1
1.2 Key components of this Plan	2
1.3 Role and scope of the DAFM	3
1.4 A Model for Woodlands & Forests in FPM Catchments	4
1.5 Linkage between Forests & Water and this Plan	4
Section 2: Freshwater Pearl Mussel: Ecology & Status in Ireland	
2.1 Freshwater Pearl Mussel in Ireland	8
2.2 Ecology and life-cycle	8
2.3 Current status in Ireland	10
2.4 Legal protection	12
2.5 Sub-Basin Management Plans	13
2.6 National Strategy for the Conservation of FPM	19
2.7 Prioritisation and the Plan	19
2.8 River Basin Management Plan	20
Section 3: Forests & Forest Activities: Threats & Opportunities	
3.1 Overview	21
3.2 Threats	21
3.3 Opportunities	23
Section 4: Forests & FPM Management Framework	
4.1 Overview	26
4.2 Context	26
4.3 Assessing site risk and identifying appropriate options	29
4.4 Forests & FPM Options	29
4.5 Submission and assessment	31
Section 5: A Model for Woodlands & Forests within FPM Catchments	
5.1 Introduction	33
5.2 Realising the Model	34
5.3 Components of the Model	35
5.4 Catchment level impact	38
Section 6: Awareness-Raising & Training	
6.1 Overview	39
6.2 Awareness-raising	39
6.3 Training for Forestry Inspectors, Registered Foresters and Contractors	41

Section 7: Monitoring

7.1 Introduction	43
7.2 Onsite monitoring by the Applicant	43
7.3 Onsite monitoring by DAFM	43
7.4 Overall monitoring of the Plan	44
Appendices	
Appendix A: Conservation Objective for FPM: Example	46
Appendix B: Site Risk & Operations Form	52
Appendix C: Forests & FPM Options	60
Appendix D: Daily Monitoring Form	88
Appendix E: Site Contingency Plan	93
Appendix F: Priority 8 FPM Catchments	95
Appendix G: References & Further Reading	176
Appendix H: Glossary	179

Executive Summary

The document sets out a draft Plan for Forestry & Freshwater Pearl Mussel in Ireland, developed by the Department of Agriculture, Food & the Marine (DAFM) as part of the national strategy for the conservation of the species.

Freshwater Pearl Mussel (FPM) is a bivalve mollusc that lives in clean, fast-flowing streams and rivers. It is Ireland's oldest living animal, with individuals reaching up to 120 years of age. It is protected under the Wildlife Act 1976 and the Wildlife (Amendment) Act 2000, and is listed under Annex II and Annex V of the EU Habitats Directive. The species is in decline internationally, and Ireland's population, which itself represents a significant portion of Europe's, is decreasing. The Habitats Directive Article 17 report for 2013 presents the overall conservation status for the species as 'Bad' and declining.

FPM has a multi-stage life-cycle and requires the cleanest of waters to survive and to reproduce successfully. However, pressures such as diffuse pollution of sediment and nutrients from various land uses and changes in hydromorphology place extreme stress on individual populations, preventing the recruitment of young age classes and leading to the direct mortality of adults.

Inappropriately-sited forests and poorly-managed forest activities can act as a source of pollution (both diffuse and point, in the case of acute incidents) and can affect river morphology. Conversely, woodlands and forests can be located, designed and managed to contribute to the protection of FPM.

This Plan builds on the enhanced baseline level of protection for water set out in the Department's document, Forests & Water: Supporting the Achievement of Objectives under Ireland's River Basin Management Plan 2018-2021 (see www.agriculture.gov.ie/forestservice/grantsandpremiumschemes2015-2018/).

The Plan's area comprises the hydrological catchments of FPM populations within 26 Special Areas of Conservation (SACs) designated for the species, plus the Owentaraglin subcatchment of the (Munster) Blackwater River SAC. The objective of the Plan is to eliminate, reduce or mitigate diffuse and point sources of sediment and nutrients and the disruption of the natural hydrological regime, arising from forests and regulated forestry activities within the Plan's area, to ensure that these do not threaten the achievement of the conservation objectives for FPM set for each of the SACs involved.

This will be ensured though the application of a Forests & FPM Management Framework that identifies appropriate forestry operations, practices and measures of individual sites, based on site risk. Within this Framework, those eight catchments identified for prioritisation in the national FPM conservation strategy are afforded a higher level of risk, thereby limiting the range of options available in these areas. The application of this Framework will be supported by: engagement with stakeholders, owners, foresters and forestry operators; awareness-raising, peer-to-peer learning and training; and monitoring. Coordination will also take place with the National Parks & Wildlife Service, Inland Fisheries Ireland, Local Authorities and the Environmental Protection Agency, and with relevant initiatives such as Kerry LIFE and the newly-established Pearl Mussel Project, an EIP locally-led scheme. The roll-out of the Plan will also be complemented by the ongoing development and implementation of forestry support schemes, including the Native Woodland Scheme.

This document sets out the draft Plan for Forests & Freshwater Pearl Mussel in Ireland, for the purposes of public consultation. It sets out the threats and opportunities forests and forest activities represent, describes the Management Framework and supporting components, outlines a model for woodlands and forests in FPM catchments, and includes a description of the priority eight catchments and the nature of the forest resource within each.

Section 1 Introduction

1.1 Overview

The Freshwater Pearl Mussel (FPM) is a bivalve mollusc that lives in clean, fast-flowing streams and rivers. It is Ireland's oldest living animal, with individuals reaching up to 120 years of age. The current population of FPM is estimated at 11 million adults, and its distribution in more than 160 rivers in Ireland is considered widespread. However, FPM is in severe decline nationally, with the above population estimate representing a fall of 8% since 2007. FPM became legally protected under the Wildlife Act 1976 and the Wildlife (Amendment) Act 2000, from injury or from disturbance or damage to their breeding or resting place. Due to the European and international significance of FPM, the species is also listed under Annex II and Annex V of the EU Habitats Directive.

Under the Forestry Act 2014 (as commenced by the Forestry Regulations 2017, S.I.191 of 2017), the Department of Agriculture, Food & the Marine (DAFM) regulates the following types of forest development: afforestation; forest road works; tree felling; and aerial fertilisation. As a public body under the European Communities (Birds & Natural Habitats) Regulations 2011 (S.I.477 of 2011), DAFM has a direct responsibility under the Habitats Directive to ensure that any activity receiving consent¹ does not have a significant effect on the qualifying interests of, or prevent the achievement of the conservation objectives set for, a Natura site, including a Special Areas of Conservation (SAC) established for the conservation of (inter alia) FPM. These responsibilities provide the underlying basis for the development of this Plan for Forests & Freshwater Pearl Mussel in Ireland ('the Plan'), as

part of the national strategy for the conservation of FPM developed by National Parks & Wildlife Service (NPWS, 2011).

This Plan for Forests & FPM in Ireland applies to the hydrological catchments of FPM populations within 26 SACs designated for the species, plus the Owentaraglin subcatchment of the (Munster) Blackwater River SAC (see Table 2.2). The objective of this Plan is to eliminate, reduce or mitigate diffuse and point sources of sediment and nutrients and the disruption of the natural hydrological regime, arising from forests and regulated forestry activities within the area of the Plan, to ensure that these do not threaten the achievement of the conservation objective for each of the SACs involved, in relation to FPM.

Table 2.2 lists the catchments involved and the respective conservation objectives.

This will be achieved through the application of a tailored Forest & FPM Management Framework to identify the level of risk associated with each individual site, and to match operations appropriate to that risk. The framework will operate within the context of a significantly enhanced 'baseline' level of protection for water and aquatic habitats and species, as set out in the DAFM document Forests & Water: Achieving Objectives under Ireland's River Basin Management Plan 2018-2021 (2018). As such, readers of this draft Plan should also refer to Forests & Water.

In developing this Plan, DAFM takes cognisance of recent and ongoing research and initiatives, including KerryLIFE, the INTERREG Freshwater Pearl Mussel Project, FORMMAR, CROW, HYDROFOR and the European COST Action entitled 'Payments

Photo 1.1 Well-sited and managed woodlands and forests can contribute significantly to the conservation of FPM in Ireland.



for Ecosystem Services (Forests for Water)', as outlined in Section 11 of *Forests & Water*. This is in addition to experiences (both positive and negative) gained by the DAFM and the wider forest sector in relation to individual sites where issues have arisen regarding forests, water and FPM.

1.2 Key components of this Plan

The following sets out the context within which the Forests & FPM Management Framework will operate.

- Once this Plan is finalised, the Forestry & FPM Framework will be activated via a DAFM circular to Registered Foresters and Forestry Stakeholders, effective for all applications submitted from the next date onwards. The circular will also deactivate the current Forestry & FPM Requirements and amendments, and will set out training days for Registered Foresters and contractors operating within the Plan's area.
- ➤ The Framework will apply to all applications for S.I.191 / 2017 licences (for afforestation, forest road construction, tree felling, and the aerial fertilisation of forests) and forestry grants, for 'project areas' (defined as that area specified in the application as being where the proposed activity (and ancillary operations) is to take place) within or partially within the area of the Plan.
- ➤ The area of this Plan extends to the hydrological catchments of FPM populations within 26 SACs designated for the species, plus the Owentaraglin subcatchment of the (Munster) Blackwater River SAC (see Table 2.2). (Note, on commencement of the Plan, the 6 km zone underpinning the Forestry & FPM Requirements (2008) will no longer apply.) These catchments are assigned 'Water Sensitivity Category C' (see Table 3.3 of Forests & Water), as indicated by a dedicated layer in the GIS MapViewer in iFORIS (for Forestry Inspectors and Administration) and iNET (for Registered Foresters).
- The Framework comprises: the Site Risk & Operations Form and associated Forests & FPM Options; and specific provisions that are applied to the evaluation of applications.
- ➤ The Framework also operates within the context of the programme of awareness-raising, training and monitoring set out in this Plan.
- The function of the Framework is to enable Applicants and Registered Foresters to evaluate

- the degree of sensitivity regarding FPM, and to select the most appropriate option(s) regarding the activity in question. This will result in applications appropriately tailored to the sensitivities regarding FPM, pre-submission to DAFM and as early in the planning process as possible.
- A key component of the Forest & FPM Management Framework is the DAFM's Appropriate Assessment Procedure (AAP). The AAP represents the primary mechanism for ensuring that all forestry operations are consistent with the protection of FPM within the area of the Plan, as detailed in Table 2.2.
- All applications within or partially within the area of the Plan (as detailed in Table 2.2) will be subjected to 100% field inspection by District Forestry Inspectors throughout the lifetime of this Plan. All applications will also be referred internally to the Forest Service Ecologist and to an appointed Forestry Inspector with a coordinating role regarding the Water Framework Directive and other water-related issues, for recommendations.
- Subsequently, the project can only be licensed by DAFM if it has ascertained: via AA screening, that there is no possibility of the project having a significant effect on the conservation objectives of a Natura site; or via Appropriate Assessment (if required), that the project will not adversely effect the Natura site. Key throughout is that the project does not threaten the achievement of the conservation objectives for each SAC in relation to FPM (see Table 2.2) (alongside those relating to other qualifying interests and alongside other legal responsibilities, e.g. those under the WFD).
- The Forests & FPM Management Framework is applied within the context of, and in addition to, the enhanced baseline level of protection for water, as set out in the DAFM document Forests & Water: Achieving Objectives under Ireland's River Basin Management Plan 2018-2021 (2018). Regulatory and promotional measures of particular relevant include: the Forestry Act 2014 and associated Forestry Regulations 2017; the Land Types for Afforestation procedure; the Environmental Requirements for Afforestation; the Reforestation Objectives system, the Native Woodland Scheme funding package and the proposed Environmental Enhancement of Forests Scheme; the Woodland for Water measure; and DAFM's application process (as set out in Section 7 of Forests & Water).

¹ Under S.I.477 of 2011, "consent" includes any licence, permission, permit, derogation, dispensation, approval or other such authorisation granted by or on behalf of a public authority (which include Ministers of the Government and Coillte), relating to any activity, plan or project that may affect a European Site, and includes the process of adoption by a public authority of its own land use plans or projects.

- The model for woodlands and forests in FPM catchments, as presented in Section 5, comprises water setbacks and Continuous Cover Forestry Zones. This will form the basic structure to be achieved under this Plan, primarily through forest restructuring and afforestation. This outcome, realised at a site level and coalescing into a significant landscape feature at the subcatchment level, is designed to eliminate potential negative impacts arising from forestry and other land uses, while maximising the contribution woodlands and forests make to water quality and aquatic ecosystems in general, and FPM in particular.
- As set out, DAFM can only act within its regulatory and promotional remit, as set out in Section 1.3. It cannot compel landowners or forest owners to undertake activities, and most await the submission of applications for the various forestry activities, before it can act. However, as outlined, it can encourage certain developments through targeted supports such as the NWS Establishment.
- (Possible processes that may operate in parallel to this Plan include: (i) a programme of conversion / buffer retro-fitting by Coillte; and (ii) the targeting of sites where particular problems or opportunities exists. As these are undefined, they have been excluded from the Plan and hence from above.)

See Table 1.1 for a summary of the four key measures comprising the draft Plan for Forests & FPM in Ireland.

1.3 Role and scope of the DAFM

DAFM has a key role to play in regulating forestry developments (principally under the Forestry Act 2014 and Forestry Regulations 2017) and in promoting the sustainable development of the forest sector (principally through schemes and other support mechanisms under the current Forestry Programme 2014-2020). For details, see Section 1 of Forests & Water.

It regulates key forest activities through the Forestry Regulations 2017, by assessing applications received and by attaching appropriate conditions to any licences / approvals issued. The Forestry Regulations (Section 19(6)) and S.I.477 of 2011 (Section 44(2)) both contain provisions for amending or revoking an issued licence, where conditions are breached or where the continuation of the licence could threaten a Natura site.

DAFM also operates particular schemes, i.e. the Native Woodland Establishment Scheme, the Native Woodland Conservation Scheme and the NeighbourWood Scheme (and the Environmental Enhancement of Forests Scheme, in preparation), which can be used specifically for the targeted delivery of water-related ecosystem services, in partnership with owners and others.

Section 7 of *Forests & Water* sets out in detail the application process applied by DAFM, and its fundamental components, including:

pre-approval assessment & other inspection processes;

Table 1.1 A summary of the four key measures comprising the draft Plan for Forests & FPM in Ireland.

Measure	Proposal
Forests & FPM Management Framework	The Plan for Forests & FPM in Ireland will be implemented through the application of the Forest & FPM Management Framework. The function of this framework is to enable applicants and Registered Foresters to evaluate the degree of sensitivity regarding FPM, and to select the most appropriate approach regarding the operation in question. This results in applications appropriately tailored to the sensitivities regarding FPM, which then enter the DAFM evaluation process.
Proposed Model for Woodlands and Forests within FPM Catchments	A central driver of this Plan is a model for woodlands and forests within the area of the Plan, to be achieved principally through appropriate afforestation and forest restructuring at the clearfell / reforestation stage, and delivering a permanent semi-natural buffer along watercourses comprising an undisturbed setback and native woodland habitat realised with minimum site inputs and to be managed under continuous cover forestry (CCF). This model will be realised at a site level, eventually coalescing into a landscape feature at a subcatchment level.
Awareness Raising and Training	Once the Plan is finalised, DAFM will instigate a campaign to promote awareness amongst Registered Foresters, contractors and forest owners, <i>via</i> circulars to the trade, articles in relevant publications and a tailored information brochure, and through direct training.
Monitoring	Licence applications within FPM catchments will be subjected to a higher level of site inspection by DAFM. Three levels of monitoring are proposed: - onsite monitoring by the applicant; - onsite monitoring by the DAFM; and - overall monitoring of the Plan.

- the Land Types for Afforestation procedure, the Environmental Requirements for Afforestation, & the Felling & Reforestation Policy;
- > iFORIS & iNET;
- > the referral process & public consultation;
- the DAFM / EPA / COFORD Acid Sensitivity Protocol:
- procedures regarding Appropriate Assessment and Environmental Impact Assessment (EIA);
- the application of requirements, mandatory 'guidelines' and other procedures;
- requests for further information;
- licensing conditions;
- > available sanctions; and
- > training for Registered Foresters.

DAFM operates within this remit, and therefore has a defined ability to control and influence forest development and management. DAFM will apply the various measures set out in this Plan to all applications received for S.I.191 of 2017 licensing and grant approval for sites within or partially within the Plan's area. It will also encourage action at individual sites that prove to be key for the protection and enhancement of water - see Section 3.7 of *Forests & Water*.

However, it cannot compel individual land- / forest owners to undertake afforestation or felling specifically aimed at protecting and enhancing water quality and FPM.

1.4 A Model for Woodlands and Forests in FPM Catchments

A central component of this Plan is a model for woodlands and forests within the Plan's area, achieved principally through appropriate afforestation and forest restructuring at the clearfell / reforestation stage, and delivering a permanent and seminatural buffer along the watercourse comprising an undisturbed water setback and a CCF zone typically comprising native woodland, realised with minimum site inputs. These features combined deliver a wide range of ecosystem services that directly benefit water quality and the aquatic habitat for FPM, namely:

- reduction in sediment mobilisation and runoff into watercourses;
- > interception of nutrient runoff into watercourses;
- bank stabilisation;
- food input into the aquatic ecosystem;
- shading / cooling;
- > regulation of floodwater; and
- riparian restoration.

This model, realised at a site level and coalescing into a significant landscape feature at the subcatchment level, is designed to eliminate potential negative impacts arising from forestry and other land uses, while maximising the contribution woodlands and forests make to water quality and aquatic ecosystems in general, and FPM in particular. For details, see Section 5.

In relation to the restructuring of existing forests, the operations involved in felling existing areas pose particular challenges, especially in relation of sediment and nutrient release. However, notwithstanding this challenge, the realisation of the above model will deliver ongoing benefits on a permanent basis. The 'do nothing' alternative is untenable in most situations, as existing forests within these areas, particularly monoculture conifer plantations on peat, will reach a point where they become prone to windblow, resulting in a chaotic uncontrolled situation and a significant economic loss of investment.

1.5 Linkage between *Forests & Water* and this Plan

This Plan for Forests & FPM in Ireland operates within the context of a significantly enhanced 'baseline' level of protection for water, as set out in the DAFM document Forests & Water: Supporting the Achievement of Objectives under Ireland's River Basin Management Plan 2018-2021 (see www.agriculture.gov.ie/forestservice/ grantsandpremiumschemes2015-2018/). Forests & Water sets out how the DAFM and the wider forest sector will fulfil their role in achieving the objectives under the 2nd cycle of the Water Framework Directive (WFD), as set out in the River Basin Management Plan for Ireland 2018-2021 (RBMP), prepared by the Department of Housing, Planning & Local Government. This enhanced baseline involves legislation, policy, regulation, promotion and research, and provides a far greater range of targeted measures to underpin the implementation of the Plan.

As set out in *Forests & Water* (DAFM, 2018), in addition to the actions listed for forestry in the RBMP, the key principles guiding the DAFM's input into achieving the objectives of the RBMP are:

- to safeguard water during all forestry operations;
- to restructure existing forests to reflect water sensitivities, where required; &
- to situate & design new woodlands & forests in a way that protects water quality.

Using the WFD's 'source-pathway-receptor'

model, reducing sources & breaking pathways are key.

The aim is to fully realise the significant role woodlands & forests can have in protecting & enhancing Ireland's waters & associated aquatic ecosystems.

Section 3 of *Forests & Water* is key, as it sets out how the forest sector will fulfil its responsibilities regarding the achievement of the objectives and priorities under the RBMP. It presents the various water-related measures on hand (summarised below in Table 1.2 and detailed in Sections 4-16 of *Forests & Water*). Several of these measures have been tailored specifically to provide necessary functionality to support the implementation of this Plan (e.g. the Native Woodland Scheme package, the Felling & Reforestation Policy and the accompanying Reforestation Objectives system).

Section 3 of *Forests & Water* describes how these measures are to be 'mobilised', *via*:

- > inter-agency coordination;
- training and peer-to-peer learning;
- > involvement in the Areas for Action programme;
- the targeting of individual sites for the protection and enhancement of water;
- protocol for handling acute forestry and water incidents; and
- the assessment of forest licence and grant applications

These measures significantly enhance the baseline level of protection regarding water, aquatic habitats and aquatic species, and also create opportunities whereby forestry can be used to enhance water

quality. In this regard, the DAFM document Woodland for Water: Creating new native woodlands to protect and enhance Ireland's waters (2018) is particularly relevant, as it proposes the strategic deployment under the 2nd cycle of the WFD, of new native woodlands and associated undisturbed water setbacks, to form permanent semi-natural habitats designed to deliver critical water-related ecosystem services.

It is within this improved context that this Plan for Forests and FPM in Ireland will operate, to eliminate, reduce or mitigate diffuse and point sources of sediment and nutrients and the disruption of the natural hydrological regime, arising from forests and regulated forestry activities within the area of the Plan, to ensure that these do not threaten the achievement of the conservation objective for each of the SACs involved, in relation to FPM.

Specifically, provisions under this Plan come into force in relation to applications for forest licensing / grant approval under Water Sensitivity Category C – see Table 3.3 of *Forests & Water*.

For conciseness and to avoid repetition, this Plan for Forests & FPM in Ireland refers to the *Forests & Water* document, as relevant.

Table 1.2 A summary of the water-related measures underpinning DAFM's input into achieving the objectives set out in the River Basin Management Plan (see relevant sections of *Forests & Water* for details).

Measure	Relevance to the River Basin Management Plan
Forestry Act 2014	This Act, commenced by the Forestry Regulations 2017 (S.I.191 of 2017), integrates the protection of the environment and associated EU and national legislation into the central licensing process regulating the key forestry activities of afforestation, tree felling, forest road works and the aerial fertilisation of forests.
Forest Policy & Funding	Changes in Ireland's forest policy and funding (as represented by EU funding rules and the Forestry Programme 2014-2020) recognise the water-related ecosystem services woodlands and forests can deliver, and further integrate the protection of water and aquatic ecosystems into State funding for forestry.
Scheme Rules	Any forestry activity receiving grant aid is subject to particular scheme rules. These incorporate the protection of the environment and outline consequences, where breaches occur.

Continued

Measure	Relevance to the River Basin Management Plan
	DAFM's forestry application process provides a solid platform for assessing applications for S.I.191 / 2017 licences and grant support in relation to regulated forest activities. A central consideration throughout is compatibility with the protection of water and aquatic ecosystems and species.
	Components include:
	pre-approval assessment & other inspection processes
	the Land Types for Afforestation procedure, the Environmental Requirements for Afforestation, & the Felling & Reforestation Policy
	➢ iFORIS & iNET
Application	> referral process & public consultation
Process	> Acid Sensitivity Protocol
	 Appropriate Assessment Procedure & Assessment to Determine EIA Requirement
	requirements, mandatory 'guidelines' and other procedures
	requests for further information
	> licensing conditions
	> sanctions
	➤ training for Registered Foresters
	See Figure 3.1 in Forests & Water for an overview of the application process.
Land Types for Afforestation	This procedure, introduced in March 2016, rules out afforestation on a range of water-sensitive site types, thereby eliminating potential pressures on water associated with this land use change.
Environmental Requirements for Afforestation	These requirements, released in December 2016, consolidate and update environmental safeguards relating to afforestation previously contained in DAFM 'guidelines' for water, archaeology, landscape and biodiversity. The Requirements enhance the baseline protection regarding water, with the water setback representing an important feature. Corresponding Environmental Requirements for Felling & Reforestation in
	preparation.
Reforestation Objectives & Permanent Forest Removal	The DAFM document <i>Felling & Reforestation Policy</i> (2017) sets out a series of Reforestation Objectives, each with a particular application and set of prescriptions. Two of these, 'Reforestation for Continuous Cover Forest' (CCF) and 'Reforestation for Biodiversity & Water Protection' (BIO), are highly relevant to the site-specific restructuring of existing forests at clearfelling / reforestation stage, to protect water. The same document also clarifies situations where permanent tree removal may be
	acceptable in relation to protected habitats, species and water.
Research &	Recent and ongoing research and demonstration projects are directly influencing policy and practice regarding forests and water.
Demonstration	These include (<i>inter alia</i>) FORMMAR, HYDROFOR, CROW, HYDROFOR and KerryLIFE.

Continued

Measure	Relevance to the River Basin Management Plan
Plan for Forests & Freshwater Pearl Mussel in Ireland	In line with the national conservation strategy, DAFM is currently developing a draft Plan for Forests & FPM in Ireland. This Plan, once implemented, will have direct relevance in relation to high ecological status (HES) objective water bodies.
Native Woodland Scheme Package	This grant package provides support to farmers and other landowners to establish new native woodland and to restore existing native woodland (including conversion from conifer forest to native woodland), to protect and enhance water and aquatic ecosystems.
Agro-Forestry Scheme	Agro-forestry, supported under GPC 11 of the Afforestation Scheme, facilitates forestry and agriculture on the same piece of land and has a potential role in protecting waters from agricultural pressure.
Environmental Enhancement of Forests Scheme	This proposed grant scheme is designed to encourage forest owners to undertake particular works within existing forests and during current rotations, to achieve structural changes and to improve the environmental 'footprint' of those forests regarding impacts on (<i>inter alia</i>) water quality.
	The Woodland for Water measure highlights to the wider 'water community' the use of new native woodland and associated setbacks to protect water and aquatic ecosystems, through the delivery of various water-related ecosystem services including:
	reduction in sediment mobilisation and runoff into watercourses
Woodland for	interception of nutrient runoff into watercourses
Water	▶ bank stabilisation
	➢ food input into the aquatic ecosystem
	> shading / cooling
	> regulation of floodwater
	> riparian restoration

Section 2 Freshwater Pearl Mussel: Ecology & Status in Ireland

2.1 Freshwater Pearl Mussel in Ireland

The Freshwater Pearl Mussel (FPM) is a bivalve mollusc that lives in clean, fast-flowing streams and rivers. It is Ireland's oldest living animal, with individuals reaching up to 120 years of age. It is also characterised by a complex life-cycle that involves a larvae stage which depends on the presence of young salmonid (salmon, trout) within the river, and an early growth stage during which young mussels remain hidden within gravel stream beds. (See Figure 2.1 for an overview of the ecology of FPM.) In order to survive and to reproduce successfully. FPM requires pristine, well-oxygenated water free of nutrients and siltation. As such, it is a key indicator species, with its status reflecting the quality of both water and the aquatic habitat in Ireland's streams, rivers and lakes.

Ireland has two species of FPM: Margaritifera margaritifera, which occurs throughout Ireland but in serious decline throughout its range; and the closely-related M. durrovensis, which is limited to the River Nore in the south-east, and in imminent danger of extinction in the wild. (Note, a question of the species status of M. durrovensis exists, with many regarding it as a subspecies of M. margaritifera. However, this Plan adopts the differentiation made by the most recent Article 17 report (NPWS, 2013), which treats it as a separate species.)

According to Ireland's Habitat Directive Article 17 report for 2013 (see extracts further below), M. margaritifera occurs in more than 160 rivers and a handful of associated lakes, with an estimated national population of 10.99 million adults (NPWS, 2013). Individual populations range from very small relict populations with a few remaining older mussels that have not successfully recruited for 50 years, to some of the largest populations in the world. The national population represents approximately 46% of the total population of the European Union. The species is considered extinct or approaching extinction within most EU countries, with only a few (Scotland, Finland and Sweden) hosting populations with varying levels of juvenile recruitment. Overall, the species is endangered worldwide and in serious decline throughout its range.

The population of *M. durrovensis* in the River Nore represents the sole remaining endemic population in the entire world.

It is clear, therefore, that Ireland has a very significant international responsibility for the conservation of the species.

2.2 Ecology and life-cycle

FPM is a freshwater bivalve with a distribution range across northern Europe, from Ireland to Russia, and across North America. For most of its life, FPM is a filter feeder, pumping large quantities of water through its siphons, where food particles are trapped and passed to the mouth.

FPM requires pristine, fast-flowing watercourses with clean gravel beds and very low levels of nutrients. The FPM uses its muscular foot to anchor itself to the riverbed. It feeds by sieving food particles from the river water, which is pumped in and out by a pair of siphons. In general, the water quality and the streambed habitat must be at reference level, i.e. natural conditions.

As illustrated in Figure 2.1, FPM has a highly complex life cycle. The adults are long-lived, with *M. margaritifera* surviving for over 100 years and *M. durrovensis* living to 50–60 years of age. Mussels mature between 7–15 years of age and can have a prolonged fertile period lasting into old age. They can grow up to 14 cm in length.

The sexes are generally separate. Reproduction occurs when sperm are released into the open water via the male's exhalant siphon in early summer (June to July), and are carried to the eggs through the female inhalant siphon, with actual fertilisation occurring in the brood chambers. The fertilised eggs develop into the larval stage, called glochidia, which are temporarily brooded in the female gills for a number of weeks before being released into the open water in high numbers between July and September. This release is a sudden, highly synchronised event, usually lasting one to two days. The exact timing varies among populations and is probably dictated by temperature or other environmental factors. The numbers of glochidia released has been found to vary, but may be up to 28 million per individual female.

When the glochidia leave the female, they are 0.06–0.07 mm long and resemble tiny mussels, with their shells held open. If inhaled by a salmonid fish, the glochidium attaches to the gill filament by

Glochidia attach to young trout or salmon Juvenile mussels drop off and bury Glochidia released by into the gravel female mussel Sperm taken in by female mussel Young mussels visible after approx. 5 year Adult Pearl Mussel in gravel

Figure 2.1 Life-cycle of the Freshwater Pearl Mussel (from Moorkens, 1999).

snapping shut its shell. Although mostly occurring within a few hours, attachment can occur up to 6 days after release from the female. Typically, 99.9% of the glochidia fail to find a host within 24 hours. The association does not appear to harm the fish, and it allows young mussels to colonise new areas upstream. The hosts for FPM glochidia in Ireland are young salmonids.

The glochidia remain attached to the host's gills for 9–11 months. They are nourished by the fish and increase to about six times their original length. However, large numbers (up to 95%) of glochidia probably fall off and die during the period of attachment. *Margaritifera* glochidia drop off the host

fish from May to mid-July and must land in clean gravelly substrates. At this stage, they are only 0.5 mm in length. The young mussels bury themselves into the gravel and remain so for about 5 to 10 years within the river bed substrate, until large enough to withstand the flow of open water. It is likely that as few as 5% of the mussels that fall off fish survive to reach 3-6 years of age. Adult pearl mussels burrow to two-thirds of their shell depth and are almost sessile in nature, often not moving for many decades.

For further information on the ecology for FPM, see the DAFM / EPA funded study *Forestry Management* for the Freshwater Pearl Mussel Margaritifera (FORMMAR) (Moorkens et al., 2013). Also see the Article 17 report on the Conservation Status in Ireland of Habitats and Species listed in the European Council Directive on the Conservation of Habitats, Flora and Fauna 92/43/EEC, in particular, the Species Assessments (NPWS, 2013).

2.3 Current status in Ireland

As set out in Ireland's Habitats Directive Article 17 report for 2013, entitled *The Status of EU Protected Habitats and Species in Ireland* (NPWS, 2013) (see extracts below), the current population of FPM is estimated at 10.99 million adults, and its distribution in more than 160 rivers in Ireland is considered widespread. However, FPM is in severe decline nationally, with the above population estimate representing a fall of 8% since 2007. This reflects the ongoing chronic decline throughout recent decades, since national scientific monitoring of the species commenced.

The Habitats Directive Article 17 report for 2013 presents the overall conservation status for the species as 'Bad' and declining. Table 2.1 details the scores for each of the four parameters ('Range', 'Population', 'Habitat for the Species', 'Future Prospects') contributing to this overall assessment, comparing 2013 with the previous Article 17 report in 2007.

The causes behind this chronic decline are many and varied, but central drivers are diffuse sources of siltation and nutrients associated with agriculture, forestry and onsite wastewater treatment facilities (typically, septic tanks associated with dwellings) within individual FPM catchments, and changes to river morphology. Subsequent impacts on FPM are summarised in the literature review undertaken to inform the development of the Sub-Basin Management Plans required for the 27 populations:

The loss of pearl mussel populations mostly

occurs from continuous failure to produce a new generation of mussels due to loss of clean gravel beds, which have become infiltrated by fine sediment. This blocks the required levels of oxygen from reaching young mussels. Juvenile mussels spend their first five years buried within the river bed substrate.

Other losses that lead to unsustainable populations are from untimely deaths of adult mussels through kills from major pollution incidents, such as toxic poisoning (e.g. from sheep dip), eutrophication [i.e. nutrient enrichment of the aquatic habitat] (through smothering of adult mussels by filamentous algae or macrophyte [rooted plants] growth). (RPS, 2010)

Recent surveys and monitoring within the Kerry Blackwater and Caragh (Moorkens, 2016), the Owenriff (Moorkens, 2017) and the Glaskeelan (Moorkens, 2017) all reflect continued decline.

In summary, while FPM populations are generally widespread in Ireland, the vast majority comprise limited and declining populations dominated by older adult mussels, with little or no recruitment of juvenile mussels to reproducing adults in recent decades. Therefore, as the current adult populations die off, FPM in Ireland is facing effective extinction in the wild over the coming decades, unless significant improvement in water quality and the aquatic habitat is secured to enable sufficient breeding and recruitment. As set out in Ireland's 2013 Article 17 report, this must involve close coordination and cooperation between different land use sectors:

"Ensuring the long-term future of the freshwater pearl mussel requires significant, integrated catchment management to prevent direct impacts and to reduce losses of sediment and nutrients from all indirect sources." (NPWS, 2013)

The following extracts are from the 2013 Habitats Directive Article 17 report (NPWS, 2013) describing

Table 2.1 The 2013 Habitats Directive Article 17 report assessment summary regarding the conservation status of FPM (M. margaritifera) (with results for 2007, for comparison) (NPWS, 2013). Note, regarding 'Future Prospects', prospects may improve for this species, in part due to the various initiatives.

Conclusion	2007	2013
Range	Favourable	Favourable
Population	Bad	Bad ↓
Habitat of the species	Bad	Bad ↓
Future prospects	Bad	Bad û
Overall status	Bad	Bad ↓
Reason for change	Genuine	e decline

Freshwater Pearl Mussel (Margaritifera margaritifera) Annex II, V

The freshwater pearl mussel (*Margaritifera margaritifera*) is a large, long-lived, bivalve mollusc found in clean, fast-flowing rivers. Freshwater pearl mussels are widespread in Ireland, occurring in more than 160 rivers and a handful of associated lakes. [See Figure 2.2 for distribution map.] The national population estimate of 10.99 million adult mussels represents a decline of 8% since 2007. As the name suggests, this mussel produces freshwater pearls and, because of historic exploitation, the species is protected under the Wildlife Acts, 1976 and 2000 and Annex V of the Habitats Directive. The species' current severe decline is not, however, the result of exploitation, rather it is because of sedimentation and enrichment of its habitat.

Until relatively recent years, the severity of the species' decline was not fully recognised. The freshwater pearl mussel has an unusual life-cycle and produces very tiny young that burrow into river gravels to prevent being washed to sea. The species requires very clean and well oxygenated rivers. When experts began searching for the young they discovered that most Irish populations have not recruited since the 1970s or 80s. Riverbeds have become clogged with silt, algae and rooted-plants so that the young mussels can no longer survive. In some rivers, pollution is sufficiently severe that adult mussels are also dying.

The sediment and nutrients that enter mussel rivers come from a wide variety of sources (e.g. urban wastewater, development activities, farming and forestry), often well upstream of the location of the mussels. The species can also suffer direct impacts from in-stream works such as channelisation, bridge construction and recreational fishery structures.

Ensuring the long-term future of the freshwater pearl mussel requires significant, integrated catchment management to prevent direct impacts and to reduce losses of sediment and nutrients from all indirect sources. The Overall Status is assessed as Bad and declining, however the prospects may improve for this species.

Irish Freshwater Pearl Mussel (Margaritifera durrovensis) Annex II, V

The Nore pearl mussel (*Margaritifera durrovensis*) is a hard water form of the freshwater pearl mussel. It does not occur outside of Ireland, where it is now only found in the main channel of the River Nore. [See Figure 2.2 for distribution map.] The Nore pearl mussel is recognised in the Habitats Directive as a separate species, but its status as such has been the subject of scientific debate since it was first discovered almost 90 years ago. Regardless, the Nore pearl mussel is morphologically distinct, significantly shorter-lived than its soft-water relatives and one of the most threatened animals in Ireland.

The estimated population of 585 adult mussels is widely dispersed along approximately 33 km of the river channel, with most of the mussels found in approximately 3 km near Durrow, Co. Laois. When healthy and fully-functioning, it is likely that the Nore population numbered in the hundreds of thousands or millions of adult mussels. The adult population continues to decline rapidly; at two survey stretches adult numbers declined by 23 and 67% between 2004 and 2009.

Sedimentation of the Nore pearl mussel's habitat has been the main cause of its decline and the habitat quality continues to be in bad condition. Young have failed to survive in the heavily silted riverbed since the early 1970s and high turbidity and sedimentation cause adult deaths. Significant conservation efforts have been made to save the Nore pearl mussel and further work is planned, however it is unlikely that its habitat will be restored before the extinction of the wild population. Recent successes in an assisted breeding programme provide some hope, however this project has also suffered episodic and catastrophic losses of both adult and juvenile mussels in captivity[*]. The future of the Nore pearl mussel remains very uncertain and therefore the Overall Status is assessed as Bad and declining.

[* Note, assisted breeding programme is now discontinued.]

From the 2013 Habitats Directive Article 17 report assessment (NPWS, 2013).

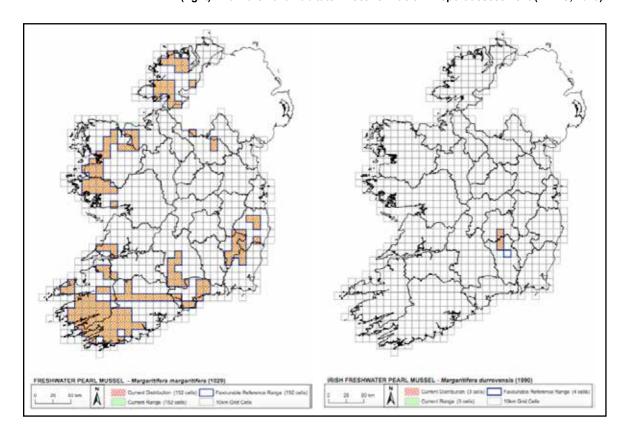


Figure 2.2 Known or best estimate of distribution of Margaritifera margaritifera (left) and M. durrovensis (right). From the 2013 Habitats Directive Article 17 report assessment (NPWS, 2013).

the (then) current status of *Margaritifera margaritifera* and *M. durrovensis*.

Improving the status of FPM is identified as a clear priority within Ireland's current *Prioritised Action Framework for Financing NATURA 2000* (NPWS, 2013), a document required by the European Commission to identify key national conservation priorities, in order to promote greater coordination regarding the uptake of EU funds (e.g. LIFE+) for the management of sites within the NATURA 2000 network.

2.4 Legal protection

Due to historical exploitation by pearling of onceabundant populations (for a historical account, see *The Irish Pearl: A Cultural, Social and Economic History* (Lucey, 2005)), FPM became legally protected under the Wildlife Act 1976 and the Wildlife (Amendment) Act 2000, from injury or from disturbance or damage to their breeding or resting place, wherever they occur. Due to its European and international significance, the species was

also included under Annex II and Annex V¹ of Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive'), transposed by the European Communities (Birds & Natural Habitats) Regulations 2001 (S.I.477 of 2011).

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species that are threatened throughout Europe and deemed highly sensitive to change. These habitats and species are listed in the Habitats Directive and the Birds Directive (Directive 2009/147/EC). Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) – which collectively form the EU-wide NATURA 2000 Network – are designated to afford protection to the most vulnerable of these habitats and species.

As an Annex II species, Ireland is required under the Habitats Directive to designate SACs for both species of FPM. Ireland has listed *M. margaritifera* as a qualifying interest in 19 SAC, within which 26 populations are identified (Figure 2.3). *M. durrovensis* is listed as a qualifying interest in a

¹ As per the Habitats Directive, Annex II species are "Animal and plant species of Community interest whose conservation requires the designation of Special Areas of Conservation." Annex V species are "Animal and plant species of Community interest whose taking in the wild and exploitation may be subject to management measures."

single SAC. The core objective within these SACs is to maintain or, where appropriate, restore to a favourable conservation status, the habitat of the species. Many of the SACs have site-specific conservation objectives for FPM (see Table 2.2 for summary).

Table 2.2 lists the SACs designated for (*inter alia*) FPM, as listed in the first schedule of the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (S.I.296 of 2009). Also included are the results of a prioritisation exercise undertake by Moorkens (2010). See Figure 2.3 below for geographical spread.

These FPM catchments (noting the focus on the Owentaraglin subcatchment only of the (Munster) Blackwater River SAC) represent the 'area' of this Plan for Forests & Freshwater Pearl Mussel in Ireland.

2.5 Sub-Basin Management Plans

In response to a European Court of Justice case C-282/02 under the Dangerous Substance Directive, Ireland put in place the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (S.I.296 of 2009). These set out legally binding objectives for water quality in those rivers inhabited by FPM and designated as SACs for the species, and require that the necessary steps to reach those objectives are taken. S.I.296 also stipulates the following:

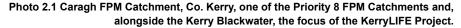
- investigation and monitoring within each of the relevant 27 river sub-basins to establish baseline conditions and threats and pressures to FPM;
- the preparation of a programme of measures needed to reach the ecological objectives in each relevant river; and
- the publication of a management plan for each sub-basin.

The Regulations also require the Environmental Protection Agency (EPA), when classifying surface waters in accordance with the ecological objectives approach of the Water Framework Directive, to assign a status of "less than good ecological status", where FPM is found to be in an unfavourable conservation status under the Habitats Directive structure. This would trigger further actions within the context of Ireland's implementation of the WFD, as waters classified as such must be restored to at least "good ecological status" within a prescribed time frame. This requirement has since been incorporated into the current River Basin Management Plan for Ireland 2018-2021, published by the Department of Housing, Planning & Local Government (2018).

The development of the draft Sub-Basin Management Plans (SBMPs) for the 27 FPM SAC populations collated historic and NPWS data on FPM, as well as existing data on pressures within each catchment, and augmenting both through detailed field survey work. (See Freshwater Pearl Mussel Plans 2009-2015, www. catchments.ie/download/freshwater-pearl-mussel-plans-2009-2015/)

The main outcomes of this work were as follows:

- One population (Bundorragha) did recover to favourable conservation status, due in part to reductions in overgrazing pressures within the Bundorragha catchment, but has since declined. (Note, however, that this population is currently in a favourable conservation status.)
- 26 populations are in unfavourable conservation status (including the sole population of *M.* durrovensis).
- A few populations are relatively close to favourable conservation status, but have too few juvenile mussels as a result of habitat deterioration.
- Many of the remaining populations and their habitats failed all criteria and objectives as set





conservation objectives. Colour coding included to reflect prioritisation by Moorkens (2010): "Group 1 (green) contains priority classes 3 to 6; Group 3 (grey) contains priority classes 7 and 6; Group 4 (red) contains priority class 9.)" Table 2.2 FPM populations and corresponding SACs (as per S.I. 296 of 2009), and overview of relevant

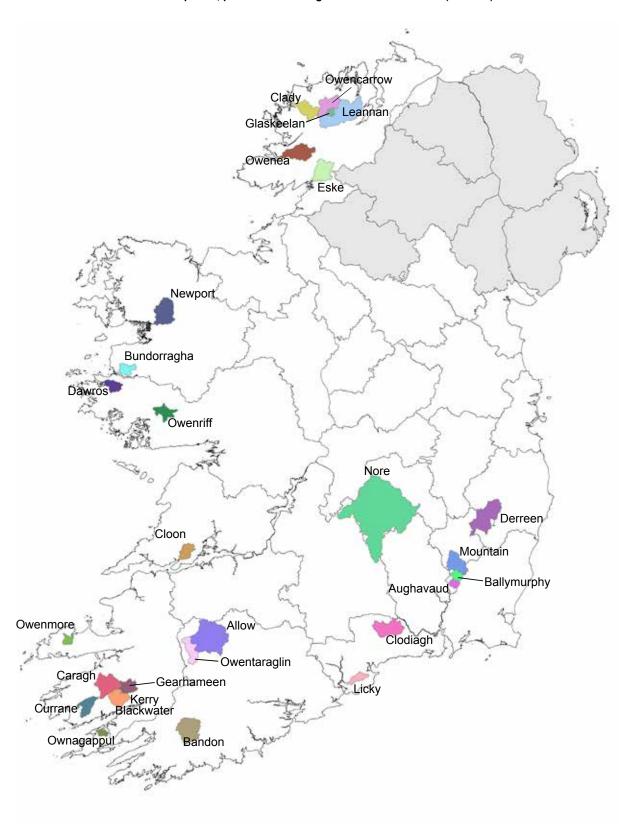
FPM population & corresponding SAC(s)	Conservation Objectives (as presented in the relevant NPWS Conservation Objectives Series report, as of 18 June 2018) See Appendix A for example of specific attributes and targets Note, <i>Margaritifera margaritifera</i> (1029) in all cases, unless otherwise specified
Bandon – Bandon River SAC (002171)	Non-specific conservation objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species [inter alia, FPM]. See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/C0002171.pdf
Aughavaud (Barrow) – River Barrow & River Nore SAC (002162)	The status of the freshwater pearl mussel (<i>Margaritifera margaritifera</i>) as a qualifying Annex II species for the River Barrow and River Nore SAC is currently under review. The outcome of this review will determine whether a site-specific conservation objective is set for this species. Please note that the Nore freshwater pearl mussel (<i>Margaritifera durrovensis</i>) remains a qualifying species for this SAC. This document contains a conservation objective for the latter species. To restore the favourable conservation condition of the Nore freshwater pearl mussel [<i>Margaritifera durrovensis</i> , 1990] in the River Barrow and River Nore SAC, which is defined by the following list of attributes and targets: [See www.npws.ie/sites/default/files/protected-sites/conservation-objectives/C0002162.pdf]
Ballymurphy (Barrow) - River Barrow & River Nore SAC (002162)	As per Aughavaud (Barrow)
Mountain (Barrow) – River Barrow & River Nore SAC (002162)	As per Aughavaud (Barrow)
Bundorragha – Mweelrea / Shreefry / Erriff Complex SAC (001932)	To restore the favourable conservation condition of Freshwater Pearl Mussel in Mweelrea / Sheeffry / Erriff Complex SAC, which is defined by the following list of attributes and targets: [See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO001932.pdf]
Caragh – Killarney National Park, Macgillycuddy's Reeks & Caragh River Catchment SAC (000365)	To restore the favourable conservation condition of Freshwater Pearl Mussel in Killamey National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC, which is defined by the following list of attributes and targets: [See www.npws.ie/sites/default/files/protected-sites/CO000365.pdf]

Clady – Fawnboy Bog / Lough Nacung SAC (000140)	To restore the favourable conservation condition of Freshwater Pearl Mussel in Fawnboy Bog / Lough Nacung SAC, which is defined by the following list of attributes and targets: [See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/C0000140.pdf]
Owenriff (Corrib) – Lough Corrib SAC (000297)	To restore the favourable conservation condition of Freshwater Pearl Mussel in Lough Corrib SAC, which is defined by the following list of attributes and targets: [See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000297.pdf]
Currane – Killarney National Park, Macgillycuddy's Reeks & Caragh River Catchment SAC (000365)	To restore the favourable conservation condition of Freshwater Pearl Mussel in Killamey National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC, which is defined by the following list of attributes and targets: [See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000365.pdf]
Dawros – The Twelve Bens / Garraun Complex SAC (002031)	To restore the favourable conservation condition of Freshwater Pearl Mussel in The Twelve Bens / Garraun Complex SAC, which is defined by the following list of attributes and targets: [See www.npws.ie/sites/default/files/protected-sites/conservation objectives/C0002031.pdf] See Appendix A for full text.
Eske – Lough Eske & Ardnamona Wood SAC (000163)	Non-specific conservation objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species [inter alia, FPM]. See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000163.pdf
Kerry Blackwater – Blackwater River (Kerry) SAC (002173) and Killarney National Park, Macgillycuddy's Reeks & Caragh River Catchment SAC (000365)	For 002173: Non-specific conservation objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species [inter alia, FPM]. See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/C0002173.pdf For 000365: To restore the favourable conservation condition of Freshwater Pearl Mussel in Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC, which is defined by the following list of attributes and targets: [See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/C0000365.pdf]
Gearhameen (Laune) – Killarney National Park, Macgillycuddy's Reeks & Caragh River Catchment SAC (000365)	To restore the favourable conservation condition of Freshwater Pearl Mussel in Killamey National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC, which is defined by the following list of attributes and targets: [See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000365.pdf]

Glaskeelan (Leannan) – Cloghernagore Bog & Glenveagh National Park SAC (002047)	To restore the favourable conservation condition of Freshwater Pearl Mussel in Cloghernagore Bog and Glenveagh National Park SAC, which is defined by the following list of attributes and targets: [See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/C0002047.pdf]
Leannan – Leannan River SAC (002176)	Non-specific conservation objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species [inter alia, FPM]. See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/C0002176.pdf
Allow (Munster Blackwater) – Blackwater River SAC (Cork / Waterford) (002170)	To restore the favourable conservation condition of the Freshwater Pearl Mussel in the Blackwater River (Cork / Waterford) SAC, which is defined by the following list of attributes and targets: [See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/C0002170.pdf]
Licky – Blackwater River (Cork / Waterford) SAC (002170)	To restore the favourable conservation condition of the Freshwater Pearl Mussel in the Blackwater River (Cork / Waterford) SAC, which is defined by the following list of attributes and targets: [See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/C0002170.pdf]
Munster Blackwater – Blackwater River SAC (002170) NOTE: In relation to the Munster Blackwater population, following communication from NPWS, this Plan focuses on the Owentaraglin subcatchment only.	To restore the favourable conservation condition of the Freshwater Pearl Mussel in the Blackwater River (Cork / Waterford) SAC, which is defined by the following list of attributes and targets: [See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/C0002170.pdf]
Newport – Newport River SAC (002144)	Non-specific conservation objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species [inter alia, FPM]. See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/C0002144.pdf
Nore – River Barrow & River Nore SAC (002162)	The status of the freshwater pearl mussel (Margaritifera margaritifera) as a qualifying Annex II species for the River Barrow and River Nore SAC is currently under review. The outcome of this review will determine whether a site-specific conservation objective is set for this species. Please note that the Nore freshwater pearl mussel (Margaritifera durrovensis) remains a qualifying species for this SAC. This document contains a conservation objective for the latter species. To restore the favourable conservation condition of the Nore freshwater pearl mussel [Margaritifera durrovensis, 1990] in the River Barrow and River Nore SAC, which is defined by the following list of attributes and targets: [See www.npws.ie/sites/default/files/protected-sites/conservation objectives/CO002162.pdf]

Owencarrow – Cloghernagore Bog & Glenveagh National Park SAC (002047)	To restore the favourable conservation condition of Freshwater Pearl Mussel in Cloghernagore Bog and Glenveagh National Park SAC, which is defined by the following list of attributes and targets: [See www.npws.ie/sites/default/files/protected-sites/CO002047.pdf]
Owenea – West of Ardara / Maas Road SAC (000197)	To restore the favourable conservation condition of Freshwater Pearl Mussel in West of Ardara / Maas Road SAC, which is defined by the following list of attributes and targets: [See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/C0000197.pdf]
Owenmore – Mount Brandon SAC (000375)	To restore the favourable conservation condition of Freshwater Pearl Mussel in Mount Brandon SAC, which is defined by the following list of attributes and targets: [See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000375.pdf]
Ownagappul – Glanmore Bog SAC (001879)	To restore the favourable conservation condition of Freshwater Pearl Mussel in Glanmore Bog SAC, which is defined by the following list of attributes and targets [See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/C0001879.pdf]
Cloon (Shannon Estuary) – Lower River Shannon SAC (002165)	To restore the favourable conservation condition of Freshwater Pearl Mussel in the Lower River Shannon SAC, which is defined by the following list of attributes and targets: [See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/C0002165.pdf]
Derreen (Slaney) – Slaney River Valley SAC (000781)	The status of the freshwater pearl mussel (Margaritifera margaritifera) as a qualifying Annex II species for the Slaney River Valley SAC is currently under review. The outcome of this review will determine whether a site-specific conservation objective is set for this species. See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000781.pdf
Clodiagh (Suir) – Lower River Suir SAC (002137)	To restore the favourable conservation condition of Freshwater Pearl Mussel in Lower River Suir SAC, which is defined by the following list of attributes and targets: [See www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO002137.pdf]

Figure 2.3 Map of Ireland illustrating the area of the Plan for Forests & FPM in Ireland, i.e. the hydrological catchments of FPM populations within 26 SACs designated for the species, plus the Owentaraglin subcatchment of the (Munster) Blackwater River SAC.



out in S.I.296 of 2009. In the worst cases, a total absence of juvenile mussels is combined with significantly elevated mortality rates in adults and extremely bad habitat conditions.

- > One population (Aughavaud) may be extinct.
- The principal cause of the species' decline is sedimentation, with eutrophication also a significant factor.
- The rate of population decline relates to the number and magnitude of the pressures in the catchment.
- The most significant pressures across the 27 catchments are: point sources in relation to quarries, sand and gravel pits, and wastewater treatments plants; and diffuse sources associated with agriculture (including overgrazing), forestry, and on-site wastewater treatment systems.
- Other more localised pressures include peat extraction, flow regulation, abstractions and morphological changes to river beds and banks.

2.6 National Strategy for the Conservation of FPM

The process of preparing the draft Sub-Basin Management Plans and the outcomes and data generated, informed the formulation of a national conservation strategy for the species. This strategy was finalised by NPWS in September 2011, following consultation with other key Government bodies, and presented to the European Commission in a document entitled *Strategy for Conservation of the Freshwater Pearl Mussel* (NPWS, 2011).

Drawing from research by Moorkens (2010), the strategy seeks to ensure the long-term survival of the species in Ireland, while maintaining its broad geographic and genetic ranges. It advocates the full implementation of measures in those catchments where:

- > the largest FPM populations occur;
- the population is closest to favourable conservation status and, as such, has the greatest chance of recovery;
- the FPM habitat is most likely to demonstrate improvements in the ecological quality objectives set out in S.I.296 of 2009; and
- the impacting pressures are best understood and, therefore, associated measures to address these are expected to be effective.

The strategy prioritises the conservation of FPM populations in eight of the 27 catchments, with the aim of achieving maximum conservation outputs for the restoration effort in terms of numbers of mussels and populations conserved and protected over the long term. These priority eight catchments are:

- Bundorragha (Co. Mayo)
- Caragh (Co. Kerry)
- Owenriff (Corrib) (Co. Galway)
- Currane (Co. Kerry)
- Dawros (Co. Galway)
- Kerry Blackwater (Co. Kerry)
- ➤ Leannan-Glaskeelan (Co. Donegal))
- Ownagappul (Co. Cork)

These eight catchments encompass approximately 9.6 million or 80% of Ireland's FPM population, equating to *c*.37% of the EU population, and include those with the best chance of recovery.

The strategy also proposes particular measures for the *M. durrovensis* population in the River Nore, including captive breeding. (This programme of captive breeding has since ceased.)

As set out in the national FPM strategy, this prioritisation ensures the wise use of resources that will deliver the maximum nature conservation benefits. It offers the greatest chance that the largest FPM populations in Ireland will return to favourable conservation status in the short to medium term. The strategy aims to achieve the maximum conservation outputs, in terms of numbers of mussels and populations sustained over the long-term, for the restoration effort invested.

Various studies, together with the draft SBMPs, identify agricultural and forestry-related sources of diffuse pollution, in terms of siltation and nutrient enrichment, as being a key threat to FPM and a key driver in population decline. The prioritisation strategy details measures for agriculture and forestry to address the urgent need to eliminate reduce or mitigate this diffuse pollution.

2.7 Prioritisation and the Plan

This Plan for Forests & Freshwater Pearl Mussel in Ireland takes cognisance of these 8 Priority FPM Catchments through the risk scoring system embedded in the Forests & FPM Management Framework (see later), which limits the range of options available in relation to various forestry developments. For example, applying the Framework, DAFM envisages than any afforestation within these areas will be limited to native woodland established under the Native Woodland Establishment Scheme. A highly sensitive approach will be required in relation to any felling, and reforestation will be dominated by native woodland, with possible funding under the Native Woodland Conservation Scheme assisting in this restructuring process.

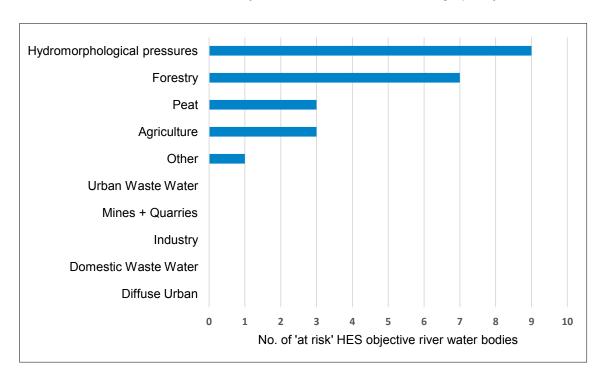


Figure 2.4 Significant pressures impacting on the 15 'at risk' HES objective river water bodies within the eight priority FPM catchments.

Similarly, in addition to the 100% field inspection regime and internal referral to relevant experts within the Forestry Inspectorate in relation to all applications received, conditions attached to any licences issued in these areas will require a higher degree of monitoring, including the likely appointment of environmental Clerk of Works to oversee environmental protection during operations.

2.8 River Basin Management Plan

As set out in *Forests & Water* (Section 2.6), the priority 8 FPM catchments comprise 28 river water bodies, all of which are assigned the high ecological status (HES) objective. Of these, 12 (43%) met this objective in the 2010-2015 monitoring cycle. However, 15 are 'at risk' of decline, with forestry deemed to be a significant risk (either alone or in combination with other pressures) in seven - see Figure 2.4.

Section 3 Forests & Forest Activities: Threats & Opportunities

3.1 Overview

DAFM recognises the range of threats and opportunities presented by woodlands and forests and by forest practices in relation to FPM. The success of this Plan for Forests & FPM in Ireland will be contingent on eliminating the former and realising the latter.

3.2 Threats

Regarding threats associated with forestry, the Sub-Basin Management Plans and other studies and experiences identify forest establishment (including ground preparation, drainage and fertilisation), aerial fertilisation, forest road construction, thinning, final harvesting (i.e. clearfelling) and reforestation as major potential diffuse sources of both siltation and nutrients within FPM catchments. The DAFM / EPA funded study Forestry Management for the Freshwater Pearl Mussel Margaritifera (FORMMAR), (Moorkens et al., 2013) set out aspects of forestry that may affect aquatic quality in FPM catchments, including soil type, effects on flow, effects on sedimentation, and effects on nutrients and other water quality parameters (pH, temperature, heavy metals and other toxic substances, dissolved organic carbon).

The following summarises the various impacts on FPM arising from these stages in the forest cycle. These forestry-based sources can contribute to chronic long-term decline of FPM populations over decades, or sudden catastrophic decline, as a result of an individual incident or event. It is also important to note the complexity of impacts that can arise.

The level of risk associated with threats associated with forestry can be significantly heightened by afforestation on unsuitable sites (e.g. deep peat, steep slopes), by poor forest design (e.g. insufficient water setbacks, insufficient silt traps and settlement areas within the drainage system), and inappropriate management practices (e.g. overuse of extraction tracks during harvesting, leading to deep rutting and soil mobilisation). Conversely, the level of risk can be eliminated, through good forest practice, based on recognition of the potential impacts on FPM throughout all stages of the forest rotation.

3.2.1 Afforestation

- ➤ The release of silt and sediment into watercourses, as a result of site cultivation and draining at afforestation: Fine sediment can affect adult FPM, as it interferes with filter feeding. It can also dramatically change the nature of a river bed where juveniles require water movement through gravel beds to obtain oxygen. Even short-term sedimentation is likely to kill all juveniles present.
- Nutrient enrichment during the establishment stage: Potential for run-off of nutrients into receiving watercourses, leading to nutrient enrichment (i.e. eutrophication) of (typically nutrient-poor) water, and subsequent algal growth. This depletes oxygen levels within the water, leading to mussel stress and morality. The most critical nutrient is phosphorus, as it is often primarily responsible for eutrophication. As well as nutrient enrichment as a result of leaching of fertiliser that has been applied, nutrient rich sediment can also contribute. In addition, soil disturbance at establishment can also contribute other nutrients such as nitrogen over short or medium term periods, which can in turn be converted to ammonia. Nutrient enrichment may also occur as a result of subsequent fertilisation pre-canopy closure, typically via aerial fertilisation on sites where nutrient deficiency is evident (often associated with peat soils, with poor nutrient retention capacity). This creates the potential for run-off of nutrients into receiving watercourses.
- Additional threats posed by afforestation can include elevated alkalinity as a result of fertiliser runoff, reduction in water temperature as a result of slowing or ponding of watercourses, the creation of shade from tree canopies, and heavy metals entering watercourses as a result of improper cypermethrin use.

3.2.2 Existing forests

Machine operations and site disturbance during harvesting (including thinning and clearfelling) and forest road construction. Soil disturbance, potential for erosion and the release of silt into receiving watercourses as a result of the improper selection and use of machinery in forestry operations. The potential

Photo 3.1 An upland plantation established prior to the introduction of mandatory water setbacks. Such forests can be a source of ongoing issues and their eventual clearfell poses a significant challenge, due to their proximity to the water's edge.



Photo 3.2 Windblow along watercourses in older 'legacy' sites can create sedimentation, needle drop and the physical disruption of the stream bank.



Photo 3.3 Poor-quality forests planted on acutely sensitive sites may be considered for permanent forest removal.



for sedimentation can be dependent on the soil type, vehicle type, the number of vehicle passes, slope, proximity to the watercourse, etc. Sudden loss of canopy exposes poorly-vegetation soil, leading to increased sediment loss, and the potential to expose new edges that are not wind firm, increasing the risk of windblow. According to Moorkens (2013), when felling becomes more frequent than once every 10 years in a catchment, it can result in damage to the river bed habitat at a frequency where sets of juvenile mussels are consistently disrupted and effective reproduction ceases.

- ➤ Nutrient enrichment after thinning and clearfell: Nutrient-rich sediment may enter watercourses following harvesting. Also, the decomposition of harvest residue onsite can lead to the release of P for several years after harvesting, disrupting the P cycle within the watercourse. There may also be a short term increase of nitrate following the felling of large forest areas.
- Onsite use of chemicals, fuels or oils: Potential risk of spillage, through accident or bad practice, and subsequent entry into receiving watercourses, leading to contamination and subsequent FPM death.
- Inappropriate reforestation: E.g. failure to introduce a sufficient water setback into the subsequent rotation, failure to adopt more appropriate silvicultural systems other than the standard clearfell / replant approach. Potential threats become 'locked-in' for another rotation lasting 40 years or over.

> Trees planted beside watercourse:

- Ongoing needle-drop into the watercourse throughout the rotation, which subsequently break down into finer, gravel-clogging organic matter, preventing juvenile survival.
- Risk of windblow directly adjacent to the watercourse, creating localised sediment release from upturned root plates.
- Shading of watercourses can lead to a drop in water temperature.
- At clearfelling, the felling of trees situated directly adjacent to watercourses can result in needle and debris drop into the watercourse, and result in a sudden transition from deep shade to open light, with a subsequent impact on the aquatic habitat and increase in the growth of alga and rooted aquatic plants (particularly where waters are enriched), as well as potential temperature changes.
- Existing drains beneath the forest canopy opening directly into watercourses: These can act as a continuous source of siltation throughout the rotation, and a potential pathway for silt and

- nutrient runoff to receiving watercourse, during and after road construction, thinning and clearfell.
- Existing forest roads: These can form pathways for sediment discharge into aquatic zones, especially if poorly-designed and constructed, or left damaged following use (e.g. post-thinning or post-clearfell). The use of inappropriate material in construction (i.e. limestone-based gravel) may impact pH of receiving waters.
- Catchment-scale impact on natural hydrological patterns: For example, through canopy interception within wide-spread forest cover, the amount of rainfall entering watercourses may be reduced, leading to lower water levels in streams and rivers and heightened stress within FPM populations. Conversely, heavy rainfall on large sites that have been recently clearfelled can quickly run off into receiving waters, leading to flash flooding. Artificial drainage in the catchment has compounding effects on sediment and nutrient problems during low flows, and exacerbating erosion and flood damage during high flows (Moorkens, 2013).

Schedule 4 of the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (S.I.296 of 2009) set out the ecological quality objectives for FPM (see Table 3.1). The threats described above undermine the realisation of these objectives.

The recently-published Irish Standard I.S. EN16859:2017, entitled Water quality: Guidance standard on monitoring freshwater pearl mussel (Margaritifera margaritifera) populations and their environment (NSAI, 2017), provides guidance on methods for monitoring populations of FPM and the environmental characteristics important for maintaining populations in favourable condition. This European-wide standard, given national status through I.S. EN16859:2017, is based on best practice developed and used by FPM experts in Europe, and describes approaches that individual countries have adopted for survey, data analysis and condition assessment. The applications of the standard include the provision of site-level data that will contribute to reporting under Article 17 of the Habitat Directive, undertaking environmental impact assessment, and restoring pearl mussel populations. The document stresses that FPM surveys can only be carried out under licence and that the methods used should fully comply with any conditions imposed.

3.3 Opportunities

The majority of potential threats from forestry relate to inappropriately sited conifer forests and unsuitable

Table 3.1 Ecological quality objectives for FPM, as listed in 4th Schedule of S.I.296 of 2009.

Element	Objective	Notes
Macroinvertebrates	EQR ≥0.90	High status
Filamentous algae (Macroalgae)	Absent or Trace (<5%)	Any filamentous algae should be wispy and ephemeral and never form mats
Phytobenthos (Diatoms)	EQR ≥0.93	High status
Macrophytes — rooted higher plants	Absent or Trace (<5%)	Rooted macrophytes should be absent or rare within the mussel habitat
Siltation	No artificially elevated levels of siltation	No plumes of silt when substratum is disturbed

management. As a sustainable long-term land use, woodlands and forests that are carefully positioned and designed, and subsequently subjected to appropriate silvicultural management (typically Continuous Cover Forestry, or CCF), can make a significant contribution to the protection of FPM and the enhancement of water quality and the aquatic habitat. For example, native woodland combined with an appropriate water setback, installed either through the establishment on 'greenfield' sites on farmland or through the conversion of commercial conifer forests (typically at restocking stage, through planting and / or natural regeneration), can deliver important ecosystem services relating to water quality, as described below.

Native woodland created on strategically selected sites adjoining watercourses and elsewhere within the catchments, and managed under CCF, creates semi-natural habitats that act as permanent and stable buffers vis-à-vis water quality. These woodlands intercept potential sediment and nutrient flows and pulses arising

- from 'upslope' land uses (including agriculture and commercial forestry), contribute to erosion prevention on slopes, and help reinstate natural hydrological patterns.
- Immediate 'bankside' benefits arising from native woodland development on sites adjoining watercourses include: the filtering-out of sediment and nutrients from overland flow; bank stability; the restoration of natural dynamics between the terrestrial / riparian / aquatic systems; the provision of dappled shade; the regulation of water temperatures; and the provision of appropriate inputs that enhance instream diversity.

The above water-related ecosystem services demonstrate the proactive contribution woodlands and forests can make to water quality and associated aquatic species and ecosystems, a role explored in the UK Forestry Commission publication *Woodland for Water: Woodland Measures for Meeting Water Framework Directive* (Nisbet *et al.*, 2011). Wider biodiversity benefits also arise, which will

Photo 3.4 Appropriately-sited native woodland, realised through afforestation, woodland restoration or conversion from conifer forests, delivers significant ecosystem services regarding the protection of water and aquatic ecosystems.



complement other qualifying interests within the relevant SACs, namely: the protection and expansion of threatened native woodland ecosystems (including native riparian woodlands); and the promotion of larger scale habitat connectivity between existing (highly fragmented) native woodlands, natural open habitats and watercourses.

Furthermore, native woodlands managed under CCF represent a sensitive and compatible land use option for farmers and other landowners within the catchments, with the potential for future hardwood production and downstream rural enterprises within these environmentally-sensitive areas.

The potential contribution of woodlands and forest, and appropriate forest management, to the protection of FPM is becoming increasingly recognised in recent and ongoing initiatives, such as KerryLIFE, the INTERREG Freshwater Pearl Mussel Project, and changes in early 2013 to the Forest Service / EPA / COFORD acid sensitivity protocol for afforestation, allowing the submission of applications under the Native Woodland Establishment Scheme without the need for water sampling. This change to the acid sensitivity protocol is relevant, as most of the Priority FPM Catchments (with the exception of the Bundorragha and the Ownagappul), lie within acid sensitive areas identified under the protocol.

In addition to those outlined already, forestry can also have a positive role in the protection of FPM through a wide range of measures, including: the setting-aside of 'protection' forests or woodland areas where appropriate; the creation of semi-natural water setbacks to intercept the flow of sediment and nutrients; the blocking of drains in forests planted pre-guidelines (typically at reforestation stage); the introduction of CCF silvicultural systems to avoid future clearfelling; brash removal at harvesting or whole tree harvesting to reduce nutrient release; use of cable systems for extraction; grass-seeding post-clearfell; and the pollarding of retained broadleaves where there may be a risk of windblow.

A wide range of possible water-related ecosystem services deliverable through native woodland afforestation and through conversion to native woodland¹ on appropriate sites are explored in the DAFM (2018) document *Woodland for Water:* Creating New Native Woodlands to Protect and Enhance Ireland's Waters. Ecosystem services arising from a permanent landscape feature alongside watercourses and comprising a combination of an undisturbed water setback and native woodland include:

- reduction in sediment mobilisation and runoff into watercourses;
- interception of nutrient runoff into watercourses;
- bank stabilisation;
- food input into the aquatic ecosystem;
- shading / cooling;
- regulation of floodwater; and
- > riparian restoration.

The Woodland for Water document sets out an overview of research illustrating the ecosystem services delivered by this approach, under each of the above headings. This overview has been compiled with input from Woodlands of Ireland within the context of the partnership between that organisation and DAFM in the ongoing development and implementation of the Native Woodland Scheme package.

The Woodland for Water measure can be realised through a combination of NWS Establishment, NWS Conservation and the Environmental Enhancement of Forests Scheme (in preparation), and the application of Reforestation Objectives 'CCF' and 'BIO' under the Felling & Reforestation Policy. Also see Cross & Collins (2017) Management Guidelines for Ireland's Native Woodlands, for practical instructions on creating new native woodland through afforestation and the conversion of non-native forest (either through gradual transformation or more rapid replacement) to native woodland.

While the Woodland for Water measure is not presented as a 'one-size-fits-all' solution for sites within FPM catchments, it does have a clear application, and the review of research underpinning the approach (as set out in the Woodland for Water document) has direct relevant to this Plan. Also, any related application received by the DAFM will be subject to the full assessment process (as set out in Section 7 of *Forests & Water*), and will have to satisfy silvicultural and environmental requirements.

¹ Conversion to native woodland includes the gradual 'transformation' of a non-native woodland to native woodland, through the application of CCF techniques, and abrupt 'replacement', through reforestation after clearfelling. See Cross & Collins (2017) for guidance.

Section 4 Forests & FPM Management Framework

4.1 Overview

The Plan for Forests & FPM in Ireland will be implemented through the application of the Forest & FPM Management Framework to all applications submitted in relation to forestry developments within the area of the Plan. The area of the Plan comprises the hydrological catchments of FPM populations within 26 SACs designated for the species, plus the Owentaraglin subcatchment of the (Munster) Blackwater River SAC. The Plan's objective is to eliminate, reduce or mitigate diffuse and point sources of sediment and nutrients and the disruption of the natural hydrological regime, arising from forests and regulated forestry activities within the Plan's area, to ensure that these do not threaten the achievement of the conservation objective for FPM set for each of the SACs involved.

This section sets out how the Forest & FPM Management Framework will operates. In summary, Applicants and Registered Foresters (where relevant) are guided through a process whereby they evaluate, at a site level and prior to the application for S.I.191/2017 licensing and grant approval, the degree of sensitivity regarding FPM, and subsequently select the most appropriate approach regarding the development in question (afforestation, tree felling, etc.), to take account of this degree of sensitivity.

This process takes place through the completion by the Applicant and the Registered Forester of the Site Risk & Operations Form. The overall aim is to identify site risk and contributing factors, and to tailor the proposed forestry development accordingly, as early in the planning process as possible.

4.2 Context

The following sets out the context within which the Forests & FPM Management Framework will operate.

- Once this Plan is finalised, the Forestry & FPM Framework will be activated via a DAFM circular to Registered Foresters and Forestry Stakeholders, effective for all applications submitted from the next date onwards. The circular will also deactivate the current Forestry & FPM Requirements and amendments, and will set out training days for Registered Foresters and contractors operating within the Plan's area. (Such circulars are frequently issued for a variety of reasons see www.agriculture.gov.ie/forestservice/ grantsandpremiumschemes2015-2018/ schemecirculars/).
- ➤ The Framework will apply to all applications for S.I.191 / 2017 licences (for afforestation, forest road construction, tree felling, and the aerial fertilisation of forests) and forestry grants, for 'project areas' (defined as that area specified in the application as being where the proposed activity (and ancillary operations) is to take place) within or partially within the area of the Plan.
- ➤ The area of the Plan comprises the hydrological catchments of FPM populations within 26 SACs designated for the species, plus the Owentaraglin subcatchment of the (Munster) Blackwater River SAC (see Table 2.2). (Note, on commencement of the Plan, the 6 km zone underpinning the Forestry & FPM Requirements (2008) will no longer apply.) These catchments are assigned

Photo 4.1 The Native Woodland Establishment Scheme provides funding for the development of various native woodland types. This includes pioneer birchwood, which may be appropriate within many FPM catchments.



- 'Water Sensitivity Category C' (see Table 3.3 of Forests & Water), as indicated by a dedicated layer in the GIS MapViewer in iFORIS (for Forestry Inspectors and Administration) and iNET (for Registered Foresters).
- The Framework comprises: the Site Risk & Operations Form and associated Forests & FPM Options listed in Appendix C; and specific provisions that are applied to the evaluation of applications.
- The Framework also operates within the context of the programme of awareness-raising and training (see Section 6) and monitoring (Section 7) set out in this Plan.
- The function of the Framework is to enable Applicants and Registered Foresters to evaluate the degree of sensitivity regarding FPM, and to select the most appropriate option(s) regarding the activity in question. This will result in applications appropriately tailored to the sensitivities regarding FPM, pre-submission to DAFM and as early in the planning process as possible.
- ➤ A key component of the Forest & FPM Management Framework is the DAFM's Appropriate Assessment Procedure (AAP) see text box below. The AAP represents the primary mechanism for ensuring that all forestry operations are consistent with the protection of FPM within the area of the Plan, as detailed in Table 2.2.
- All applications within or partially within the area of the Plan (as detailed in Table 2.2) will be subjected to 100% field inspection by District Forestry Inspectors throughout the lifetime of this Plan. All applications will also be referred internally to the Forest Service Ecologist and to an appointed Forestry Inspector with a coordinating role regarding the Water Framework Directive and other water-related issues, for recommendations.
- Subsequently, the project can only be licensed by DAFM if it has ascertained: via AA screening, that there is no possibility of the project having a significant effect on the conservation objectives of a Natura site; or via Appropriate Assessment (if required), that the project will not adversely effect the integrity of the Natura site. Key throughout is that the project does not threaten the achievement of the conservation objectives for each SAC in relation to FPM (see Table 2.2) (alongside those relating to other qualifying interests and alongside other legal responsibilities, e.g. those under the WFD).
- The Forests & FPM Management Framework is applied within the context of, and in addition to, the enhanced baseline level of protection for

- water, as set out in the DAFM document Forests & Water: Achieving Objectives under Ireland's River Basin Management Plan 2018-2021 (2018). Regulatory and promotional measures of particular relevant include: the Forestry Act 2014 and associated Forestry Regulations 2017; the Land Types for Afforestation procedure; the Environmental Requirements for Afforestation; the Reforestation Objectives system, the Native Woodland Scheme funding package and the proposed Environmental Enhancement of Forests Scheme; the Woodland for Water measure; and DAFM's application process (as set out in Section 7 of Forests & Water).
- The model for woodlands and forests in FPM catchments, as presented in Section 5, comprises water setbacks and Continuous Cover Forestry Zones. This will form the basic structure to be achieved under this Plan, primarily through forest restructuring and afforestation. This outcome, realised at a site level and coalescing into a significant landscape feature at the subcatchment level, is designed to eliminate potential negative impacts arising from forestry and other land uses, while maximising the contribution woodlands and forests make to water quality and aquatic ecosystems in general, and FPM in particular.
- As set out, DAFM can only act within its regulatory and promotional remit, as set out in Section 1.3. It cannot compel landowners or forest owners to undertake activities, and most await the submission of applications for the various forestry activities, before it can act. However, as outlined, it can encourage certain developments through targeted supports such as the NWS Establishment.
- Furthermore, other approaches may also emerge, including a programme of FPM measures involving Coillte properties, or the 'targeting' of individual sites for the protection and enhancement of water (see Section 3.7 of Forests & Water) whereby particular issues or opportunities exist to eliminate a particular risk or to realise a particular range of ecosystem services, and the initiation of change in cooperation with the relevant owner. Due to their unknown nature, these approaches cannot be included in this Plan. However, each will give rise to an application for evaluation by the DAFM, and therefore, the Forests & FPM Management Framework will apply.)
- With prior agreement, alternative processes and formats developed by individual bodies may be acceptable to DAFM, where these are consistent with the approach underpinning the Framework.

DAFM Appropriate Assessment Procedure

The overall aim of the Habitats Directive (92/43/EEC) is to maintain or restore the favourable conservation status of habitats and species of Community interest. These habitats and species are listed in the Habitats Directive and the Birds Directive (2009/147/EC), and Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) are designated to afford protection to the most vulnerable of these. Both designations are also termed 'European sites' and are collectively known as the 'Natura 2000 network'.

The Habitats and Bird Directives are transposed into Irish law by (*inter alia*) the European Communities (Birds & Natural Habitats) Regulations 2011 (S.I.477 of 2011) (see the Irish Statute Book www. irishstatutebook.ie).

As required under the Habitats Directive and as set out under S.I.477 of 2011, on receipt of any application for licensing and / or grant approval, DAFM (as the consenting authority) must undertake 'screening' to assess whether or not the project - either individually or in combination with other plans or projects - is likely to have a significant effect¹ on a SAC or SPA (whether surrounding, adjoining or remote), in view of both the conservation objectives of that Natura site and best scientific knowledge.

If a significant effect is likely or where uncertainty exists, DAFM must seek a Natura Impact Statement (NIS) from the applicant. Upon receipt of the NIS, it then undertakes an 'appropriate assessment' to gauge whether or not there will be an adverse effect on the integrity of the Natura site(s) concerned, based on (*inter alia*) the nature of the impact and the effectiveness of any avoidance, amelioration or mitigation measures proposed.

Screening for appropriate assessment, and the appropriate assessment itself, must be carried out in accordance with Regulation 42 of S.I.477 of 2011. When carrying out the appropriate assessment (if required), the Department must include a determination under Article 6(3) of the Habitats Directive as to whether or not the project would adversely affect the integrity of the Natura site(s) concerned. The assessment carried out under Article 6(3) cannot have any deficiencies or data / information gaps and must contain complete, precise and definitive findings and conclusions capable of removing all reasonable scientific doubt as to the effects of a project on the Natura site(s) concerned.

DAFM can only approve an application where it deems (at screening stage) that there is no likely significant effect on any Natura site, or (at appropriate assessment stage, if required) that there will be no adverse effect on the integrity of any Natura site.

This process is set out in the Forest Service Appropriate Assessment Procedure, developed in consultation with NPWS. The AAP is described to applicants, Registered Foresters and the wider forest sector, in Section 20 and accompanying Appendices 20-22 of the *Forestry Standards Manual* (with Appendix 20 setting out guidance on compiling a NIS) (DAFM, 2015). The document *Forest Service Appropriate Assessment Procedure: Forestry Inspector's Manual* (DAFM, 2013) sets out the standard operating procedure for District Inspectors undertaking the AAP, with further amendments recently introduced to take account of the Court of the European Union (CJEU) Judgement C-323/17.

The Forestry Inspector applies the AAP as part of his / her assessment of an application, and is supported in this role by the Forest Service Ecologist. The AAP is embedded into all workstreams, i.e. afforestation, tree felling, forest road works and the aerial fertilisation of forests.

Note Case C258/11 Preliminary Ruling under Article 267 TFEU - Lough Corrib site - N6 Galway City Outer Bypass road scheme case: Article 6(3) of Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora must be interpreted as meaning that a plan or project not directly connected with or necessary to the management of a site will adversely affect the integrity of that site if its liable to prevent the lasting preservation of the constitutive characteristics of the site that are connected to the presence of a priority natural habitat whose conservation was the objective justifying the designation of the site in the list of sites of Community importance, in accordance with the directive. The precautionary principle should be applied for the purposes of that appraisal.

¹ A project may have a significant effect on a Natura site if it (inter alia):

reduces the area of an Annex 1 habitat, the habitat of an Annex II species, or the overall Natura site;

damages the physical quality of the environment (e.g. water quality & supply, soil compaction) within the Natura site;

causes serious or ongoing disturbance to species or habitats for which the Natura site is selected (e.g. increased noise, human activity);

results in direct or indirect damage to the size, characteristics or reproductive ability of populations within the Natura site; or

interferes with mitigation measures put in place for other plans or projects.

4.3 Assessing site risk and identifying appropriate options

When preparing an application for a S.I.191 / 2017 licence and / or forestry grant, and prompted by a new mandatory question to be introduced into iNET (the Department's online portal for Registered Foresters to submit applications) and into all hardcopy application forms, the Registered Forester assesses whether or not the site lies wholly or partially within the area of this Forestry & FPM Plan. If so, the fact that the Forests & FPM Management Framework applies and that a completed Site Risk & Operations Form must be submitted as part of the application, is highlighted.

Having identified this, Registered Forester must:

- assess the site (both in-field and desk-based, using MapViewer on iNET);
- identify the level of risk associated with the site (or parts thereof) regarding the potential for sediment and nutrient release and other negative impacts, arising from: the nature, size and location of the project (including all operations and ancillary works) over the short, medium and long term; and the potential for in-combination effects with other plans and projects; and then
- select the appropriate option (or combination of options) that match the level of risk identified, drawing from a list of forestry operations, practices and measures ('options') set for each type of forestry development (as set out under S.I.191 of 2017). Appropriate ancillary options must also be selected.

The Registered Forester is guided through these steps by the Site Risk & Operations Form (Appendix B). This process is designed to be user-friendly, scenario-led and replicable, with relevant direction incorporated into the form itself. This approach avoids reliance on detailed matrices and instead focuses on identifying whether or not particular

scenarios apply, based on the key factors that heighten the potential risk of impact on water quality, the aquatic habitat, and FPM.

Note, proximately to FPM populations is deliberately excluded from the process, as all aquatic zones within each catchment are regarded as supporting, or having the potential to support, a FPM population.

4.4 Forests & FPM Options

Appendix C sets out a wide range of forestry operations, practices and measures - or 'Forestry & FPM Options' - for each of the different types of forestry development regulated under the Forestry Act 2014 and Forestry Regulations 2017 (with the felling of trees subdivided into 'Thinning / Clearfell' and 'Reforestation'). Also included are options for various 'ancillary works' that may apply to two or more development types.

This list has been developed specifically in support of the Plan, and draws in practices emerging from research, initiatives and experiences to date.

Additional options may be added in the future, as new operations, practices and measures emerge.

Table 4.1 summaries the range of options set out in Appendix C, for each development type and under ancillary works. NOTE, options are presented under the most relevant development type, but are interchangeable. For example, a 'Thinning & Clearfelling' operation might include some element of temporary access, which is listed under 'Forest Road Works'.

In Appendix C, the options presented for each development type (and ancillary works) range from standard forestry practice to forestry operations, practices and measures for high risk sites. Each option is accompanied by a description outlining its relevance to FPM and key management considerations. Where appropriate, each option is also assigned a site risk score, indicating the general



Photo 4.2 Forest machinery will be suitable on many forest sites within FPM

Table 4.1 Summary of forestry operations, practices and measures ('options') for each type of forestry development (under Forestry Ac t 2014) and for 'crosscutting' ancillary works. See Appendix C for full details.

Afforestation	Tree F	Tree Felling	Forest Access,	Ancillary Works	
	Thinning & Clearfell	Post-clearfell, including reforestation	including Forest Roading	Sediment & Nutrient Control, Grazing, Invasive Species, Fire, Hazardous Material	rol, Grazing, Invasive Material
No afforestation Afforestation with native woodland Afforestation using agro- forestry Standard afforestation	Standard thinning No thin, retain indefinitely No thin, leading to clearfell Over-thin Retro-fit water setback Clearfell at commercial maturity Pre-mature clearfell Over-mature clearfell Conversion to Continuous Cover Forestry (CCF) Halo-thinning Cable extraction Aerial extraction	Reforestation for: (i) Conifer Forest for wood production; (ii) Broadleaf Forest for wood production or (iii) Mixed Forest for wood production or (iii) Mixed Forest for wood production or Introduce permanent native woodland buffer via 'CCF' Reforestation Objective Introduce permanent native woodland buffer via 'BIO' Reforestation Objective Permanent Forest Removal Reforest by natural regeneration of native trees Conifer regeneration	No access Develop track network to facilitate CCF Introduction of new forest road through construction and / or upgrade Develop temporary access Co-operative roading Forest road abandonment	Motor manual felling Drain management Silt traps Silt fencing Log dams Soil dams Soil dams Straw bles Settlement areas Drain diversion Willow planting Hydrological reinstatement Timing of operations Brash mats Removal of branches & fallen trees from aquatic zones	Grass seeding Crossing small drains Crossing large drains & small aquatic zones Pollard retaining native broadleaves Reposition rootplates of windblown trees Fell-to-waste Reduced product range Ring barking Mechanical horses Grazing Invasive species Fire Preparation, storage & use of potentially hazardous material
				Nethoval of Drash Horn Site	

appropriateness of that option to different sites (or parts thereof) assigned different levels of risk.

Note, the various options are presented and explored individually, but are intended to be modular in nature. Different options can be applied alone or in combination in different parts of an individual site, as appropriate, depending on the site risk identified for all or parts of the site. Furthermore, other options may be appropriate, and can be proposed in the Site Risk & Operations Form.

The options presented in Appendix C focus on FPM, and DAFM recognises that other constraints and considerations will apply, e.g. site quality and stability, cost, income foregone regarding future production, other Natura-related qualifying interests. However, DAFM can only issue a S.I.191 / 2017 licence and forestry grant approval where it has fulfilled its responsibilities under Habitats Directive Article 6(3) that the project will not threaten the achievement of the conservation objective for each SAC in relation to FPM (see Table 2.2) (alongside those relating to other qualifying interests).

When selecting the most appropriate / preferred forestry option(s), the following must be considered:

- No commercial conifer afforestation is envisaged within close proximity to aquatic zones within the Plan's area on sites deemed to be highly sensitive in nature. On such sites, afforestation will be excluded or limited to the creation of new native woodland under NWS Establishment. Section 5 sets out the model for new afforestation sites, where deemed appropriate. Thicket stage is generally characterised to be a period of non-intervention, but various options can be pursued to restructure existing thicket stage forests, to minimise future risks to the FPM.
- A reduced or no-thin policy may be needed where certain site conditions exist (e.g. high water table, high exposure) which elevate the risk of windblow and subsequent sediment release. Any area proposed for clearfelling will need to be assessed individually and an appropriate harvesting plan put in place. In most cases, it is anticipated that standard harvesting machinery will be used to clearfell the majority of existing sites, with alternative options (such as manual felling and cable extraction) considered for more sensitive sites or parts of sites.
- Careful consideration is required regarding the most appropriate post-clearfell option or combination of options, using the Reforestation Objective system set out in the Felling & Reforestation Policy document (see Section 10 of Forests & Water). Section 5 sets out a model for forest restructuring at reforestation stage, involving enhanced water setbacks, CCF Zones (typically involving native woodland) and (if

suitable) areas where commercial reforestation will be enabled. Natural regeneration should be encouraged, where suitable and viable. In some catchments, grazing pressure may adversely affect the success of broadleaf natural regeneration. On reforestation sites with marginal fertility, wide-spaced replanting with pine species may be considered in lieu of fertiliser application and conventional replanting. The option of not replanting all or sections of some clearfelled areas should be considered in parts of each catchment, where sensitivities regarding FPM are acute and also where the potential for commercial forestry is marginal. This is catered for through the incorporation of open spaces in the reforestation plan, or through forest removal, where more extensive areas are involved (see Section 10 of Forests & Water).

- Forest access is an essential component of good forest management, enabling access to the forest for a variety of purposes, including monitoring, maintenance, inventory, fire control, etc. Key among these is access for the extraction of timber realised at thinning stage and at clearfell. Access is typically via a forest road network, usually installed at 1st thinning stage. However, sites exist on which forest road construction is not feasible for environmental and / or economic reasons, necessitating alternative options.
- The aerial fertilisation of forests requires a licence from the Minister for Agriculture, Food & the Marine under S.I.191 of 2017. As a general policy, forest owners should assume that this activity will not be permitted in any of the 27 FPM Catchments.

4.5 Submission and assessment

The forestry application is then submitted to the DAFM, complete with the Site Risk & Operations Form and associated mapping, and is subsequently evaluated.

Figure 3.1 and Section 7 of *Forests & Water* describe the application process that applies in relation to applications for S.I.191 / 2017 licences and forestry grant support. Key components of this process, all of which are described in detail, include:

- pre-approval assessment & other inspection processes;
- the Land Types for Afforestation procedure, The Environmental Requirements for Afforestation, & the Felling & Reforestation Policy;
- ➢ iFORIS & iNET;
- > referral process & public consultation
- the DAFM / EPA / COFORD Acid Sensitivity Protocol;

- Appropriate Assessment Procedure & Assessment to Determine EIA Requirement;
- requirements, mandatory 'guidelines' and other procedures;
- > requests for further information;
- licensing conditions;
- sanctions; and
- training for Registered Foresters

Figure 3.1 of *Forests & Water* provides an overview of this evaluation process.

All applications within the area of the Forestry & FPM Plan (as described in Table 2.2) will be subjected to 100% field inspection by District Forestry Inspectors throughout the lifetime of this Plan.

All applications will be referred internally to the Forest Service Ecologist and to an appointed Forestry Inspector with a coordinating role regarding the WFD and other water-related issues, for recommendations. These individuals may undertake a desk-based evaluation of the application, or may opt to undertake a field visit. As per standard internal procedures, recommendations will be relayed back to the District Inspector for consideration and incorporation into his / her certification ('Further Information Required', 'Approve with Conditions', 'Refuse', etc.). In certain cases, DAFM may resort to external advice from an outside hydrological consultant, should particular sensitivities / complexities arise.

As part of the evaluation process, each application will undergo AA screening by DAFM under the AAP, to determine if there is a possibility of a significant effect on the conservation objective for FPM (and that for any other qualifying interest(s) listed for the SAC in question).

The information provided in the submission (including the Site Risk & Operations Form) will inform the AA screening, by demonstrating site risk assessment and the appropriate tailoring of operations. Where site risk has been accurately identified and the proposed operations have been appropriately tailored, this may (taking cognisance of other qualifying interests) enable the DAFM to arrive at a decision at screening stage that there is no possibility of a significant effect on the Natura site. The application can then (from the perspective of the AAP) proceed for licensing (with conditions), assuming other environmental and silvicultural requirements are met.

However, if the possibility of a significant effect still exists, or where there is uncertainty (due, for example, to a failure to submit or adequately complete the Site Risk & Operations Form, or if the site is particularly complex), DAFM will not be able to arrive at a decision at AA screening stage, and

the project must undergo Appropriate Assessment. This triggers the requirement for a NATURA Impact Statement (NIS) to be submitted by the Applicant, to inform the Appropriate Assessment itself.

(This NIS, to be compiled by the Applicant with necessary expert advice, must follow the NIS template provided the DAFM (as per Appendix 20 in the *Forestry Standards Manual*). This template is to be updated to incorporate additional headings regarding other projects and plans, consideration of the medium and long term time-frames, and also, an exploration of the 'do nothing' option.)

Alternatively, in some instances, screening may result in refusal of the application, where it is deems wholly incompatible with the Natura site or where the cumulative risk in relation to other plans and projects, as assessed by the DAFM, is too great.

The AAP is undertake by the DAFM District Inspector as part of his / her evaluation of the application (as set out in Section 7 of *Forests & Water*), following a site inspection and taking cognisance of responses from referrals, both internal (from the Forest Service Ecologist and the appointed Forestry Inspector with a coordinating role regarding water-related issues) and external (from NPWS, Inland Fisheries Ireland, etc.)

The project can only be licensed or approved by DAFM if it has ascertained – either at screening or at Appropriate Assessment – that the project does not threaten the achievement of the conservation objectives for each SAC in relation to FPM (see Table 2.2) (alongside those of other qualifying interests).

The FPM site risk assessment must accurately reflect site characteristics, and the Forests & FPM Options (Appendix C) selected must reflect the Site Risk & Operations Form and associated maps, and must be a genuine attempt to arrive at the optimal solution for the site. The focus throughout is on the selection of appropriate options that best reflect the risk assessment of the site (or parts of the site) in relation to FPM. As above, inaccurate site risk assessment and / or the selection of inappropriate options will lead to a request for additional information in the form of a NIS, or to the application being refused.

Section 5 A Model for Woodlands & Forests within FPM Catchments

5.1 Introduction

The objective of the Plan for Forests & Freshwater Pearl Mussel in Ireland is to eliminate negative impacts arising from forestry development undertaken within each of the 27 FPM Catchments) as per Table 2.2), to ensure that these developments do not threaten the achievement of the conservation objectives for each SAC in relation to FPM (alongside those of other qualifying interests).

This is in keeping with the overall approach set out in DAFM's *Forests & Water* (2018) in relation to the River Basin Management Plan for Ireland 2018 – 2021. In addition to the actions listed for forestry in the RBMP, the key principles guiding the DAFM's input into achieving the objectives of the RBMP are:

- to safeguard water during all forestry operations;
- to restructure existing forests to reflect water sensitivities, where required; &
- to situate & design new woodlands & forests in a way that protects water quality.

Using the WFD's 'source-pathway-receptor' model, reducing sources & breaking pathways are key.

The aim is to fully realise the significant role woodlands & forests can have in protecting & enhancing Ireland's waters & associated aquatic ecosystems.

A key element in achieving this is the ongoing restructuring of the overall forest estate (in terms of water setbacks, age class structure, species composition, silvicultural regimes, etc.), to integrate permanent protection from forest-related risks, and to realise the range of ecosystem services woodlands, forests and forestry practices can deliver in protecting water quality and aquatic habitats and species. Similarly, where afforestation is deemed appropriate and is being pursued, similar measures must be installed at the very outset, again to protect water and to realise potential ecosystem services, as set out in DAFM's *Woodlands for Water* document (2018).

This will be achieved through the tailoring of individual applications for S.I.191 / 2017 licensing and for forestry grants for the different types of forestry development, using the Forests & FPM Management Framework and supported by funding under the Native Woodland Scheme package and / or the Environmental Enhancement of Forests Scheme (in preparation).

This section sets out the model for restructuring existing forests and creating new woodland cover in favour of FPM, using a schematic representation of an individual site. This will assist all relevant stakeholders – from forest owners to the various regulatory bodies involved – to visualise the significant outcome arising from the implementation of this Plan, i.e. the creation – over time and in both existing and new forest properties – of permanent semi-natural areas adjoining watercourses that will eventually coalesce at a subcatchment level into a vital resource underpinning FPM protection and conservation.

Photo 5.1 Native woodland combined with a water setback, illustrating the use of the Native Woodland Establishment Scheme in protecting water.



5.2 Realising the Model

The model for woodlands and forests within FPM catchments is structured around two main types of forestry development: tree felling (i.e. clearfelling and reforestation) and afforestation.

- Clearfelling / reforestation creates an opportunity to restructure the existing forest estate and to install Reforestation Objectives (primarily Objectives CCF and BIO) that will eliminate future risks from forest activity and that will help buffer against negative impacts arising from other land uses.
- Afforestation (where deemed appropriate) creates the potential to establish native woodland accompanied by a water setback (as per the Woodland for Water measure utilising the NWS Establishment see Section 16 of Forests & Water), which will develop into a permanent water protection feature within the landscape.

The aim is to realise a basic configuration comprising a water setback and an appropriate CCF zone (typically, but not exclusively, native woodland) between the watercourse and the adjoining (upslope) land use, which may include agriculture, commercial forestry, or other. This configuration, illustrated in Figure 5.1, will enable natural ground vegetation and natural drainage conditions to return, thereby creating fringe wetlands and semi-natural woodland that will deliver a wide range of ecosystem services regarding the protection and enhancement of water quality and aquatic habitats, and the protection of FPM and other aquatic species. As described for the Woodland for Water measure, these ecosystem services include the following:

- reduction in sediment mobilization & runoff into watercourses;
- interception of nutrient runoff into watercourses;
- bank stabilization;
- food input into the aquatic ecosystem;
- shading / cooling;
- > regulation of floodwater; and
- > riparian restoration.

In partnership with owners and foresters and through coordination with other bodies (e.g. NPWS, Inland Fisheries Ireland), the DAFM will seek to realise this model through the application of the Forest & FPM Management Framework, underpinned by the regulatory and promotional measures regarding forests and water, and the Department's response to the River Basin Management Plan (as set out in *Forests & Water* - also see Table 1.1).

NOTE, Figure 5.1 does not attempt to capture all forestry activities, e.g. forest road work construction

is excluded. Nor is it exhaustive in the restructuring options available. For example:

- Transformation via continuous cover forestry: A silvicultural process whereby a conifer, mixed or broadleaf plantation originally intended for future clearfelling, is subjected to a CCF management regime that introduces a greater diversity of sizes, ages and species over a number of years. Note, many existing forests within FPM catchments may not be suited to transformation (e.g. older conifer plantations on peat), due to windthrow risk. However, opportunities may exist whereby this option can be pursued, particularly in the case of younger conifer plantations via 'halo' thinning, for example.
- Other in-rotation works (funded under the Environmental Enhancement of Forests Scheme, in prep.) to ensure that an effective wellvegetated water setback is in situ for future forest operations, including clearfelling. These include: retro-fitting or widening new or existing water setbacks to a required 'footprint'; more intensive thinning along the aquatic zone; ring-barking; and the slow-water damming of drains. Crop stability and the risk of windblow will dictate which operations are viable.
- Native woodland restoration under NWS Conservation, whereby an existing native woodland along a watercourse is subjected to restoration management to address various issues compromising the native woodland ecosystem, e.g. rhododendron infestation, overgrazing by deer, the presence of a large number of non-native trees in the canopy. Woodland restoration returns the ecological functionality of native woodlands, and these have a direct bearing on the protection and enhancement of adjoining watercourses.
- Afforestation through agro-forestry, whereby the woodland canopy is realised through trees planted at wide spacing, facilitating ongoing pastoral grazing and grass growing into the future – see Section 14 of Forests & Water.

As set out in the Felling & Reforestation Policy document, on particularly sensitive sites, permanent forest removal may also be considered by DAFM, on a case-by-case basis (i.e. where "the continuation (via reforestation) of forest cover on a particular site within an SAC may be deemed incompatible with the maintenance and restoration of a particular habitat for which that SAC was designated. Similar situations may also exist under the Water Framework Directive, where provisions under the Reforestation Objectives CCF and BIO may not suffice.")

Similarly, Figure 5.1 does not attempt to capture specific protective measures undertaken during the operations involved (e.g. the exact extraction

routes used to avoid 'hotspots', site assessment to inform drain blocking). However, the schematic does illustrate how individual forests will be restructured under the Forests & FPM Management Framework to build in permanent protection from forest-related pressures, pressures from other land uses, and hydro-morphological risks, and to capitalize on the positive contribution woodlands, forests and forestry practices can have in enhancing water quality and the aquatic habitat for FPM.

5.3 Components of the Model

5.3.1 Water setback

The water setback directly adjoins the watercourse itself and is aimed at separating the watercourse from forest operations and to intercept sediment and nutrient runoff into receiving waters. This feature is described in the DAFM's Woodland for Water document (2018) (within the context of the afforestation, but also applicable to reforestation). In summary, the purpose of the water setback is to create at the outset, a buffer of natural ground vegetation positioned between defined water features¹ and the forest crop and associated operations, in order to protect water quality and aquatic ecosystems from possible sediment and nutrient runoff from the site at afforestation (or reforestation) and into the medium- to long-term future. The water setback is incorporated during afforestation, and also at reforestation stage on existing forest land, where the existing forest was previously planted up to the water's edge.

At afforestation stage, the water setback must not be crossed by new drains. At reforestation stage, the introduction of the water setback may be accompanied by hydrologically-informed slow-water damming (see below) within existing drains and other potential pathways, to reinstate natural wet conditions. In both cases, this enables ponding and the filtering out of sediments / nutrients, before the

flow enters into the receiving waters.

The required width of the water setback at afforestation is set out in Table 5 of the DAFM's *Environmental Requirements for Afforestation* document (2016). Note, however, that wider water setbacks of up to 50 metres or greater may be sought under the Forest & FPM Management Framework set out in this draft Plan, depending on site sensitivities.

Adopting this requirement as the minimum width, the actual width of the water setback on-the-ground can then be increased at various points along its length, to increase the degree of safeguard at specific locations onsite, as informed by site-level hydrology. For example, the Environmental Requirements for Afforestation stipulates the following:

- Widen the water setback at various points along its length, to include adjoining wet hollows and other low-lying areas where water gravitates towards as it drains from the land.
- Based on the immediate landform / topography, vary the setback to avoid artificial lines and to create a naturally undulating forest edge.

Varying the width of the water setback (particularly in relation to sunlight) will also increase the biodiversity-related edge effect between the (predominantly) open habitat within the water setback and the adjoining CCF Zone (see below).

The Environmental Requirements for Afforestation also encourage edge planting and setback planting with single or small groups of native trees, to further diversity this habitat. See Section 9 of *Forests & Water* for details.

5.3.2 Continuous Cover Forestry Zone

The Continuous Cover Forestry (CCF) Zone will



Photo 5.2 The reforestation stage enables the complete redesign of the forest, including the installation of

typically comprise native woodland, created at either afforestation or reforestation, using NWS Establishment or NWS Conservation respectively, to realise the most appropriate native woodland type for the site. (Works where grant support is not being sought will also require this approach.) The resulting native woodland canopy will be subject to low impact CCF silviculture systems, i.e. shelterwood, selection or coppicing, into the future.

The CCF Zone could also be realised through gradual transformation from a single-aged canopy (if stable), using CCF silviculture (with possible support from the proposed CCF Scheme arising from the mid-term review of the Forestry Programme 2014-2020).

In all of the above approaches, recent publications entitled *Management Guidelines for Ireland's*Native Woodlands (Cross & Collins, 2017) and Pro Silva Silviculture: Guidelines on Continuous Cover Forestry / Close to Nature Forestry Management Practices (Sanchez, 2017) are highly relevant. The CCF Zone, together with the water setback (and associated 'setback planting'² – see Figure 5.1 (opposite) and Section 9 of Forests & Water), are intended to deliver various water-related ecosystem services outlined in Woodland for Water.

Other options may exist, including the long-term retention of the existing crop and reforestation with non-native species suited to CCF management.

Note, where sought by the owner as a co-objective and where appropriate to the site (in relation to soil conditions, fertility, slope, overall water sensitivity, etc.), this CCF Zone may be subjected to wood production under CCF silviculture and using appropriate extraction systems. However, the key focus will remain on low impact operations to complement the water setback and to protect the watercourse itself. The minimum width of the CCF Zone will be 20 metres (in addition to the water setback). However, depending on the outcome of the Forests & FPM Management Framework, the actual width may be 100 metres or greater.

5.3.3 Commercial Forest Zone (or other)

In low risk areas of the site disconnected from the aquatic zone, appropriate afforestation or reforestation (as relevant) with commercial forest species and subsequent commercial forest management, can be pursued, but with ongoing cognisant of the position of the site within a FPM catchment.

5.3.4 Drain treatment

In the case of reforestation sites, existing forest drains will be treated in order to disrupt direct pathways to the watercourse. This may include drain blocking or slow-water damming. Such treatment will be applied strategically outside (i.e. upslope) of the water setback, to disconnect historic forest drains from receiving waters and to prevent direct discharge into the aquatic zone. Water percolates overland from the point of the blockage, resulting in silt and nutrient capture. Drain blocking / slowwater damming will slow water and reduce possible nutrient and sediment inputs into watercourses. It will result in the reinstatement of natural draining conditions and may result in the creation of pocket wetlands, which will act as settlement ponds and aid in silt and nutrient capture.

Drain blocking and slow-water damming within main and feeder drains can be achieved through various methods, e.g. direct drain blocking using soil or logs positioned in the drain's channel at appropriate locations along its length

This operation must be hydrologically-informed, to achieve the intended aim and to avoid unforeseen consequences such as canopy instability and the creation of unwanted pathways for water to flow from source to receptor.

Similar treatment may also be applied to existing land drains in the case of afforestation.

However, where existing drains are well-vegetated and stable, the above treatment is not envisaged.

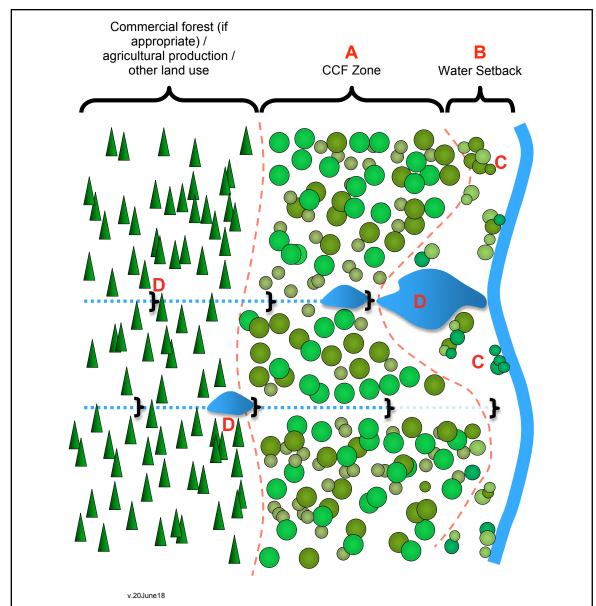
5.3.5 Natural vegetation within the water setback

The treatment of the water setback is set out in the Woodland for Water document. Natural vegetation will be allowed to develop undisturbed within the water setback, complimented by setback planting with single or small groups of trees of suitable native riparian species. Over time, a mosaic of mixed natural habitats will emerge, typically comprising pockets of low-lying woodland, single trees, pocket wetland and other natural habitats and plant communities. This requires ongoing monitoring and possible interventions, in agreement with the relevant statutory bodies, to control unwanted invasives (e.g. regenerating conifers, rhododendron), to prevent excessive tunnelling of the watercourse by native trees, and to enable access for anglers (where relevant).

¹ Aquatic zones, relevant watercourses, hotspots and water abstraction points, as defined in Circular 12 / 2017.

² Single, small groups & irregular belts of trees of appropriate native riparian species (e.g. willow, alder, birch, rowan, pedunculate oak, as site conditions allow) within the water setback (see Section 9 of *Forests & Water*).

Figure 5.1 Envisaged site-level outcome of the Forests & FPM Plan, arrived typically through reforestation or afforestation. Other outcomes are also possible, including forest removal. See key below.



Key:

A CCF Zone, typically comprising native woodland created at reforestation, 20 metres or greater in width. Can be strategically widened at key locations to eliminate source and pathway risks.

- **B** Permanent undisturbed water setback, 10-25 metres in width (or greater, if required), uncrossed by new drains & largely unplanted. Can be strategically widened at key locations to eliminate source and pathway risks.
- **C** Setback planting comprising single or small groups of trees of suitable native riparian species, strategically planted & maintained for bank stabilisation, dappled shading & as a food source for aquatic life.
- D Possible interventions within existing drains (e.g. silt traps, slow-flow dams) based on hydrological assessment, to break existing pathways from source to the receiving watercourse, & to create pocket wetlands & settlement areas.

5.3.6 Tree cover within the water setback

Tree cover within the water setback can include:

- ➤ Existing native broadleaf trees onsite. In the case of reforestation, these may be retained from the previous rotation, but may require pollarding to prevent windblow (which may otherwise give rise to sediment release from upturned root plates close to the watercourse, or direct disruption of the watercourse by the falling tree). In the case of afforestation, these may be trees already present onsite, which should already be windfirm. In both cases, these trees act as important seed sources.
- ➤ As set out in the *Woodland for Water* document, setback planting may be undertaken, whereby individual or groups of trees of appropriate native riparian species (e.g. alder, willow, birch, rowan, pedunculate oak) are strategically planted within the water setback to form 10-20% tree cover, in order to deliver direct instream benefits (e.g. bank stabilisation, cooling / shading, food input into the aquatic ecosystem).

5.4 Catchment level impact

Through incremental application at clearfelling stage, and through proactive targeted interventions *via* afforestation, retro-fitting, pre-mature felling and transformation *via* CCF, the model described in this section can be realised throughout the catchment.

Such areas will coalesce into a permanent seminatural habitat directly adjoining streams, rivers and lakes. This habitat will directly contribute on an ongoing basis to the protection and enhancement of water quality and the aquatic ecosystem, and the conservation of FPM. This transforms forestry from an existing pressure to a direct support for FPM within these catchments.

Section 6Awareness-Raising and Training

6.1 Overview

This section outlines of the proposed awarenessraising and targeted training measures to be implemented by DAFM in co-ordination with NPWS, to support the roll-out and implementation of the Plan for Forests & Freshwater Pearl Mussel in Ireland. Note, these measures are to commence after the Plan is finalised, following the consultation process.

Close coordination between the Forest Service and NPWS on the delivery of this aspect of the Plan will ensure a consistent message in relation to forests and FPM and will enable, where possible, the pooling of resources.

Note, the activities set out below are in addition to the training and peer-to-peer learning proposed in Section 3 of *Forests & Water*, to support the achievement of the objectives under Ireland's River Basin Management Plan 2018-2021.

6.2 Awareness-raising

Once the Plan is finalised and commenced *via* a DAFM circular, a campaign will be instigated to promote awareness amongst foresters and forest owners, through further circulars, articles in relevant publications and a tailored information brochure.

The overall aims of this awareness-raising process are as follows:

To increase awareness amongst the forest sector of FPM and its rarity, and the significance of Ireland's population at the European level. The link between the species' presence and the high quality nature of streams, rivers and lakes, will be highlighted.

- To outline the species' extreme sensitivity to potential impacts arising from forests and forest activity, particularly in relation to nutrients and siltation running off sites into receiving waters.
- To outline the beneficial role woodlands and forests can play in protecting water quality and conserving the species. The model for woodlands and forests outlined in Section 5 of this Plan will be central to this message.
- To outline the scope and objectives of the Plan for Forests & FPM in Ireland, i.e. to ensure that forestry and forest-related activities within the catchment do not impact negatively on FPM, and where possible, are deployed proactively as a tool to protect and enhance water quality and the aquatic habitat.
- ➤ To outline the key mechanisms involved in realising this, i.e. the Forests & FPM Management Framework and the availability of support under the NWS package, the incoming Environmental Enhancement of Forests Scheme, and the proposed Continuous Cover Forestry Scheme.
- ➤ To promote awareness of the range of appropriate forestry practices possible on various sites, ranging from high risk sites (e.g. native woodland creation through natural regeneration) to low risk sites (e.g. commercial forestry, with enhanced safeguards).

In the context of the training and peer-to-peer learning set out in *Forests & Water*, officials within other relevant bodies, including NPWS, Inland

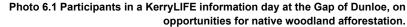




Photo 6.2 NWS Establishment training for foresters and ecologists, organised by DAFM and Woodlands of Ireland and held at Delphi, Co. Mayo, within the Bundorragha FPM Catchment.



Fisheries Ireland, WFD Regional Operations Committees and the LAWCO Office, EPA, Teagasc, etc., will be informed of the Plan and how it operates.

In particular, officials whose operational areas overlap with the various FPM catchments will be the focus of information events. These events will present an overview of the Plan and the role of the DAFM (as the national forest authority) in implementing it, and the use of the Forests & FPM Management Framework and its components (e.g. the Site Risk & Operations Form, the list of Forests & FPM Options in Appendix C). These events will explore the types of forestry practices appropriate for various levels of site risk regarding FPM, and will highlight practices that can actively contribute to the enhancement of water quality. The various regulatory and promotional tools available to DAFM to realise change, including its Appropriate Assessment Procedure (AAP), the Woodland for Water measure and the availability of funding under the Native Woodland Scheme package and others, will also be outlined.

This measure will increase awareness amongst local statutory personnel who can positively influence landowners through their own interaction on-the-ground. This will also help ensure that responses received from the various statutory bodies, following referral by DAFM, are framed within the context of the overall Plan.

6.3 Training for Forestry Inspectors, Registered Foresters and Operators

The DAFM will host training events for Forestry Inspectors, Registered Foresters and Forestry

Operators whose area of operation overlaps with each FPM catchment. Training events undertaken in 2017 in relation to Annex 1 habitats and environmental setbacks on afforestation sites, demonstrate the effectiveness of this approach. Preparation for training will include the production of a guidance document focused on presenting case studies and examples of good (and bad) practice, and this document will be further refined and reissued, as the training programme progresses.

Training for Registered Foresters and contractors will be practical in nature, and will focus on the following:

- the extreme sensitivity of FPM to nutrient enrichment, siltation, pollution and hydrological change;
- inappropriate forestry practices that can impact severely on the species, and appropriate practices that are compatible and proactive regarding FPM conservation and the protection and enhancement of water quality;
- the use of the Forests & FPM Management Framework as the key decision-making tool for forest management within the catchments;
- the use, under the Framework, of the Site Risk & Operations Form and the list of Forests & FPM Options, to guide risk assessment and the selection of the most appropriate forest management option(s), based on site sensitivity;
- basic training regarding water monitoring (equipment, interpretation) and mitigation measures; and
- the various regulatory and promotional tools to realise change, including licence conditions and the availability of funding under the Native Woodland Scheme (see Part B of Forests &

Water).

The model for woodlands and forests set out in Section 5 will form a central part of this training, by highlighting the required outcome of the Plan whereby all forests within each catchment will be accompanied by a permanent, semi-natural buffer along aquatic zones, designed and managed to protect water quality and FPM.

These training events will stress the need to tailor applications before submission to DAFM, and the mechanisms that will otherwise be deployed, e.g. the potential requirement for a NATURA Impact Statement (NIS).

These training events will take place at a suitable location based on FPM catchment clusters, and may incorporate a field element.

Further training events are also envisaged in the medium to long term, using sites that have undergone appropriate treatment in relation to FPM, including demonstration sites treated under the KerryLIFE project.

Section 7 Monitoring

7.1 Introduction

Various levels of monitoring are required regarding the implementation of this Plan for Forests & Freshwater Pearl Mussel in Ireland, to ensure that licensed forestry developments do not threaten the achievement of the conservation objectives for each SAC in relation to FPM (see Table 2.2) (alongside those of other qualifying interests).

Three levels of monitoring are required:

- > onsite monitoring by the Applicant;
- onsite monitoring by the DAFM; and
- overall monitoring of the Plan.

7.2 Onsite monitoring by the Applicant

During-operation monitoring will be undertaken by the Applicant and his / her agents, as a condition of licensing. As a basic requirement, daily monitoring and contingency planning are required, using the Daily Monitoring Form and the Site Contingency Plan described in Appendices D and E, respectively.

Further monitoring may also be specified by the DAFM as a condition of any licensing / approval issued, based on the sensitivity of the site and the level of risk envisaged. Options include:

- advanced notification to various bodies of the commencement of works;
- the delivery of a 'toolbox talk' for all operators before the commencement of works, to highlight sensitivities onsite:

- the appointment of an environmental Clerk of Works to oversee the implementation of protective measures:
- the maintenance of a Water Protection Measure register, to track and record works and the assessment of protective measures;
- during-operation sample collection and analysis of key water parameters; and
- before and after water monitoring, to establish a baseline for post-operation comparison.

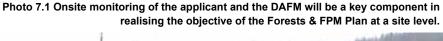
Adherence to the monitoring conditions will checked accordingly by the DAFM (see below).

7.3 Onsite monitoring by DAFM

In addition to the site inspections as part of the initial evaluation, DAFM will undertake spot checks during operations, to ensure compliance to the various conditions (both general and specific) attached to the licence. The checking of onsite Daily Monitoring Forms and other monitoring requirements (e.g. the return of water sample results) will also form part of this inspection. Any breaches detected will trigger an appropriate response from the DAFM, typically involving the immediate cessation of operations and the implementation of appropriate mitigation measures, based, if required, on the input of a hydrologist or FPM ecologist.

Post-works inspections will also be undertaken, to ensure appropriate site restoration.

During- and post-works inspections by DAFM will be unannounced. The number of these inspections will be initially high, focused on potential high risk forest





areas, based on distance from aquatic zones (less than or equal to 100 metres), slope (greater than or equal to 15%) and soil (peaty soil and non-peaty soils)¹. Forestry Inspectors can also select files for field assessment, at their discretion. A selection of medium and low risk sites will also be inspected, but at a lower intensity. Over time, the site inspection regime will be adjusted as required to reflect results on-the-ground (e.g. high compliance may result in a lower number of inspections).

As set out in Section 7 of *Forests & Water*, various options are available to DAFM to: (i) achieve compliance with licensing conditions, should divergence arise; and (ii) to stop poor practice. These options, applied on a proportional basis, include:

- the suspension or revoking of licences for afforestation, felling, forest road works or aerial fertilisation;
- the withholding of grant and premiums (where relevant) until appropriate remedial work has been completed to the satisfaction of DAFM;
- the application of proportionate financial penalties under the DAFM Forestry Scheme Penalty Schedules:
- the application of sanctions under the DAFM Register of Foresters and Forestry Companies, including increased site inspections of projects involving individual Registered Foresters, or temporary removal from the Register and consequential exclusion from future work; and
- the initiation of legal proceedings, either under Forestry Act 2014 or in tandem with other statutory bodies under other environmental legislation, e.g. European Communities (Birds & Natural Habitats) Regulations 2011 (S.I.477 of 2011).

Incidences of afforestation, forest road works, felling and aerial fertilisation alleged to have been carried out without a licence will be investigated and if a case exists, will be pursued through the provisions set out in the Forestry Act 2014, focusing on site restoration and where appropriate, legal action.

Section 3.8 of *Forests & Water* sets out the protocol for handling acute forest and water incidents. (Typically, such incidences are observed directly by DAFM, or are reported by other statutory bodies, eNGOs or members of the public.)

7.4 Overall monitoring of the Plan

As with any plan for change, DAFM must monitor the implementation of the Plan, to track and record progress, to identify and eliminate deficiencies, and where required, to apply appropriate measures to achieve consistency and compliance, to ensure that forest activity undertaken within each catchment does not threaten the achievement of the conservation objectives for each SAC in relation to FPM (see Table 2.2) (alongside those of other qualifying interests). This system builds on existing controls whereby compliance with conditions attached to any licence is checked through follow-up DAFM inspections.

Existing sections within DAFM will have a key role in regulatory oversight and in the operation of forestry schemes in support of the implementation of the Plan. These include the Forestry Inspectorate, the Felling Section, and the Approvals Section. In addition, specific personnel will be assigned to provide centralised coordination for the Plan and to undertake the following roles:

- to orchestrate the roll-out of the Forests & FPM Management Framework, including the awareness-raising and training measures detailed in Section 6;
- to provide internal coordination within the Forest Service (Inspectorate and Administration), with other divisions within the Department, and with agencies under the Department's auspice (e.g. Teagasc);
- to coordinate with NPWS and other relevant statutory bodies, such as Inland Fisheries Ireland, the WFD Regional Operations Committees and the Local Authority Community Water Office (LAWCO);
- to instigate the engagement of a FPM ecologist and a hydrologist, as and when required, to support the Inspectorate in decision-making;
- to provide ongoing support to Forestry Inspectors, Administration, Registered Foresters and Forest Owners;
- to provide regular updates to DG Environment on progress in implementing the Plan; and
- to apply quality control, to ensure consistency in the application of the Forests & FPM Management Framework from pre-approval stage onwards, both externally (Forest Owners, Registered Foresters and Forestry Contractors) and internally within DAFM (this function will operate in addition to standard quality control and oversight, and will identify and implement any additional safeguards or refinements required).

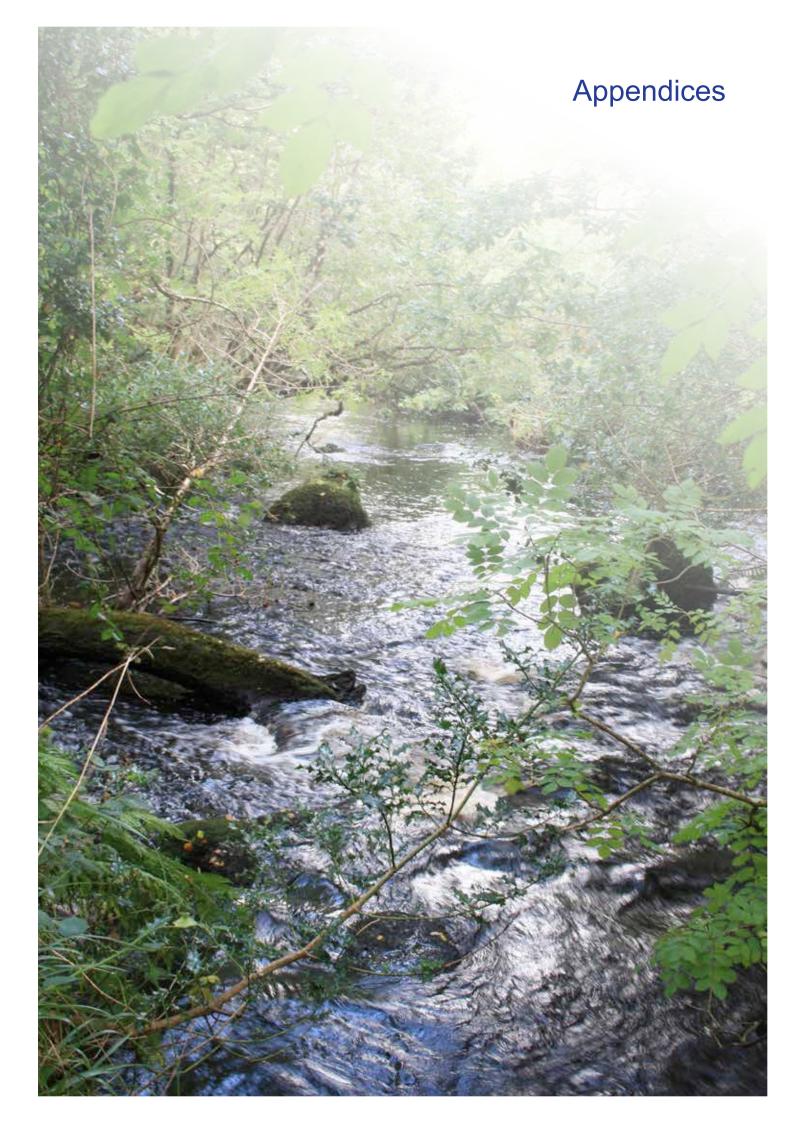
Overall monitoring of progress regarding the implementation of the Plan will be undertaken by the Forest Service in close coordination with NPWS, within the context of parallel measures being deployed for agriculture (e.g. under the recently-launched Pearl Mussel Project locally-led scheme¹). While it is envisaged that direct surveys of FPM populations within each catchment will be undertaken by NPWS, DAFM will track progress

regarding a range of indicators that illustrate the restructuring of the catchment-wide forest resource towards the protection and enhancement of water quality and the aquatic habitat in favour of FPM (i.e. the realisation of the model presented in Section 5). These indicators include (*inter alia*) the following:

- the area (ha) of new native woodland established on 'greenfield' sites adjoining watercourses;
- the area (ha) of new native woodland created through the reforestation of former conifer forest;
- the length (m) and area (ha) of new water setbacks installed at afforestation stage, during the rotation (e.g. 'retro-fitted' at 1st thinning stage), and at reforestation stage;
- the area of former conifer forest converted from clearfell system to CCF / long-term retention;
- the area of forest reforested under the CCF or BIO Reforestation Options;
- the area of conifer forest converted to widelyspaced pine forest; and
- the area of conifer forest deforested and reverted to open habitat.

A feedback loop will also be established, whereby experiences gained in rolling out the Plan will result in the ongoing refinement of the Forests & FPM Management Framework and the list of Forests & FPM Options (Appendix C). Related research and demonstration projects (including KerryLIFE and the Pearl Mussel Project locally-led scheme) will also be closely monitored, and further improvements made to capture relevant outputs from these. Registered Foresters and Forest Owners within the catchments will be notified of any material refinement to the Management Framework, and further training undertaken, as deemed necessary.

¹ The Pearl Mussel Project is a European Innovation Partnership (EIP) locally-led scheme funded by DAFM as part of Ireland's Rural Development Programme 2014-2020 (see www.pearlmusselproject.ie).



Appendix AConservation Objective for FPM: Example

The following extract from the NPWS Conservation Objective report for the Twelve Bens/Garraun Complex SAC (002031), sets out the specific conservation objective for FPM, as defined by specific attributes and targets. This is included in this draft Forests & FPM Plan, for illustration purposes.

Dawros - The Twelve Bens/Garraun Complex SAC (002031) (from NPWS Conservation Objectives Series report, www.npws.ie/protectedsites/sac/002031)

Conservation Objective: To restore the favourable conservation condition of Freshwater Pearl Mussel [Margaritifera margaritifera, 1029] in The Twelve Bens/Garraun Complex SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution	Kilometres	Maintain distribution at 6.43 km. See map 5 [in NPWS publication]	The conservation objective applies to the Dawros freshwater pearl mussel (Margaritifera margaritifera) population in The Twelve Bens/Garraun Complex SAC, which is of international importance and one of eight Irish populations prioritised for conservation action (Moorkens, 2010; NPWS, 2010). It is listed on the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (Statutory Instrument No. 296 of 2009). The distribution and abundance of the species in the Dawros was mapped in 2003 and 2008 (Aster, 2003; Moorkens, 2008; Moorkens and Killeen, 2008). The species is known to extend from above Tullywee Bridge to the tidal limit downstream of Dawros Bridge; however, the stretch upstream of Tullywee Bridge has been little surveyed and requires further investigation. The target is for the species to be sufficiently widespread to maintain itself on a long-term basis as a viable component of the Dawros system. See NPWS (2010) for further information.
Population size	Number of adult mussels	Restore Dawros population to at least 800,000 adult mussels	Aster (2003) estimated a population of between 10,750 and 19,322 per linear kilometre of the Dawros River. Moorkens (2008) estimated the total Dawros population at 800,000 to 1 million. Aster (2003) mapped the distribution and abundance from downstream of Tullywee Bridge to Dawros Bridge and categorised mussels as frequent or abundant throughout most of this length. The maximum density recorded in 2008 was 256 per square metre and an average abundance of 148 mussels per linear metre calculated from 9 samples (Moorkens, 2008; Moorkens and Killeen, 2008). NPWS (2013) in producing a national population estimate, assumed that all priority populations had declined at a rate of 1% per year from 2007 to 2012. The target is for the species to be sufficiently abundant to maintain itself on a long-term basis as a viable component of the Dawros system

Population structure: recruitment	Percentage per size class	Restore to at least 20% of population no more than 65 mm in length; and at least 5% of population no more than 30 mm in length	Mussels of no more than 65mm are considered 'young mussels' and may be found buried in the substratum and/or beneath adult mussels. Mussels of no more than 30mm are 'juvenile mussels' and are always buried in the substratum. See the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009. Size profile studies in the Dawros by Ross (1988) and Moorkens (2008) are summarised in NPWS (2010). In 2008, the smallest mussel was 22mm, and the Dawros failed both targets with 3.7% ≤65mm and 1.86% ≤30mm (Moorkens, 2008; Moorkens and Killeen, 2008). No juveniles were found in2016, and 10% was ≤65mm (Moorkens, 2016). The Dawros population is unsustainable owing to lack of survival of juvenile mussels. The target is for sufficient juvenile recruitment to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system
Population structure: adult mortality	Percentage	No more than 5% decline from previous number of live adults counted; dead shells less than 1% of the adult population and scattered in distribution	5% is considered the cut-off between the combined errors associated with natural fluctuations and sampling methods and evidence of true population decline. 1% of dead shells is considered to be indicative of natural losses. The Dawros passed both targets in 2008 (Moorkens, 2008; Moorkens and Killeen, 2008; NPWS, 2010). The occurrence of dead and moribund mussels in 2016 indicated an unnatural decline in adult numbers (Moorkens, 2016). The target is for sufficient survival of adults to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system
Suitable habitat: extent	Kilometres	Restore suitable habitat in more than 4.8 km in the Dawros system (see map 5) and any additional stretches necessary for salmonid spawning	The extent of the mussel habitat in the Dawros system downstream of Tullywee Bridge is welldocumented and corresponds with its distribution (Aster, 2003; Moorkens, 2008; Moorkens and Killeen, 2008). Stretches upstream of Tullywee Bridge require further survey. Most of the mapped habitat in the Dawros system is occupied by adult mussels; however, it is unsuitable for juvenile recruitment (Moorkens, 2008, 2016; Moorkens and Killeen, 2008; NPWS, 2010). Hydromorphological changes, including bank erosion/slumping and siltation, are key impacts on the Dawros mussel habitat. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system

Suitable habitat: condition	Kilometres	Restore condition of suitable habitat	The species' habitat is a combination of 1) the area of habitat adult and juvenile mussels can occupy, 2) the area of spawning and nursery habitats the host fish can occupy. Fish nursery habitat typically overlaps with mussel habitat. Fish spawning habitat is generally adjacent to mussel habitat, but may lie upstream of the generalised mussel distribution. Only those spawning areas that can regularly contribute juvenile fish to areas occupied by adult mussels should be considered. The availability of mussel and fish spawning/nursery habitats is determined by flow and substratum conditions. It is highly sensitive to hydromorphological changes, sedimentation and nutrient enrichment. Pressures throughout the catchment (map 5) contribute to such impacts. The habitat in the Dawros cannot support sufficient juvenile survival. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system
Water quality: macroinvertebrate and phytobenthos (diatoms)	Ecological quality ratio (EQR)	Restore water quality - macroinvertebrates: EQR greater than 0.90 (Q4-5 or Q5); phytobenthos: EQR greater than 0.93	The EQR targets correspond to high ecological status for these two Water Framework Directive biological quality elements. They represent high water quality with very low nutrient concentrations (oligotrophic conditions). In 2009, the habitat in the Dawros system failed the macroinvertebrate target, but passed the diatom target (Williams, 2009; NPWS, 2010). See also The European Communities Environmental Objectives (Surface Waters) Regulations 2009. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system
Substratum quality: filamentous algae (macroalgae); macrophytes (rooted higher plants)	Percentage	Restore substratum quality - filamentous algae: absent or trace (less than 5%); macrophytes: absent or trace (less than 5%)	The Dawros failed both targets in 2009 (NPWS, 2010). Up to 70% algal cover was recorded in mussel habitat, while high macrophyte cover (particularly Myriophyllum) was frequent (Williams, 2009; NPWS, 2010). In 2016, 91% of quadrats were in moderate or poor condition, mostly owing to algal cover (Moorkens, 2016). Bacterial and fungal growth and detritus accumulation also require further investigation in the Dawros, given the loading of organic fine sediment entering the river (Williams, 2009; Monaghan, 2012). Sufficient recruitment of juvenile mussels is being prevented by the poor condition of the river substratum. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system

Substratum quality: sediment	Occurrence	Restore substratum quality - stable cobble and gravel substrate with very little fine material; no artificially elevated levels of fine sediment	The Dawros failed the target for the Sub-basin Management Plan, with fine sediment recorded throughout the mussel habitat in 2008 and 2009 (Moorkens, 2008; Moorkens and Killeen, 2008; Williams, 2009; NPWS, 2010). There was a clear relationship between heavy siltation and higher macrophyte cover abundance. In 2016, the Dawros passed the target and silt plumes were restricted to marginal areas, suggesting siltation is episodic and deposited fine sediments are periodically flushed-out by high flows (Moorkens, 2016). Sufficient survival of juvenile mussels is being prevented by the poor condition of the river substratum. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system
Substratum quality: oxygen availability	Redox potential	Restore to no more than 20% decline from water column to 5 cm depth in substrate	Differences in redox potential between the water column and the substrate correlate with differences in oxygen levels. Juvenile mussels require full oxygenation while buried in gravel. In suitable habitat, there should be very little loss of redox potential between the water column and underlying gravels. The Dawros failed the redox target in 2008, with an average loss of 35% redox potential at 5cm (Moorkens, 2008; Moorkens and Killeen, 2008; NPWS, 2010). In 2016, 92% of redox measurements in the Dawros passed the target and the overall average was 16% (Moorkens, 2016). The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system
Hydrological regime: flow variability	Metres per second	Restore appropriate hydrological regime	The availability of suitable freshwater pearl mussel habitat is largely determined by flow (catchment geology being the other important factor). In order to restore the habitat for the species, flow variability over the annual cycle must be such that: 1) high flows can wash fine sediments from the substratum; 2) high flows are not artificially increased so as to cause excessive scour of mussel habitat; 3) low flows do not availability or aspects of fine sediment or growth of algae/macrophytes and 4) low flows do not cause stress to mussels in terms of exposure, water temperatures, food availability or aspects of the reproductive cycle; see Moorkens and Killeen (2014). Groundwater inflow to the substratum also contributes to water-cycling and favourable habitat condition. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system

Host fish	Number	Maintain sufficient juvenile salmonids to host glochidial larvae	Salmonid fish are host to the larval stage of the freshwater pearl mussel and, thus, are essential to completion of the life cycle. 0+ and 1+ fish are typically used, both because of habitat overlaps and the development of immunity with age in fish. Fish presence is sufficient, as higher fish density and biomass is indicative of enriched conditions in mussel rivers. Geist et al. (2006) found that higher densities of host fish coincided with eutrophication, poor substrate quality for mussels and a lack of mussel recruitment, while significantly lower densities and biomass of host fish were associated with high numbers of juvenile mussels. Fish movements must be such that 0+ fish remain in the mussel habitat until their 1+ summer. No fish stocking should occur within the mussel habitat until their 1+ summer. No fish stocking should or residency time. In 2009, glochidia were found on salmon, but not trout, in the Dawros (Johnston, 2009; NPWS, 2010)
Fringing habitat: area and condition	Hectares	Maintain the area and condition of fringing habitats necessary to support the population	Riparian habitats, including those along lake fringes, particularly natural/semi-natural woodlands and wetlands, even where they do not form part of a natural floodplain, are an integral part of the structure and functioning of river systems. Fringing habitats aid in the settlement of fine suspended material, protect banks from erosion and contribute to nutrient cycling and to the aquatic food web (e.g. allochthonous matter such as leaf fall), and provide habitat (refuge and resources) for certain life-stages of fish, birds and aquatic invertebrates. Shade may also be important in suppressing algal and macrophyte growth in enriched rivers and moderating temperatures. Equally, fringing habitats are dependent on rivers/lakes, particularly their water levels, and support wetland communities and species of conservation concern. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system

Appendix BSite Risk & Operations Form



Forests & Freshwater Pearl Mussel Management Framework

SITE RISK & OPERATIONS FORM

Forestry development type: (i.e. Afforestation, Forest Road Works, Felling (incl. reforestation), Aerial Fertilisation)	
Forestry scheme being applied under (if relevant):	
Relevant stage in the forest cycle	Afforestation & Thicket □ Forest assess □ Thinnings (1 st & subsequent) □ Clearfelling / Reforestation □
Applicant's name:	
Site location (townland, county):	
Freshwater Pearl Mussel Catchment	

Notes:

- A completed SITE RISK & OPERATIONS FORM is required with all applications to the DAFM for sites anywhere within the area included in the Plan for Forestry & FPM in Ireland (see Map 2.3 of Plan document).
- > This form must be based on a field assessment (walking both the perimeter & interior) completed by a competent person.
- ➤ The form is designed to be completed onscreen, printed off & signed, & included with the relevant application submitted to DAFM.
- ➤ The form must also be accompanied by a SITE RISK MAP illustrating various features (aquatic zones, relevant watercourses, hotspots, etc.) and an OPERATIONS MAP illustrating the type & extent of operations onsite.
- ➤ Both maps must comprise a OS 1:5,000 colour aerial photograph printed from the Department's online mapping system, iFORIS Internet (iNET) or an original composite Ordnance Survey map at a scale of 1:5,000 (based on the OSi 1:5,000 National Raster product). General mapping conventions set out in the *Forestry Standards Manual* (2015) apply, including a clear legend capturing site details & operations.

Definitions

The following define terms used in this form:

- An aquatic zone is defined as any natural river, stream or lake (but not an artificial drain) illustrated on an Ordnance Survey 6 inch map. (Note: The EPA water layer on iNET may not capture all aquatic zones onsite.)
- > A **relevant watercourse** is any other watercourse that has the potential to act as a pathway for the movement of significant amounts of sediment and/or nutrients from the site to an aquatic zone. Relevant watercourses are often artificial, & include existing drains & channels & other potential pathways that may contain flowing water during & immediately after rainfall.
- A hotspot is a particular small-scale physical feature or operational area onsite that can give rise to heightened risk of sedimentation. Examples include the following:

Hotspot type	Code (for labelling)
Soft wet ground (including wet, deep peat)	А
Flushes & springs	В
Floodplains or flood prone areas	С
Portions of site with complex matrix of drainage channels	D
Wind-blown areas / stands	E
Steep slopes, escarpments, rocky ravines / gullies, rock outcrops	F
Areas where ground traffic access is difficult due to slope or ground bearing capacity	G
Area likely to be intensively trafficked	Н
Other (specify)	J

> A **functional water setback** comprises a strip of land adjoining an aquatic zone / relevant watercourse, which creates distance between the forest / forestry operation & the water, & which serves to filter out potential sediment & nutrients from surface flow. Typically, a functional water setback will have the following characteristics: width 10 meters or greater; undisturbed; natural vegetation (ground vegetation & / or low-lying woodland ('scrub'); not traversed by feeder drains; slope moderate; mineral soil.

PART 1: SELECTING THE RELEVANT SCENARIO

Having walked the perimeter & interior of the site, which of the following scenarios applies? (Select one, two or more, as applies.) Each of these scenarios has an initial risk level assigned to it, regarding sediment & nutrient release, & other potential negative impacts on FPM.

SCENARIO	Tick Yes / No & following instructions ref. mapping	INITIAL RISK SCORE NOTE, this is the <u>INITIAL</u> risk score only
1. Is the site within one of the Priority 8 FPM Catchments?	Yes □ No □	If 'Yes', HIGH RISK
2. Is there an aquatic zone(s) present on or immediately adjoining the site?	Yes □ No □ If 'Yes', mark on Site Risk Map, labelling 'AZ1', 'AZ2', etc.	If 'Yes', HIGH RISK
3. Is there an aquatic zone(s) nearby (i.e. within 50 metres) (*) the site? (* Establishing whether or not an AZ is nearby (i.e. within 50 metres) of the site may involve a visual assessment (including the use of aerial photography), where the intermediate land is under separate ownership.)	Yes □ No □ If 'Yes', mark on Site Risk Map, Iabelling 'AZ1', 'AZ2', etc.	If 'Yes', LOW RISK
4. Is there a relevant watercourse(s) on or immediately adjoining the site?	Yes □ No □ If 'Yes', mark on map, labelling 'RW1', 'RW2', etc.	If 'YES', MODERATE RISK
5. Are there any 'hotspot(s)' present on the site?	Yes □ No □ If 'Yes', mark on map, labelling 'HS1', 'HS2', etc. If 'Yes', list hotspot type(s) (see note for list) & identify on the map. (Note, if more than one of the same hotspot type exists on site, add number to differentiate, i.e. 'G1, G2, G3'.)	If 'Yes', MODERATE RISK
6. Are there any other potential 'pathways' for overland flow from the site to an AZ, or to a RW & onwards to an AZ?	Yes □ No □ If 'Yes', describe & mark on map.	If 'Yes', MODERATE RISK
7. Is there a functional water setback(s) already in place on all AZs & RWs?	Yes □ No □	If 'Yes', LOW RISK
8. Is there a functional water setback(s) already in place on some AZs & RWs?	Yes □ No □ List which AZs & RWs in particular (e.g. 'AZ1', 'RW3')	If 'Yes', MODERATE RISK
9. Is there no functional water setback(s) in place on any AZs & RWs?	Yes □ No □	If 'Yes', HIGH RISK

10. Does the site contain areas which slope moderately (<15%) directly down to an aquatic zone?		Yes		No		If 'Yes', LOW RISK
11. Does the site contain areas which slope steeply (15% to 30%) or very steeply (>30%) directly down to an aquatic zone?		Yes		No		If 'Yes', HIGH RISK
12. Does the site contain soils that are particularly erodible in nature (i.e. podzols, peats, lithosol)		Yes		No		If 'Yes', MODERATE RISK
13. In the case of <u>afforestation</u> or <u>restocking</u> following clearfell, is fertiliser application proposed?	Yes		No		N/A	If 'Yes', MODERATE RISK
14. In the case of <u>afforestation</u> or <u>restocking</u> following clearfell, is new drainage proposed (including mound drains)?	Yes		No		N/A	If 'Yes', MODERATE RISK
15. In the case of <u>afforestation</u> or <u>restocking</u> following clearfell, are other forms of site cultivation proposed?	Yes		No		N/A	If scrap mounding, ripping, pit planting, LOW RISK If other, HIGH RISK
16. In the case of felling operations, is new forest roading required.	Yes		No		N/A	If 'Yes' but no river crossing involved, LOW RISK If 'Yes' & river crossing involved, HIGH RISK
17. Is the operation a subsequent thinning (where lop-and-top for extraction paths is typically in short supply)?	Yes		No		N/A	If 'Yes', MODERATE RISK
18. In the case of thinning or clearfell, is there a risk of windblow in the retained or adjoining canopy?	Yes		No		N/A	If 'Yes', MODERATE RISK
19. In the case of clearfell, is the underlying soil type peat or peaty podzol (Such soils have a poor capacity to retain nutrients arising from decaying lop-and-top?)	Yes		No		N/A	If 'Yes', MODERATE RISK
20. In the case of a thinning or clearfell, is one or more crossings over an aquatic zone or relevant watercourse required?	Yes		No		N/A	If 'Yes', MODERATE RISK.
21. Can the operator(s) demonstrate proficiency of working on environmentally sensitive sites?		Yes		No		If 'Yes', LOW RISK
Initial RISK SCORE Specify the HIGHEST RISK SCORE g	enerated	d by t	he ta	ble al	bove.	LOW RISK MODERATE RISK HIGH RISK

PART 2: MITIGATING OR AGGRAVATING SITE FACTORS

Having identified the relevant scenario & initial risk score...

	·	
describe & represent on the map any site factors that, in your assessment, <u>reduces</u> the risk level from HIGH to MODERATE		
or from MODERATE to LOW.		
describe & represent on the map any site factors that, in your assessment, increases the risk level from LOW to MODERATE		
or from MODERATE to HIGH.		
PAR	T 3: FINAL RISK ASSESSMENT	
	T 3: FINAL RISK ASSESSMENT Part 1 & Part 2 above, identify the	LOW MODERATE HIGH
Taking account of the outcome of	Part 1 & Part 2 above, identify the el in LOW or MODERATE, are	LOW MODERATE
Taking account of the outcome of overall risk level for this site? In cases where the overall risk lev there localised areas of the site will result the site will result the site will result the site will result and result results are as a site of the site will result results are a site of the site will result results are a site of the site will result results are a site of the site of	Part 1 & Part 2 above, identify the el in LOW or MODERATE, are here a MODERATE or HIGH risk	LOW MODERATE HIGH
Taking account of the outcome of overall risk level for this site? In cases where the overall risk lev there localised areas of the site will level applies?	Part 1 & Part 2 above, identify the el in LOW or MODERATE, are here a MODERATE or HIGH risk	LOW MODERATE HIGH
Taking account of the outcome of overall risk level for this site? In cases where the overall risk lev there localised areas of the site will level applies?	Part 1 & Part 2 above, identify the el in LOW or MODERATE, are here a MODERATE or HIGH risk	LOW MODERATE HIGH
Taking account of the outcome of overall risk level for this site? In cases where the overall risk lev there localised areas of the site will level applies?	Part 1 & Part 2 above, identify the el in LOW or MODERATE, are here a MODERATE or HIGH risk	LOW MODERATE HIGH
Taking account of the outcome of overall risk level for this site? In cases where the overall risk lev there localised areas of the site will level applies?	Part 1 & Part 2 above, identify the el in LOW or MODERATE, are here a MODERATE or HIGH risk	LOW MODERATE HIGH

PART 4: OPERATIONAL DETAILS

From the list of Forests & FPM Options (see Appendix C of the Plan document) relevant to the proposed forestry development type, identify the option(s) proposed onsite. Options selected must reflect the level of risk identified for the site. Also select relevant ancillary works.

Note, the specifications for each option must be adhered to, unless otherwise agreed to by the DAFM.

	ry Development (tick which tted application refers to)	List the Forests & FPM Options to be pursued onsite, & illustrate location & extent on OPERATIONS MAP
Afforestation □		
Felling	Thinning / Clearfell □	
	Reforestation □	
Forest Road Wo	orks 🗆	
(Aerial Fertilisati	on □)	
Ancillary Works List the ancillar the OPERATION	ry works relevant to this applica	ation, & illustrate the location & extent of each on
LIST:		

In all cases, provide details where specifications differ.

Declarations

Declaration by Registered Forester

- > I am aware of the sensitivities regarding Freshwater Pearl Mussel in this catchment, potential impacts arising from the proposed forestry development, & the specific procedures that apply under the Forests & FPM Plan.
- ➤ I have completed this SITE RISK & OPERATIONS FORM, having walked the site in question (including perimeter & interior) on the following date(s): _
- > To the best of my knowledge, this completed SITE RISK & OPERATIONS FORM accurately reflects

site conditions	s on-the-ground.
development	the combination of Forests & FPM Options selected for this proposed forestry will prevent the possibility of a significant effect on Freshwater Pearl Mussel within a Special Area of Conservation.
Registered Forester:	Signed:
	Date:
Declaration by Appl	icant
impacts arisin	the sensitivities regarding Freshwater Pearl Mussel in this catchment, potential g from the proposed forestry development, & the specific procedures that apply ests & FPM Plan.
Applicant:	Signed:
	Date:

Appendix CForests & FPM Options

This appendix lists a range of operations, practices and measures (or 'Forests & FPM Options') for the different types of forestry development regulated under S.I.191 of 2017, and is set out to support the completion of the Site Risk & Operations Form.

The list may be updated in the future, as new techniques and research emerge. The options are also designed to the modular in nature, i.e. different options can be applied in different areas of a project site, to deliver the necessary level of protection for water quality and FPM, and to realise the model for woodlands and forests in FPM catchments, as per Section 5.

AFFORESTATION

NO AFFORESTATION

Afforestation licensing highly unlikely for sites deemed to be of HIGH risk, unless 'Afforestation with Native Woodland'

Overall approach

- > Afforestation does not proceed, eliminating the potential for forestry-related disturbance.
- > Net benefit to FPM dependent on the nature of the current land use, which may have greater impacts compared to, e.g. native woodland under managed under CCF.

Management issues

> Note, if site abandoned, colonisation by invasive rhododendron may emerge, requiring control.

AFFORESTATION WITH NATIVE WOODLAND

Possible application on LOW RISK, MODERATE RISK and HIGH RISK sites.

Overall approach & relevance to FPM

- Afforestation with native woodland takes place, typically using NWS Est., adhering to that scheme's requirements (e.g. minimal site input, future management under CCF), with species selection representative of the most appropriate native woodland type identified for the site.
- Combined with undisturbed water setback as set out in the Environmental Requirements for Afforestation (or wider, if deemed necessary).
- Minimal site disturbance / inputs at establishment (see Photo), future management under CCF. Site evolves into a seminatural and permanent feature of the landscape, acting as a protective buffer between water and other land uses. As per the Woodland for Water measure, this approach will deliver a wide range of water related ecosystem services(*):
 - > reduction in sediment mobilisation and runoff into watercourses
 - > interception of nutrient runoff into watercourses
 - > bank stabilisation
 - > food input into the aquatic ecosystem
 - > shading / cooling
 - regulation of floodwater
 - riparian restoration
- Overall, a long-term reduction of risks regarding sediment and nutrient sources and pathways (hydrological connectivity). Onsite water retention.
- (* In addition to other ecosystem services regarding native woodland biodiversity, habitat linkage, carbon sequestration, amenity, environmental interpretation, etc.)



Management issues

- Practical silvicultural challenges arising from restrictions under NWS Est. regarding allowable inputs at establishment stage.
- > Control of deer / goat / sheep grazing, via fencing, wider control.
- Control of conifer regeneration (Sitka spruce, Lodgepole pine) & of invasive exotic species (principally rhododendron), to prevent site overrun.
- > Design considerations to facilitate future deer management and also wood production under CCF, where appropriate and desired by owner.

AFFORESTATION WITH AGRO-FORESTRY

Possible application on LOW RISK and MODERATE RISK sites.

Overall approach & relevance to FPM

- Afforestation takes place under the Agro-Forestry option of the Afforestation Scheme, involving the planting of widely-spaced, individually-protected native trees (predominantly native), and the continuation of pastoral farming in between.
- Combined with undisturbed water setback as set out in the Environmental Requirements for Afforestation (or wider, if deemed necessary).
- Establishment of agro-forestry far less intensive than standard afforestation site development. For example, drains not required. Over the medium to long term, site evolves into a seminatural and permanent feature of the landscape, acting as a protective buffer between water and other land uses.



Overall, a long-term reduction of risks regarding sediment and nutrient sources and pathways (hydrological connectivity).

Management issues

- > Practice well-established in other parts of the world, but new to Ireland. Therefore, demand and capacity to develop.
- > Allows farmer to continue to farm land in between growing trees.
- > Control of livestock within field *via* individual tree guards. In some areas, protection against deer may also be required.
- Design considerations to facilitate future deer management and also wood production under CCF, where appropriate and desired by owner.

STANDARD AFFORESTATION

Limited to LOW RISK sites only.

Overall approach & relevance to FPM

Afforestation takes place using conventional afforestation techniques involving (as appropriate to site needs) drainage, cultivation, fencing, closely-planted transplant stock, fertiliser application and vegetation management, e.g. under Grant & Premium Category 3 of the Afforestation Scheme.

Combined with undisturbed water setback as set out in the *Environmental Requirements for Afforestation* (or wider, if deemed necessary).

Management operations (depending of species



planted and silvicultural needs) include shaping, respacing, tending, forest roading, thinning (1st and subsequent) and final harvesting and reforest. Alternatively, can be managed under CCF.

Characteristics of forest and associated operations have potential risk regarding water quality. However, may represent a less intensive land use change, with fewer inputs.

Management issues

- Need to be well-sited and properly managed, with full adherence to Land Types for Afforestation, Environmental Requirements for Afforestation, *Forestry Standards Manual* and other requirements.
- > Control of deer / goat / sheep grazing, via fencing, wider control.
- Design considerations to facilitate future deer management and also wood production under CCF, where appropriate and desired by owner.

TREE FELLING: THINNING & CLEARFELL

STANDARD THINNING

May be appropriate on LOW RISK and certain MODERATE RISK sites.

Overall approach & relevance to FPM

- ➤ Standard thinning prescription to maximise crop value, based on 1st, 2nd and subsequent thinnings. with standard safeguards as per the Forest Service Forest Harvesting & the Environmental Guidelines(*).
- This provides the baseline level of protection on site regarding the possible risk of disturbance to watercourses

(* New Environmental Requirements for Forest Harvesting & Reforestation in prep.)



Management issues

Requires detailed knowledge of, and adherence to, the specific requirements set out in the Forest Harvesting & the Environmental Guidelines. Also requires assessment of site and crop parameters, to evaluate crop stability and possibility of windblow.

NO-THIN, RETAIN INDEFINITELY

Likely to be required for sites of HIGH RISK, unless ruled out by site factors (e.g. location adjoining watercourse, with risk of windblow).

Overall approach & relevance to FPM

- Exclude all operations and inputs on site, allow crop to develop unthinned and to grow on indefinitely beyond normal rotation, for long-term retention.
- > This approach eliminates onsite disturbance and risk of runoff arising from thinning operations in the short- to medium-term, with subsequent reduction of risk to water.
- ➤ However, approach may create the potential for future (long-term) windblow within the aging canopy (particularly within even-aged plantations on wet, exposed sites), with associated risk of disturbance to watercourse arising from sediment release and physical damage arising from trees falling into and blocking flow.
- > Over the longer term, sites may have the potential to develop into a stable mosaic of native woodland and / or open habitat and / or uneven aged conifer canopy, as gaps created by windblow or direct intervention (fell-to-waste, ring-barking) create opportunities for natural processes to take hold.

Management issues

Some initial intervention may be advisable, to reduce the risk of future windblow, e.g. manual fell-to-waste or ring-barking within sensitive areas of the site while crop is still young.

- Medium- to long-term monitoring and intervention required to manage the risk arising from windblown trees, e.g. the repositioning of upturned root plates adjoining watercourses, the removal of windblown trees falling into / across watercourse.
- ➤ Long- to very long-term, management input to steer the development of the site as the existing canopy breaks down see Reforestation Options 'Revert to Open Habitat' and 'Reforest by Natural Regeneration' (e.g. fencing, slow-water damming of drains, control of conifer regeneration).

NO-THIN, LEADING TO CLEARFELL

Likely to be required for sites of HIGH RISK.

Overall approach & relevance to FPM

- > Adopt a no-thin policy onsite, leading to clearfell of unthinned crop at a future point.
- > This approach eliminates onsite disturbance and risk of runoff arising from thinning operations in the short- to medium-term, with subsequent reduction of risk to water. It also reduces the risk of windblow generated sedimentation and direct instream damage to watercourse from falling trees during the course of rotation.
- > Due to the smaller diameter of individual stems, a non-thin approach may also facilitate the use of lighter harvesting / forwarding equipment at clearfell stage, and less intensive approaches / methods.

Management issues

- Compared to fully thinned conifer crop approaching maturity, an unthinned canopy will result in dense overhead canopy and therefore, minimal ground vegetation at clearfell stage, with subsequent reduction in filtration of overland flow. Therefore, some initial intervention at an early stage (e.g. heavy (manual) thinning-to-waste or ring-barking) within areas adjoining watercourses and other critical sediment source areas, may be beneficial, to introduce a lighter canopy and denser ground cover.
- > A no-thin regime may result in reduced quantities of lop-and-top onsite at clearfell stage, restricting the creation of effective brash mats.

OVER-THIN

May be required on certain MODERATE RISK and HIGH RISK sites, where windblow is not a factor.

Overall approach & relevance to FPM

- > Apply heavier-than-normal thinning regime throughout the rotation, to create a more open canopy and to encourage denser ground vegetation cover.
- > Denser ground vegetation will increase soil stability and the capacity of the site to filter sediment and nutrients from overland flow. This provides increased levels of protection to receiving waters, particularly at later thinning stages and at clearfell.

Management issues

- ➤ Heavier thinning may lead to an increased possibility of windblow on many sites, with associated risks to watercourse. Therefore, careful assessment required before proceeding with approach.
- > May require larger harvesting / extraction equipment at late thinning and clearfell stage, to handle larger stem diameters.
- Lighter canopy may facilitate the colonisation by invasive exotics, in particular, rhododendron, which may eliminate natural ground cover. Monitoring and follow-up control needed.

RETRO-FIT WATER SETBACK

Likely to be a requirement on LOW, MODERATE and HIGH RISK sites with hydrological connectivity.

Overall approach & relevance to FPM

Within conifer forests planted pre-Forestry & FPM Requirements, retro-fit a 25 m (or wider) water setback along aquatic zones and relevant watercourses. Create using suitable methods (e.g. motormanual fell-to-waste, dragging material back from the water course), to create an effective buffer of natural ground vegetation for the remainder of the current rotation & for future rotations. Likely to only be an option at 1st thinning stage (or 2nd thinning stage on very



stable sites) only. Otherwise, windblow near the watercourse may result, with associated risks.

Results in an effective buffer zone of natural ground vegetation *in situ* for the remainder of the current rotation and for future rotations. Gives rise to increased levels of protection to receiving waters, particularly at later thinning stages and at clearfell / reforestation stage, due to physical separation from forestry operations, and soil stabilisation and filtering capacity arising from dense ground vegetation along watercourse. Overall, a long-term reduction of risks regarding sediment and nutrient sources and pathways (hydrological connectivity).

Management issues

- ➤ Likely to only be an option at 1st thinning stage (or 2nd thinning stage on very stable sites) only. Otherwise, windblow near the watercourse may result, with associated risks.
- > Vary width to take account of micro-topography, e.g. widen at points likely to be receiving greater overland flow.
- > Extreme diligence during operation, as it involves felling in close proximity to the watercourse.
- Requires the strategic filling-in / slow-water damning of existing drains back to a point outside of the new water setback, to ensure effective buffer. Alternatively, or in conjunction, greening-up of existing drains left *in situ* will create a filtering effect.

CLEARFELL AT COMMERCIAL MATURITY

May be appropriate on LOW RISK and certain MODERATE RISK sites.

Overall approach & relevance to FPM

Clearfell undertaken at financial maturity, with standard safeguards as per the Forest Service *Forest Harvesting & the Environmental Guidelines*(*). Adjust standard approach, to increase level of protection.

This provides the baseline level of protection on site regarding the possible risk of disturbance to watercourses.

(* New Environmental Requirements for Forest Harvesting & Reforestation in prep.)

Management issues

Requires detailed knowledge of, and adherence to, the specific requirements set out in the *Forest Harvesting & the Environmental Guidelines*.

PRE-MATURE CLEARFELL

May be appropriate on HIGH RISK sites.

Overall approach & relevance to FPM

- Undertake clearfelling before financial maturity, e.g. at thicket stage, at early thinning stage.
- > This removes the existing forest cover from the site within a shorter time-frame. In most cases, site likely to be reforested with native woodland or reverted to open habitat. Future potential risks arising from commercial forestry operations therefore eliminated from the site into the future. The approach also creates opportunities for restructuring forest properties to break up otherwise even-aged blocks of forestry.
- > Due to the small stem diameters and (potentially) greater quantities of brash, clearfell less intensive in nature, with less potential risk to water.

Management issues

- ➤ The quantity of recoverable timber depends, *inter alia*, on crop age.
- > Fell-to-waste may be an option in younger stands.
- ➤ Ensure the type of harvesting and extraction equipment used is matched to tree size, and focus on the use of lighter machinery onsite, where possible.

OVER-MATURE CLEARFELL

May be appropriate on certain MODERATE and HIGH RISK sites, where windblow is not a factor. Careful assessment of use required.

Overall approach & relevance to FPM

- > Retain crop past the age of financial maturity.
- > This defers the clearfelling operation and creates opportunities for restructuring forest properties to break up otherwise even-aged blocks of forestry.
- ➤ However, potential for windblow exists if applied in inappropriate situations. Also, larger stem diameter at eventual clearfell will require heavier harvesting and extraction equipment on site.

Management issues

- Careful silvicultural assessment of the site and the crop are needed, to identify where this is a feasible option. Risk of windblow if applied in inappropriate situations. Therefore, careful assessment required before proceeding with this approach.
- Heavier timber assortments at eventual clearfell stage, requiring heavier harvesting & extraction equipment.

CONVERSION TO CONTINUOUS COVER FORESTRY (CCF)

May be appropriate on certain MODERATE and HIGH RISK sites, where windblow is not a factor. Careful assessment of use required.

Overall approach & relevance to FPM

> Management converts from the standard thin / clearfell / replant model to Continuous Cover Forestry (CCF). Under CCF,

individual and groups of trees are harvested and replaced using silvicultural principles that emulate natural processes, with natural regeneration playing a major role. Overall canopy remains intact.

- Periods of major site inputs and risk of disturbance to watercourses (arising mainly from clearfell) are avoided. Under CCF, activities onsite are less intensive, involve lighter machinery, and are spread out over space and time.
- > Greater levels of ground vegetation are present under CCF, creating a greater potential for the filtration of sediment and nutrients from overland flow. Overall, a long-term reduction of risks regarding sediment and nutrient sources and pathways (hydrological connectivity).
- This approach creates opportunities for restructuring forest properties to break up otherwise even-aged blocks of forestry. However, conversion to CCF is not possible on many site types, with risk of windblow high.

Management issues

- > Careful silvicultural assessment of the site and the existing canopy is needed to ensure the feasibility of conversion to CCF. Otherwise, windblow and subsequent risk of disturbance to watercourse can occur.
- > CCF requires an intensive network of access tracks within the forest, to facilitate management / extraction.
- > Specialised silvicultural expertise is required, and detailed ongoing monitoring of canopy development.
- > The ability of restock using natural regeneration may be restricted by deer.
- Lighter canopy typical under CCF may facilitate the colonisation by invasive exotics, in particular, rhododendron, which may eliminate natural ground cover. Monitoring and follow-up control needed.

HALO-THINNNING

May be appropriate on certain MODERATE and HIGH RISK sites, where windblow is not a factor.

Overall approach & relevance to FPM

> Centred on existing birch and other native broadleaves within the canopy, undertake manual felling (typically to waste) and / or ring-barking in the immediate area, to facilitate natural regeneration for seed tree. Repeat 3-4 times over

subsequent years, expanding these areas until they coalesce to form a native woodland cover over the entire site. A form of conversion to CCF.

O CCF.

- Suited to younger conifer plantations which are substandard and gappy.
- Overall, a long-term reduction of risks regarding sediment and nutrient sources and pathways (hydrological connectivity).



- Consider site and existing crop parameters carefully, to avoid windblow and associated risks to watercourse.
- > Risk of invasive exotics overtaking coupes, instead of native regeneration. Monitoring and follow-up control needed.
- Protect natural regeneration within coupes from grazing, especially deer. Possibility to utilise felled material for dead-hedging.



CABLE EXTRACTION

May be required on HIGH RISK sites, in extreme circumstances.

Overall approach & relevance to FPM

- Felled material extracted to roadside with minimal site disturbance / soil impact. Typically used at clearfelling, but can also be applied to thinning. Cabling is suitable for steep slopes where machine access in not feasible, and also on sensitive sites where machine passage should be excluded.
- Cabling creates an option to extract timber on the most sensitive sites or parts of sites.

Management issues

Cabling is very costly and may be economically non-viable in poor quality crops. There is also a limited availability of the system in Ireland.



AERIAL EXTRACTION

May be required on HIGH risk sites, in extreme circumstances.

Overall approach & relevance to FPM

Aerial extraction, using helicopter, to remove manually felled stems of highly sensitive sites, thereby avoiding the need for forest roads and overland extraction.

Aerial extraction circumvents the requirement for forest roading and overland extraction, thereby avoiding all associated risks.

Management issues

- > Highly specialised and extremely costly extraction technique, as yet unproven within the Irish context. Currently being studying under the KerryLIFE project
- Likely only to be justifiable on only the most sensitive of sites, where timber removal is imperative.
- May be suitable in areas where clearfell is identified as being the last major operation on site, e.g. 'Forest Removal', 'Revert to natural habitat' or 'Reforest by natural regeneration of native trees'.

POST-CLEARFELL, INCLUDING REFORESTATION

REFORESTATION FOR: (i) CONIFER FOREST FOR WOOD PRODUCTION; (ii) BROADLEAF FOREST FOR WOOD PRODUCTION; OR (iii) MIXED FOREST FOR WOOD PRODUCTION

May be appropriate for sites of LOW RISK.

Overall approach & relevance to FPM

- > This objective represents the standard option for reforesting with conifer species, with broadleaf species, or a mixture of broadleaf and conifer species (with each component representing at least 20% of the canopy at maturity). Applied where deemed silviculturally and environmentally appropriate. See Section 4.2, 4.3 and 4.4 of *Felling & Reforestation Policy* for specifications.
- ➤ Reforest with standard safeguards as per the Forest Service Forest Harvesting & the Environmental Guidelines(*).

 Adjust standard approach, to increase level of protection, e.g. increasing water setback width at key points along the watercourse, to maximise the protective function of the setback where it is intersected by potential overland pathways.
- Approach represents the baseline level of protection against possible sedimentation / nutrient runoff from reforestation stage, with potential for increased protection.

(* New Environmental Requirements for Forest Harvesting & Reforestation in prep.)

Management issues

- Hydrological assessment of preferred flow paths on the site required to identify where increased water setbacks should be located.
- Control of deer / goat / sheep grazing, via fencing, wider control.
- > Control of conifer regeneration (Sitka spruce, Lodgepole pine) & of invasive exotic species (principally rhododendron), to prevent site overrun.
- > Design considerations to facilitate future deer management and also forest management for wood production.

INTRODUCE PERMANENT NATIVE WOODLAND BUFFER VIA 'CCF' REFORESTATION OBJECTIVE

Likely to be a requirement on LOW, MODERATE and HIGH RISK sites with hydrological connectivity.

Overall approach & relevance to FPM

- > This reforestation objective applied to all or part of the site, to create a 50-100 m (or wider) buffer of permanent highforest native woodland to be retained indefinitely and to be managed under CCF for the protection of water and intrinsic native woodland biodiversity value (with a possible of hardwood co-objective, if compatible). See Section 4.5 of the Felling & Reforestation Policy for specifications.
- Combined with



- introduced water setback, creates permanent native woodland buffer in which operations and associated disturbance are precluded, physically separating the watercourse from commercial forest & other land uses further upslope.
- > Greater onsite retention of water and long-term reduction in pathways, sediment and nutrient source risks and hydrological connectivity. Approach will deliver a wide range of water-related ecosystem services as per the Woodland for Water measure.

Management issues

- > Reforest *via* planting and / or natural regeneration.
- > Control of deer / goat / sheep grazing, via fencing, wider control.
- > Possibility of blocking existing forest drains within native woodland buffer, creating small wetlands for settling.
- Control of conifer regeneration (Sitka spruce, Lodgepole pine) & of invasive exotic species (principally rhododendron), to prevent site becoming overrun.
- > Design considerations to facilitate future deer management and also management and wood production under CCF, where appropriate and desired by owner.

INTRODUCE PERMANENT NATIVE WOODLAND BUFFER VIA 'BIO' REFORESTATION OBJECTIVE

Likely to be a requirement on MODERATE and HIGH RISK sites with hydrological connectivity.

Overall approach & relevance to FPM

- ➤ This reforestation objective applied to all or part of the site, to create a 50-100 m (or wider) semi-natural buffer comprising a mixture of native woodland and open habitat (accompanied by slow-water damming of drains), predominantly for water protection and biodiversity. To be retained indefinitely and allowed to develop naturally (with interventions, as necessary as opposite). Approach involves widely-spaced planting of native species and natural regeneration see Section 4.6 of *Felling & Reforestation Policy* for specifications.
- Combined with introduced water setback, creates a permanent semi-natural buffer in which operations and associated disturbance are precluded, physically separating the watercourse from commercial forest & other land uses further upslope.
- > Greater onsite retention of water and long-term reduction in pathways, sediment and nutrient source risks and hydrological connectivity. Approach will deliver a wide range of water-related ecosystem services as per the Woodland for Water measure.

Management issues

- > Reforest *via* planting and / or natural regeneration.
- > Control of deer / goat / sheep grazing, via fencing, wider control.
- > Possibility of blocking existing forest drains within native woodland buffer, creating small wetlands for settling.
- Control of conifer regeneration (Sitka spruce, Lodgepole pine) & of invasive exotic species (principally rhododendron), to prevent site becoming overrun.
- > Design considerations to facilitate future deer management.

PERMANENT FOREST REMOVAL

May be appropriate for HIGH RISK sites of an acute nature.

Overall approach & relevance to FPM

- ➤ Forest removal pursued on part or all of the site, where specific case-by-case justification is presented to, and accepted by, DAFM, on the grounds of overriding environmental considerations(*) see Section 5.2 of the *Felling & Reforestation Policy*.
- > Instead, natural processes allowed to proceed unhindered, to restore the site to a natural habitat(s) with associated

vegetation. Depending on site conditions, exposure, elevation, etc., this may result in open habitat, or a mosaic of open habitat with pockets of native low-lying woodland.

> This approach creates little or no operational input immediately after clearfell, with reduced risk of site disturbance & runoff. It can be used to eliminate the subsequent forest cycle, thereby avoiding the potential for future risks associated with forestry land use & forest operations. Through the creation of natural open habitat, water-related benefits (including the reinstatement of natural hydrological conditions) are realised.

* Extract:

In certain situations, trees and forests may be incompatible with the conservation of protected Annex habitats and species at a site and / or national level, and deforestation may be considered. For example, the continuation (via reforestation) of forest cover on a particular site within an SAC may be deemed incompatible with the maintenance and restoration of a particular habitat for which that SAC was designated. Similar situations may also exist under the Water Framework Directive, where provisions under the Reforestation Objectives CCF and BIO may not suffice. In such situations, permanent forest removal may be considered by the Forest Service, on application.

Management issues

- > Approach needs to be justified on a case-by-case basis.
- > Treatment of post-clearfell debris, stumps, etc.
- Possible blocking of existing drains to reinstate natural drainage conditions. Requires hydrological assessment.
- Control of conifer regeneration (Sitka spruce, Lodgepole pine) & of invasive exotic species (principally rhododendron) (and also unwanted birch), to prevent site overrun.
- > Control of deer / goat / sheep grazing, via fencing, wider control, to prevent overgrazing of natural ground vegetation.

REFOREST BY NATURAL REGENERATION OF NATIVE TREES

Likely to be applicable on MODERATE and HIGH RISK sites.

Overall approach & relevance to FPM

Secure the necessary reforestation of part or all of clearfelled site, through the natural regeneration of native trees. Applicable under Reforestation Objectives CCF and Bio – Section 4.10 of the *Felling & Reforestation Policy* outlines application in relation to both(*).

This approach requires little or no operational input immediately after clearfell, with reduced risk of site disturbance & runoff. On suitable sites, it can lead to native woodland cover suitable for management under CCF, with water-related ecosystem services accruing.

* Extract:

Natural regeneration (NR) is the establishment of new trees from seed arriving naturally (by animals, wind, water, etc.) onto the plot from overhead, adjoining or nearby seed sources. Areas on the plot where NR is to be actively pursued (primarily under Objective BIO) are to be clearly identified on the reforestation map, and relevant operations described. The following applies:

Such areas must be limited to where



there is a realistic expectation of successful natural regeneration (in terms of area, seed source, etc.) achieving the required restocking target of the Reforestation Objective involved (as set out under 'Prescription'). This assessment should be based on, for example, evidence of advanced regeneration or the presence of suitable parent trees in the overhead canopy or adjoining hedgerows. (A typical approach on a particular site would involve a mixture of planting and NR, the latter focused in areas nearest to adjoining seed sources.)

- > Preparatory operations associated with these NR areas can include scarification, fencing and vegetation control.
- Monitor closely, and undertake supplementary planting, if needed, in order to achieve the required restocking target for the Reforestation Objective involved (as set out under 'Prescription' [of CCF and Bio sections])."

Management issues

- > Unpredictability of natural regeneration, success depends on site quality, seed source, etc.
- > Retain possible seed trees on site, consider pollarding at clearfell stage to prevent windblow.
- > Possibility to realise *via* direct seeding, principally manual (but potential for drone-drop).
- > Site may require windrowing & some scarification to encourage natural regeneration, and these need to be carefully assessed regarding the risk of soil disturbance and runoff.
- Control of deer / goat / sheep grazing, via fencing, wider control.
- > Additional planting may be needed to supplement natural regeneration.
- Control of conifer regeneration (Sitka spruce, Lodgepole pine) and of invasive exotic species (principally rhododendron), to prevent site overrun.
- > Possible intervention needed in medium- to long-term, to prevent overshadowing of watercourse and .
- > Potential for compatible hardwood production exists, using CCF silviculture.

CONIFER REGENERATION

May be appropriate on MODERATE and HIGH RISK sites.

Overall approach

Where site conditions allow and where profuse, reforest site / portions of site earmarked to remain in commercial forestry, through the natural regeneration of Sitka spruce and Lodgepole pine.

Functionality regarding FPM

By substituting replanting, approach avoids many operations associated with restocking & associated potential for disturbance & runoff.

Management issues

- > Unpredictability of conifer regeneration. Success depends on site quality, seed source, etc.
- > Site may require scarification & other operations to encourage natural regeneration, and these need to be carefully assessed regarding the risk of soil disturbance and runoff.
- > Control of deer / goat / sheep grazing, via fencing, wider control.
- > Additional planting may be needed to supplement regeneration.
- > Conversely, respacing required, where very dense.
- Intervention needed to clear regenerating conifers from water setbacks, firebreaks and other required open spaces.

FOREST ACCESS, INCLUDING FOREST ROADING

NO ACCESS

Likely to be applicable on HIGH RISK sites with hydrological connectivity and acute sensitivity.

Overall approach & relevance to FPM

No access developed to facilitate management of forests and extraction of timber, thereby avoiding risks with forest road construction and use.

Management issues

- > Implications for forest management, limited or no access for machinery to carry out thinning, felling, etc. Also, access for water protection works (e.g. retro-fitting of buffer) limited
- Possibly suitable in conjunction with certain options regarding fell-to-waste and forest removal.

DEVELOP TRACK NETWORK TO FACILITATE CCF

Likely to be appropriate where CCF planned.

Overall approach & relevance to FPM

- Develop a track network within forest undergoing conversion to CCF or reforestation for CCF, to facilitate CCF management and harvesting / extraction of single trees / small groups.
- A track network is a key component of CCF management, and needed to facilitate the realisation of associate benefits arising from CCF. The type of track network required for CCF is typically far more extensive that standard forest roading, and requires a fraction of construction inputs.

Management issues

- > Careful design of track layout needed to best facilitate CCF management.
- Ongoing monitoring of tracks, and associated maintenance, as required.

INTRODUCTION OF NEW FOREST ROAD, THROUGH CONSTRUCTION AND / OR UPGRADE

May be appropriate on MODERATE and HIGH RISK sites.

Overall approach & relevance to FPM

- Construct new forest road and/ or upgrade existing routes to required forest road standard (as per COFORD Forest Road Manual), to create or extend forest road network.
- Forest roads facilitate greater access to the forest along carefully



positioned and stable routes, facilitating many of the options set out above. The presence of a hardcore road reduces overland extraction routes, reducing associated risk to watercourses.

Management issues

- > Careful layout and design of forest road route (including minimising of crossings) to avoid risk during construction stage and future use.
- Similarly, strict adherence to standards set out in COFORD Forest Road Manual, to avoid risk during construction stage and future use.
- > Imported material to come from appropriate source, to reflect underlying geology of catchment.
- Proper design, construction and maintenance of associated drainage (including roadside drains and culverts) will prove crucial regarding pathway risk management.

DEVELOP TEMPORARY ACCESS

Likely to be a requirement on HIGH RISK sites.

Overall approach & relevance to FPM

- Required access to operation site provided using techniques that are temporary in nature and reversible, e.g. geotextiles, portable sections, log roads left to decay *in situ*.
- > This can avoids risk associated with standard forest road construction.

Management issues

- May be suitable in areas where clearfell is identified as being the last major operation onsite, e.g. 'Forest Removal', 'Revert to natural habitat' or 'Reforest by natural regeneration of native trees'.
- Specialist expertise needed regarding route and material.

CO-OPERATIVE ROADING

May be required on MODERATE and HIGH risk sites, where possible.

Overall approach & relevance to FPM

- > Adjoining forest owners integrate respective forest roading to develop network serving both forests.
- This is likely to require sections of new forest road to create an integrated network, but requires less forest construction overall. It facilitates greater access to forest properties along carefully position and stable routes, facilitating many of the options set out above.
- > Presence of hardcore road reduces overland extraction routes, reducing associated risk to watercourses.

Management issues

> Agreement required between forest owners regarding layout, cost, maintenance, usage, etc.

FOREST ROAD ABANDONMENT

May be required on HIGH risk sites, in extreme circumstances.

Overall approach & relevance to FPM

- > The existing forest road is abandoned, and route allowed to grow over with vegetation.
- > Future threats arising from the presence of the forest road are significantly reduced. This includes road failure arising from use for forest operations, and the fact that access for various works is no longer available.
- > Overall, a long-term reduction of risks regarding sediment and nutrient sources and pathways (hydrological connectivity).

Management issues

May be suitable in areas where clearfell is identified as being the last major operation on site, e.g. 'Forest Removal', 'Revert to natural habitat' or 'Reforest by natural regeneration of native trees'.

ANCILLARY WORKS

The following lists 'ancillary works' that may apply across two or more types of forestry development.

MOTOR MANUAL FELLING

Chainsaw operators deployed in sensitive areas (along watercourses, within hotspots), where the use of conventional harvesting machinery is not suitable due to the risk of soil disturbance and mobilisation into receiving waters. Trees felled away from the watercourse / hotspot. Avoids the creation of a sediment source and potential pathways (e.g. rutting tracks). May be fell-to-waste or extraction *via* mechanical horse or (if within reach) forwarder arm. H&S considerations.

DRAIN MANAGEMENT

Assessing the risk of existing drains as pathways for sediments and nutrients, and managing this risk before, during and after operations, are key aspects of protecting water and the aquatic ecosystem. Various parameters will dictate the level of risk, e.g. hydrological connectivity with sources of sediment / nutrients, water velocity within the drain, the presence and degree of in-drain vegetation (to slow water and filter sediment and nutrients), and temporal factors (e.g. the risk of an old dry drain being reactivated following clearfell).

Careful drain and sediment management must be employed before, during and after any forest operation, including drainblocking and slow-water damming, the creation of settlement ponds, silt fences or other sediment trapping techniques.

Permanent drain blocking will be particularly suitable within the CCF Zone and water setback itself, and in relation to critical source areas, to reinstate natural drainage conditions and pocket wetlands, slowing water velocity, and increasing the capacity for filtration (i.e. 'pathway disruption').

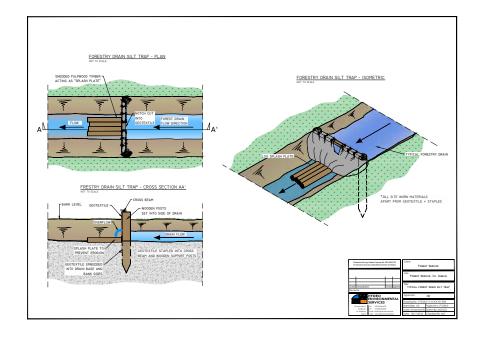
Drain management measures to be based on a hydrological assessment of the site. Features to be monitored during and after operations, and maintained as necessary to prevent a build-up of sediment and possible failure of the feature. Future



removal of feature (e.g. silt fencing) only after the site has stabilised and captured sediment has become fully vegetated and stabilised.

SILT TRAPS

Ensure appropriate silt traps are installed in all forest drains present on site. Silt traps, comprising staked geotextile, to be installed as per the specifications below (or similar). Silt traps are to be installed prior to the commencement of the operation, to intercept sediment, needles, etc. Silt traps to be staggered along the entire length of each forest drain at a maximum interval of 50 m, and not only at the lower reaches of drains.

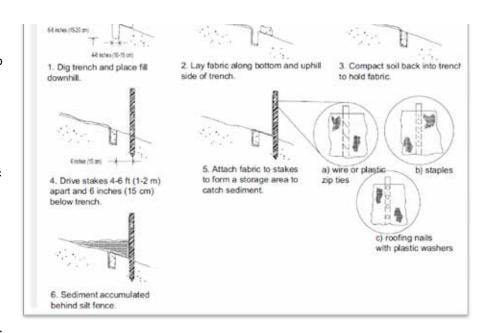


Also install appropriate

staked geotextile silt traps along the entire length of roadside drains adjoining and downstream of the operational area.

SILT FENCING

Installation of a silt fence to capture potential sediment runoff from the site, before entry into receiving water. Silt fences comprise the erection of a single or double line of purposedesigned fabric at strategic locations across potential pathways, supported by stakes at 2 m spacing. Fabric embedded into the ground to a depth of 100 mm using a spade. Temporary in nature, postoperation removal when site has become stabilised and captured sediment has



greened over. Various specifications / installation guides, e.g. opposite:

LOG DAMS

Sections of logs felled are placed into forest drains (parallel to the channel) during and immediately after felling, to promote onsite retention of water during rainfall, and as part of the restoration of natural hydrological conditions onsite. Useful in areas were permanent drain blocking is pursued, to break the hydrological connectivity between the forest and receiving waters, and to encourage hydrological restoration onsite.

SOIL DAMS

Existing drain is blocked by inserting 1-2 metre 'plug' of soil at one or more points along its length. Soil derived from nearby onsite, and compacted down into the drain. Suitable for level, shallow sloping drains only. Useful in areas were permanent drain blocking is pursued, to break the hydrological connectivity between the forest and receiving waters, and to encourage hydrological restoration onsite.

STRAW BALES

Existing drain is blocked by insert a straw bale into drain. Due to decay, temporary in nature, and danger of pulse of sediment released if the straw bale fails. Can be pinned in place with willow slips, which may 'strike' successfully while the straw bale breaks down. Useful in areas were permanent drain blocking is pursued, to break the hydrological connectivity between the forest and receiving waters, and to encourage hydrological restoration onsite.



SETTLEMENT AREAS

Settlement area identified along the length of a drain, where damming can create a wider pool for settlement of silt. Also, ponds can be created on site and drains diverted into them, to slow the flow of water and to allow sediment drop. Position and size must be hydrologically informed, i.e. where would water settle naturally on site? Can be further reinforced by the planting of willow in surrounding area, and allowing the pond to develop into a pocket wetland in



years following. Useful in areas were permanent drain blocking is pursued, to break the hydrological connectivity between the forest and receiving waters, and to encourage hydrological restoration onsite.

DRAIN DIVERSION

Diversion of water from an existing field drain leaving the forest into a vegetated buffer area, to reduce connectivity between the project areas and the receiving waters. Must be informed by careful hydrological assessment.

WILLOW PLANTING

Promote soil stabilisation and the ongoing uptake of nutrients within the medium to long term by establishing willow at key locations onsite (e.g. around hotspots, in dry mound drains and downslope of harvesting operations). Establish using strikes cut from existing willow plants on the site and struck into the ground – see Native Woodland Conservation Scheme document for details (DAFM, 2015).

Also potential use in firebreaks, as alternative to screefing, to provide a barrier to fire entering a forest.

HYDROLOGICAL REINSTATEMENT

Informed by hydrological assessment, areas of the site are identified for restoration to wetland conditions that existed prior to land drainage. Created by combining draining blocking / damming and the creation of settlement areas (typically larger in scale that those above) and willow planting.

TIMING OF OPERATIONS

Careful timing of the operation to avoid conditions that elevate the risk of soil disturbance and mobilisation offsite.

Machine operations must not take place in the 48-hour period before predicted heavy rain, during heavy rain, or in the 48-hour period following heavy rain. Heavy rain is defined by Met Éireann as a precipitation rate that exceeds 2 mm per hour averaged over 3 or 6 hours. Consult the Met Éireann website www.met.ie and review the forecast details for the meteorological station nearest to the site.

Use contingency planning to enable the redeployment of operations to more stable areas of the site, should these conditions occur.

The Environmental Clerk of Works (eCoW) (where engaged) to have the authority to cease all operations onsite during and after rain, where ground conditions are wet and the mobilisation of sediment becomes possible.

Undertake the clearfell and extraction operation during the late spring / summer / early autumn period and only during dry weather. Where operation involves reseeding with grass (for nutrient uptake), undertake in spring in order to enable the establishment of the grass during the growing season.

BRASH MATS

During the harvesting operation, the harvester deposits branches in the direct to travel. In addition, the last pulp wood length is left unprocessed and deposited at a right angle to the direction on travel, to add further bulk and load-bearing capacity. Brash mats must be wide enough to provide a trackable surface for the harvester and subsequent forwarder, with an addition 1-2 metres either side beyond the wheels / tracks.

Avoids soil disturbance and compaction, reducing potential source risk (i.e. mobilised soil) and pathways (i.e. rutting tracks). Careful onsite monitoring required to avoid overuse and breakdown of mat. Also, volume of material may be limited on sites (e.g. subsequent thinnings).

REMOVAL OF BRANCHES & FALLEN TREES FROM AQUATIC ZONES

Removal of branches and fallen trees arising naturally or during operations, from aquatic zone, in order to prevent impact of the aquatic habitat (e.g. needle breakdown and smothering of gravel beds) and possible obstacle to water flow, which could disturbance bankside edges during spate flows and create bank 'blow-outs' and sedimentation. Typically done manually but heavy



branches and whole tree sections likely to require the use of winches or harvester arm. Instream access to undertake the work should only be undertaken with prior agreement of NPWS, and has obvious H&S implications. Note, material that has been *in situ* for a considerable length of time and which appears 'settled' should not be disturbed, as this may generate a plume of silt.

REMOVAL OF BRASH FROM SITE

Removal of branch, lop-and-top and other debris from areas of the site with high connectivity to receiving water, to offset nutrient seepage immediately after and in the years following, the operation. Undertaken after harvesting and extraction (as brash may be used brash mats) and applied within set distances from aquatic zones or key relevant watercourses, or over larger areas of the site (e.g. upslope of active pathways).

Material moved manually (if on small scale) or by machine (e.g. a hydraulic thumb attachment on an excavator). If on a larger scale, may need to be moved by forwarder to a low risk and accessible area of site, for possible chipping / bundling and removal offsite.

Careful coordination of operations is needed onsite, particularly where the material is used as brash mats to protect soil during machine operations. Must represent the last operation performed in those areas receiving treatment.



Photo forestenergy.ie

Wood fuel supply chains

currently operate in Ireland that use brash as a fuel to feed biomass boilers. One such supply chain uses a machine called a brash bundler (pictured) that gathers and compacts the brash into bales *in situ* on the site. The bales are forwarded to the roadside using a timber forwarder, and then hauled to an end-user using timber trucks. The bundles are shredded before being fed into a boiler.

GRASS SEEDING

On clearfell sites, sow grass seeds immediately after harvesting (when safe to do so) in high risk areas, to establish ground vegetation to provide for natural filtering of sediment and nutrient (P) absorption capacity as soon as possible. Focused on the water setback area but also within other areas of the site where overland flow of water is likely. Utilise a 50:50 mix of two native grass species (*Holcus lanatus* and *Agrostis capillaris*).

CROSSING SMALL DRAINS

To facilitate the crossing of forest drains during harvesting and extraction, while avoiding the breakdown of the drain structure itself, insert lengths of felled timber into the drain, parallel with the channel. Brash mat then overlaid on top. Only use on level sites and where drains are inactive. Measure regarded as being temporary in nature, remove after operations are completed, unless required as part of the restoration of wetland conditions onsite.

CROSSING LARGE DRAINS & SMALL AQUATIC ZONES

For harvesting and extraction operations, minimise the number of crossing points of larger drains and smaller aquatic zones onsite (balanced with need to avoid overuse of any single crossing). Where necessary, provide machine access over these by installing log bridges, using sections of harvested trees. Log bridges to span from bank-to-bank proud of the channel, to prevent breakdown and erosion of the drain side. Should be wide enough to carry span of machine's footprint plus 1 metre on both sites. Overlay with geotextile material and brash, to intercept soil falling off wheels / tracks. Extend

geotextile and brash mat several meters at both ends. Regard measure as being temporary in nature – remove after the operation is completed, applying due care to avoid soil and debris falling into the channel. Peel back the geotextile from the crossing towards the bank, ensuring any lop-and-top / brash on top is deposited away from the watercourse.

Other engineering solutions are possible (e.g. drop-in bridge).



POLLARD RETAINED NATIVE BROADLEAVES

Apply pollarding(*) to native tree(s) (often birch) present within the former canopy, as boundary trees or along watercourses, and exposed by clearfelling. Such trees are often tall, spindly and unstable and can blow over and become uprooted, creating a risk of sediment release, especially if adjoining a watercourse. Pollarding will enable these trees to survive and grow on and ultimately, to act as a seed source for natural



regeneration onsite, thereby contributing to the development of an emerging woodland with a more diverse structure. (* Pollarding is the practice of cutting a tree to leave a permanent trunk typically 2-4 metres in height and supporting a mass of branches above the reach of browsing animals.)

REPOSITION ROOT PLATES OF WINDBLOWN TREES

When fallen trees with exposed root plates are being cut during clearfelling, the exposed root plates to be manoeuvred back into their original positions, to eliminate a possible sources of siltation.



FELL-TO-WASTE

A management option on a thinning or clearfell site, whereby felled trees are not extracted off site, but are instead left onsite, typically *in situ* where felled. This practice foregoes the value of recoverable wood but eliminates the extraction operation, avoiding risks to water from this operation. A suitable option on sites deemed highly sensitive or inaccessible by machinery. Also referred to as 'fell-to-recycle', as the entire tree remains onsite as deadwood, with nutrients returned to the soil naturally through decay.

REDUCED PRODUCT RANGE

Similar to 'fell-to-waste', except that certain products (typically the higher value assortments) are extracted after harvesting. This reduces the number of machine passes and associated risk to water.

RING-BARKING

Ring-barking is a silvicultural treatment involving the removal of the bark and vascular tissue (typically using a small axe or chainsaw) from around the entire circumference of a standing tree, for the purpose of killing it *in situ*. Applications within the native woodland context include the elimination of individual or small groups of non-native trees, and the creation of standing deadwood. The practice gradually eliminate trees without felling and the associated sudden nutrient release. As tree dies gradually, the nutrient pulse from decaying needles is staggered.

Method enables the elimination of tree cover without the need for machine access for felling and extraction. May also facilitate tree removal in areas prone to windblow, as treated trees are left *in situ*, retaining sheltering effect to some extent.

Often requires repeat treatment to bring about tree dead. Issues regarding H&S (creating standing deadwood) and landscape (as standing dead trees are unsightly).

Useful application in the retrofitting of water setbacks, enabling the elimination of tree cover and the encouragement of ground vegetation, without the need for felling and extraction. Similar application in halo-thinning.

Note, as the operation renders a tree liable to fall over time, ring-barking requires a felling licence.

MECHANICAL HORSES

Utilise new machinery designed to extract timber from highly sensitive sites, e.g. along watercourses. Expensive to operate and require experienced operators, but create opportunities to recover valuable timber on highly sensitive and / or inaccessible areas.



GRAZING

If applied without due consideration, methods to control grazing (principally deer) can lead to impacts of water, the aquatic habitat, and FPM. The area is complex, and solutions are often site-specific. Key considerations are as follows

DAFM Forestry Standards Manual (2015): "Plantations [under the Afforestation Scheme] must be fully protected [from grazing by livestock, deer and feral goat, rabbits, hare] from the time of planting. There is no requirement to duplicate existing stock-proof fences, rivers, substantial walls, or other stock-proof boundaries with additional fencing. Where fencing is required, specifications set out in Table 12.1 apply. Adequate access to plantations for management purposes can be provided using styles and / or secured temporary openings in fence lines."

Refer to Höna et al. (in prep.) The Management of Deer in Native Woodlands (Woodland of Ireland Information Note, publication imminent) for information on good practice regarding deer surveys (to assess deer damage and the appropriate 'carrying capacity of the woodland), woodland design and the use of fencing to control deer in tandem with other sensitivities, including water, and for information on methods and features such as A-frame fencing, deer leaps and shooting positions.

Particular care if fencing alongside riverbanks, as fence can trap debris during flood and lead to blow-out of banks. Similarly, avoid crossing watercourses with fencing. Consider potential for impact during installation. Also, consider how animals will react outside of the fence, e.g. a fence running parallel to a watercourse may lead to high deer traffic and soil poaching, creating the potential of soil mobilisation and runoff.

Improve overall forest design (principally at afforestation and clearfelling / reforestation) to incorporate deer management features that will reduce the impacts of over-grazing / browsing. The creation of ridelines and open areas for grazing will ensure that deer habitat use is included at all stages of forest planning. Make the woodland / forest 'hunter friendly', by allowing space to evaluate and to cull deer effectively. There should be a co-operative approach taken with neighbouring landowners, and decisions should be taken at a landscape level to ensure effective control.



There can be huge negative effects of over-grazing in FPM areas, ground vegetation along watercourses is providing a key filtering function. In rocky, steep area, consider alternative deer fencing systems (e.g. A-frame fencing, pictured) to protect vulnerable areas. Avoid fencing large areas - consider retaining pathways through the area, and compartmentalising the area with smaller enclosures. Maintain open areas / ridelines as suitable deer habitats, to facilitate assessment and control. Consider fencing method with lower inputs, e.g. utilise topped stems as fence posts.

INVASIVE SPECIES

If applied without due consideration, methods to control invasive species can lead to impacts of water, the aquatic habitat, and FPM. The area is complex, and solutions are often site-specific. Key considerations are as follows.

Various invasive species represent a threat to water, e.g. rhododendron, red-osier dogwood, Himalayan balsam and Japanese knotweed. The mechanisms vary. For example, among other impacts, rhododendron infestation suppresses natural ground flora which would otherwise play a protective role. Similarly, by suppressing other vegetation but then dying-

off seasonally, Himalayan balsam exposes banks to excessive erosion during the winter months.

Regarding invasives along rivers and streams, where best practice involves herbicide use, consult with NPWS and Inland Fisheries Ireland in advance, due to the extreme sensitivity of FPM to the contamination of water with biocides. Chemical control in such situations is likely to be limited to stem injection. Controlling such species is difficult and expensive, and often requires a wider catchment approach for progress to be sustained.



Refer to Section B7: Invasive Species of the publication *Management Guidelines for Ireland's Native Woodlands* (Cross & Collins, 2017) and to the Woodland of Ireland Information Note *The control of rhododendron in native woodlands* (Barron, 2007).

FIRE

Refer to DAFM *Prescribed Burning Code of Practice – Ireland*, and taking cognisance of Fire Danger Notices on the DAFM website www.agriculture.gov.ie/forestservice/firemanagement/

Note, the positioning and maintenance of firelines can lead to the creation of a pathway for silt and sediment. Do not position new firelines leading towards receiving waters. The Forestry Standards Manual specifies (in relation to new plantations): "Planned ridelines normally require a 6 metre wide unplanted strip. Firebreaks must comprise a 6 metre wide fuel-free zone." Fuel-free zone normally achieved by screefing, but this may be problematic on certain sites, regarding water. Instead, achieve this fuel-free status by planting firelines with willow.



PREPARATION, STORAGE AND USE OF POTENTIALLY HAZARDOUS MATERIAL

- > Urea shall not be applied to stumps within 10 m of any aquatic zone.
- No fertilisers or insecticides are permitted during reforestation. Herbicide application to adhere to safeguards regarding water, as set out in the *Environmental Requirements for Afforestation*, *Forestry & Water Quality Guidelines*, *Forest Protection Guidelines* and the *Guidelines for the Use of Herbicides in Forestry*.
- > Throughout both felling and replanting, and in addition to the inspections to be completed by the eCoW (where deployed), the following shall apply:
 - > Store and prepare (if relevant) all chemicals, fuel and machine oils at a dry, elevated location onsite at least 50 m from the nearest aquatic zone and at least 20 m from the nearest relevant watercourse.
 - > Similarly, undertake all machine refuelling, maintenance and repair at a dry, elevated location onsite at least 50 m from the nearest aquatic zone and at least 20 m from the nearest relevant watercourse.
 - Never discharge chemicals, fuel or machine oils into an aquatic zone, relevant watercourse, hotspot, or into any drain or silt trap, either existing or created during the site works.
 - > Never rinse out chemical, fuel or oil containers onsite.
 - > Do not clean equipment within 50 m of an aquatic zone, or within 20 m of a relevant watercourse or hotspot. All wash waters must be disposed of carefully.
 - > Where possible, biodegradable oil should be used as a substitute for mineral oil.
 - > Collect and retain spent machine oil for appropriate disposal off-site.
 - > Remove all empty chemical, fuel and oil containers, and all general refuse, from the site during and after site works, and dispose of appropriately off-site.
 - > Adhere to relevant sections of the *Guidelines for the Use of Herbicides in Forestry* and the *Forest Protection Guidelines*.

Appendix DDaily Monitoring Form

Notes on use

- The operator in charge of site works on a dayto-day basis is required to monitor operations on a daily basis to ensure that no impact on water quality is occurring and that the operations are being carried out in accordance with conditions.
- The Daily Monitoring Form is to be completed by the operator in charge of day-to-day works at the end of each day and retained onsite (typically in the machine cabin).
- It must be accompanied by the conditions attached to the licence issued, and a site map illustrating all water features (aquatic zones, relevant watercourses, hotspots, abstraction points), the extent of all water setbacks and the location of water protection measures.
- The form stipulates a visual assessment of the baseline conditions of any receiving waters (with a focus on outflows into aquatic zones) prior to the commencement of all works, and from then on, at the end of each day of operations (or before daylight fades).
- ➤ In addition to visual assessment, where possible, REDOX and conductivity should be measured. Both are readily measured using hand-held devices, and are useful indicators of key water quality parameters, i.e. oxygenation and suspended solids.
- The form also stipulates the visual assessment of silt traps and silt fences to check that these are functioning, and of other key water protection measures, such as water setbacks and brash mats, to check continued effectiveness.
- A summary of the weather conditions on site during each day of the operation is required.
- The Daily Monitoring Form must also be used to record: any emerging or actual issues that arise onsite, which may give rise to a heightened risk regarding siltation, nutrient runoff or any other impact on water quality; confirmation that the person ultimately responsible for the operation has been informed; and a record of the immediate and subsequent corrective action(s) taken.
- The Daily Monitoring Form must be signed by the operator in charge of day-to-day works, and by the person with overall responsibly for the operation, on a weekly basis.
- The form must be retained as a record by the forest owner, and made available for inspection by DAFM, either onsite or subsequently.



Forests & Freshwater Pearl Mussel Management Framework

DAILY MONITORING FORM

, Thinning,				:rations:			te map r features,
Forest operation (i.e. Afforestation, Forest Road Construction, Thinning, Clearfelling (and Replanting)):	Forest Service Reference Number:	Applicant's name:	Site location (townland(s), county):	Name of operator-in-charge of day-to-day onsite operations:	Date of commencement of operations:	Monitoring carried out during week ending:	Confirm that the conditions(s) of the licence <u>and</u> a site map are attached to this form, the latter illustrating water features, setbacks & other water-related safeguards

Site details	Aquatic zone present on, immediately adjoining or nearby (i.e. within 50 metres) the site?	Yes 🗆	□ oN
	Relevant watercourses present on, immediately adjoining or nearby (i.e. within 50 metres) the site?	Yes 🗆	□ oN
	Hotspots present on site?	Yes 🗆	No 🗆

Day-to-Day Monitoring Record

Record of Emerging / Actual Issues (*)

Day and Date (DD / MM / YY)	Emerging / Actual Issue	Applicant / Licensee informed?	Corrective action taken (describe)
		Yes□ No□	
		Yes 🗆 No 🗆	
		Yes 🗆 No	
		Yes□ No□	
		Yes 🗆 No 🗆	

(* Defined as any issue / situation that may give rise to a heightened risk regarding siltation, nutrient enrichment or any other impact on water quality.)

Declaration

Declaration by Applicant / Licencee and Op	int / Licencee and Operator-in-Charge of Operation
V lam / we are a operation, and	I am / we are aware of the sensitivities regarding Freshwater Pearl Mussel in this catchment, potential impacts arising from the proposed operation, and all conditions attached to the licence / approval for this operation.
V In relation to the	hightarrow In relation to this FPM Site Monitoring Form, I am / we are completing the form on a daily basis.
V To the best of	> To the best of my /our knowledge, this completed FPM Site Monitoring Form accurately reflects the site conditions.
Applicant / Licensee	Signed:
	Date:
Operator-in-Charge	Signed:
	Date:

Appendix ESite Contingency Plan

Notes on use

- Prior to operations commencing, a Site Contingency Plan must be prepared by that person with overall responsibly for the operation (or the environmental Clerk of Works (ECoW), if appointed), following the attached template (or similar).
- The Site Contingency Plan must contain relevant instructions and contact details for key personnel, directing operators of how to react and who to contact, should an unexpected event arise that damages, or creates an imminent risk of damage to, water (e.g. the release of siltation due to silt trap failure, an accidental spillage of fuel or chemicals, a period of intense rainfall).
- Copies of the Site Contingency Plan must be held by all operators onsite, and available at all times.
- If the Site Contingency Plan is triggered for whatever reason, notify the relevant District Forestry Inspector immediately.



Forests & Freshwater Pearl Mussel Management Framework

SITE CONTINGENCY PLAN

An Roinn Talmhaíochta, Bia agus Mara Department of Agriculture, Food and the Marine

Continued Local Authority: National Monuments Service: National Museum of Ireland: Adjoining landowner(s):	Contacts to be notified immediately (see above for contact details), should this event occur or becomes imminent					Completion date:
Contact details (input actual names and telephone numbers, as relevant): Applicant: Registered Forester: Forest Service District Inspector: Inland Fisheries Ireland: National Parks & Wildlife Service:	First action, should this scenario occur or becomes imminent (outline))
Site location: Townland: County: Forest Service Reference Number:	Potential risk scenario (describe)	1.	2.	3.	(Add further scenarios, as necessary)	Site Contingency Plan completed by: Name of Registered Forester:

Appendix FPriority 8 FPM Catchments

This appendix gives an overview of each of the Priority 8 FPM Catchments, i.e.

- Bundorragha (Co. Mayo)
- Caragh (Co. Kerry)
- Owenriff (Corrib) (Co. Galway)
- Currane (Co. Kerry)
- Dawros (Co. Galway)
- Kerry Blackwater (Co. Kerry)
- Glaskeelan (Leannan) (Co. Donegal)
- Ownagappul (Co. Cork)

Each catchment is described under the following headings:

- > Physical description
- Soils and land use
- > Status of FPM
- > Forest land
- > Forest operations.

Also included are maps illustrating:

- > Streams, rivers and lakes, and FPM habitat
- Soil types
- > CORINE land cover
- > Forest ownership
- > Forest type
- > Forest age class structure.

Photographs are also included to illustrate various features within each catchment.

The purpose of this catchment-by-catchment overview is to provide background information to inform forest owners, foresters, forestry operators and other stakeholders regarding forestry-related decision-making within each of the Priority 8 FPM Catchments.



Physical description

The Bundorragha FPM Catchment is situated in southwest Co. Mayo. The corresponding SAC is the Mweelrea / Shreefry / Erriff Complex SAC (001932), the Conservation Objectives of which include the restoration of FPM within the SAC to favourable conservation status, as defined by specific attributes and targets set out in the relevant NPWS Conservation Objectives Series report (see www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO001932.pdf).

The catchment comprises a series of interconnecting lakes and rivers in a valley between the Mweelrea Mountains to the west and the Sheeffry Hills to the east. The main system rises in the Mweelrea Mountains and flows firstly into Cunne Lough, and then into Glencullin Lough and Doo Lough, the largest body of water in the catchment. The Glenummera River flows westwards through the valley between Sheeffry Hills and Ben Gorm into Doo Lough. A number of smaller tributaries cascade into Doo Lough from the east and from Mweelrea Mountains to the west. From Doo Lough, the Owengar River flows to Fin Lough. From Fin Lough, the Bundorragha River flows southwards into Killary Harbour. A series of steep cascading tributaries enter

the Bundorragha River from the Ben Gorm to the east.

The catchment is characterised by dry mountain podsols with pockets of heath, blanket bog on low-lying areas, and small pockets of alluvial soil and gley associated with watercourses.

The Bundorragha FPM Catchment is approximately 48.3 km² (4,830 ha) in area. The total river length in the catchment is 13.5 km (Map 1).

Table 1 summarises WFD details of individual water bodies within the catchment, and inclusion or otherwise in the current acid sensitivity protocol regarding afforestation.

Soils and land use

An analysis of the EPA / Teagasc soils data indicates that the main soil types in the Bundorragha FPM Catchment are peaty gleys and peaty podsols, with some brown earths and podsols in areas around the Glenummera and Owenaglogh Rivers (Map 2).

While not designed for detailed reporting, the CORINE Land Cover (2006) does indicate main land use types within the catchment. The most common land uses are peat bog (54.8%), natural grassland

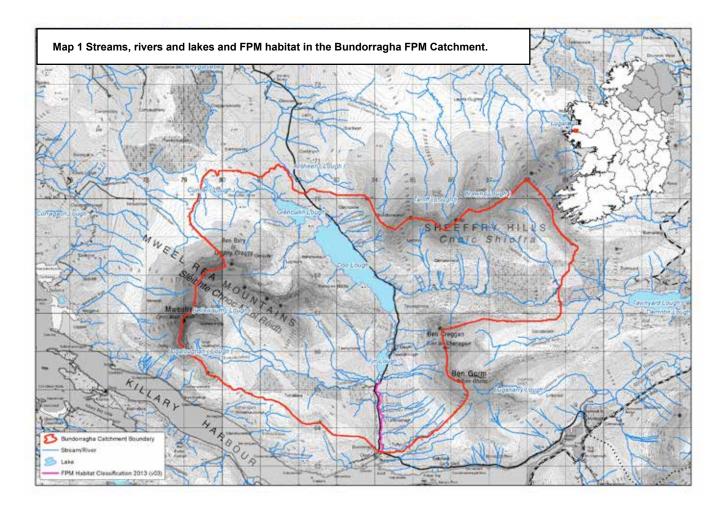
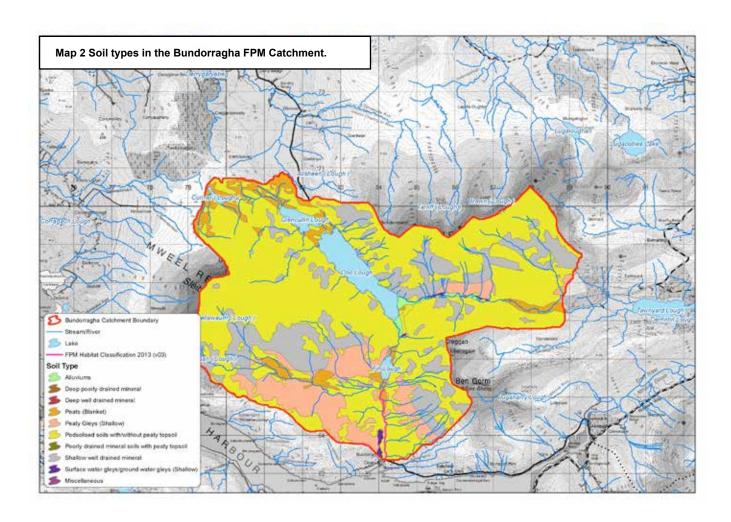


Table 1 Bundorragha FPM catchment: Water body details (from www. catchments.ie, 26June18), inclusion under the RBMP Area for Action programme (from www.watersandcommunities.ie/areas-for-action/), and Acid Sensitivity Area status (from Appendix 11 of DAFM's Forestry Standards Manual (2015)).

Water body	Туре	Status	WFD risk	Pressure	Area for Action	Acid Sensitive Area	
Bundorragha_010	River	Unassigned	Review	Investigative assessment required	Yes	No	
Glenummera_010	River	HES	Not at risk	None assigned	No	No	
Bundorragha_020	River	Good	At risk	Hydromorphology	Yes	No	
Glencullin	Lake	HES	Not at risk	None assigned	No	No	
Doo MO	Lake	Good	Not at risk	None assigned	No	No	
Fin MO	Lake	Unassigned	Not at risk	None assigned	No	No	
Cunnel	Lake	Unassigned	Not at risk	None assigned	No	No	









(22.3%) and bare rock (14.8%). Forests and woodlands account for approximately 6.2% of land in the catchment (Map 3).

FPM status

According to the FPM Bundorragha Sub-basin Management Plan, mussels within the catchment are primarily confined to the 2 km length of the Bundorragha River between Fin Lough and Killary Harbour. A survey in 2005 found that mussels were absent from Fin Lough and above, but were abundant in places along the Bundorragha River. The total population is estimated to be in the region of 2 million individuals.

In 2009, a survey of the Bundorragha River was carried out at two of the locations previously surveyed in 2005. The resurvey indicated that there had been no decline in the population since 2005, and that mussels of all ages were present, indicating that recruitment was occurring in the river.

An electro-fishing exercise was also undertaken at two locations during the 2009 survey to assess whether fish bearing FPM glochidia were present. Glochidia were absent from fish caught upstream of the main mussel populations. However, at the site

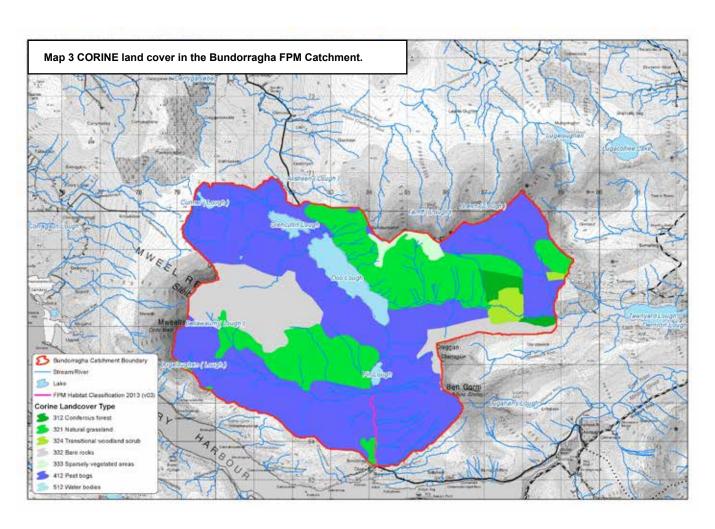
downstream of the main population, a total of seven trout and seven salmon were caught. Glochidia were found attached to five of the salmon, indicating that salmon rather than trout are acting as hosts to the Bundorragha mussel population.

The 2009 survey also noted that salmon and sea trout populations within the Bundorragha River appear to have improved since the previous survey. A healthy fish population is vital to the conservation of FPM populations.

FPM is at favourable conservation status in the Bundorragha FPM Catchment. The Bundorragha population is ranked at the top of the 27 FPM SAC populations in the country, based on population status, habitat condition and current pressures. Bundorragha is the only catchment in Ireland to achieve favourable conservation status.

Water quality within the catchment achieved all five of the Environmental Quality Objectives (EQOs) specified in Schedule 4 of the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations, S.I.296 of 2009.

Recent improvements to water quality in the Bundorragha Catchment appear to have had a positive effect on the mussel population. The indications are that if the favourable conditions



that currently exist are maintained, a large healthy population of FPM can be sustained in the catchment in the long term.

Forest land

The total area of forest cover within the Bundorragha FPM Catchment is approximately 300 ha. This represents *c*.6.2% of the total land use within the catchment, which is lower than the national average forest cover of 11%.

Forest cover in the catchment is largely confined to three distinct areas. The largest forest area (*c*.195 ha) is owned by Coillte and is located along the upper reaches of the Glenummera River in the east of the catchment. A significant portion of this forest has been clearfelled in recent years and is currently unstocked. However, reforestation planning is currently underway, with a focus on appropriate native woodland and the introduction of unplanted setbacks along water courses and for landscaping purposes. Grazing and rhododendron are likely to be key challenges during reforestation.

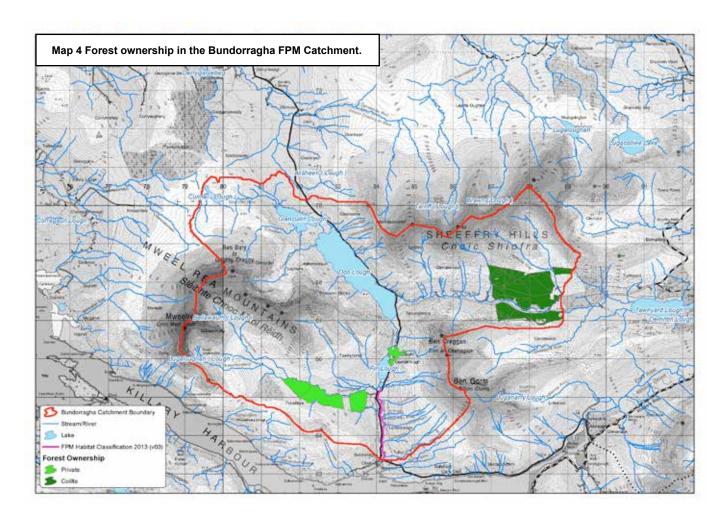
The other two significant areas of forest cover are under private ownership. These include: (i) two adjacent blocks of forest totalling *c.*70 ha in the

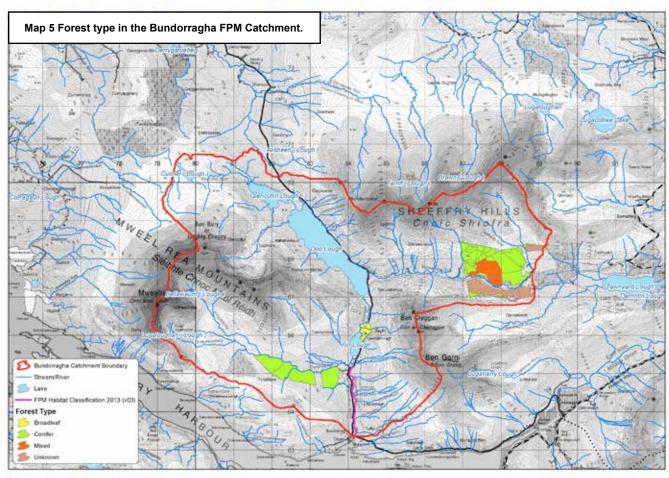
townland of Tonatleva adjacent the Owennaglogh and Sruhaundoo Rivers to the west of Delphi Mountain Resort; and (ii) an old woodland at Delphi Lodge (c.11 ha) on the northern shore of Fin Lough. Due to its proximity to key sections of the Bundorragha River FPM population, any works within the forest cover at Tonatleva will prove acutely sensitive.

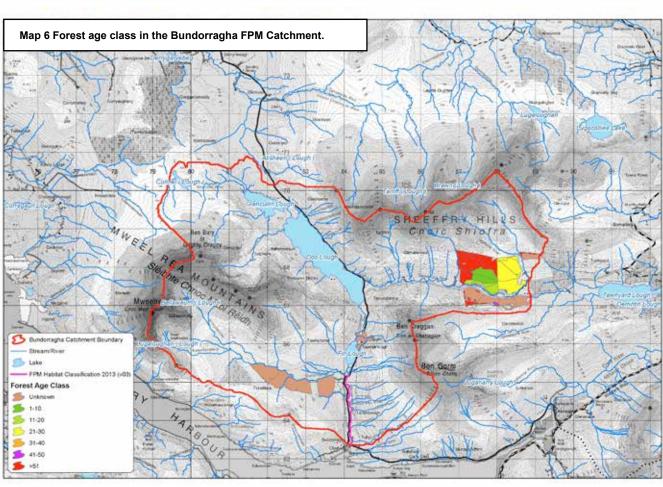
Four new areas of privately-owned native woodland totalling *c*.19 ha were planted on former grazing land along the Bundorragha, Owengar and Glenummera Rivers during 2013. These new native woodland projects, supported under the DAFM Native Woodland Establishment Scheme in consultation with NPWS and Woodlands of Ireland, were designed with the primary aim of protecting and enhancing water quality and the aquatic habitat within the catchment, to benefit fish stocks and FPM. Young woodland cover comprising (*inter alia*) birch and alder is now emerging on these sites.

Approximately 75% of the catchment's forests are growing on podsol soils with / without peaty topsoil, 19% on peaty gleys, and 6% on blanket peat.

Forest ownership, type and age class structure within the Bundorragha FPM Catchment are illustrated in Maps 4-6.







Forest operations

Afforestation

Most of the Bundorragha FPM Catchment is not suitable for production forestry, due to environmental sensitivities and the large areas of unproductive blanket bog that dominate. As a result of these factors, no new commercial conifer forests have been planted in the catchment since 1990. Opportunities for new afforestation are very limited and are likely to be confined to localised areas of native woodland creation on sites along watercourses, specifically for water protection purposes.

Under S.I.191 of 2017, afforestation requires a licence from the Minister for Agriculture, Food & the Marine. DAFM envisages that any new afforestation licensed (with or without grant support) within the Bundorragha FPM Catchment will be limited to native woodland establishment, following the requirements set out in the Native Woodland Establishment Scheme regarding the identification of the most appropriate native woodland type, species mixtures, site input, and future management (see Forest Service Circular 05/2018). A focus on the strategic use of new native woodland to consolidate existing semi-natural woodland (including low-lying woodland) and to protect and enhance water quality and the aquatic habitat for FPM, will also be sought, based on the Woodlands for Water model (DAFM, 2018). Recent native woodland planting along the Bundorragha, Owengar and Glenummera Rivers demonstrates this approach.

Felling and reforestation

The majority of future forest operations within the Bundorragha FPM Catchment will involve those relating to forest management, primarily the felling (thinning and clearfelling) and replanting of existing forests and associated operations such as forest road construction (including upgrade). Felling and forest road construction are potentially high impact forestry operations from a water protection perspective, due to the potential for sedimentation from soil disturbance by heavy machinery, and the risk of nutrient runoff from decomposing brash following felling. These risks are particularly pronounced on sloped sites with soft peat soils and areas located near or adjacent to watercourses.

The privately owned forests in the catchment are located on moderate (<15%) to steep (15% - 30%) slopes. The majority of Coillte forest land is located on steep to very steep (>30%) slopes, but much of this area has been clearfelled in recent years and is currently unstocked.

Coillte is the main productive forest owner within the

catchment, and consequently, the main harvesting operator.

The largest privately owned forest in the catchment is located at Tonatleva (c.70 ha). Visitors to the nearby adventure centre currently use it primarily for amenity and adventure sport activities. The forest is relatively mature and (assuming a standard 40 year rotation) may be subject to subsequent thinnings and eventual clearfell over the coming years. In view of its proximity to the Owennaglough and Sruhaundoo Rivers, and its connectivity to the Bundorragha River near existing FPM populations, any forest operation in this area will prove highly significant, and will require due rigour regarding planning and implementation.

The reforestation of clearfelled forests will require careful consideration, particularly near watercourses. Due to catchment sensitivities, it is envisaged that future reforestation will move away from the typical 'clearfell and replant' system to Continuous Cover Forestry (CCF) involving appropriate native species and / or Lodgepole pine, with a potential for realising timber production using associated closeto-nature techniques. Considerable opportunities exist for the permanent restructuring of existing forests at this crucial stage in the forest cycle, to introduce a range of features to protect and enhance water quality and the FPM habitat, and to redirect productive forestry towards less sensitive areas. Such measures include enhanced water setbacks, areas reforested with native woodland (in particular, pioneer birch woodland – see Circular 05/2018), and the restoration of original habitats, such as bogs and wetlands, either as part of introduced open spaces or at a larger deforestation scale. The DAFM Felling & Reforestation Policy document provides details on available options, such as Reforestation Objectives 'CCF and 'Bio', and situations where permanent forest removal may be acceptable, due to overriding environmental considerations.

General soil stability under existing forests would facilitate the application of CCF systems within the subsequent rotation on many sites. Replanting with native species and / or Lodgepole pine would also negate, to a large extent, the need for future fertilisation, which might otherwise be required if reforesting with spruce. It is important to note that replanting with native species and / or Lodgepole pine for CCF must not be seen as land abandonment – active future management will be required.

Fertilisation

The existing forests in the Bundorragha FPM Catchment were established over 30 years ago, so little or no requirement for fertiliser application is envisaged. However, fertiliser application may be

required to reforest clearfelled sites with spruce. In sensitive parts of the catchment, it may be possible to reduce or to eliminate any need to apply fertiliser to reforest clearfelled sites, by selecting site-appropriate native species or Lodgepole pine, or by allowing natural regeneration.

Any decision to apply fertiliser within forests – at establishment stage, reforestation stage or otherwise - must be substantiated by the results of a soil or foliar analysis, following sampling protocols set out in the DAFM Forestry Standards Manual. The type and rate of application must also be tailored for the site, as per the results of the analysis, and must not exceed the standard application rates. Application is limited to manual spot application during the most appropriate month(s) of the year in terms of silvicultural uptake. It can only be applied on sites where the required water setback has already developed a ground vegetation layer. Furthermore, fertiliser must not be applied during or after periods of heavy rainfall, or when the ground is saturated with water. Where phosphorus is required, the granulated form must be used, to reduce the likelihood of any drift and wash-off to surface waters. Other fertiliser formulations based on slow release organic formulations should also be favoured.

Aerial fertilisation requires a licence under the Forestry Act 2014 (as commenced by S.I.191 of 2017) from the Minister for Agriculture, Food & the Marine. DAFM does not envisage issuing licences for this activity within the Bundorragha FPM Catchment.

Catchment but is a possibility. Uncontrolled burning of land leads to the destruction of forests and natural habitats and can place human lives, property and livestock at risk. There is also a risk of soil erosion and ash runoff into nearby watercourses following fire events. Where prescribed burning of vegetation is necessary, it should be carried out by an appropriate number of personnel with adequate training, knowledge and experience in safely managing controlled burning operations. The DAFM Prescribed Burning Code of Practice (2011) provides guidance to landowners who use controlled burning as a land management tool. The DAFM also issues Fire Danger Notices reflecting fire risk levels - see www.agriculture.gov.ie/forestservice/ firemanagement/ for detail.

Rhododendron ponticum is present in the catchment. This highly-invasive exotic species presents a possible threat to forests (particularly young emerging native woodlands) and adjacent open natural habitats. It can also infest streamand riverbanks, with a deleterious impact on the aquatic habitat. It is important that rhododendron is controlled and is prevented from colonising newly established forests, native woodlands (both emerging and existing) and deforested sites. Various methods of control, including those appropriate in areas directly adjoining watercourses, are set out in the Woodlands of Ireland Information Note *The Control of Rhododendron in Native Woodlands* (Barron, 2007).

Forest road construction

Forest road works is a regulated activity under the Forestry Act 2014 (as commenced by S.I.191 of 2017), and requires a licence (with or without grant approval) from the Minister of Agriculture, Food & the Marine. It must be undertaken according to the COFORD Forest Road Manual: Guidelines for the Design, Construction and Management of Forest Roads (2004) and the Forest Harvesting & the Environment Guidelines, in order to avoid environmental risk during both the construction stage and subsequent use. The extent of new forest road construction projects in the Bundorragha FPM Catchment will be largely determined by the extent of forest harvesting in the catchment. Techniques involving the creation of temporary roading will be considered, particularly on sensitive sites or where forests are being permanently removed (deforested) or converted from conifer to native woodland.

Other forest-related activities

The use of fire to clear vegetation is not a feature of land management in the Bundorragha FPM



The Caragh FPM Catchment is situated on the Iveragh Peninsula in Co. Kerry. The corresponding SAC is the Killarney National Park, Macgillycuddy's Reeks & Caragh River Catchment SAC (000365), the Conservation Objectives of which include the restoration of FPM to favourable conservation status, as defined by specific attributes and targets set out in the relevant NPWS Conservation Objectives Series report (see www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000365.pdf). The catchment lies completely within the SAC.

Caragh River flows westwards draining the southern slopes of Macgillicuddy's Reeks and half a dozen small loughs before turning northwards near Boheesil and flowing for 6 km to Lough Caragh. On leaving Lough Caragh, it flows 3 km westwards to Dingle Bay. Lough Reagh and Cloon Lough are drained by the Owenroe River, which flows north to join the Caragh River near Boheeshil. The Caraghbeg River drains Lough Acoose and flows westwards for 5 km to the confluence with the Caragh River some 700 m upstream of Blackstones Bridge. The Meelagh River drains from the eastern slopes of Meenteog and joins the Caragh River just north of Blackstones Bridge.

The Caragh FPM Catchment is approximately

133.67 km² (13,367 ha) in area. The total river length in the catchment is 253 km (Map 1).

Table 1 summarises WFD details of individual water bodies within the catchment, and inclusion or otherwise in the current acid sensitivity protocol regarding afforestation.

Soils and land use

An analysis of the EPA / Teagasc soils data indicates that the main soil types in the Caragh FPM Catchment are podsol soils with / without peaty topsoil (40%), blanket peat (37%) and poorly-drained mineral soils with peaty topsoil (16%) (Map 2).

While not designed for detailed reporting, the CORINE Land Cover (2006) does indicate main land use types within the catchment. The most common land uses are peat bogs (62.8%) and natural grassland (10.5%). Forests and woodlands account for approximately 8.7% of land in the catchment (Map 3).

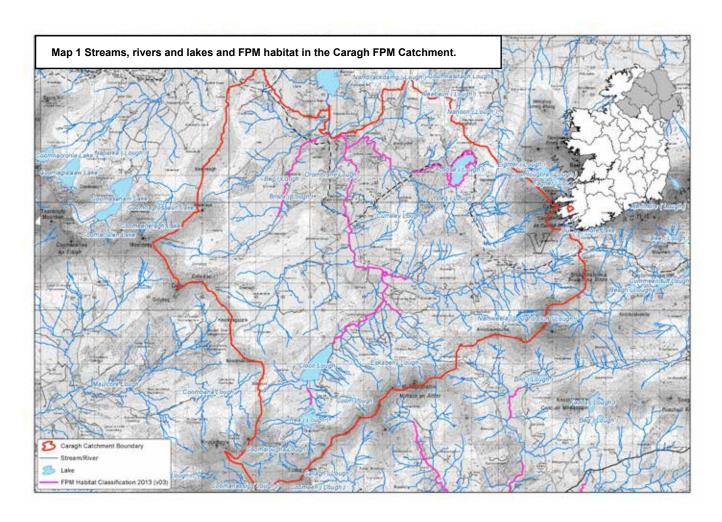
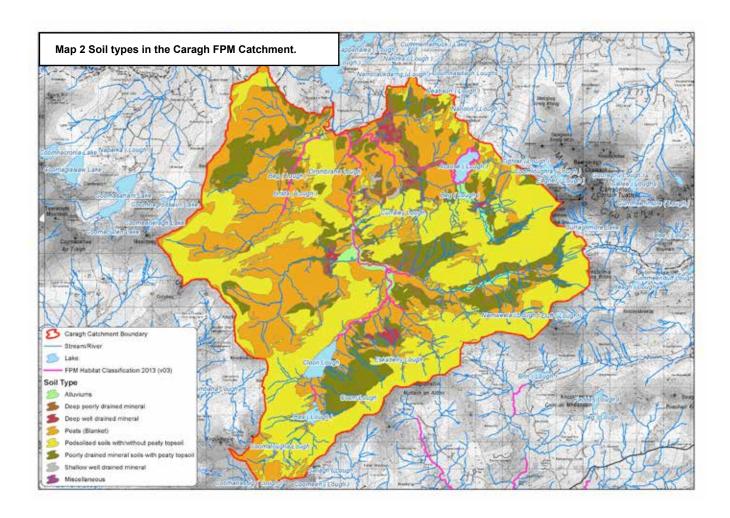


Table 1 Caragh FPM catchment: Water body details (from www.catchments.ie, 26June18), inclusion under the RBMP Area for Action programme (from www. watersandcommunities.ie/areas-for-action/), and Acid Sensitivity Area status (from Appendix 11 of DAFM's Forestry Standards Manual (2015)).

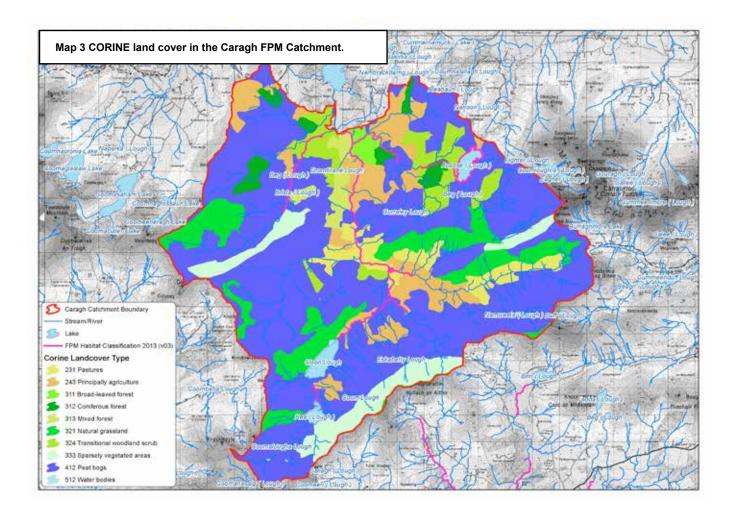
Water body	Туре	Status	WFD risk	Pressure	Area for Action	Acid Sensitive Area
Caragh_040	River	Moderate	At risk	Hydromorphology, forestry, domestic waste water	No	Yes
Caragh_030	River	HES	Not at risk	None assigned	No	Yes
Acoose	Lake	Good	Not at risk	None assigned	No	Yes
Caragh_010	River	Poor	At risk	Hydromorphology, agriculture	Yes	Yes
Caragh_020	River	Good	At risk	Hydromorphology, agriculture	Yes	Yes
Owenroe (Caragh)_010	River	Good	At risk	Agriculture, hydromorphology	Yes	Yes
Coomnacarrig_010	River	Good	At risk	Forestry	No	Yes
Reagh Mullaghanattin	Lake	Unassigned	Not at risk	None assigned	No	Yes
Cloon KY	Lake	Unassigned	Review	Anthropogenic	No	Yes
Meelagh_010	River	Good	At risk	Forestry	No	Yes











FPM status

FPM has a wide distribution within the Caragh FPM Catchment. It is estimated that the total population within the catchment is approximately 3 million individuals. Within the Caragh River itself, the mussel population is continuous, and abundant in places, from 1 km above the confluence with the Owenroe River downstream to Lough Caragh. The Owenroe River has a continuous population of mussels from Cloon Lough to the confluence with the Caragh River, and upstream from Cloon Lough in the Glashawee River. The Caraghbeg River has mussel populations from Lough Acoose downstream for 750 m and from the lower third of the river to its confluence with the Caragh River. Mussels are also found in the Meelagh River along the lower 3 km length of the tributary.

Surveys of the catchment were carried out in 1996, 1999, 2004 and 2005. The 2005 survey found that mussels of all sizes were present in the Caragh River, but that the number of juvenile mussels was low and well below that required for a sustainable population. No juveniles were found in the Caraghbeg River.

A resurvey of three transects from the 2004 survey was carried out in 2009, one transect each on the

Caragh (main channel), Owenroe and Caraghbeg Rivers. Increases in mussel number were recorded at the Caragh and Owenroe sites, but a decrease was recorded at the Caraghbeg site. Only two juvenile mussels (<30 mm) were found at the Owenroe site, and 10 juveniles were found at the Caragh site. A freshly dead juvenile mussel was observed at the Owenroe site. No juvenile mussels were found at the Caraghbeg site. Habitat conditions on the Owenroe and Caraghbeg Rivers were poor, with filamentous algae, siltation and cattle waste observed. Conditions on the Caragh River appeared to be good.

The Caragh population is currently ranked second out of the 27 FPM SAC populations in the country, based on population status, habitat condition and current pressures.

Water quality within the catchment fails three of the five Environmental Quality Objectives (EQOs) specified in Schedule 4 of the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations, S.I.296 of 2009.

FPM is at unfavourable conservation status in the Caragh Catchment. While adult mussels are abundant throughout the catchment, juvenile mussels are rare due to unsuitable habitat conditions. It is likely that the population will become extinct within a generation if the habitat quality within the catchment is not improved.

An assessment of the FPM population in 2016 (Moorkens, 2016) deemed the conservation status to be unfavourable. This assessment indicated that the river conditions were suboptimal in terms of morphology, flow and gradient, resulting in physical or organic sediment depressing the condition of the riverbed substrate. The severe stress that reduced the adult numbers between 2004 and 2014 appears to have abated for the moment, with adult mussels surviving over the last two years.

Forest land

The total area of forest cover in the Caragh FPM Catchment is approximately 1,160 ha. This represents *c*.8.7% of the total land use within the catchment, which is lower than the national average forest cover of 11%. Forests are mainly located in the lower reaches of the catchment along the Caragh, Caraghbeg and Meelagh Rivers, and are generally upstream of FPM populations. Approximately 399 ha of forest cover in the catchment are located within 100 metres of a watercourse.

Coillte owns c.54% (c.627 ha) of the forest area in the catchment (Map 4). The majority of these forests are dominated by Sitka spruce, with some Lodgepole pine and Japanese larch, and date from the 1970s or earlier. Also included under Coillte ownership are some old native woodlands such as Lickeen Wood at Glencar.

The remaining forest areas, totalling *c*.533 ha, are privately-owned, mainly by farmers. Of these, *c*.336 ha were established between 1986 and 1999 under Government afforestation support schemes, with a further 9 ha planted in 2007. There has been no new afforestation in the Caragh FPM Catchment since 2007, apart from a recently planted *c*.10 ha of native woodland establishment on a private site, under the auspices of KerryLIFE (see below). The remaining privately-owned forest cover is predominantly old woodland and areas of semi-natural low-lying woodland.

There is a mixture of forest types in the catchment (Map 5). Forests dominated by conifer species account for *c*.53% (618 ha) of the total forest estate. Forests comprising mixtures of conifer and broadleaf species account for 30%, and woodlands predominantly broadleaved in nature (including low-

lying woodland) account for 15%.

Of the privately-owned forests established with grant support, 90% (c.311 ha) comprise conifer species only, with the remainder broadleaved in nature.

There are a number of old woodland and areas of semi-natural woodland within the catchment. These include an important old sessile oak woodland at Lyranes Lower in the north of the catchment on the eastern side of the Caragh River near Blackstones Bridge. The site was included in a NPWS Service survey of old sessile oak woods (O'Neill & Barron, 2013), which found that the woodland was favourable in terms of structure and function but unfavourable / inadequate in terms of future status and overall condition. A number of smaller privatelyowned mature broadleaf woodlands, ranging in size from 5 ha to 20 ha, occur along the western side of the Caragh River.

Approximately 59% of the catchment's forests are growing on blanket peat, 18% on podsol soils with / without peaty topsoil, and 23% on poorly drained mineral soils with peaty topsoil.

Forest ownership, type and age class structure within the Caragh FPM Catchment are illustrated in Maps 4-6.

Forest operations

KerryLIFE

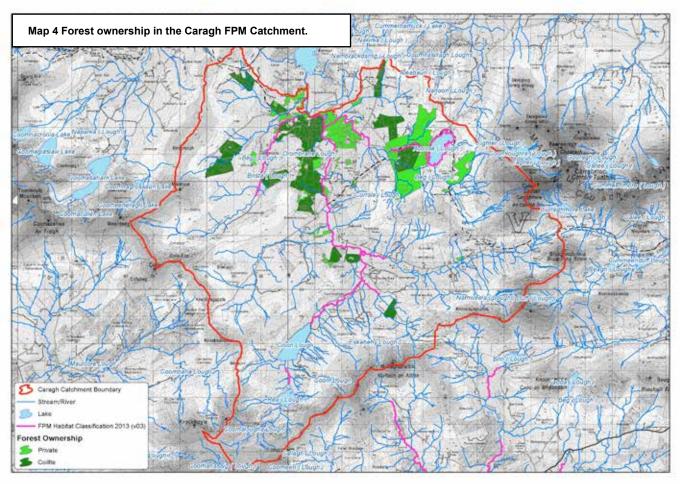
Kerry LIFE¹ is a 6-year project focused on both agriculture and forestry within both the Caragh and adjoining Kerry Blackwater FPM Catchments, Co. Kerry. Through a range of practical initiatives involving land use management, local participation and training, the project aims to improve the habitat condition for FPM, increase the level of recruitment of juvenile mussels, and promote a greater awareness and understanding of FPM amongst the local community and key stakeholders.

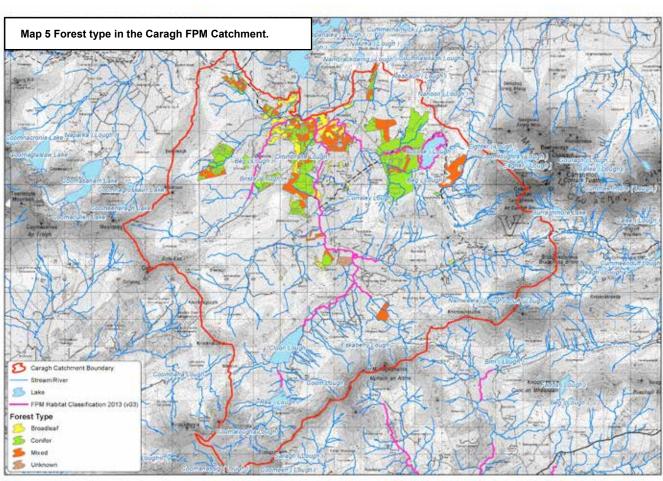
Activities focus on the development and implementation of effective and cost-efficient measures for reducing diffuse losses of sediment and nutrients from forestry and farming.

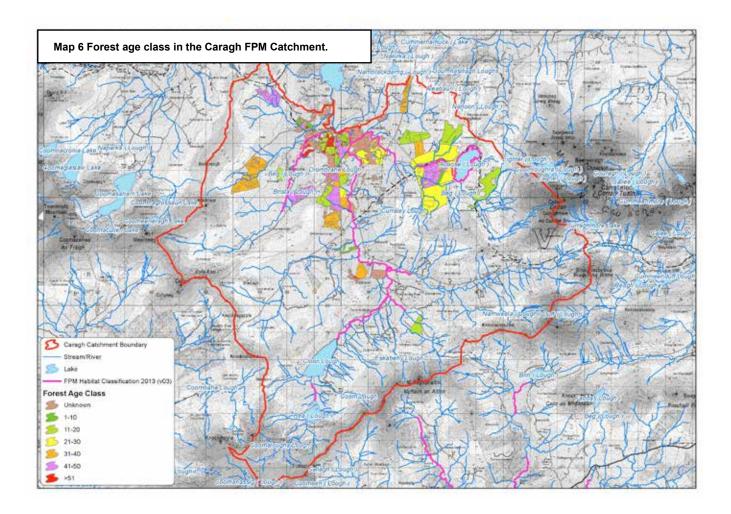
Key measures targeting forestry at specific strategic locations within both catchments include:

- > the establishment 15 ha of native woodland;
- the management of 10 ha of existing broadleaf woodland:
- > the conversion of 15 ha to native broadleaf

¹ KerryLIFE (full title 'Sustainable land use management for the conservation of freshwater pearl') project partners include National Parks & Wildlife Service of the Department of Culture, Heritage & the Gaeltacht, the Forest Service and the Nitrates, Biodiversity & Engineering Division of the DAFM, the South Kerry Development Partnership Ltd., Coillte and Teagasc.







woodland; and

the restructuring of 175 ha of commercial plantations into long-term retention woodland.

For further details, see Section 11.4.5 of *Forests & Water* (DAFM, 2018).

KerryLIFE-related work has been completed or is ongoing at several sites within the Caragh FPM Catchment.

Afforestation

Parts of the Caragh FPM Catchment are very suitable for growing production forests, particularly the more fertile low-lying areas. However, the catchment also contains large areas of blanket bog ,which are unsuitable for commercial forestry. Also, the catchment lies within an acid sensitive area, as defined under the DAFM / COFORD / EPA Protocol for the determination of the acid sensitivity of surface water in the context of afforestation (see Appendix 11 of the *Forestry Standards Manual*). This reflects the fact that soils in the catchment have a low capacity to neutralise acidity caused by atmospheric scavenging by conifer forests, which can lead to the acidification of surface waters. As a consequence of these factors, afforestation in the catchment has

been severely restricted for some years. The only afforestation within the catchment in the past 13 years comprised *c*.9 ha of mixed woodland (oak / Scots pine) planted in 2007, and the recently native woodland planting, previously mentioned.

Under S.I.191 of 2017, afforestation requires a licence from the Minister for Agriculture, Food & the Marine. DAFM envisages that any new afforestation licensed (with or without grant support) within the Caragh FPM Catchment will be limited to native woodland establishment, following the requirements set out in the Native Woodland Establishment Scheme regarding the identification of the most appropriate native woodland type, species mixtures, site input, and future management (see Forest Service Circular 05/2018). A focus on the strategic use of new native woodland to consolidate existing semi-natural woodland (including low-lying woodland) and to protect and enhance water quality and the aquatic habitat for FPM, will also be sought, based on the Woodlands for Water model (DAFM, 2018).

In February 2013, the existing acid sensitivity protocol for afforestation was amended with the agreement of the EPA, enabling the DAFM to accept, process and approve (where appropriate) applications under the Native Woodland

Establishment Scheme for sites within acid sensitive areas, without the requirement for water sampling.

Potential opportunities exist in the catchment to create new native woodlands or to expand existing semi-natural woodland (including low-lying woodland) though planting on adjoining 'greenfield' sites, particularly within the more fertile low-lying areas. However, the presence of red deer in the catchment will be a practical consideration.

Felling and reforestation

The majority of future forest operations within the Caragh FPM Catchment will involve those relating to forest management, primarily the felling (thinning and clearfelling) and replanting of existing forests and associated operations such as forest road construction (including upgrade). Felling and forest road construction are potentially high impact forestry operations from a water protection perspective, due to the potential for sedimentation from soil disturbance by heavy machinery, and the risk of nutrient runoff from decomposing brash following felling. These risks are particularly pronounced on sloped sites with soft peat soils and areas located near or adjacent to watercourses.

Almost all forests in the Caragh Catchment are located on even to moderate slopes (>15%), with the exception of a small area (c.10 ha) of young Coillte forest at Glencar beside a tributary stream of the Caragh River. Part of this site is located on a very steep slope (>30%), and forest operations in this area will prove acutely sensitive.

As the largest forest owner, most of the thinning and clearfelling activities in the catchment over the next 10 years will be undertaken by Coillte.

Coillte-owned old woodlands, such as Lickeen Wood, are being managed under Continuous Cover Forestry using low impact silvicultural systems.

All privately-owned production forests established with afforestation support schemes are less than 30 years of age (approximately). Therefore, assuming a standard 40-year rotation, clearfelling operations are unlikely to commence within the private estate before 2025. However, some older forests are now approaching thinning stage, and the level of this operation in the catchment will increase over the coming years as these forests mature. The final harvesting of privately-owned forest crops is scheduled to commence around 2026 and will continue to 2035, assuming a 40-year crop rotation.

Recent felling licences were issued by the DAFM for properties at Gortdirragh, Shanacashel and Gortmaloon East. These are in addition to the KerryLIFE-related sites detailed above.

The reforestation of clearfelled forests will require careful consideration, particularly near watercourses. Due to catchment sensitivities, it is envisaged that future reforestation will move away from the typical 'clearfell and replant' system to Continuous Cover Forestry (CCF) involving appropriate native species and / or Lodgepole pine, with a potential for realising timber production using associated closeto-nature techniques. Considerable opportunities exist for the permanent restructuring of existing forests at this crucial stage in the forest cycle, to introduce a range of features to protect and enhance water quality and the FPM habitat, and to redirect productive forestry towards less sensitive areas. Such measures include enhanced water setbacks, areas reforested with native woodland (in particular, pioneer birch woodland - see Circular 05/2018), and the restoration of original habitats, such as bogs and wetlands, either as part of introduced open spaces or at a larger deforestation scale. The DAFM Felling & Reforestation Policy document provides details on available options, such as Reforestation Objectives 'CCF and 'Bio', and situations where permanent forest removal may be acceptable, due to overriding environmental considerations.

Fertilisation

Forests in the Caragh FPM Catchment are generally in good condition, with little or no requirement for fertiliser application envisaged.

Any decision to apply fertiliser within forests – at establishment stage, reforestation stage or otherwise - must be substantiated by the results of a soil or foliar analysis, following sampling protocols set out in the DAFM Forestry Standards Manual. The type and rate of application must also be tailored for the site, as per the results of the analysis, and must not exceed the standard application rates. Application is limited to manual spot application during the most appropriate month(s) of the year in terms of silvicultural uptake. It can only be applied on sites where the required water setback has already developed a ground vegetation layer. Furthermore, fertiliser must not be applied during or after periods of heavy rainfall, or when the ground is saturated with water. Where phosphorus is required, the granulated form must be used, to reduce the likelihood of any drift and wash-off to surface waters. Other fertiliser formulations based on slow release organic formulations should also be favoured.

Aerial fertilisation requires a licence under the Forestry Act 2014 (as commenced by S.I.191 of 2017) from the Minister for Agriculture, Food & the Marine. DAFM does not envisage issuing licences for this activity within the Caragh FPM Catchment.

Forest road construction

Forest road works is a regulated activity under the Forestry Act 2014 (as commenced by S.I.191 of 2017), and requires a licence (with or without grant approval) from the Minister of Agriculture, Food & the Marine. It must be undertaken according to the COFORD Forest Road Manual: Guidelines for the Design, Construction and Management of Forest Roads (2004) and the Forest Harvesting & the Environment Guidelines, in order to avoid environmental risk during both the construction stage and subsequent use. The extent of new forest road construction projects in the Caragh FPM Catchment will be largely determined by the extent of forest harvesting in the catchment. Techniques involving the creation of temporary roading will be considered, particularly on sensitive sites or where forests are being permanently removed (deforested) or converted from conifer to native woodland.

Other forest-related activities

Forest fires arising from the uncontrolled burning of vegetation in upland areas is a major issue in the Caragh Catchment. Uncontrolled burning of land leads to the destruction of forests and natural habitats and can place human lives, property and livestock at risk. There is also a risk of soil erosion and ash runoff into nearby watercourses following fire events. Where prescribed burning of vegetation is necessary, it should be carried out by an appropriate number of personnel with adequate training, knowledge and experience in safely managing controlled burning operations. The DAFM Prescribed Burning Code of Practice (2011) provides guidance to landowners who use controlled burning as a land management tool. The DAFM also issues Fire Danger Notices reflecting fire risk levels - see www.agriculture.gov.ie/forestservice/ firemanagement/ for detail.

There is a risk of unlicensed tree felling in the catchment in the form of 'scrub' woodland clearance for land reclamation purposes. Under the Forestry Act 2014, apart from listed exemptions, it is an offence to fell any tree without a Felling Licence (see the DAFM's document Felling & Reforestation Policy document and www.agriculture.gov.ie/forestservice/tree felling/ for details). Furthermore, it is an offence to commence the use of uncultivated land or seminatural areas for intensive agriculture without first applying to the Minister for Agriculture, Food & the Marine for a screening decision, as such use may have a significant effect on protected habitats and species, including FPM.



The Owenriff FPM Catchment is situated in Co. Galway in the west of Ireland. The corresponding SAC is Lough Corrib SAC (000297), the Conservation Objectives of which include the restoration of FPM to favourable conservation status, as defined by specific attributes and targets set out in the relevant NPWS Conservation Objectives Series report (see www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000297.pdf). The catchment overlaps with this SAC and also the Connemara Bog Complex SAC (002034).

Owenriff River system originates in the western part of the catchment, where the Derrygouna River drains from Lough Cromlee to Loughaphreaghaun. The Glashanasmearany River drains from Loughaphreaghaun to Lough Bofin. From Lough Bofin, the Owenriff River flows through Lough Adrehid and Lough Agraffarad to Lough Corrib at Oughterard. In the south of the catchment, the Glengawbeg River drains from Cloosh Valley through Lettercraffroe Lough, and joins the Owenriff River just east of Agraffard. The Bunowen River originates in the north of the catchment on the eastern slopes of Knockletterfore, and flows southerly to met the Owenriff River at Lough Ateenan, approximately 5

km upstream from Oughterard.

The Owenriff FPM Catchment is approximately 67 km 2 (6,743 ha) in area. The total river length in the catchment is c.105 km (Map 1).

Table 1 summarises WFD details of individual water bodies within the catchment, and inclusion or otherwise in the current acid sensitivity protocol regarding afforestation.

Soils and land use

An analysis of the EPA / Teagasc soils data indicates that the Owenriff FPM Catchment is dominated by peats, with pockets of podsol soils along the middle reaches, and deep, well-drained mineral soils in the lower reaches in the east of the catchment (Map 2).

While not designed for detailed reporting, the CORINE Land Cover (2006) does indicate main land use types within the catchment. The most common land uses are peat bogs (64%) and natural grassland (10.4%). Forests and woodlands account for approximately 19.2% of land in the catchment (Map 3).

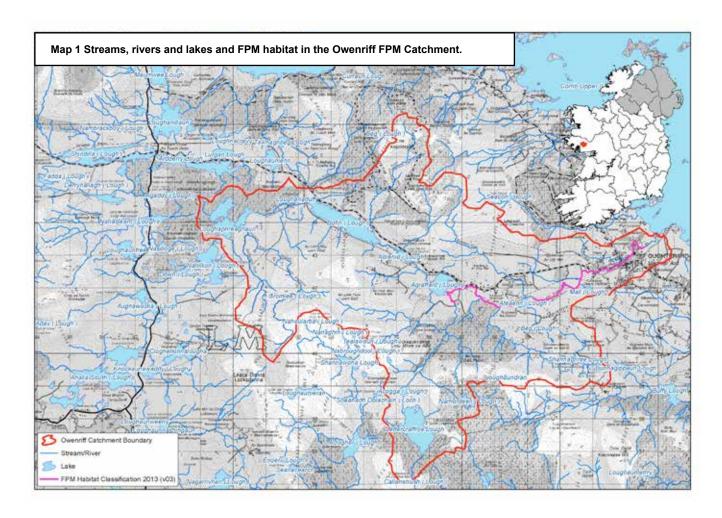
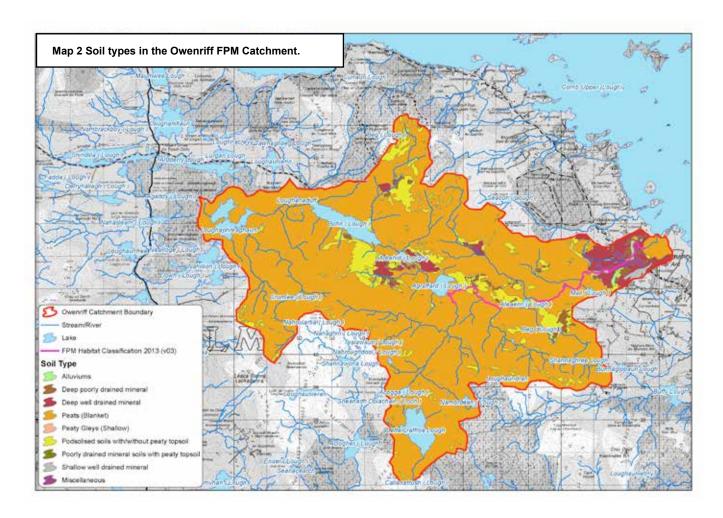


Table 1 Owenriff FPM catchment: Water body details (from www.catchments.ie, 26June18), inclusion under the RBMP Area for Action programme (from www. watersandcommunities.ie/areas-for-action/), and Acid Sensitivity Area status (from Appendix 11 of DAFM's Forestry Standards Manual (2015)).

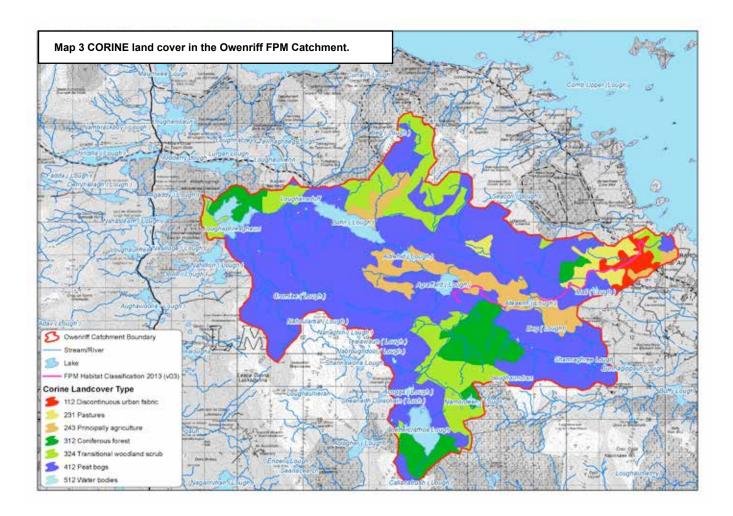
Water body	Туре	Status	WFD risk	Pressure	Area for Action	Acid Sensitive Area
Owenriff (Corrib)_010	River	Good	At risk	Hydromorphology	Yes	Yes
Loughaphreaghaun	Lake	Unassigned	Not at risk	None assigned	No	Yes
Bofin GY	Lake	HES	Not at risk	None assigned	No	Yes
Adrehid	Lake	Unassigned	Not at risk	None assigned	No	Yes
Owenriff (Corrib)_020	River	Good	At risk	Hydromorphology	Yes	Yes
Glengawbeg_010	River	HES	Not at risk	None assigned	No	Yes
Lettercraffroe	Lake	Moderate	At risk	Forestry	Yes	Yes
Agraffard	Lake	Unassigned	Not at risk	None assigned	No	Yes
Acogga	Lake	Unassigned	Review	Forestry	Yes	Yes











FPM status

Up until recently, the Owenriff River system was one of the few remaining in the EU where FPM was breeding successfully, making it among the most important sites internationally. Surveys in the 1980s and the mid-90s confirmed that mussels were abundant in the vicinity of Oughterard, with an excellent range of age classes evident.

In 2004, the Owenriff River suffered a number of extensive algae blooms throughout its length. This led to significant losses to the FPM population across all age profiles, from juvenile to very old mussels. These events prompted a survey for baseline abundance data, and seven transects and 10 sample quadrats were taken as baseline counts. Monitoring to assess the status of the population has continued. These monitoring surveys have found that the river system continues to support a large FPM population, estimated to be in the region of 2 million individuals. However the population is in decline, with little juvenile recruitment taking place.

The Owenriff population is currently ranked fourth out of the 27 FPM SAC populations in the country, based on population status, habitat condition and current pressures.

Water quality within the catchment fails four of the five Environmental Quality Objectives (EQOs) specified in Schedule 4 of the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations, S.I.296 of 2009.

FPM is at unfavourable conservation status in the Owenriff FPM Catchment. Despite relatively high population levels in parts of the catchment, there has been an observed reduction of mussel numbers since 2004, and a general absence of juvenile mussels. On the basis of the 2009 survey results, it is predicted that the species will become extinct within the Owenriff FPM Catchment before the end of the century, if habitat quality within the system is not improved.

A survey and condition assessment in 2016 (Moorkens, 2017), indicated that the intensification of land use through 'scrub' clearance and drainage, followed by nutrient application, are ongoing and worsening in the catchment. Drainage of peat is leading to fine sediment release into the aquatic environment, with nutrient application creating additional pressure. Future approved and planned construction works may potentially be an additional source of pressure.

Forest land

The total area of forest cover in the Owenriff FPM Catchment is approximately 1,293 ha. This represents c.19.2% of the total land use within the catchment, which is higher than the national average forest cover of 11%. Approximately 496 ha of the forest cover within the catchment are located within 100 metres of a watercourse.

Coillte owns c.995 ha of the forest area in the catchment (Map 4). The majority of these forests are dominated by Sitka spruce, with some Lodgepole pine and Japanese larch, and date from the 1970s or earlier.

The remaining forest areas are privately-owned. Of this, 248 ha were established under State afforestation support schemes between 1986 and 1993, with a further 7 ha planted in 1998. There has been no new afforestation in the catchment since 1998. The remaining forest areas are predominantly small semi-natural broadleaf woodlands, which occur in places throughout the catchment.

There is a mixture of forest types in the catchment (Map 5). Forests dominated by conifer species account for c.86% of the total forest estate. Forests comprising a mixture of conifer and broadleaf species account for 8%, and woodlands that are predominantly broadleaved in nature (including seminatural low-lying woodland) account for 0.5%. The composition of the remainder is unknown.

Of the privately-owned forests established with grant support, 97% (248.5 ha) comprise conifer species only. The remaining 3% (7.5 ha) comprise conifer / broadleaf mixtures.

There are a few scattered pockets of semi-natural woodland within the Owenriff FPM Catchment. This suggests that the catchment might be further enhanced by the addition of areas of native woodland, where appropriate, to facilitate the protection of water and the aquatic habitat.

Approximately 95% of the catchment's forests are growing on blanket peat, 3% on podsol soils, and 2% on mineral soils.

Forest ownership, type and age class structure within the Owenriff FPM Catchment are illustrated in Maps 4-6.

Forest operations

Afforestation

Afforestation in the Owenriff FPM Catchment has been severely restricted for some years, due primarily to the poor quality of the land throughout much of the catchment, coupled with ecological sensitivities. In addition, the catchment lies within

an acid sensitive area, as defined under the DAFM / COFORD / EPA Protocol for the determination of the acid sensitivity of surface water in the context of afforestation (see Appendix 11 of the *Forestry Standards Manual*). This reflects the fact that soils in the catchment have a low capacity to neutralise acidity caused by atmospheric scavenging by conifer forests, which can lead to the acidification of surface waters. As a consequence of these factors, no new afforestation has been approved in the catchment since 1998.

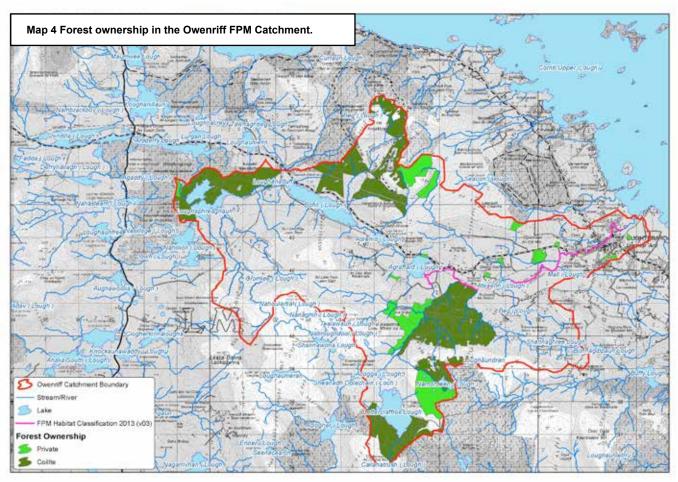
Under S.I.191 of 2017, afforestation requires a licence from the Minister for Agriculture, Food & the Marine. DAFM envisages that any new afforestation licensed (with or without grant support) within the Owenriff FPM Catchment will be limited to native woodland establishment, following the requirements set out in the Native Woodland Establishment Scheme regarding the identification of the most appropriate native woodland type, species mixtures, site input, and future management (see Forest Service Circular 05/2018). A focus on the strategic use of new native woodland to consolidate existing semi-natural woodland (including low-lying woodland) and to protect and enhance water quality and the aquatic habitat for FPM, will also be sought, based on the Woodlands for Water model (DAFM, 2018).

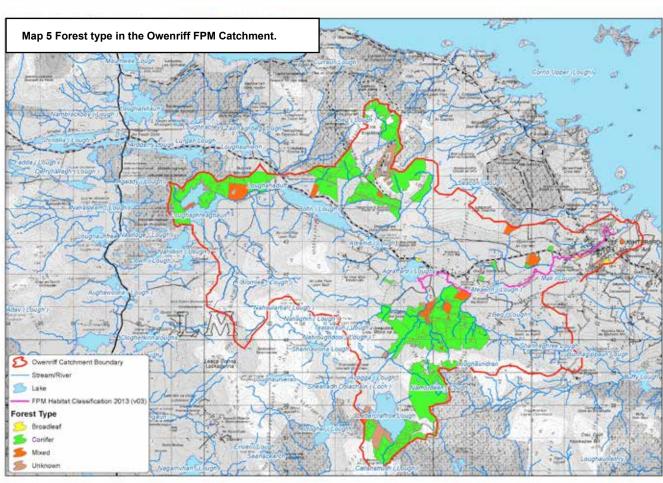
Felling and reforestation

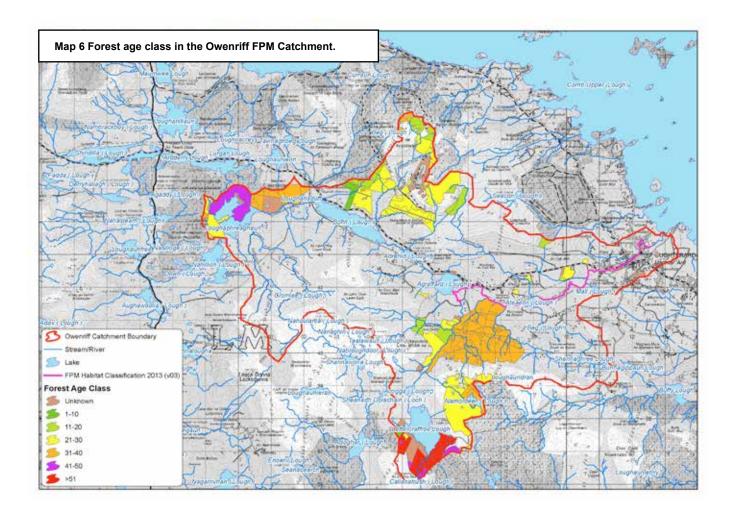
The majority of future forest operations within the Owenriff FPM Catchment will involve those relating to forest management, primarily the felling (thinning and clearfelling) and replanting of existing forests and associated operations such as forest road construction (including upgrade). Felling and forest road construction are potentially high impact forestry operations from a water protection perspective, due to the potential for sedimentation from soil disturbance by heavy machinery, and the risk of nutrient runoff from decomposing brash following felling. These risks are particularly pronounced on sloped sites with soft peat soils and areas located near or adjacent to watercourses.

Coillte will be the main harvesting operator in the Owenriff Catchment over the coming years. Thinning within Coillte forests is generally extensive in nature, due to various environmental sensitivities, the predominantly peaty nature of forest soils and the high degree of exposure, with the latter two factors combining to create a heightened risk of windblow.

Most forests in the catchment are located in the lower-lying reaches on even to moderate slopes (<15%). However, areas are located on steep slopes (15-30%) and very steep slopes (>30%). The majority of forests located on steep or very steep







slopes are Coillte-owned. Any forest operations on these sites, particularly on soft peaty soils near watercourses, will prove acutely sensitive. Where forests are growing on peat soils near watercourses, the most appropriate management option may be to implement a reduced or no-thin regime.

The private sector is also involved in forest harvesting in the Owenriff FPM Catchment. Approximately 210 ha of privately-owned productive forest were planted in the catchment between 1986 and 1998. Forest management activities have already commenced in some private forests, including thinning and forest road construction. The clearfelling and replanting of private commercial forests is likely to commence around the year 2026 and, assuming a 40-year crop rotation, is likely to continue until around 2038.

The reforestation of clearfelled forests will require careful consideration, particularly near watercourses. Due to catchment sensitivities, it is envisaged that future reforestation will move away from the typical 'clearfell and replant' system to Continuous Cover Forestry (CCF) involving appropriate native species and / or Lodgepole pine, with a potential for realising timber production using associated close-to-nature techniques. Considerable opportunities exist for the permanent restructuring of existing

forests at this crucial stage in the forest cycle, to introduce a range of features to protect and enhance water quality and the FPM habitat, and to redirect productive forestry towards less sensitive areas. Such measures include enhanced water setbacks, areas reforested with native woodland (in particular, pioneer birch woodland – see Circular 05/2018), and the restoration of original habitats, such as bogs and wetlands, either as part of introduced open spaces or at a larger deforestation scale. The DAFM *Felling & Reforestation Policy* document provides details on available options, such as Reforestation Objectives 'CCF and 'Bio', and situations where permanent forest removal may be acceptable, due to overriding environmental considerations.

Fertilisation

Some forests in the Owenriff FPM Catchment are showing signs of chlorosis, indicating that further fertiliser may be required to order to achieve commercial viability. In general, these forests are growing on nutrient-deficient and poorly-buffered peat soils. Therefore, any excess fertiliser not taken up within the short term by trees will not be retained in the soil, resulting in nutrient (primarily phosphorus) leaching into adjacent watercourses, and subsequent

eutrophication. This is a particular concern within the upper reaches of the catchment at Lettercraffroe and Lougaphreaghaun. It is critical, therefore, that any required fertiliser applications are carefully planned and implemented.

Fertiliser application may also be required to reforest clearfelled sites with spruce. In sensitive parts of the catchment, it may be possible to reduce or to eliminate any need to apply fertiliser to reforest clearfelled sites, by selecting site-appropriate native species or Lodgepole pine, or by allowing natural regeneration.

Any decision to apply fertiliser within forests – at establishment stage, reforestation stage or otherwise - must be substantiated by the results of a soil or foliar analysis, following sampling protocols set out in the DAFM Forestry Standards Manual. The type and rate of application must also be tailored for the site, as per the results of the analysis, and must not exceed the standard application rates. Application is limited to manual spot application during the most appropriate month(s) of the year in terms of silvicultural uptake. It can only be applied on sites where the required water setback has already developed a ground vegetation layer. Furthermore, fertiliser must not be applied during or after periods of heavy rainfall, or when the ground is saturated with water. Where phosphorus is required, the granulated form must be used, to reduce the likelihood of any drift and wash-off to surface waters. Other fertiliser formulations based on slow release organic formulations should also be favoured.

Aerial fertilisation requires a licence under the Forestry Act 2014 (as commenced by S.I.191 of 2017) from the Minister for Agriculture, Food & the Marine. DAFM does not envisage issuing licences for this activity within the Owenriff FPM Catchment.

Forest road construction

Forest road works is a regulated activity under the Forestry Act 2014 (as commenced by S.I.191 of 2017), and requires a licence (with or without grant approval) from the Minister of Agriculture, Food & the Marine. It must be undertaken according to the COFORD Forest Road Manual: Guidelines for the Design, Construction and Management of Forest Roads (2004) and the Forest Harvesting & the Environment Guidelines, in order to avoid environmental risk during both the construction stage and subsequent use. The extent of new forest road construction projects in the Owenriff FPM Catchment will be largely determined by the extent of forest harvesting in the catchment. Techniques involving the creation of temporary roading will be considered, particularly on sensitive sites or where forests are being permanently removed (deforested)

or converted from conifer to native woodland.

Other forest-related activities

Forest fires arising from the uncontrolled burning of vegetation in upland areas is a major issue in the Owenriff FPM Catchment. Uncontrolled burning of land leads to the destruction of forests and natural habitats and can place human lives, property and livestock at risk. There is also a risk of soil erosion and ash runoff into nearby watercourses following fire events. Where prescribed burning of vegetation is necessary, it should be carried out by an appropriate number of personnel with adequate training, knowledge and experience in safely managing controlled burning operations. The DAFM Prescribed Burning Code of Practice (2011) provides guidance to landowners who use controlled burning as a land management tool. The DAFM also issues Fire Danger Notices reflecting fire risk levels - see www.agriculture.gov.ie/forestservice/ firemanagement/ for detail.

Rhododendron ponticum is present in the catchment. This highly-invasive exotic species presents a possible threat to forests (particularly young emerging native woodlands) and adjacent open natural habitats. It can also infest streamand riverbanks, with a deleterious impact on the aquatic habitat. It is important that rhododendron is controlled and is prevented from colonising newly established forests, native woodlands (both emerging and existing) and deforested sites. Various methods of control, including those appropriate in areas directly adjoining watercourses, are set out in the Woodlands of Ireland Information Note *The Control of Rhododendron in Native Woodlands* (Barron, 2007).

There is a risk of unlicensed tree felling in the catchment in the form of 'scrub' woodland clearance for land reclamation purposes. Under the Forestry Act 2014, apart from listed exemptions, it is an offence to fell any tree without a Felling Licence (see the DAFM's document *Felling & Reforestation Policy* document and www.agriculture.gov.ie/forestservice/ tree felling/ for details). Furthermore, it is an offence to commence the use of uncultivated land or seminatural areas for intensive agriculture without first applying to the Minister for Agriculture, Food & the Marine for a screening decision, as such use may have a significant effect on protected habitats and species, including FPM.



The Currane FPM Catchment is situated on the Iveragh Peninsula in Co. Kerry. The corresponding SAC is the Killarney National Park, Macgillycuddy's Reeks & Caragh River Catchment SAC (000365), the Conservation Objectives of which include the restoration of FPM to favourable conservation status, as defined by specific attributes and targets set out in the relevant NPWS Conservation Objectives Series report (see www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000365.pdf). Most of the catchment is situated within the SAC.

The catchment comprises the lake and river system associated with the Cummeragh and the Capall Rivers, both of which flow into Currane Lough between the towns of Sneem and Waterville.

The Cummeragh River rises in the western slopes of Knocknagantee Mountain and the southern slopes of Knockmoyle Mountain and flows through a series of smaller lakes into Derriana Lough. From the exit of Derriana Lough, it flows southwest through lowerlying land into Currane Lough.

The Capall River rises in Coomcallee Mountain and flows through Isknagahiny Lough and from there, into Currane Lough.

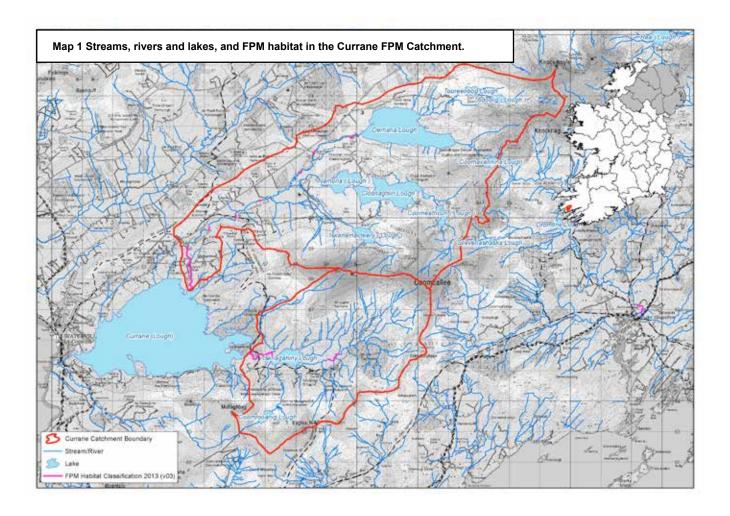
The Currane FPM catchment is approximately 75.11 km² (7,511 ha) in area. The total river length in the catchment is 124 km (Map 1).

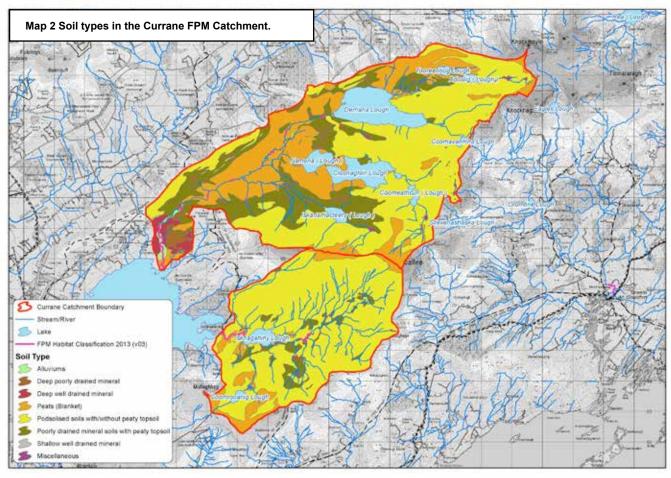
Table 1 summarises WFD details of individual water bodies within the catchment, and inclusion or otherwise in the current acid sensitivity protocol regarding afforestation.

Soils and land use

An analysis of the EPA / Teagasc soils data indicates that the Cummeragh River area of the Currane Catchment is primarily comprised of peat soils with some brown earths and podsols at the southern end of the river where it enters Currane Lough. The remainder of the catchment is dominated by peaty gleys and peaty podsols (Map 2).

While not designed for detailed reporting, the CORINE Land Cover (2006) does indicate main land use types within the catchment. The most common land uses are peat bogs (54.7%), sparely vegetated areas (11%) and pastures (9.1%). Forests and woodlands account for approximately 4.2% of land in the catchment (Map 3).





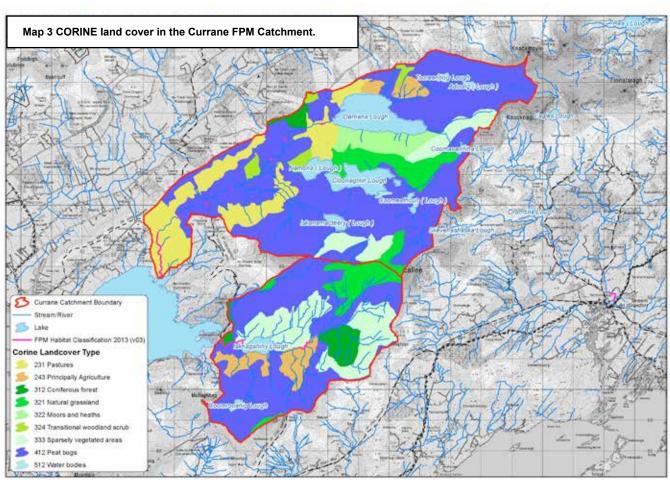








Table 1 Currane FPM catchment: Water body details (from www.catchments.ie, 26June18), inclusion under the RBMP Area for Action programme (from www. watersandcommunities.ie/areas-for-action/), and Acid Sensitivity Area status (from Appendix 11 of DAFM's Forestry Standards Manual (2015)).

Water body	Туре	Status	WFD risk	Pressure	Area for Action	Acid Sensitive Area
Cummeragh_010	River	Good	At risk	Anthropogenic	Yes	Yes
Tooreenbog	Lake	Unassigned	Not at risk	None assigned	No	Yes
Adoolig	Lake	Unassigned	Not at risk	None assigned	No	Yes
Derriana	Lake	HES	Not at risk	None assigned	No	Yes
Cummeragh_020	River	HES	Not at risk	Extractive industry (peat), forestry	No	Yes
Coomavanniha	Lake	Unassigned	Not at risk	None assigned	No	Yes
Coomeathcun	Lake	Unassigned	Not at risk	None assigned	No	Yes
Cloonaghlin	Lake	HES	Not at risk	None assigned	No	Yes
Namona	Lake	HES	Not at risk	None assigned	No	Yes
Cummeragh_020	River	HES	Not at risk	Extractive industry (peat), forestry	No	Yes
Iskanamacteery	Lake	Unassigned	Not at risk	None assigned	No	Yes
Isknagahiny Lough Stream_010	River	Good	At risk	Forestry, hydromorphology	Yes	Yes
Isknagahiny	Lake	Unassigned	Not at risk	None assigned	No	Yes
Coomrooanig	Lake	Unassigned	Not at risk	None assigned	No	Yes

FPM status

FPM has a widespread distribution within the Currane FPM Catchment. Based on information gathered in 2007 and 2009, it is estimated that the total population within the catchment is approximately 100,000 individuals, mostly located in the Cummeragh River.

A rapid assessment of the two main river populations was undertaken in 2007. This included a brief survey of 13 sites on the Cummeragh River and five sites on the Capall River.

Living mussels were found at 11 of the Cummeragh River sites. Abundant levels were recorded at seven

of these sites, and some juvenile mussels (under 30 mm or approximately 7 years of age) at two. The more upstream sites near Lough Derriana had fewer mussels and poor habitat, with evidence of eutrophication. The size frequency patterns are some of the best in Ireland and while there are some gaps in recruitment levels, the Cummeragh River would appear to have one of the most important pearl mussel populations in the country.

Along the Capall River, FPM has been recorded both upstream and downstream of Isknagahiny Lough. During the 2007 assessment, low numbers of mussels were found at two of the five sites visited. Only four living mussels were seen in the entire survey. High levels of filamentous

algae were recorded in the stretch immediately upstream of Lough Currane, suggesting a degree of eutrophication. In places, the habitat quality appeared to be very good, suggesting that larger numbers of FPM should be present. With improvements to the quality of the riverbed, it is therefore possible that this population could recover, particularly with the degree of connectivity to larger numbers of mussels in the Cummeragh River.

The Currane population is currently ranked eight out of the 27 FPM SAC populations in the country, based on population status, habitat condition and current pressures.

Water quality within the catchment fails three of the five Environmental Quality Objectives (EQOs) specified in Schedule 4 of the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations, S.I.296 of 2009.

Despite relatively high population levels in parts of the catchment, FPM is at an unfavourable conservation status in the Currane Catchment. The population will be extinct within a generation if the habitat quality within the catchment is not improved.

Forest land

The total area of forest cover in the Currane Catchment is approximately 379 ha). This represents c.4.3% of the total land use within the catchment, which is significantly less than the national average forest cover of 11%. Approximately 168 ha of the forest cover within the catchment are located within 100 metres of a watercourse.

Coillte owns c.83% (312 ha) of the forest area in the catchment (Map 4). The majority of these forests are dominated by Sitka spruce, with some Lodgepole pine and Japanese larch, and date from the 1970s or earlier.

The remaining 67 ha of forest cover comprises five privately-owned plantation forests (totalling *c*.33 ha) and three areas of old semi-natural woodland (totalling *c*.34 ha).

There is a mixture of forest types in the catchment (Map 5). Forests dominated by conifer species account for *c*.73% (278 ha) of the total forest estate, with the remainder comprising mixed forests or woodlands predominantly broadleaved in nature (including low-lying woodland).

Of the privately-owned forests established with grant support, 10 ha were planted in 1985, 17 ha in 1994, and 6 ha in 2008. Of these areas, 80% (26.2 ha) comprise conifer species only, and 16% (5.3 ha) comprise a mixture of conifers and broadleaves. Approximately 1.1 ha is broadleaf only.

The remaining areas of private forest predominantly comprise old semi-natural woodland and / or low-lying woodland. The exact composition of these woodlands is unknown, but they are likely to comprise mixed broadleaf species.

Approximately 47% of the catchment's forests are growing on podsol soils with / without peaty topsoil, 41% on blanket peat, and 9% on poorly-drained mineral soils with peaty top soil.

Forest ownership, type and age class structure within the Currane FPM Catchment are illustrated in Maps 4-6.

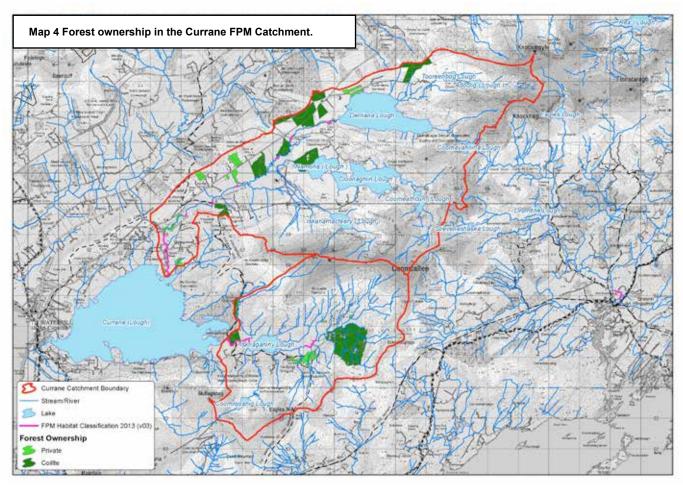
Forest operations

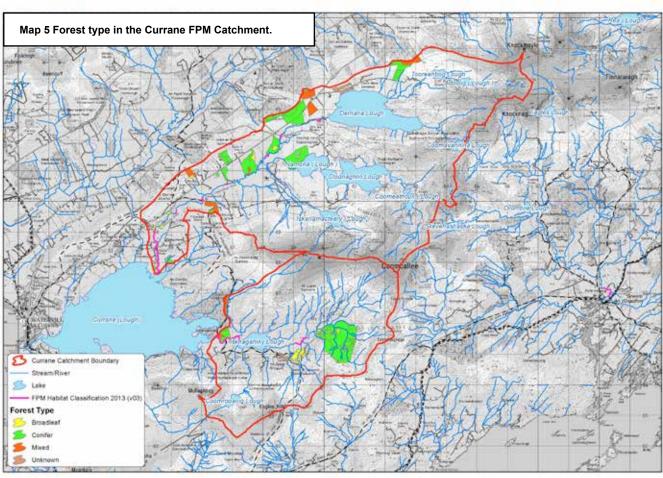
Afforestation

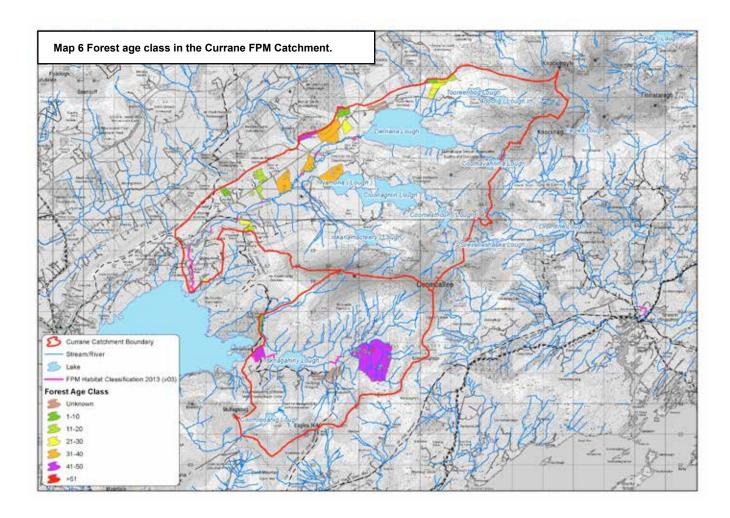
Most of the Currane FPM Catchment is not suitable for production forestry. The catchment contains large areas of unimproved blanket bog, which is unsuitable. In addition, while other parts of the Currane catchment are very suitable for production forestry, the catchment lies within an acid sensitive area, as defined under the DAFM / COFORD / EPA Protocol for the determination of the acid sensitivity of surface water in the context of afforestation (see Appendix 11 of the Forestry Standards Manual). This reflects the fact that soils in the catchment have a low capacity to neutralise acidity caused by atmospheric scavenging by conifer forests, which can lead to the acidification of surface waters. Both of these factors combined have severely limited afforestation in the catchment, particularly since 2002, when the acidification protocol was first introduced. Consequently, only 6 ha of new forest has been planted in the catchment since 1994.

Under S.I.191 of 2017, afforestation requires a licence from the Minister for Agriculture, Food & the Marine. DAFM envisages that any new afforestation licensed (with or without grant support) within the Currane FPM Catchment will be limited to native woodland establishment, following the requirements set out in the Native Woodland Establishment Scheme regarding the identification of the most appropriate native woodland type, species mixtures, site input, and future management (see Forest Service Circular 05/2018). A focus on the strategic use of new native woodland to consolidate existing semi-natural woodland (including low-lying woodland) and to protect and enhance water quality and the aquatic habitat for FPM, will also be sought, based on the Woodlands for Water model (DAFM, 2018).

In February 2013, the existing acid sensitivity protocol for afforestation was amended with the agreement of the EPA, enabling the DAFM to accept, process and approve (where appropriate)







applications under the Native Woodland Establishment Scheme for sites within acid sensitive areas, without the requirement for water sampling.

Potential opportunities exist in the catchment to create new native woodlands or to expand existing semi-natural woodland (including low-lying woodland) though planting on adjoining 'greenfield' sites, particularly on the improved agricultural lands in the north west of the catchment along the Cummeragh River.

Felling and reforestation

The majority of future forest operations within the Currane FPM Catchment will involve those relating to forest management, primarily the felling (thinning and clearfelling) and replanting of existing forests and associated operations such as forest road construction (including upgrade). Felling and forest road construction are potentially high impact forestry operations from a water protection perspective, due to the potential for sedimentation from soil disturbance by heavy machinery, and the risk of nutrient runoff from decomposing brash following felling. These risks are particularly pronounced on sloped sites with soft peat soils and areas located near or adjacent to watercourses.

The majority of forests in the catchment are on moderate slopes (<15%), particularly in the north of the catchment where most of the private forests are located. The Coillte forest in the south of the catchment is also on a moderate slope, but the southern edge of the forest is located on steep (15-30%) to very steep (>30%) slopes. Many of these slopes are characterised by soft peaty soils, therefore creating significant risk. Any forestry operations in these areas will therefore prove acutely sensitive.

As the largest forest owner, Coillte will continue to be the main harvesting operator in the Currane Catchment into the foreseeable future.

The reforestation of clearfelled forests will require careful consideration, particularly near watercourses. Due to catchment sensitivities, it is envisaged that future reforestation will move away from the typical 'clearfell and replant' system to Continuous Cover Forestry (CCF) involving appropriate native species and / or Lodgepole pine, with a potential for realising timber production using associated close-to-nature techniques. Considerable opportunities exist for the permanent restructuring of existing forests at this crucial stage in the forest cycle, to introduce a range of features to protect and enhance water quality and the FPM habitat, and to redirect

productive forestry towards less sensitive areas. Such measures include enhanced water setbacks, areas reforested with native woodland (in particular, pioneer birch woodland – see Circular 05/2018), and the restoration of original habitats, such as bogs and wetlands, either as part of introduced open spaces or at a larger deforestation scale. The DAFM *Felling & Reforestation Policy* document provides details on available options, such as Reforestation Objectives 'CCF and 'Bio', and situations where permanent forest removal may be acceptable, due to overriding environmental considerations.

Fertilisation

Forests in the Currane Catchment are generally in good condition, with little or no requirement for fertiliser application envisaged.

Any decision to apply fertiliser within forests – at establishment stage, reforestation stage or otherwise - must be substantiated by the results of a soil or foliar analysis, following sampling protocols set out in the DAFM Forestry Standards Manual. The type and rate of application must also be tailored for the site, as per the results of the analysis, and must not exceed the standard application rates. Application is limited to manual spot application during the most appropriate month(s) of the year in terms of silvicultural uptake. It can only be applied on sites where the required water setback has already developed a ground vegetation layer. Furthermore, fertiliser must not be applied during or after periods of heavy rainfall, or when the ground is saturated with water. Where phosphorus is required, the granulated form must be used, to reduce the likelihood of any drift and wash-off to surface waters. Other fertiliser formulations based on slow release organic formulations should also be favoured.

Aerial fertilisation requires a licence under the Forestry Act 2014 (as commenced by S.I.191 of 2017) from the Minister for Agriculture, Food & the Marine. DAFM does not envisage issuing licences for this activity within the Currane FPM Catchment.

Forest road construction

Forest road works is a regulated activity under the Forestry Act 2014 (as commenced by S.I.191 of 2017), and requires a licence (with or without grant approval) from the Minister of Agriculture, Food & the Marine. It must be undertaken according to the COFORD Forest Road Manual: Guidelines for the Design, Construction and Management of Forest Roads (2004) and the Forest Harvesting & the Environment Guidelines, in order to avoid environmental risk during both the construction stage and subsequent use. The extent of new forest

road construction projects in the Currane FPM Catchment will be largely determined by the extent of forest harvesting in the catchment. Techniques involving the creation of temporary roading will be considered, particularly on sensitive sites or where forests are being permanently removed (deforested) or converted from conifer to native woodland.

Other forest-related activities

Forest fires arising from the uncontrolled burning of vegetation in upland areas is a major issue in the Currane Catchment. Uncontrolled burning of land leads to the destruction of forests and natural habitats and can place human lives, property and livestock at risk. There is also a risk of soil erosion and ash runoff into nearby watercourses following fire events. Where prescribed burning of vegetation is necessary, it should be carried out by an appropriate number of personnel with adequate training, knowledge and experience in safely managing controlled burning operations. The DAFM Prescribed Burning Code of Practice (2011) provides guidance to landowners who use controlled burning as a land management tool. The DAFM also issues Fire Danger Notices reflecting fire risk levels - see www.agriculture.gov.ie/forestservice/ firemanagement/ for detail.

Rhododendron ponticum is present in the catchment. This highly-invasive exotic species presents a possible threat to forests (particularly young emerging native woodlands) and adjacent open natural habitats. It can also infest streamand riverbanks, with a deleterious impact on the aquatic habitat. It is important that rhododendron is controlled and is prevented from colonising newly established forests, native woodlands (both emerging and existing) and deforested sites. Various methods of control, including those appropriate in areas directly adjoining watercourses, are set out in the Woodlands of Ireland Information Note *The Control of Rhododendron in Native Woodlands* (Barron, 2007).

There is a risk of unlicensed tree felling in the Currane FPM Catchment in the form of 'scrub' woodland clearance for land reclamation purposes. Under the Forestry Act 2014, apart from listed exemptions, it is an offence to fell any tree without a Felling Licence (see the DAFM's document Felling & Reforestation Policy document and www.agriculture.gov.ie/forestservice/tree felling/ for details). Furthermore, it is an offence to commence the use of uncultivated land or semi-natural areas for intensive agriculture without first applying to the Minister for Agriculture, Food & the Marine for a screening decision, as such use may have a significant effect

on protected habitats and species, including FPM.



The Dawros FPM Catchment is situated in northwest Co. Galway. The corresponding SAC is the Twelve Bens / Garraun Complex SAC (002031), the Conservation Objectives of which include the restoration of FPM to favourable conservation status, as defined by specific attributes and targets set out in the relevant NPWS Conservation Objectives Series report (see www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO002031.pdf). (Also see Appendix A, where these attributes and targets are reproduced.)

Over 80% of the catchment is contained within this SAC. The catchment also incorporates the northern part of Connemara National Park.

The Dawros FPM catchment contains a number of lakes and rivers including Kylemore Lough, Pollacappal Lough and Tougher Lough. The Kylemore River flows from the south of the catchment into Kylemore Lough. The Dawros River drains Kylemore Lough and flows westwards through Pollacappal Lough and into the sea at Ballynakill Bay. The other main watercourse is the Polladirk River, which flows from the southwest of the catchment and joins the Dawros River west of Pollacappal Lough.

The Dawros FPM Catchment is approximately 53.14 km² (5,314 ha) in area. The total river length in the catchment is 128 km (Map 1).

Table 1 summarises WFD details of individual water bodies within the catchment, and inclusion or otherwise in the current acid sensitivity protocol regarding afforestation.

Soils and land use

An analysis of the EPA / Teagasc soils data indicates that the Dawros Catchment is dominated by peat type soils, including blanket peat, peaty gleys and peaty podsols (Map 2).

While not designed for detailed reporting, the CORINE Land Cover (2006) does indicate main land use types within the catchment. The most common land use is peat bogs (71.7%), with sparsely vegetated areas comprising 7.4% of the catchment. Forests and woodlands account for approximately 9.3% of the land cover (Map 3).

FPM status

The main population of FPM within the Dawros

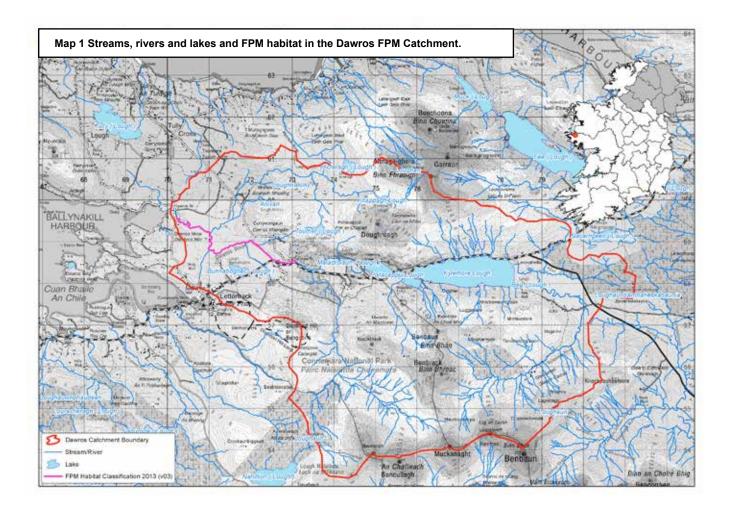
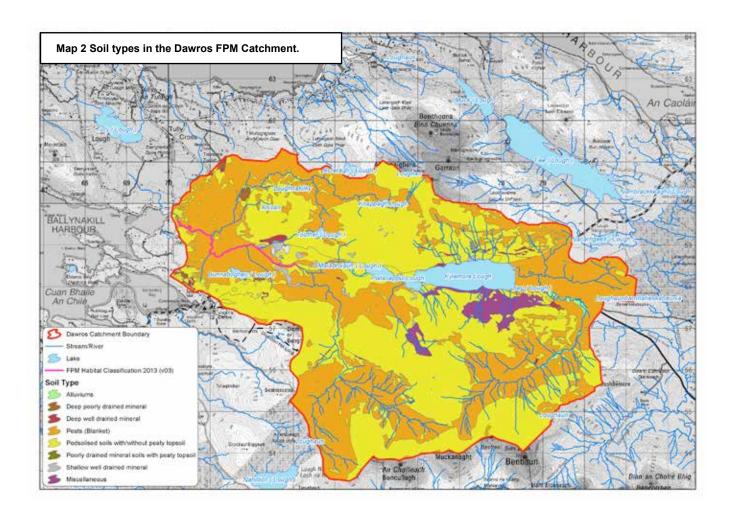


Table 1 Dawros FPM catchment: Water body details (from www.catchments.ie, 26June18), inclusion under the RBMP Area for Action programme (from www. watersandcommunities.ie/areas-for-action/), and Acid Sensitivity Area status (from Appendix 11 of DAFM's Forestry Standards Manual (2015)).

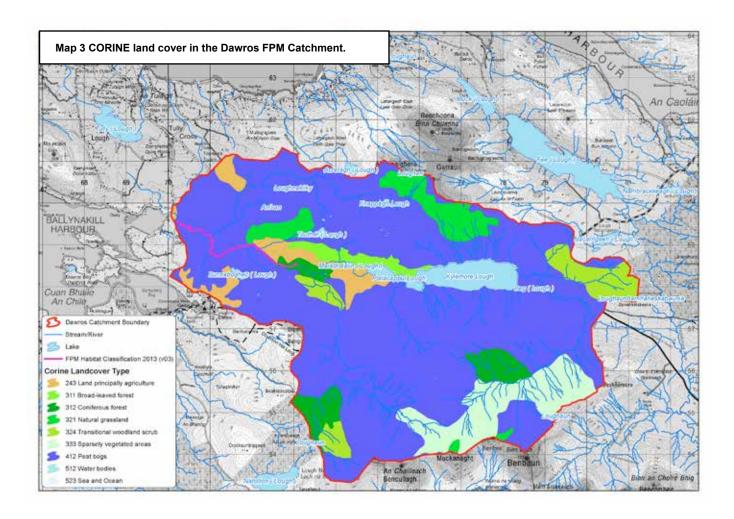
Water body	Туре	Status	WFD risk	Pressure	Area for Action	Acid Sensitive Area
Dawros_040	River	HES	Not at risk	None assigned	No	Yes
Touther	Lake	Unassigned	Not at risk	None assigned	No	Yes
Dawros_030	River	HES	Not at risk	None assigned	No	Yes
Dawros_020	River	HES	Not at risk	None assigned	No	Yes
Pollacappul	Lake	Good	Not at risk	None assigned	No	Yes
Kylemore	Lake	Good	Not at risk	None assigned	No	Yes
Dawros_010	River	Good	At risk	Forestry, hydromorphology	Yes	Yes











Catchment is located within the Dawros River between Pollacappal Lough and Ballynakill Bay.

FPM has been recorded in the Dawros River since1902. A survey to provide update information was undertaken in 2008, principally to determine the upstream and downstream limit of the population, to estimate mussel numbers, to assess size distribution, to determine recruitment status, and to assess habitat quality.

The survey found that the mussel population is continuous from upstream of Tullywee Bridge to the tidal limit downstream of Dawros Bridge. The survey estimated the population to be in the region of 1 million individuals. The assessment of size distribution found that a major proportion of the mussel population was aged between 30 and 130 years. While some juvenile mussels (7 years old or less) were observed, the number of juveniles is not sufficient to sustain the existing population.

The Dawros population is ranked third out of the 27 FPM SAC populations in the country, based on population status, habitat condition and current pressures.

Water quality within the catchment fails four of the five Environmental Quality Objectives (EQOs) specified in Schedule 4 of the European

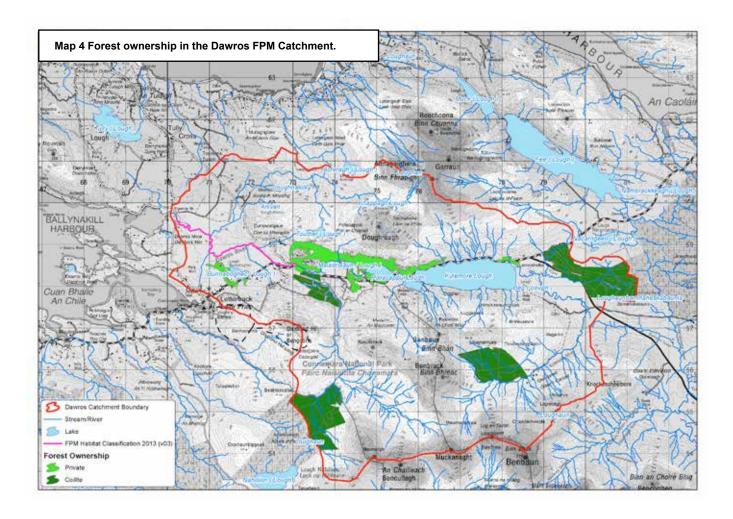
Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations, S.I.296 of 2009.

FPM is at unfavourable conservation status in the Dawros catchment. Despite relatively high population levels in parts of the catchment, the level of juvenile recruitment is insufficient to ensure the conservation of the species. Unless measures are taken to improve habitat quality, the Dawros FPM population is likely to become extinct within a generation.

Forest land

The total area of forest cover in the Dawros FPM Catchment is approximately 475 ha. This represents c.8.9% of the total land use within the catchment, which is lower than the national average forest cover of 11%. The main forest areas are located upstream of known FPM populations. Approximately 273 ha of the forest cover within the catchment are located within 100 metres of a watercourse.

Coillte owns c.72% (c.358 ha) of the forest area in the catchment, centred on three properties including part of the Ailenaveagh Property in the upper reaches of the Polladirk River, and the Glencorbet Property in the south of the catchment along the



upper reaches of the Kylemore River (Map 4). Both of these properties form part of the Baunogues Forest. The Kylemore Property in the east of the catchment forms part of Coillte's Derryclare Forest.

The remaining forest area is under private ownership. The largest privately-owned forest is a large area of broadleaf woodland (c.100 ha) at Pollacappal Lough near Kylemore Abbey, which was planted in the late 1800s. There are also areas of semi-natural woodlands adjacent to Lough Bunnabogheo (c.10 ha) and at Lemnaheltia (c.5 ha) to the northeast of Kylemore Lough, as well as a number of small semi-natural riparian woodlands at intervals along the lower stretches of the Dawros River, close to existing FPM populations. These riparian woodlands may be having a beneficial effect on water quality, perhaps suggesting that additional riparian woodland at appropriate locations within the catchment may have a role to play in improving the aquatic habitat. However, the presence of red deer may limit the opportunities for native woodland expansion in the catchment.

There are no privately-owned grant-aided productive forests in the Dawros Catchment.

Approximately 75% of the catchment's forests are growing on blanket peat, and the remaining 25% on

podsol soils with / without peaty topsoil.

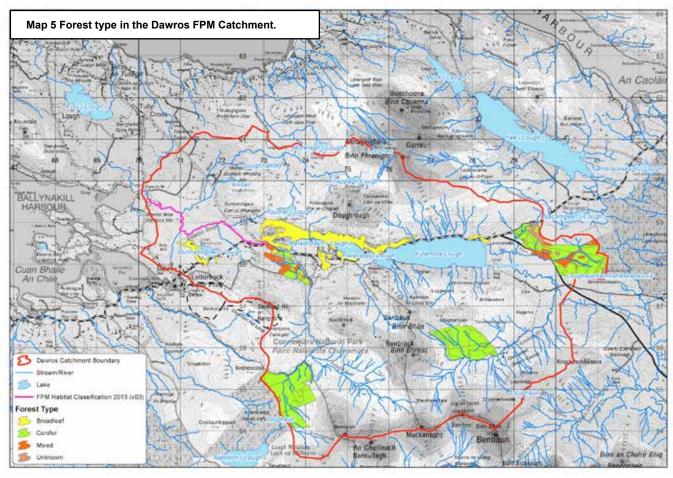
Forest ownership, type and age class structure within the Dawros FPM Catchment are illustrated in Maps 4-6.

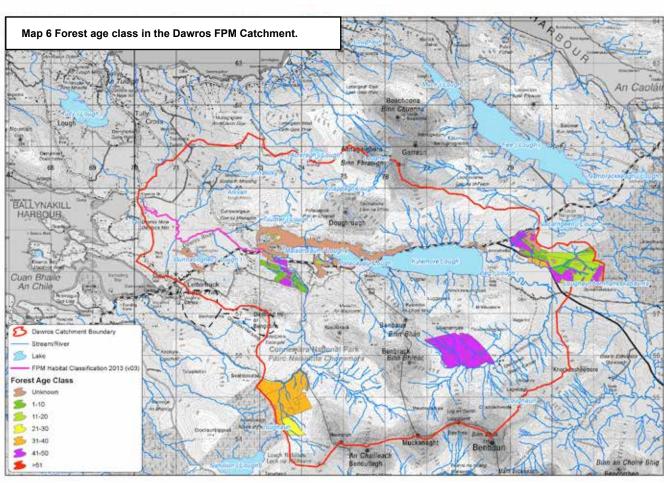
Forest operations

Afforestation

Afforestation has not been a significant feature of forestry activities in the Dawros Catchment for some time. The catchment is dominated by peat bog, which is unsuitable for production forestry. In addition, the catchment lies within an acid sensitive area, as defined under the DAFM / COFORD / EPA Protocol for the determination of the acid sensitivity of surface water in the context of afforestation (see Appendix 11 of the Forestry Standards Manual). This reflects the fact that soils in the catchment have a low capacity to neutralise acidity caused by atmospheric scavenging by conifer forests, which can lead to the acidification of surface waters. Both of these factors combined have severely limited afforestation in the catchment, particularly since 2002, when the acidification protocol was first introduced.

Under S.I.191 of 2017, afforestation requires a





licence from the Minister for Agriculture, Food & the Marine. DAFM envisages that any new afforestation licensed (with or without grant support) within the Dawros FPM Catchment will be limited to native woodland establishment, following the requirements set out in the Native Woodland Establishment Scheme regarding the identification of the most appropriate native woodland type, species mixtures, site input, and future management (see Forest Service Circular 05/2018). A focus on the strategic use of new native woodland to consolidate existing semi-natural woodland (including low-lying woodland) and to protect and enhance water quality and the aquatic habitat for FPM, will also be sought, based on the Woodlands for Water model (DAFM, 2018).

In February 2013, the existing acid sensitivity protocol for afforestation was amended with the agreement of the EPA, enabling the DAFM to accept, process and approve (where appropriate) applications under the Native Woodland Establishment Scheme for sites within acid sensitive areas, without the requirement for water sampling.

Potential opportunities exist in the catchment to create new native woodlands or to expand existing semi-natural woodland (including low-lying woodland) though planting on adjoining 'greenfield' sites, particularly at lower elevations along the Dawros River. However, the presence of red deer in the catchment will be a practical consideration.

Felling and reforestation

The majority of future forest operations within the Dawros FPM Catchment will involve those relating to forest management, primarily the felling (thinning and clearfelling) and replanting of existing forests and associated operations such as forest road construction (including upgrade). Felling and forest road construction are potentially high impact forestry operations from a water protection perspective, due to the potential for sedimentation from soil disturbance by heavy machinery, and the risk of nutrient runoff from decomposing brash following felling. These risks are particularly pronounced on sloped sites with soft peat soils and areas located near or adjacent to watercourses.

As the largest forest owner, Coillte will be the main harvesting operator in the catchment over the next 10-15 years.

The Kylemore Property is located on even to moderate slope (<15%) on peat soil adjacent to a tributary of the Kylemore River. This property has seen extensive clearfelling over the past 10-15 years, including the removal of trees and the creation of significant setbacks along some watercourses. Much of the property is currently unstocked or is

sparsely restocked.

The Ailenaveagh Property is mainly on even to moderate slope on peat soil, but some parts of the property adjacent to the Sruffaunagreagh Stream, are on a steep slope. The Glencorbert Property is mainly located on a steep (15-30%) to very steep (>30%) slope on peat soil, but the slope tapers off to moderate at distances ranging from 50 metres to 300 metres along the Kylemore River. There have been no major forestry operations at these properties in recent years. However, both properties are now over 40 years of age and are approaching clearfell age. Any forestry operations in this area will prove acutely sensitive.

The reforestation of clearfelled forests will require careful consideration, particularly near watercourses. Considerable opportunities exist for the permanent restructuring of existing forests at this crucial stage in the forest cycle, to introduce a range of features to protect and enhance water quality and the FPM habitat, and to redirect productive forestry towards less sensitive areas. Such measures include enhanced water setbacks, areas reforested with native woodland (in particular, pioneer birch woodland - see Circular 05/2018), and the restoration of original habitats, such as bogs and wetlands, either as part of introduced open spaces or at a larger deforestation scale. The DAFM Felling & Reforestation Policy document provides details on available options, such as Reforestation Objectives 'CCF and 'Bio', and situations where permanent forest removal may be acceptable, due to overriding environmental considerations.

Fertilisation

A significant portion of forests in the Dawros Catchment is growing on nutrient-deficient and poorly-buffered peat soils. Therefore, any excess fertiliser not taken up within the short term by trees will not be retained in the soil, resulting in nutrient (primarily phosphorus) leaching into adjacent watercourses, and subsequent eutrophication. This is a particular concern on sloped sites within the catchment. It is critical, therefore, that any required fertiliser application interventions are carefully planned and implemented.

Any decision to apply fertiliser within forests – at establishment stage, reforestation stage or otherwise – must be substantiated by the results of a soil or foliar analysis, following sampling protocols set out in the DAFM *Forestry Standards Manual*. The type and rate of application must also be tailored for the site, as per the results of the analysis, and must not exceed the standard application rates. Application is limited to manual spot application during the most appropriate month(s) of the year

in terms of silvicultural uptake. It can only be applied on sites where the required water setback has already developed a ground vegetation layer. Furthermore, fertiliser must not be applied during or after periods of heavy rainfall, or when the ground is saturated with water. Where phosphorus is required, the granulated form must be used, to reduce the likelihood of any drift and wash-off to surface waters. Other fertiliser formulations based on slow release organic formulations should also be favoured.

Aerial fertilisation requires a licence under the Forestry Act 2014 (as commenced by S.I.191 of 2017) from the Minister for Agriculture, Food & the Marine. DAFM does not envisage issuing licences for this activity within the Dawros FPM Catchment.

Forest road construction

Forest road works is a regulated activity under the Forestry Act 2014 (as commenced by S.I.191 of 2017), and requires a licence (with or without grant approval) from the Minister of Agriculture, Food & the Marine. It must be undertaken according to the COFORD Forest Road Manual: Guidelines for the Design, Construction and Management of Forest Roads (2004) and the Forest Harvesting & the Environment Guidelines, in order to avoid environmental risk during both the construction stage and subsequent use. The extent of new forest road construction projects in the Dawros FPM Catchment will be largely determined by the extent of forest harvesting in the catchment. Techniques involving the creation of temporary roading will be considered, particularly on sensitive sites or where forests are being permanently removed (deforested) or converted from conifer to native woodland.

Other forest-related activities

The use of fire to clear vegetation is not a feature of land management in the Dawros FPM Catchment but is a possibility. Uncontrolled burning of land leads to the destruction of forests and natural habitats and can place human lives, property and livestock at risk. There is also a risk of soil erosion and ash runoff into nearby watercourses following fire events. Where prescribed burning of vegetation is necessary, it should be carried out by an appropriate number of personnel with adequate training, knowledge and experience in safely managing controlled burning operations. The DAFM Prescribed Burning Code of Practice (2011) provides guidance to landowners who use controlled burning as a land management tool. The DAFM also issues Fire Danger Notices reflecting fire risk levels - see www.agriculture.gov.ie/ forestservice/firemanagement/ for detail.

Rhododendron ponticum is present in the

catchment. This highly-invasive exotic species presents a possible threat to forests (particularly young emerging native woodlands) and adjacent open natural habitats. It can also infest streamand riverbanks, with a deleterious impact on the aquatic habitat. It is important that rhododendron is controlled and is prevented from colonising newly established forests, native woodlands (both emerging and existing) and deforested sites. Various methods of control, including those appropriate in areas directly adjoining watercourses, are set out in the Woodlands of Ireland Information Note *The Control of Rhododendron in Native Woodlands* (Barron, 2007).

Giant rhubarb (*Gunnera tinctoria*) is another exotic invasive also present within the Dawros FPM Catchment. This species represents a similar ecological threat to that posed by rhododendron, particularly along watercourses, and a similar approach to control is needed.

There is a risk of unlicensed tree felling in the catchment in the form of 'scrub' woodland clearance for land reclamation purposes. Under the Forestry Act 2014, apart from listed exemptions, it is an offence to fell any tree without a Felling Licence (see the DAFM's document *Felling & Reforestation Policy* document and www.agriculture.gov.ie/forestservice/ tree felling/ for details). Furthermore, it is an offence to commence the use of uncultivated land or seminatural areas for intensive agriculture without first applying to the Minister for Agriculture, Food & the Marine for a screening decision, as such use may have a significant effect on protected habitats and species, including FPM.



Physical description

The Kerry Blackwater FPM Catchment is situated on the Iveragh Peninsula in Co. Kerry. There are two corresponding SACs: the Blackwater River (Kerry) SAC (002173) and Killarney National Park, Macqillycuddy's Reeks & Caragh River Catchment SAC (000365). The Conservation Objectives of the Blackwater River (Kerry) SAC (002173) are "To maintain or restore the favourable conservation condition of the Annex I habitat(s) and / or the Annex II species [inter alia, FPM]." (see www.npws.ie/sites/ default/files/protected-sites/conservation_objectives/ CO002173.pdf) The Conservation Objectives for the Killarney National Park, Macgillycuddy's Reeks & Caragh River Catchment SAC (000365) include the restoration of FPM to favourable conservation status. as defined by specific attributes and targets set out in the relevant NPWS Conservation Objectives Series report (see www.npws.ie/sites/default/files/protectedsites/conservation_objectives/CO000365.pdf).

The catchment is based around the Blackwater River and its main tributaries, the Kealduff and Derreendarragh Rivers. The Blackwater River originates in the southern slopes of Mullaghanattin in the north east of the catchment, and flows for 13 km to Kenmare Bay at Lackeen Point. The Kealduff

River drains Lough Brin and Lough Fada in the north of the catchment and joins the Blackwater 6 km upstream from Lackeen Point. The Derreendarragh River flows from the east of the catchment draining Lough Beg and joins the Blackwater 3.5 km upstream from Lackeen Point.

The Kerry Blackwater FPM Catchment is approximately 88.30 km² (8,830 ha) in area. The total river length in the catchment is 211 km (see Map 1).

Table 1 summarises WFD details of individual water bodies within the catchment, and inclusion or otherwise in the current acid sensitivity protocol regarding afforestation.

Soils and land use

An analysis of the EPA / Teagasc soils data indicates that the main soil types in the Kerry Blackwater FPM Catchment are podsol with / without peaty topsoil (38%), blanket peat (27%), poorly drained mineral soil with peaty topsoil (24%), and deep mineral soils (9%) (Map 2).

While not designed for detailed reporting, the CORINE Land Cover (2006) does indicate main land use types within the catchment. The most common

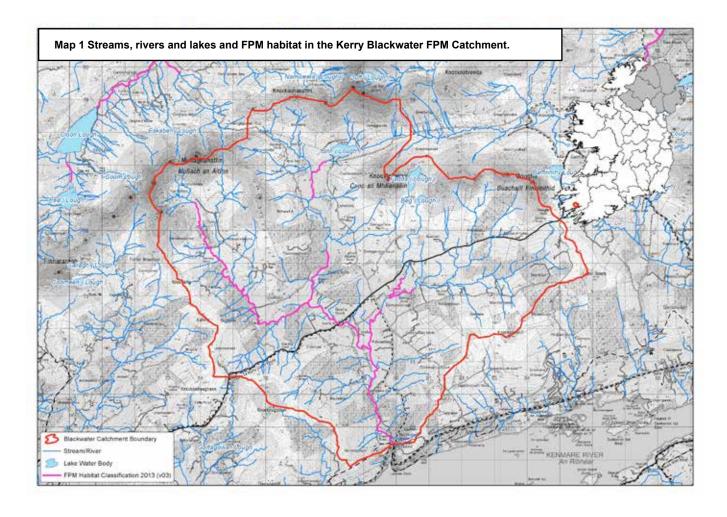
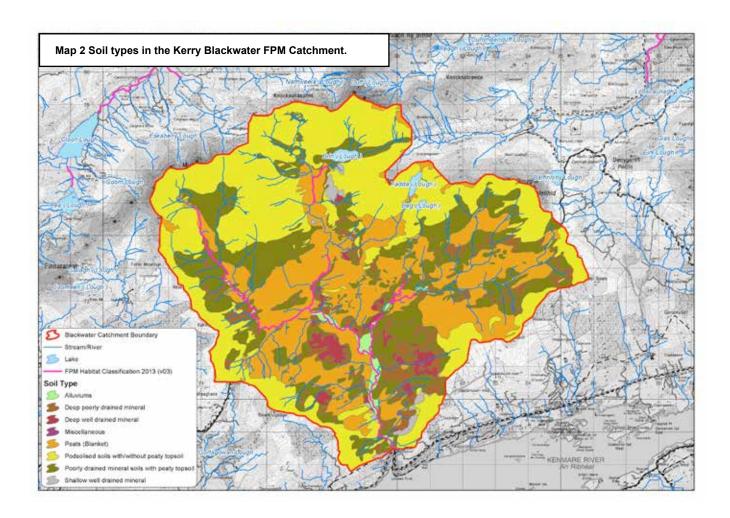


Table 1 Kerry Blackwater FPM catchment: Water body details (from www. catchments.ie, 26June18), inclusion under the RBMP Area for Action programme (from www.watersandcommunities.ie/areas-for-action/), and Acid Sensitivity Area status (from Appendix 11 of DAFM's Forestry Standards Manual (2015)).

Water body	Туре	Status	WFD risk	Pressure	Area for Action	Acid Sensitive Area
Brin	Lake	Good	Not at risk	Agriculture, hydromorphology	No	Yes
Kealduff_010	River	HES	Review	Forestry, agriculture	No	Yes
Fadda FY	Lake	Unassigned	Not at risk	None assigned	No	Yes
Beg FY	Lake	Unassigned	Not at risk	None assigned	No	Yes
Derreendarragh_010	River	HES	Not at risk	None assigned	No	Yes
Blackwater (Kerry)_020	River	HES	Not at risk	Hydromorphology	No	Yes
Blackwater (Kerry)_010	River	HES	Not at risk	Hydromorphology	No	Yes









land uses are peat bogs (60.4%) and natural grassland (10.4%). Forests and woodlands account for approximately 16.2% of land in the catchment (Map 3).

FPM status

FPM is widespread and abundant within the Kerry Blackwater FPM Catchment, with an estimated population of approximately 2.5 million individuals. The significance of the population was not recognised until the mid-1990s. The first comprehensive survey of the catchment was undertaken in 1999, and this found very large mussel populations, with very high densities in places, in the Blackwater, Kealduff and Derreendarragh Rivers. Mussels of all ages, including juveniles, were recorded, indicating that the population was recruiting successfully.

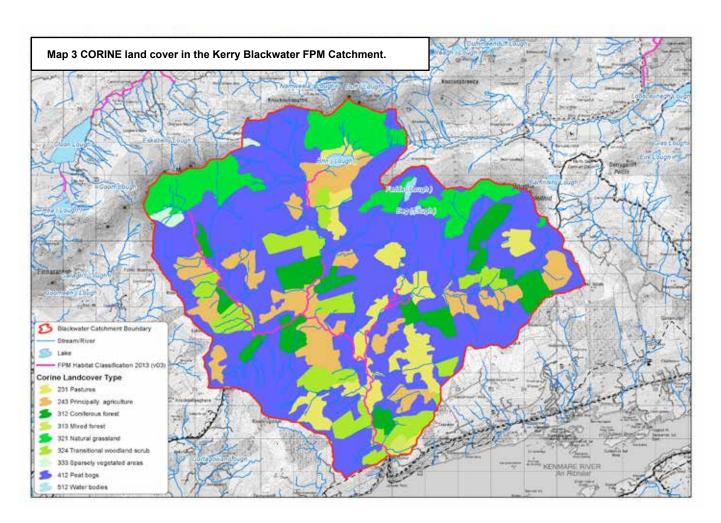
In 2004, a further survey at 24 transects confirmed the presence of large mussel populations, including juveniles, in the three rivers, making it one of the most important mussel river systems internationally. These findings were confirmed in a follow-up survey in 2005. However, the 2005 survey also noted that there was a widespread deterioration in water quality,

with heavy growths of filamentous green algae observed at all of the sites investigated.

In 2009, a repeat survey of three transects from the 2004 survey was undertaken to determine mussel size distribution and recruitment status. The survey found that mussel populations had declined at each site. While it is possible that these reductions are due to natural population fluctuations, the fact that reductions were observed at all three sites is a matter of concern. Furthermore, no juvenile mussels were recorded at any of the three sites investigated, suggesting that no significant recruitment of juvenile mussels had occurred in the 5 years since 2004. The results of the 2009 survey also showed that silt, macrophytes and filamentous green algae were present in high quantities, indicating excessive nutrient and sediment release into the river system.

The Kerry Blackwater population is currently ranked seventh out of the 27 FPM SAC populations in the country, based on population status, habitat condition and current pressures.

Water quality within the catchment fails all five of the Environmental Quality Objectives (EQOs) specified in Schedule 4 of the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations, S.I.296 of 2009.



FPM is at unfavourable conservation status in the Kerry Blackwater Catchment. Despite relatively high population levels in parts of the catchment, there has been an observed reduction of mussel numbers in the catchment since 2004, and an absence of juvenile mussels. On the basis of 2009 survey results, it is predicted that FPM will become extinct in the Kerry Blackwater Catchment before the end of the century, if habitat quality within the catchment is not improved.

An assessment of condition in 2016 (Moorkens, 2016) indicated an unfavourable conservation status, with agriculture and cattle access resulting in nutrient enrichment and siltation.

Forest land

The total area of forest cover in the Kerry Blackwater Catchment is approximately 1,430 ha. This represents c.16.2% of the total land use within the catchment, which is higher than the national average forest cover of 11%. Approximately 483 ha of the forest cover are located within 100 metres of a watercourse.

Coillte owns c.64% (c.912 ha) of the forest area in the catchment (Map 4). The majority of these forests are dominated by Sitka spruce, with some Lodgepole pine and Japanese larch, and date from the 1970s or earlier. Also included under Coillte ownership are a number of broadleaf and mixed woodlands, including Lackeen Wood, a 37 ha oak woodland near Blackwater Bridge.

The remaining forest areas, totalling *c*.516 ha, are privately-owned, mainly by farmers. Of these, *c*.408 ha were established between 1988 and 2002 under Government afforestation support schemes. There has been no new afforestation in the catchment since 2002.

The remaining privately-owned forests predominantly comprise mature broadleaf woodland, including a large woodland (c.25 ha) adjacent to the Coillteowned woodland near Blackwater Bridge in the south of the catchment, and a number of small seminatural woodlands along the lower stretches of the Blackwater River.

There is a mixture of forest types in the catchment (Map 5). Forests dominated by conifer species account for *c*.49% of the total forest estate. Forests comprising mixtures of conifer and broadleaf species account for 42%, and woodlands predominantly broadleaved in nature (including low-lying woodland)

account for 9%.

Of the privately-owned forests established with grant support, 76% (310 ha) comprise conifer species only, and 23% (95 ha) comprise conifer / broadleaf mixtures. The remaining 1% (4 ha) is broadleaved in nature.

Approximately 53% of the catchment's forests are growing on blanket peat, 23% on poorly-drained mineral soils with peaty topsoil, 15% on podsol soils with / without peaty topsoil, 7% on other mineral soils, and 2% on alluvial soils.

Forest ownership, type and age class structure within the Kerry Blackwater FPM Catchment are illustrated in Maps 4-6.

Forest operations

KerryLIFE

Kerry LIFE¹ is a 6-year project focused on both agriculture and forestry within both the Kerry Blackwater and the adjoining Caragh FPM catchments, Co. Kerry. Through a range of practical initiatives involving land use management, local participation and training, the project aims to improve the habitat condition for FPM, increase the level of recruitment of juvenile mussels, and promote a greater awareness and understanding of FPM amongst the local community and key stakeholders.

Activities focus on the development and implementation of effective and cost-efficient measures for reducing diffuse losses of sediment and nutrients from forestry and farming.

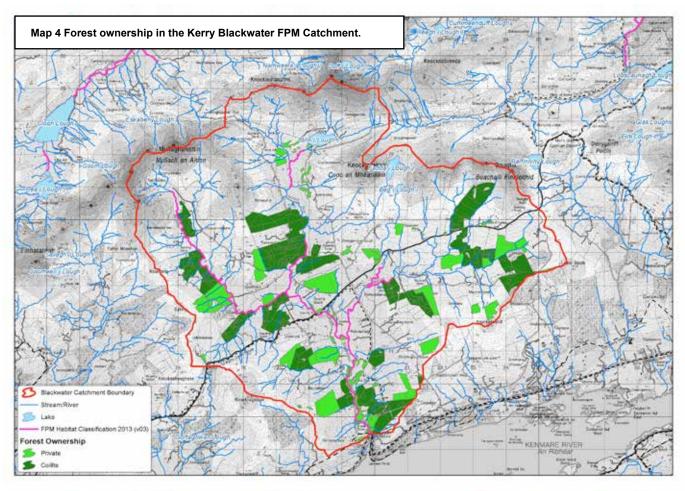
Key measures targeting forestry at specific strategic locations within both catchments include:

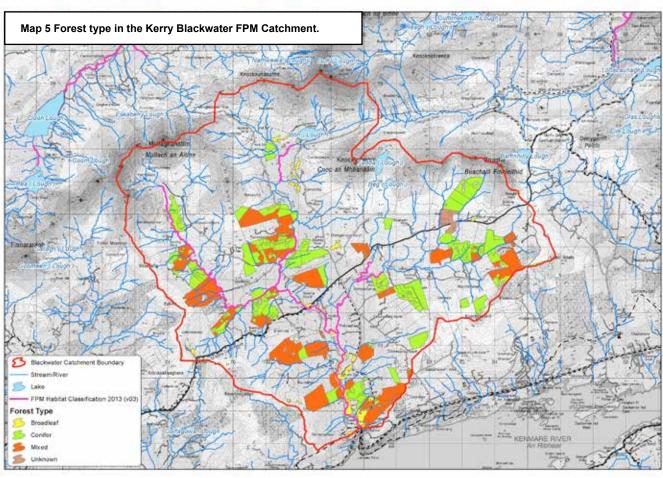
- the establishment 15 ha of native woodland;
- the management of 10 ha of existing broadleaf woodland:
- the conversion of 15 ha to native broadleaf woodland; and
- the restructuring of 175 ha of commercial plantations into long-term retention woodland.

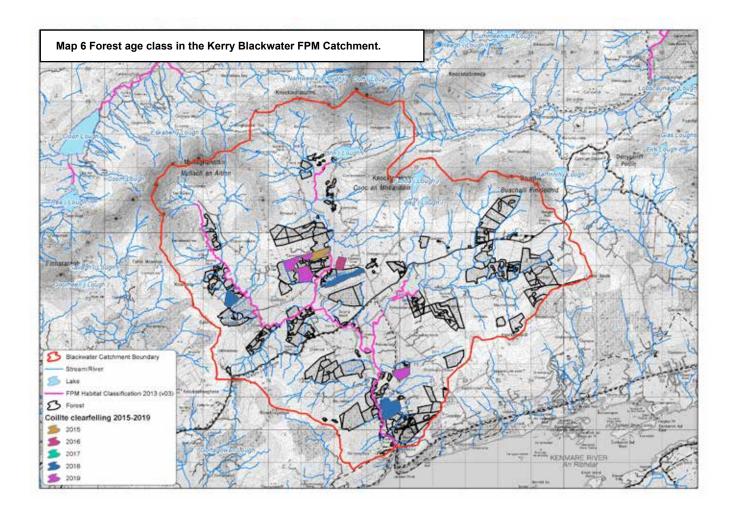
For further details, see Section 11.4.5 of *Forests & Water* (DAFM, 2018).

KerryLIFE-related work has been completed or is ongoing at several sites within the Kerry Blackwater FPM Catchment.

¹ KerryLIFE (full title 'Sustainable land use management for the conservation of freshwater pearl') project partners include National Parks & Wildlife Service of the Department of Culture, Heritage & the Gaeltacht, the Forest Service and the Nitrates, Biodiversity & Engineering Division of the DAFM, the South Kerry Development Partnership Ltd., Coillte and Teagasc.







Afforestation

Much of the Kerry Blackwater catchment is very suitable for production forestry. However, the catchment lies within an acid sensitive area, as defined under the DAFM / COFORD / EPA Protocol for the determination of the acid sensitivity of surface water in the context of afforestation (see Appendix 11 of the *Forestry Standards Manual*). This reflects the fact that soils in the catchment have a low capacity to neutralise acidity caused by atmospheric scavenging by conifer forests, which can lead to the acidification of surface waters. No new forests have been created within the catchment since 2002, when the acidification protocol was first introduced.

Under S.I.191 of 2017, afforestation requires a licence from the Minister for Agriculture, Food & the Marine. DAFM envisages that any new afforestation licensed (with or without grant support) within the Kerry Blackwater FPM Catchment will be limited to native woodland establishment, following the requirements set out in the Native Woodland Establishment Scheme regarding the identification of the most appropriate native woodland type, species mixtures, site input, and future management (see Forest Service Circular 05/2018). A focus on the strategic use of new native woodland to consolidate existing semi-natural woodland (including low-lying

woodland) and to protect and enhance water quality and the aquatic habitat for FPM, will also be sought, based on the Woodlands for Water model (DAFM, 2018).

In February 2013, the existing acid sensitivity protocol for afforestation was amended with the agreement of the EPA, enabling the DAFM to accept, process and approve (where appropriate) applications under the Native Woodland Establishment Scheme for sites within acid sensitive areas, without the requirement for water sampling.

Potential opportunities exist in the catchment to create new native woodlands or to expand existing semi-natural woodland (including low-lying woodland) though planting on adjoining 'greenfield' sites. However, the presence of red deer in the catchment will be a practical consideration.

Felling and reforestation

The majority of future forest operations within the Kerry Blackwater FPM Catchment will involve those relating to forest management, primarily the felling (thinning and clearfelling) and replanting of existing forests and associated operations such as forest road construction (including upgrade). Felling

and forest road construction are potentially high impact forestry operations from a water protection perspective, due to the potential for sedimentation from soil disturbance by heavy machinery, and the risk of nutrient runoff from decomposing brash following felling. These risks are particularly pronounced on sloped sites with soft peat soils and areas located near or adjacent to watercourses.

The vast majority of forests in the catchment are located in the lower-lying parts on even to moderate slopes (<15%). However, approximately 15% are located on steep slopes (15-30%), including large privately-owned forests at Eskine in the west of the catchment (65 ha, planted in 1988) and Coomnakilla in the south of the catchment (18 ha, planted in 1996). A number of productive Coillte forests are also located on steep slopes, including *c*.35 ha on the southern slope of the Mullaghanattin Ridge, *c*.35 ha on the southern slopes of Boughil Mountain, and *c*.30 ha of productive conifer forest at Lackeen. Forestry operations on these sites, particularly on soft peaty soils near watercourses, will be acutely sensitive in nature.

Lackeen Wood, a mature oak woodland, is also located on a steep site, but is being managed for biodiversity rather than timber production.

As the largest forest owner, most of the thinning and clearfelling activities in the catchment over the next 10 years will be undertaken by Coillte.

The private sector is also involved in forest harvesting in the catchment. Approximately 26% (409 ha) of the forest area in the catchment comprises productive forests planted by private landowners between 1988 and 2002. First thinnings are due at some of these forests, with further forests expected to reach thinning stage over the following 10-15 years. In many instances, new forest roads will be required to facilitate harvesting and timber extraction. Assuming a standard 40-year forest rotation, the clearfelling of private forests is scheduled to commence around 2028 and continue to 2054.

Recent felling licences were issued by the DAFM for properties at Derreendarragh and Gortfadda. These are in addition to the KerryLIFE-related sites detailed above.

The reforestation of clearfelled forests will require careful consideration, particularly near watercourses. Due to catchment sensitivities, it is envisaged that future reforestation will move away from the typical 'clearfell and replant' system to Continuous Cover Forestry (CCF) involving appropriate native species and / or Lodgepole pine, with a potential for realising timber production using associated close-to-nature techniques. Considerable opportunities exist for the permanent restructuring of existing forests at this crucial stage in the forest cycle, to

introduce a range of features to protect and enhance water quality and the FPM habitat, and to redirect productive forestry towards less sensitive areas. Such measures include enhanced water setbacks, areas reforested with native woodland (in particular, pioneer birch woodland – see Circular 05/2018), and the restoration of original habitats, such as bogs and wetlands, either as part of introduced open spaces or at a larger deforestation scale. The DAFM Felling & Reforestation Policy document provides details on available options, such as Reforestation Objectives 'CCF and 'Bio', and situations where permanent forest removal may be acceptable, due to overriding environmental considerations.

Fertilisation

Forests in the catchment are generally in good condition, with little or no requirement for fertiliser application envisaged. However, fertiliser application may be required to reforest clearfelled sites with spruce. In sensitive parts of the catchment, it may be possible to reduce or to eliminate any need to apply fertiliser to reforest clearfelled sites, by selecting site-appropriate native species or Lodgepole pine, or by allowing natural regeneration.

Any decision to apply fertiliser within forests – at establishment stage, reforestation stage or otherwise - must be substantiated by the results of a soil or foliar analysis, following sampling protocols set out in the DAFM Forestry Standards Manual. The type and rate of application must also be tailored for the site, as per the results of the analysis, and must not exceed the standard application rates. Application is limited to manual spot application during the most appropriate month(s) of the year in terms of silvicultural uptake. It can only be applied on sites where the required water setback has already developed a ground vegetation layer. Furthermore, fertiliser must not be applied during or after periods of heavy rainfall, or when the ground is saturated with water. Where phosphorus is required, the granulated form must be used, to reduce the likelihood of any drift and wash-off to surface waters. Other fertiliser formulations based on slow release organic formulations should also be favoured.

Aerial fertilisation requires a licence under the Forestry Act 2014 (as commenced by S.I.191 of 2017) from the Minister for Agriculture, Food & the Marine. DAFM does not envisage issuing licences for this activity within the Kerry Blackwater FPM Catchment.

Forest road construction

Forest road works is a regulated activity under the Forestry Act 2014 (as commenced by S.I.191 of

2017), and requires a licence (with or without grant approval) from the Minister of Agriculture, Food & the Marine. It must be undertaken according to the COFORD Forest Road Manual: Guidelines for the Design, Construction and Management of Forest Roads (2004) and the Forest Harvesting & the Environment Guidelines, in order to avoid environmental risk during both the construction stage and subsequent use. The extent of new forest road construction projects in the Kerry Blackwater FPM Catchment will be largely determined by the extent of forest harvesting in the catchment. Techniques involving the creation of temporary roading will be considered, particularly on sensitive sites or where forests are being permanently removed (deforested) or converted from conifer to native woodland.

Other forest-related activities

Forest fires arising from the uncontrolled burning of vegetation in upland areas is a major issue in the Kerry Blackwater Catchment. Uncontrolled burning of land leads to the destruction of forests and natural habitats and can place human lives, property and livestock at risk. There is also a risk of soil erosion and ash runoff into nearby watercourses following fire events. Where prescribed burning of vegetation is necessary, it should be carried out by an appropriate number of personnel with adequate training, knowledge and experience in safely managing controlled burning operations. The DAFM Prescribed Burning Code of Practice (2011) provides guidance to landowners who use controlled burning as a land management tool. The DAFM also issues Fire Danger Notices reflecting fire risk levels - see www.agriculture.gov.ie/forestservice/ firemanagement/ for detail.

There is a risk of unlicensed tree felling in the catchment in the form of 'scrub' woodland clearance for land reclamation purposes. Under the Forestry Act 2014, apart from listed exemptions, it is an offence to fell any tree without a Felling Licence (see the DAFM's document *Felling & Reforestation Policy* document and www.agriculture.gov.ie/forestservice/ tree felling/ for details). Furthermore, it is an offence to commence the use of uncultivated land or seminatural areas for intensive agriculture without first applying to the Minister for Agriculture, Food & the Marine for a screening decision, as such use may have a significant effect on protected habitats and species, including FPM.



Physical description

The Glaskeelan FPM Catchment is situated in northwest Co. Donegal. The corresponding SAC is the Cloghernagore Bog & Glenveagh National Park SAC (002047), the Conservation Objectives of which include the restoration of FPM to favourable conservation status, as defined by specific attributes and targets set out in the relevant NPWS Conservation Objectives Series report (see www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO002047.pdf). Most of the catchment falls within the boundary of this SAC.

Glaskeelan FPM Catchment is the smallest of the 27 FPM catchments in Ireland, and is completely surrounded by the larger Owencarrow FPM Catchment to the west and the Leannan FPM Catchment to the east.

The main water bodies are Lough Nambraddan, Lough Inshagh and the Glaskeelan River and associated tributaries. Lough Nambraddan drains southwards to a confluence with several streams draining from Leahanmore, and then flows eastwards to Lough Inshagh. The Glaskeelan River drains Lough Inshagh and flows southeast to Gartan Lough.

The Glaskeelan FPM Catchment is approximately

 17.45 km^2 (1,745 ha) in area. The total river length in the catchment is 24 km (see Map 1).

Table 1 summarises WFD details of individual water bodies within the catchment, and inclusion or otherwise in the current acid sensitivity protocol regarding afforestation.

Soils and land use

An analysis of the EPA/Teagasc soils data indicates that the Glaskeelan FPM Catchment is dominated by blanket peat (60%) and podsol soils with / without peaty topsoil (30%) (Map 2).

While not designed for detailed reporting, the CORINE Land Cover (2006) does indicate main land use types within the catchment. The most common land uses are peat bog (70%) and natural grassland (15.84%). Forests and woodlands account for approximately 7% of land in the catchment (Map 3).

FPM status

According to the FPM Glaskeelan Sub-basin Management Plan, a survey of the Glaskeelan River in the mid-1990s found a good population of

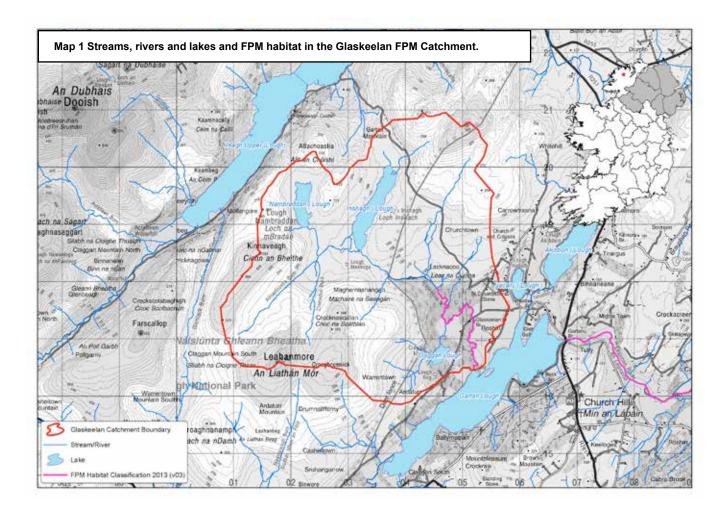
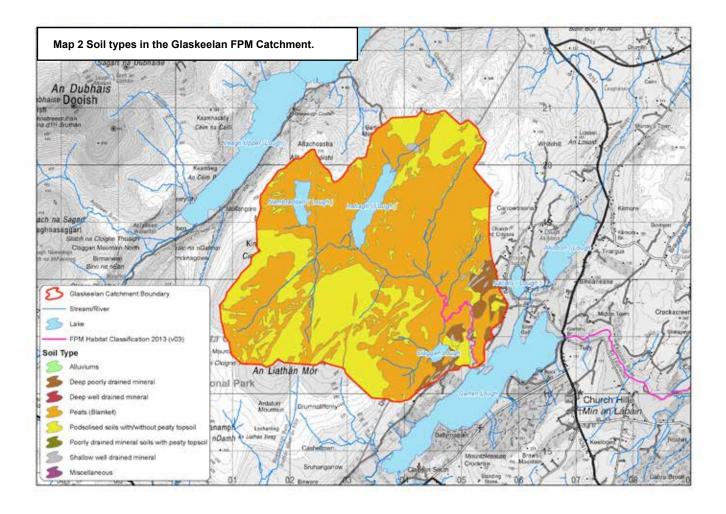


Table 1 Glaskeelan FPM catchment: Water body details (from www.catchments. ie, 26June18), inclusion under the RBMP Area for Action programme (from www. watersandcommunities.ie/areas-for-action/), and Acid Sensitivity Area status (from Appendix 11 of DAFM's Forestry Standards Manual (2015)).

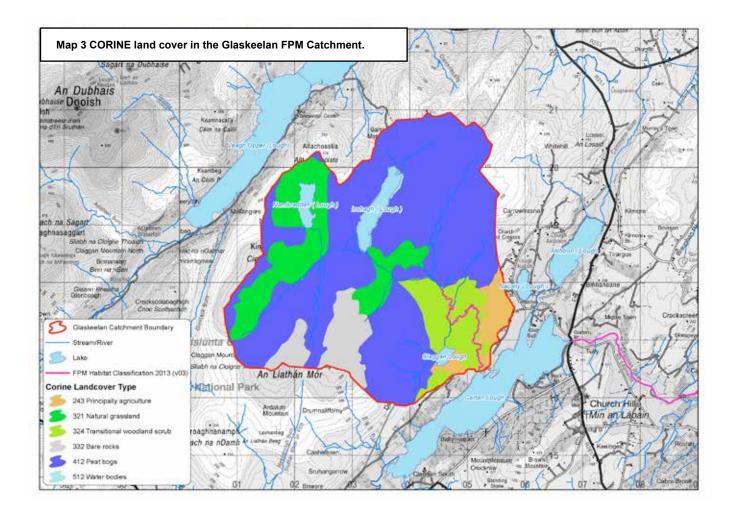
Water body	Туре	Status	WFD risk	Pressure	Area for Action	Acid Sensitive Area
Nambraddan	Lake	Unassigned	Review	None assigned	Yes	Yes
Glaskeelan_010	River	Good	At risk	Forestry, extractive industry (peat)	Yes	Yes
Inshagh	Lake	Unassigned	Review	None assigned	Yes	Yes
Leannan_010	River	HES	Not at risk	None assigned	No	Yes
Claggan	Lake	Unassigned	Review	None assigned	Yes	Yes











the species, with a good age structure ranging from individuals 7 year old to aged adults.

A repeat of the catchment in 2007 found that most of the habitat was under its natural carrying capacity, and was particularly poor in mussel density where gravel beds had become highly silted and covered in filamentous algae and macrophytes. The survey revealed an aging population, with very little juvenile recruitment evident. The population in the catchment is estimated to be in the region of 10,000 individuals.

The population is currently ranked sixth out of the 27 FPM SAC populations in the country, based on population status, habitat condition and current pressures.

Water quality within the catchment fails two of the five Environmental Quality Objectives (EQOs) specified in Schedule 4 of the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations, S.I.296 of 2009.

FPM is at unfavourable conservation status in the Glaskeelan Catchment. Although good numbers of adult mussels are present, juvenile mussels are rare due to the unsuitability of the river habitat. However, the continued present of adult mussels means that the population has the potential to recover if appropriate measures are put in place to improve

water quality and riverbed habitat.

A recent survey and condition assessment (Moorkens, 2017) found the conservation status to be very poor. The decline in conditions upstream as well as downstream of the main stream pathway suggest that there have been multiple pathways of damage to the population, although the main damage is associated with the stretch of river downstream of the main impacted stream just downstream of the old bridge piers. The study attributed the significant decline and ongoing stress on the population, as observed, to significant ground disturbance associated with a thinning operation in an adjoining Coillte-owned forest 2011 (see below).

Forest land

The total area of forest land within the Glaskeelan Catchment is approximately 121 ha. This represents *c*.7% of the total land use within the catchment, which is lower than the national average forest cover of 11%.

The entire forest area is located at the Derryveigh Property, owned by Coillte, in the east of the catchment. This property adjoins the Glaskeelin

River for *c.*4 km, approaching Gartan Lough. The forest area within the property included 76 ha (63%) under pure conifer canopy, 34 ha (28%) under mixed conifer / broadleaf canopy, and 11 ha (9%) under broadleaf canopy.

Approximately 79 ha of forest cover is located within 100 metres of a watercourse.

The first area of forest at Derryveigh was planted in the 1950s and much of the property is now in its second rotation. In 1998, a storm felled a significant number of trees in the property, and the area was subsequently replanted with oak. In addition, 50 metre wide water setbacks were created along watercourses, and these have now been colonised by birch and other native trees and shrubs.

The majority of the forest area (76 ha) is aged between 30 and 40 years and is approaching final clearfell. The remaining 45 ha are between 11 and 30 years. A significant portion of the Derryveigh Property is considered to be uneconomical, due to low timber yields and poor access. The area is prone to windblow events, which can uproot trees and cause sediment release into nearby watercourses.

In 2011, a heavy rainfall event combined with a failure to adhere to environmental requirements during the course of a thinning operation led to a

significant siltation event that threatened adjoining FPM populations. Following intervention by the DAFM and NPWS, a range of mitigation measures were installed by Coillte, and medium- to long-term plans to further stabilise the site are currently being assessed by the DAFM, based on submitted licence applications for felling and forest road construction (to extend an existing road). Reforestation is likely to comprise native woodland, accompanied by large water setbacks.

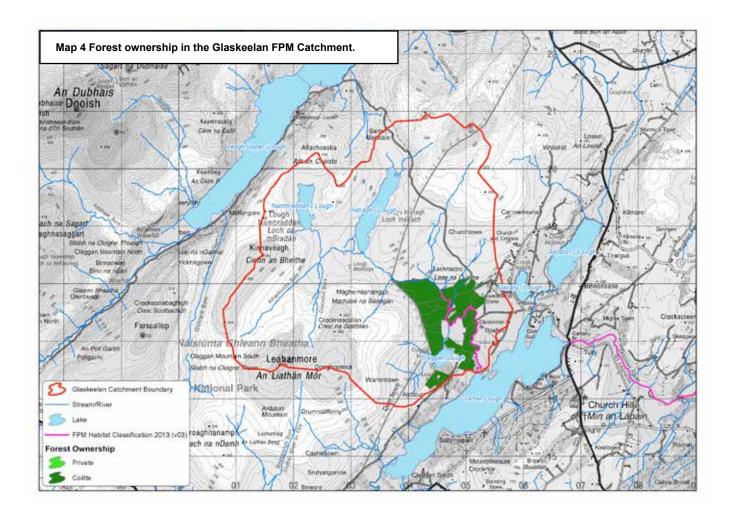
Approximately 69% of the catchment's forests are growing on blanket peat, 22% on podsol soils with / without peaty topsoil, 7% on other mineral soils, and 2% on alluvial soils.

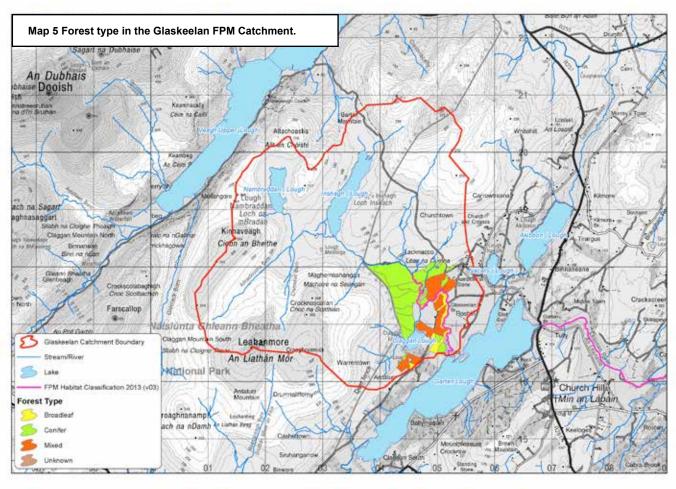
Forest ownership, type and age class structure within the Glaskeelan FPM Catchment are illustrated in Maps 4-6.

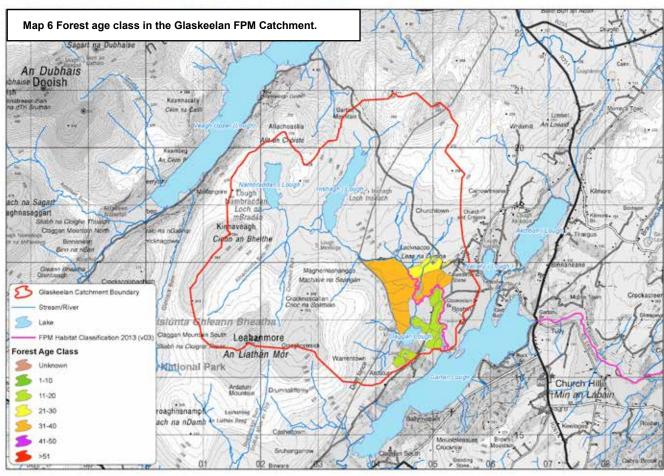
Forest operations

Afforestation

Most of the Glaskeelan Catchment is not suitable for production forestry, due to several factors. The catchment is dominated by blanket peat bog and therefore unsuitable for afforestation, both







ecologically and silvicuturally. Windblow is also a limiting factor. In addition, the catchment lies within an acid sensitive area, as defined under the DAFM / COFORD / EPA Protocol for the determination of the acid sensitivity of surface water in the context of afforestation (see Appendix 11 of the *Forestry Standards Manual*). This reflects the fact that soils in the catchment have a low capacity to neutralise acidity caused by atmospheric scavenging by conifer forests, which can lead to the acidification of surface waters. These factors combined have severely limited afforestation in the catchment, particularly since 2002, when the acidification protocol was first introduced.

Under S.I.191 of 2017, afforestation requires a licence from the Minister for Agriculture, Food & the Marine. DAFM envisages that any new afforestation licensed (with or without grant support) within the Glaskeelan FPM Catchment will be limited to native woodland establishment, following the requirements set out in the Native Woodland Establishment Scheme regarding the identification of the most appropriate native woodland type, species mixtures, site input, and future management (see Forest Service Circular 05/2018). A focus on the strategic use of new native woodland to consolidate existing semi-natural woodland (including low-lying woodland) and to protect and enhance water quality and the aquatic habitat for FPM, will also be sought, based on the Woodlands for Water model (DAFM, 2018).

In February 2013, the existing acid sensitivity protocol for afforestation was amended with the agreement of the EPA, enabling the DAFM to accept, process and approve (where appropriate) applications under the Native Woodland Establishment Scheme for sites within acid sensitive areas, without the requirement for water sampling.

Potential opportunities exist in the catchment to create new native woodlands or to expand existing semi-natural woodlands (including low-lying woodland) though planting on adjoining 'greenfield' sites, particularly on better quality agricultural land around Gartan Lough and Lough Nacally in the east of the catchment. However, the presence of deer in the catchment will be a practical consideration.

Felling and reforestation

The majority of future forest operations within the Glaskeelan FPM Catchment will involve those relating to forest management, primarily the felling (thinning and clearfelling) and replanting of existing forests and associated operations such as forest road construction (including upgrade). Felling and forest road construction are potentially high impact forestry operations from a water protection

perspective, due to the potential for sedimentation from soil disturbance by heavy machinery, and the risk of nutrient runoff from decomposing brash following felling. These risks are particularly pronounced on sloped sites with soft peat soils and areas located near or adjacent to watercourses.

Much of the existing forest area in the Glaskeelan Catchment is ready for thinning and / or clearfell.

Most of the forest land is located on even to moderate slope (<15%), with the exception of an area (c.14 ha) at the western edge of the forest, which is located on a moderate to steep slope (15 – 30%) at a distance of 120 metres to 400 metres from the Glaskeelan River. Any forestry operations in this area will be acutely sensitive in nature.

Under the INTERREG Freshwater Pearl Mussel Project (see Section 11 for the Forests & Water document), Coillte worked with Donegal County Council and other project partners in developing proposed forestry measures for the Glaskeelan FPM Catchment. Under the project, Coillte would defer particular clearfelling and establish a number of regeneration trial plots at the site. The purpose would be to restructure the existing forest area over time by, inter alia, diversifying the species mix through the introduction of an understorey of commercial species such as red cedar and beech, and native species such as birch, rowan, alder and oak. The commercial realisation of the existing timber crop as to continue, in compliance with appropriate measures aimed at ensuring no adverse impact on water quality, the aquatic habitat, and FPM populations.

The reforestation of clearfelled forests will require careful consideration, particularly near watercourses. Due to catchment sensitivities, it is envisaged that future reforestation will move away from the typical 'clearfell and replant' system to Continuous Cover Forestry (CCF) involving appropriate native species, with a potential for realising timber production using associated close-to-nature techniques. Considerable opportunities exist for the permanent restructuring of existing forests at this crucial stage in the forest cycle, to introduce a range of features to protect and enhance water quality and the FPM habitat, and to redirect productive forestry towards less sensitive areas. Such measures include enhanced water setbacks, areas reforested with native woodland (in particular, pioneer birch woodland - see Circular 05/2018), and the restoration of original habitats. such as bogs and wetlands, either as part of introduced open spaces or at a larger deforestation scale. The DAFM Felling & Reforestation Policy document provides details on available options, such as Reforestation Objectives 'CCF and 'Bio', and situations where permanent forest removal may be acceptable, due to overriding environmental considerations.

Coillte is currently restructuring its forest estate at Derryveigh. Some areas have been already been replanted with native species such as oak, and unplanted water setbacks have been created to allow the natural regeneration of native trees and shrubs along watercourses. Reforestation planning is currently underway, with a focus on appropriate native woodland and the introduction of unplanted setbacks along water courses. Many young broadleaf trees in the area have suffered from extensive browsing by deer, indicating that any new native woodland planting (either reforestation or afforestation) will have to be protected from deer.

Fertilisation

Forests in the Glaskeelan Catchment are generally in good condition, with little or no requirement for fertiliser application envisaged.

Aerial fertilisation requires a licence under the Forestry Act 2014 (as commenced by S.I.191 of 2017) from the Minister for Agriculture, Food & the Marine. DAFM does not envisage issuing licences for this activity within the Glaskeelan FPM Catchment.

Forest road construction

Forest road works is a regulated activity under the Forestry Act 2014 (as commenced by S.I.191 of 2017), and requires a licence (with or without grant approval) from the Minister of Agriculture, Food & the Marine. It must be undertaken according to the COFORD Forest Road Manual: Guidelines for the Design, Construction and Management of Forest Roads (2004) and the Forest Harvesting & the Environment Guidelines, in order to avoid environmental risk during both the construction stage and subsequent use. The extent of new forest road construction projects in the Glaskeelan FPM Catchment will be largely determined by the extent of forest harvesting in the catchment. Techniques involving the creation of temporary roading will be considered, particularly on sensitive sites or where forests are being permanently removed (deforested) or converted from conifer to native woodland.



Physical description

The Ownagappul FPM Catchment is situated on the Beara Peninsula in West Cork. The corresponding SAC is the Glanmore Bog SAC (001879), the Conservation Objectives of which include the restoration of FPM to favourable conservation status, as defined by specific attributes and targets set out in the relevant NPWS Conservation Objectives Series report (see www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO001879.pdf).

The catchment supplies the Ownagappul River, a very short river that originates on the slopes between Tooreennamna and Lackawee Mountains southeast of Ardgroom village, and flows into Ardgroom Harbour on the southern side of the Kenmare River. The main river channel is less than 3.5 km in length and drains from Glenbeg Lough in the south of the catchment. The main tributaries are the Barrees Stream, the Bunskellig Stream and the outflow from Lough Fadda, which all drain the western part of the catchment. The catchment incorporates the Glanmore Bog SAC.

The Ownagappul FPM Catchment is one of the smaller FPM catchments, with an area of approximately 22.2 km² (2,200 ha).

The total river length in the catchment is 71 km (see Map 1).

Table 1 summarises WFD details of individual water bodies within the catchment, and inclusion or otherwise in the current acid sensitivity protocol regarding afforestation.

Soils and land use

An analysis of the EPA / Teagasc soils data indicates that the Ownagappul Catchment is dominated by peat type soils, including blanket peat, peaty gleys and peaty podsols (Map 2).

While not designed for detailed reporting, the CORINE Land Cover (2006) does indicate main land use types within the catchment. The most common land uses are peat bogs (68.5%), natural grassland (9.4%) and sparsely vegetated areas (9.3%). Forests and woodlands account for approximately 7.8% of land in the catchment (Map 3).

FPM status

FPM is widespread and abundant within the Ownagappul Catchment, with an estimated

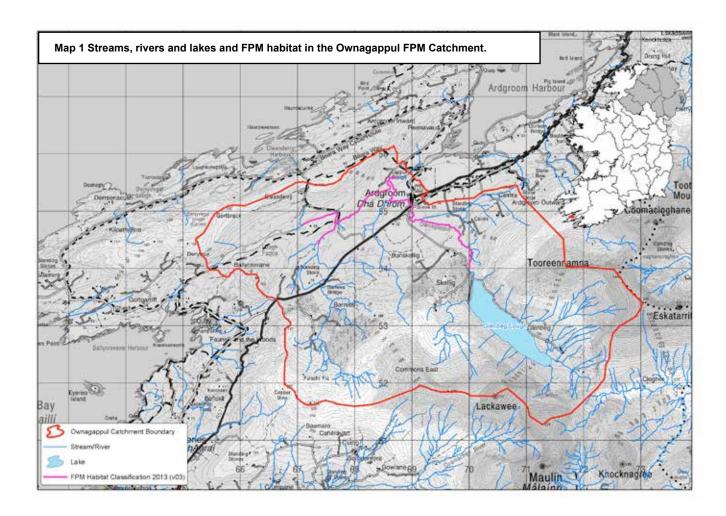
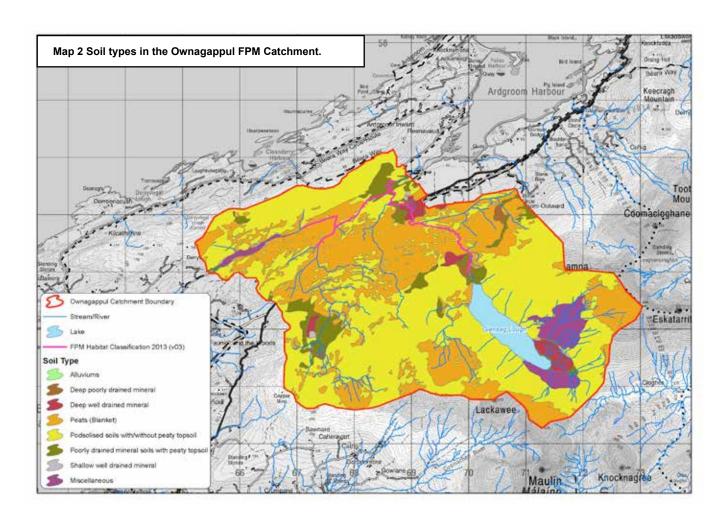


Table 1 Ownagappul FPM catchment: Water body details (from www.catchments. ie, 26June18), inclusion under the RBMP Area for Action programme (from www. watersandcommunities.ie/areas-for-action/), and Acid Sensitivity Area status (from Appendix 11 of DAFM's Forestry Standards Manual (2015)).

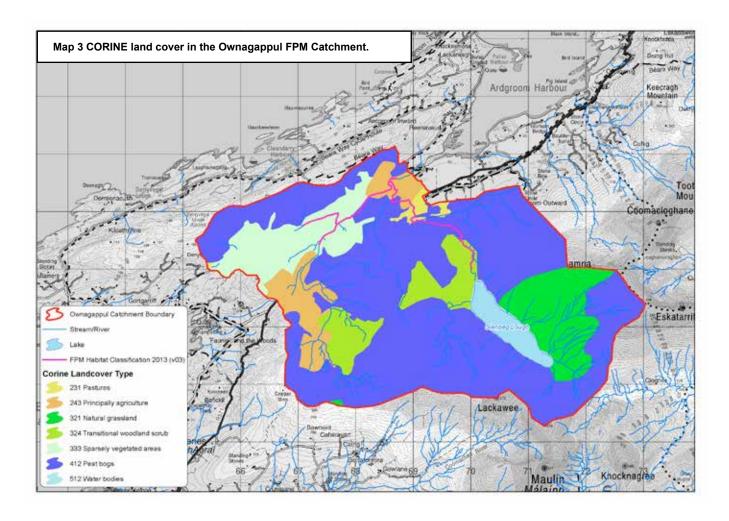
Water body	Туре	Status	WFD risk	Pressure	Area for Action	Acid Sensitive Area
Lough Fadda Stream_010	River	Good	At risk	Agriculture, extractive industry (peat), urban waste water, forestry	Yes	No
Ownagappul_010	River	Good	At risk	Agriculture, extractive industry (peat), forestry	Yes	No
Glenbeg	Lake	Good	Not at risk	None assigned	No	No
Kealincha_010	River	Good	Not at risk	None assigned	No	No











population of approximately 200,000 individuals. The carrying capacity of the Ownagappul Catchment is estimated to be in the region of 250,000 individuals.

A survey of the catchment undertaken in 1999 found that mussels were abundant along stretches of the Ownagappul River and Barrees Stream. The survey also recorded juvenile mussels, indicating that the population was successfully breeding.

A full monitoring survey undertaken in 2005 confirmed the presence of large mussel populations, including juveniles, over a large portion of the Ownagappul River. This survey also recorded that smaller size classes tended to be absent or under-represented but that some juveniles were observed, indicating that there was some successful recruitment within the population.

In 2009, further survey work to update information on the Ownagappul River was carried out at two of transects from the 2005 survey. An increase in FPM populations was recorded at both transects. However, these increases were likely to be the result of population movement due to the shallow, fast-flowing nature of the river, rather than any increase in the overall population. Although juvenile mussels had been observed at the two transects in 2005, none were observed in 2009. This suggests that no major

recruitment of juvenile mussels had occurred in the four years from 2005 to 2009. The habitat conditions observed at the time were good, possibly due to unusually high rainfall at the time of the survey.

The population is currently ranked fifth out of the 27 FPM SAC populations in the country, based on population status, habitat condition and current pressures.

Water quality within the catchment fails all five of the Environmental Quality Objectives (EQOs) specified in Schedule 4 of the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations, S.I.296 of 2009.

FPM is at unfavourable conservation status in the Ownagappul Catchment. Despite relatively high population levels in the two main rivers, the number of juvenile mussels present within the Ownagappul FPM Catchment is insufficient to ensure the long-term conservation of the species in the catchment.

Forest land

The total area of forest cover in the Ownagappul catchment is approximately 174 ha. This represents *c*.7.8% of the total land use within the catchment,

which is lower than the national average forest cover of 11%.

All forests within the catchment are privately-owned. Of these, 115 ha were planted by local landowners (mainly farmers) between the years 1990 and 2001 under Government afforestation support schemes. This includes 53 ha planted in 2000 adjacent to Glenbeg Lough, 55 ha planted in 2001 at Barrees, and three small areas totalling c.7 ha planted between 1990 and 1999. There has been no new afforestation in the Ownagappul FPM Catchment since 2001. There are also several areas of seminatural broadleaf woodland within the catchment.

There is a mixture of forest types in the catchment (Map 5). Forests dominated by conifer species account for *c*.22% (38 ha) of the forest estate. Forests comprising mixtures of conifer and broadleaf species account for 47% (81 ha), and woodlands predominantly broadleaved in nature (including low-lying woodland) account for 30% (51 ha). This includes several relatively large (>5 ha) areas of mature broadleaf and semi-natural woodland, including a 19 ha broadleaf woodland at Barreees and 8 ha of patchy sparse woodland on the western shore of Glenbeg Lough.

Approximately 57% of the catchment's forests are

growing on podsol soils with / without peaty topsoil, 23% on poorly-drained mineral soils with peaty topsoil, and 20% on blanket peat.

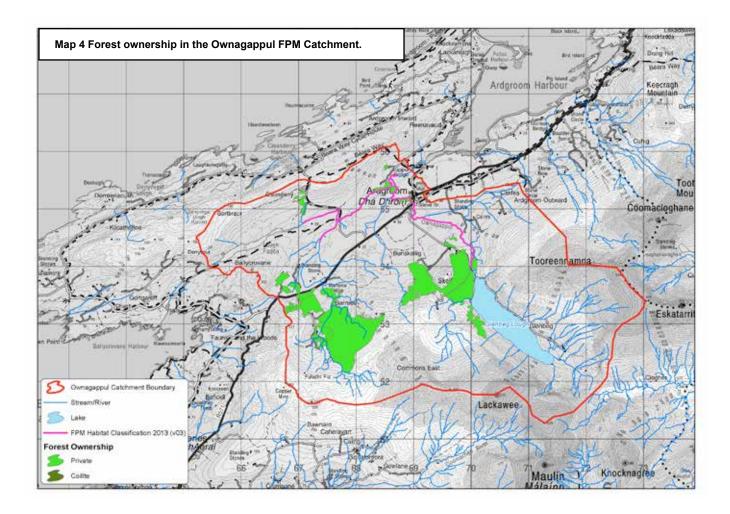
Forest ownership, type and age class structure within the Ownagappul FPM Catchment are illustrated in Maps 4-6.

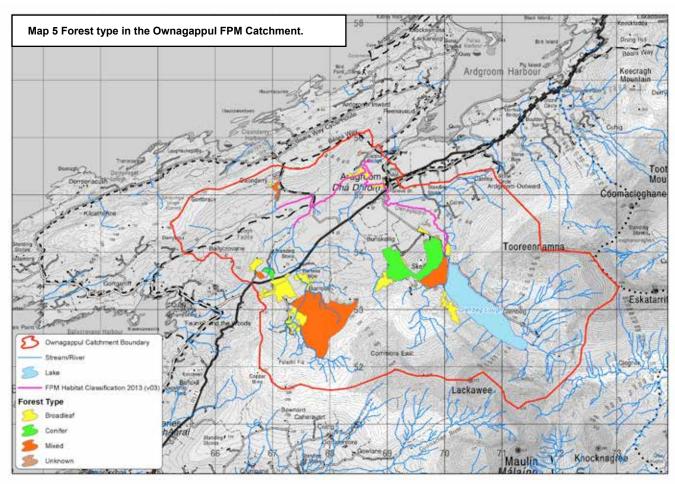
Forest operations

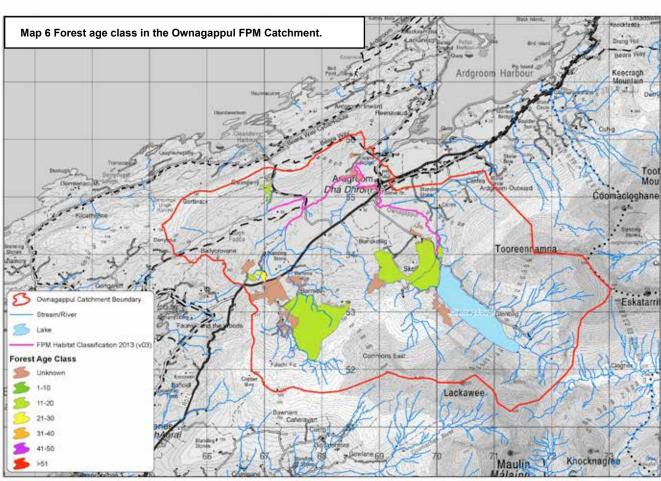
Afforestation

Much the Ownagappul FPM Catchment is not suitable for production forestry, due to the unsuitable soil type throughout much of the catchment and the environmental sensitivity of the catchment itself. Consequently, no new forests have been planted in the catchment since 2001.

Under S.I.191 of 2017, afforestation requires a licence from the Minister for Agriculture, Food & the Marine. DAFM envisages that any new afforestation licensed (with or without grant support) within the Ownagappul FPM Catchment will be limited to native woodland establishment, following the requirements set out in the Native Woodland Establishment Scheme regarding the identification of the most appropriate native woodland type, species







mixtures, site input, and future management (see Forest Service Circular 05/2018). A focus on the strategic use of new native woodland to consolidate existing semi-natural woodland (including low-lying woodland) and to protect and enhance water quality and the aquatic habitat for FPM, will also be sought, based on the Woodlands for Water model (DAFM, 2018).

Potential opportunities exist in the catchment to create new native woodlands or to expand existing semi-natural woodlands (including low-lying woodland) though planting on adjoining 'greenfield' sites. However, this will be limited by the soil type in most of the catchment.

Felling and reforestation

The majority of future forest operations within the Ownagappul FPM Catchment will involve those relating to forest management, primarily the felling (thinning and clearfelling) and replanting of existing forests and associated operations such as forest road construction (including upgrade). Felling and forest road construction are potentially high impact forestry operations from a water protection perspective, due to the potential for sedimentation from soil disturbance by heavy machinery, and the risk of nutrient runoff from decomposing brash following felling. These risks are particularly pronounced on sloped sites with soft peat soils and areas located near or adjacent to watercourses.

Approximately 115 ha of productive forest was planted in the Ownagappul Catchment between 1990 and 2001. This includes two sizeable plantations totalling *c*.108 ha, planted in 2000 and 2001. Thinning operations are scheduled to commence at one of these forests in 2020, with final harvesting scheduled to commence in 2045. The other forest block is scheduled to be clearfelled in 2050.

The risk to FPM populations from forest harvesting operations is particularly pronounced on sloped sites with soft peaty soils, as found in the Ownagappul Catchment. The two main forest blocks include areas of steep (15-30%) to very steep (>30%) slopes and are located upstream of known FPM populations. Consequently, any forestry operations in these areas will prove acutely sensitive. The area adjacent to Glenbeg Lough will require particular attention due to its close proximately to FPM populations.

There will be opportunities for restructuring existing forests following clearfell, especially on better quality land. Reforestation, either by replanting or natural regeneration, will be an option in the catchment but will require very careful consideration on a site-by-site basis. Reforesting with native species and / or pine species may be appropriate on better quality soils, whereas natural regeneration may be more

appropriate on poorer soils or exposed sites and along watercourses. This would also negate, to a large extent, the need for future fertilisation, which might otherwise be required if reforesting with spruce.

In general, it is envisaged that future reforestation will move away from the typical 'clearfell and replant' system to Continuous Cover Forestry (CCF) involving appropriate native species and / or Lodgepole pine, with a potential for realising timber production using associated close-to-nature techniques.

The reforestation of clearfelled forests will require careful consideration, particularly near watercourses. Considerable opportunities exist for the permanent restructuring of existing forests at this crucial stage in the forest cycle, to introduce a range of features to protect and enhance water quality and the FPM habitat, and to redirect productive forestry towards less sensitive areas. Such measures include enhanced water setbacks, areas reforested with native woodland (in particular, pioneer birch woodland - see Circular 05/2018), and the restoration of original habitats, such as bogs and wetlands, either as part of introduced open spaces or at a larger deforestation scale. The DAFM Felling & Reforestation Policy document provides details on available options, such as Reforestation Objectives 'CCF and 'Bio', and situations where permanent forest removal may be acceptable, due to overriding environmental considerations.

Fertilisation

Forests in the Ownagappul FPM Catchment are generally in good condition, with little or no requirement for fertiliser application envisaged.

Any decision to apply fertiliser within forests – at establishment stage, reforestation stage or otherwise - must be substantiated by the results of a soil or foliar analysis, following sampling protocols set out in the DAFM Forestry Standards Manual. The type and rate of application must also be tailored for the site, as per the results of the analysis, and must not exceed the standard application rates. Application is limited to manual spot application during the most appropriate month(s) of the year in terms of silvicultural uptake. It can only be applied on sites where the required water setback has already developed a ground vegetation layer. Furthermore, fertiliser must not be applied during or after periods of heavy rainfall, or when the ground is saturated with water. Where phosphorus is required, the granulated form must be used, to reduce the likelihood of any drift and wash-off to surface waters. Other fertiliser formulations based on slow release organic formulations should also be favoured.

Aerial fertilisation requires a licence under the Forestry Act 2014 (as commenced by S.I.191 of 2017) from the Minister for Agriculture, Food & the Marine. DAFM does not envisage issuing licences for this activity within the Ownagappul FPM Catchment.

Marine for a screening decision, as such use may have a significant effect on protected habitats and species, including FPM.

Forest road construction

Forest road works is a regulated activity under the Forestry Act 2014 (as commenced by S.I.191 of 2017), and requires a licence (with or without grant approval) from the Minister of Agriculture, Food & the Marine. It must be undertaken according to the COFORD Forest Road Manual: Guidelines for the Design, Construction and Management of Forest Roads (2004) and the Forest Harvesting & the Environment Guidelines, in order to avoid environmental risk during both the construction stage and subsequent use. The extent of new forest road construction projects in the Ownagappul FPM Catchment will be largely determined by the extent of forest harvesting in the catchment. Techniques involving the creation of temporary roading will be considered, particularly on sensitive sites or where forests are being permanently removed (deforested) or converted from conifer to native woodland.

Other forest-related activities

Forest fires arising from the uncontrolled burning of vegetation in upland areas is a major issue in the Ownagappul FPM Catchment. Uncontrolled burning of land leads to the destruction of forests and natural habitats and can place human lives, property and livestock at risk. There is also a risk of soil erosion and ash runoff into nearby watercourses following fire events. Where prescribed burning of vegetation is necessary, it should be carried out by an appropriate number of personnel with adequate training, knowledge and experience in safely managing controlled burning operations. The DAFM Prescribed Burning Code of Practice (2011) provides guidance to landowners who use controlled burning as a land management tool. The DAFM also issues Fire Danger Notices reflecting fire risk levels - see www.agriculture.gov.ie/forestservice/ firemanagement/ for detail.

There is a risk of unlicensed tree felling in the catchment in the form of 'scrub' woodland clearance for land reclamation purposes. Under the Forestry Act 2014, apart from listed exemptions, it is an offence to fell any tree without a Felling Licence (see the DAFM's document *Felling & Reforestation Policy* document and www.agriculture.gov.ie/forestservice/ tree felling/ for details). Furthermore, it is an offence to commence the use of uncultivated land or seminatural areas for intensive agriculture without first applying to the Minister for Agriculture, Food & the

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Appendix H Glossary

Adapted from Management Guidelines for Ireland's Native Woodlands (Cross & Collins, 2017) and Ireland's National Forest Inventory 2017: Main Findings (DAFM, 2018).

Afforestation The creation of new woodland or forest on open land that has not been under forest cover in contemporary history. Implies a change from non-forest to forest. Defined under the Forestry Act 2014 as the conversion of land to a forest.

Age The number of growing seasons since initial planting or natural regeneration.

Age class structure The distribution of defined age categories of trees within a stand. The long term sustainability of that stand will often depend on achieving and maintaining a certain distribution of age classes within it, to ensure the ongoing recruitment of younger trees into the canopy.

Agro-forestry A land use that combines the growing of trees with conventional farming practices. Trees can be planted at wide spacings either singly, in groups or in rows. Where grazing is intended, tree shelters (1.5 m or taller) are used.

Ancient tree See Veteran tree.

Ancient woodland An area assessed as having been under woodland cover since 1660, based on the oldest reliable national records such as estate records and the Down and Civil Surveys.

Annex I habitat A natural habitat listed under the Habitats Directive as being of EU Community interest and whose conservation requires the designation of Special Areas of Conservation. Member States are legally obliged to protect Annex I habitats.

Aquatic buffer zone (ABZ) An area at least 10 metres in width and created alongside a stream, river or lake, within which forestry operations are limited in order to protect water from direct disturbance and the runoff of sediment and nutrients. Within the context of afforestation, the ABZ remains generally undisturbed to allow a protective strip of natural ground vegetation to emerge. The creation of appropriate ABZs is a general requirement attached to licences / approvals issued by the Forest Service for regulated forestry activities. For details in relation to afforestation (in which context, the ABZ is referred to as the 'water setback'), see the Forest Service Environmental Requirements for Afforestation (DAFM, 2016).

Aquatic zone A permanent or seasonal river, stream or lake shown on an Ordnance Survey 6 inch map.

Basal Area The cross-sectional area of a tree measured at 1.3 m from the ground, or the sum of the basal areas of trees in a specified area, expressed in square metres (m²).

Beating up See Filling-in.

Biodiversity The variety of living organisms, including: the diversity of species; the genetic diversity or variation within the species; and the ecosystems in which the species occur.

Birds Directive Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds.

Brash mat A layer of cut branches set down during harvesting and extraction operations in order to prevent or reduce soil damage by forest machinery.

Broadleaves Trees with broad, flat leaves, e.g. oak, ash, beech and sycamore. Growth is not in whorls but almost always diffusely branched. Usually deciduous.

Bryophyte A division of the plant kingdom that contains small, rootless, non-vascular plants such as mosses and liverworts.

Cabling A method of timber extraction whereby felled tree lengths are removed from the site through the use of cables attached to anchor trees. Although specialised and expensive, cabling may be an option on steep slopes or sensitive sites, where extraction by wheeled or tracked machine is deemed to be impractical or unsuitable.

Canopy The combined crowns of individual trees within a woodland or forest. The composition and condition of the canopy provides foresters with vital information about the overall health and development of the woodland.

Carbon pool A system with the capacity to accumulate or release carbon, expressed in mass units (tonnes C).

Carbon sequestration The process by which carbon dioxide is removed from the atmosphere and stored as carbon in plant tissue (including wood), soil litter and deadwood.

Catchment The area from which a stream, river or

lake derives its water.

Clearfell A form of harvesting whereby a continuous block of trees (typically an even-aged stand) is felled in a single operation. Clearfelling is the most common form of harvesting within Ireland's commercial forest sector.

Climax vegetation The vegetation that theoretically would exist in any given place, as determined by the climate and soils and without the impact of human activity.

Close-to-nature silviculture An approach to forest management which mimics natural processes such as windthrow and fire, and which utilises natural processes such as natural regeneration, in order to influence age and species diversity within a woodland or forest.

Coillte Old Woodland Survey A desk-based survey undertaken by Coillte in 2001, which involved tracing the history of woodland cover on all of its properties by consulting the 1st and 3rd Edition Ordnance Survey map series. The survey found that *c.*27,000 ha constituted old woodland sites (also referred to as 'long-established woodland').

Conifers Trees which bear cones and have needle-like leaves. They are usually, but not always, evergreen.

Conservation objective The specification of the overall target for the species & / or habitat types for which a European site is designated, in order for it to contribute to maintaining or reaching favourable conservation status of the species & habitat concerned, at the national, the biogeographical or the European level.

Conservation status (habitat) An assessment of the health of a natural habitat, based on the sum of the influences acting on that habitat and its typical species that may affect its long term natural distribution, structure and functions as well as the long term survival of its typical species. Methods for assessing conservation status were drawn up by the European Topic Centre for Nature Conservation in conjunction with the Scientific Group of the Habitats Directive. It involves the application of a 'favourable', 'inadequate', 'bad' or 'unknown' assessment to four separate parameters (i.e. range, area, structures and functions, and future prospects) and an assessment of overall status (NPWS, 2013).

Continuous cover forestry (CCF) A type of lowimpact silviculture that involves the use of selective harvesting and natural regeneration to promote uneven-aged stands and a continuous tree cover more typical of natural forests. CCF systems most relevant to native woodland management are selection, shelterwood and coppice. CCF is generally regarded as close-to-nature silviculture. **Conversion** The process of changing a non-native forest to native woodland. Conversion can be carried out through *via* gradual transformation or more abrupt replacement.

Coppice A tree cut just above ground level and allowed to produce new shoots, which are subsequently also cut. Defined under the Forestry Act 2014 as a forest crop raised from shoots produced from the cut stumps of the previous crop.

Coppicing A CCF system in which trees are cut just above ground level to encourage the production of multiple stems. These stems are then grown on and subsequently harvested after a number of years (depending on the diameter required for a particular end-use), thereby initiating a repeat of the cycle. Coppicing is an ancient form of woodland management in Ireland.

Coupe A small-scale opening within an existing canopy, created to facilitate woodland rejuvenation through natural regeneration and / or planting. In the context of commercial plantations, the term also applies to an area of clearfell.

Crown The foliage-bearing part of a tree, including the branches, foliage and upper stem.

Deadwood Dead stems, branches and other woody debris standing or lying on the forest floor. As the deadwood breaks down and decays, it provides a range of valuable habitats for a wide variety of organisms.

Deciduous A term used to describe species of trees that shed their leaves annually in autumn and replace them the following spring. In Ireland, examples include broadleaves such as sessile oak, silver birch and common beech, and some conifers, such as European larch.

Diameter at breast height (dbh) The dbh of a tree is the stem diameter at 1.3 m from ground level.

Dormant season The period of the year during which the physiological processes within the tree are at their lowest ebb. Trees should ideally be planted during their dormant season, to minimise planting shock.

Ecosystem A dynamic, interacting community of interdependent organisms (plants, animals, fungi, bacteria, etc.) together with the physical environment which they inhabit and upon which they depend.

Ecosystem services Benefits provided by ecosystems that contribute to making human life both possible and worth living. These include: provisioning services such as food and water; regulating services such as the maintenance of water quality, flood and

disease control; cultural services such as spiritual, recreational and cultural benefits; and supporting services, such as nutrient cycling, that maintain the conditions for life on Earth. The services and goods that an ecosystem provides are often undervalued, as many of them are without market value.

Emergent A tree that grows above the main canopy, usually singly and widely-spaced.

Environmental guidelines Operational guidelines compiled by the Forest Service and setting out measures that are mandatory for all regulated (and grant-aided, where relevant) forestry activities, in order to protect various environmental features and sensitivities, e.g. landscape, water, archaeology, biodiversity. Mandatory measures applying to afforestation are set out in the document Environmental Requirements for Afforestation (DAFM, 2016).

Establishment The point at which a young tree is free-growing, i.e. above the height of competing vegetation. Within the context of early woodland development, it refers to the point at which an adequate number of trees of the desired species are free-growing.

European Communities (Birds & Natural Habitats) Regulations 2011 (S.I.477 of 2011)

The principal instrument transposing the Birds and Habitats Directives into Irish law, with provisions for (*inter alia*): the conservation of natural habitats and habitats of species; activities, plans or projects affecting European sites; appropriate assessment; and the protection of flora and fauna.

European site Term used to describe a Special Area of Conservation or a Special Protection Area.

Evergreen A term used to describe species of trees that retain their leaves through the year, shedding and replacing them over a several year cycle. In Ireland, examples include conifers such as Norway spruce, Scots pine and yew, and some broadleaves, such as holly and Holm oak.

Favourable conservation status (habitat) The conservation status of a natural habitat will be taken as favourable when: its natural range and areas it covers within that range are stable or increasing; and the specific structure and functions which are necessary for its long term maintenance exist and are likely to continue to exist for the foreseeable future; and the conservation status of its typical species is favourable (NPWS, 2013).

Favourable conservation status (species) The conservation status of a species will be taken as favourable when: population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its

natural habitats; and the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Felling licence A licence permitting the felling of trees, issued by the Minister of Agriculture, Food & the Marine under the Forestry Act 2014, as set out under Forestry Regulations 2017 (S.I.191 of 2017). Applications for Felling Licences are assessed by the Forest Service.

Fell-to-recycle See Fell-to-waste.

Fell-to-waste A management option on a thinning or clearfell site, whereby felled trees are not extracted off site, but are instead left onsite, typically in situ where felled. This practice foregoes the value of recoverable wood but eliminates the extraction operation, and is therefore a suitable option on sites deemed highly sensitive, due to existing habitats and species, sensitive soils or steep slope. Also referred to as 'fell-to-recycle', as the entire tree remains onsite as deadwood, with nutrients returned to the soil naturally through decay.

Fertiliser A substance used to enrich the soil with particular nutrients, to boost tree establishment and early growth. Slow release formulations should be favoured, applied manually into the planting pit or around the base of the newly planted tree.

Filling-in A silvicultural operation involving the planting of new trees within an establishing woodland, to replace dead trees and to fill vacant planting positions, and thereby to aid establishment. The operation is normally carried out in the second or third year after initial planting, to ensure that stocking levels are maintained and to avoid gaps in the emerging canopy. Also referred to as 'beating up'.

Floodplain Land adjacent to a stream, river or lake that experiences flooding during periods of high discharge.

Forest Defined under the Forestry Act 2014 as land under trees with a minimum area of 0.1 ha and tree crown cover of more than 20% of the total area (or the potential to achieve this cover at maturity), and includes all species of trees.

Forest land A collective term applied to planted and natural forests, as well as temporarily unstocked areas (e.g. recent clearfell sites) and permanently unstocked areas within forest boundaries.

Forest reproductive material A collective term used to describe seeds, plants and other propagating material important for forestry purposes, particularly of those species specified in the Forest Reproductive Material Directive (Council Directive 1999/105/ EC). Defined under the Forestry Act 2014 as the reproductive material of tree species and artificial

hybrids that are important for forestry purposes.

Forest Reproductive Material Directive EU Council Directive 1999/105/EC on the marketing of forest reproductive material. It stipulates that forest reproductive material may not be marketed unless it is from one of four specified categories, and that only approved basic material (the trees from which reproductive material is harvested) may be used for its production. The Directive requires the registration of seed collectors and nursery growers, and the development of a chain of custody, from seed collection right through to the eventual planting site.

Forest Service Ireland's national forest authority, responsible for forest policy, the promotion of the forest sector, the administration of forestry grant schemes, felling control, forest protection, and the National Forest Inventory. Part of the Department of Agriculture, Food & the Marine (DAFM) (www.agriculture.gov.ie/forestservice).

Forestry Act 2014 An Act to make further and better provision in relation to forestry, to provide for the development and promotion of forestry in a manner that maximises the economic, environmental and social value of forests within the principles of sustainable forest management, to confer power on the Minister for Agriculture, Food & the Marine to make regulations for the effective management of the forest sector, to make further provision for the giving effect to acts of the institutions of the European Union by regulation made by that Minister in respect of forestry and forestry-related activities, to repeal the Forestry Act 1946, to amend the Wildlife Act 1976, to amend the Agriculture Appeals Act 2001, to amend the Environment (Miscellaneous Provisions) Act 2011 and to provide for related matters. Forestry Regulations 2017 (S.I.191 of 2017) apply.

Forestry Standards Manual Forest Service publication detailing the operational and administrative procedures and the silvicultural and environmental standards that apply under various forestry grant schemes. The Forestry Standards Manual also sets out the environmental referral protocol and the Forest Service Appropriate Assessment Procedure.

Formative pruning See Shaping.

Gallery woodland A type of alluvial woodland comprising tall willows alongside river channels, and occasionally on river islands, where the tree roots are almost continuously submerged.

Geographical Information System (GIS) A multilayered computer-based system that enables the efficient inputting, storage, analysis and retrieval of geographic and land attribute data.

Global Positioning System (GPS) A satellite-based

system used to determine the latitude and longitude of a receiver device on or near the earth's surface.

Gross Annual Volume Increment Mean annual volume of tree increment of trees with a dbh ≥7 cm, totalled for a given number of years. Includes the increment of trees that have been felled or have died during the reference period.

Growing stock The overbark volume of living trees with a dbh ≥7 cm, from stump to 7 cm top diameter.

Habitat The physical and biotic environment in which an organism or community of organisms lives.

Habitats Directive The Council Directive 92/43/ EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, which aims to promote the maintenance of biodiversity in Europe. taking account of economic, social, cultural and regional requirements. The EU Habitats Directive, together with the Birds Directive, forms the cornerstone of Europe's nature conservation policy, and establishes the EU-wide Natura 2000 ecological network of protected areas. Annex I and Annex II list natural habitats and species (both animal and plant) of community interest whose conservation requires the designation of Special Areas of Conservation by Member States. The Habitats Directive is transposed into Irish law under the European Communities (Birds & Natural Habitats) Regulations 2011 (S.I.477 of 2011).

Herbicide A chemical formulated to cause plant death. A range of formulations are available, with different modes of action. Their typical use within a woodland context is to manage competing vegetation around the base of young trees, to aid establishment.

High forest A forest that has a high proportion of sawlog approaching or at normal rotation length.

Indigenous species See Native species.

Invasive species A species capable of rapid spread and which has a deleterious impact on other species and habitats. Although a few native species may be considered as invasive, the term is more typically applied to non-native species that are injurious to native species. Within a woodland context, invasive plants such as rhododendron and cherry laurel can suppress natural ground flora and the natural regeneration of woodland trees. Invasive animals include most species of deer (except red deer), which can cause considerable damage by overgrazing and stripping bark from trees.

Invert mounding A form of cultivation used to prepare a site for afforestation, whereby the soil is excavated, inverted and replaced back into its original location, into which the tree is then planted.

Inverted mounding involves minimal site disturbance and creates a vegetation-free planting position, thereby reducing competition during the first growing season. This form of cultivation is best suited to mineral soils (as opposed to peat), as the mound disintegrates back into the pit.

Irish Deer Management Forum A forum established in 2015 to implement a series of actions on deer management and conservation set out in the document Deer management in Ireland: A framework for action, compiled following widespread consultation. The Forum itself comprises representatives from the main stakeholder areas such as landowners, forestry, hunting and conservation organisations, as well as representatives from the Department of Agriculture, Food & the Marine and the Department of Culture, Heritage & the Gaeltacht.

Light demanding species Species that require high levels of light to survive. This is particularly important during the early years of growth, as species that are light demanding at seedling stage will die off if adequate light is not available.

Long-established woodland An area that has remained continuously wooded since at least the 1st Edition OS maps of the 1830s and 1840s, but for which there is no positive evidence that it had been wooded for longer, or for which there is evidence that the woodland is not ancient. Also referred to as 'old woodland'.

Mast year A year during which a tree produces a much higher than average quantity of seed in response to various natural cues.

Micro-climate The climatic conditions (temperature, humidity, light levels, etc.) within the immediate vicinity of a tree or within an area of woodland.

Minimal intervention area An identified area within a woodland where the native canopy is allowed to develop naturally into old growth forest and where the trees are allowed to complete their entire life cycle. Minimal intervention areas may still need management input to control unnatural threats to the woodland, e.g. invasive rhododendron. Also referred to as 'refuge area.'

Mulch Material added around the base of newly planted trees, to suppress competing ground vegetation and to promote establishment. Mulching may provide an alternative to the application of herbicides for managing vegetation on sensitive sites that are small in scale. A wide variety of organic and inorganic mulches are available.

Multi-storey forest Forest with trees present at

various stages of development, i.e. height.

National Forest Inventory (NFI) A statistical and multi-resource inventory carried out on a cyclical basis on the national forest estate by the Forest Service, in order to record and assess the extent and nature of Ireland's forests, both public and private, in a timely, accurate and reproducible manner. The NFI, undertaken initially in 2006 and again in 2009-12, is repeated in order to assess changes in the forest estate over time, to conform with national and international reporting requirements. Parameters recorded include: area and species composition, growing stock (m³), biodiversity, health and vitality, carbon content and soil type, and data on minor tree species and natural regeneration. The 2nd NFI also recorded forest area change, volume increment and the latest harvesting volume estimates, thereby allowing the monitoring of aspects of sustainable forest management.

National Park An area of land protected for its outstanding scientific (biological, geological, geomorphological) and landscape importance and for its recreational, educational and scientific use, and recognised as such by the International Union for the Conservation of Nature (IUCN). All of Ireland's National Parks fall into the IUCN Category 2 and are owned by the State. Category 2 areas are typically large and conserve a functioning ecosystem, although to be able to achieve this, the protected area may need to be complemented by sympathetic management in surrounding areas.

National Parks & Wildlife Service (NPWS) The national body charged with the conservation of habitats and species in Ireland. Currently part of the Department of Culture, Heritage & the Gaeltacht (see www.npws.ie), but it has been attached to various Government departments over the years.

National Survey of Native Woodlands A national survey of native woodlands undertaken between 2003 and 2008. The survey recorded (*inter alia*) plant species and information on area, location, soils, topography, invasive species, deadwood, grazing and natural regeneration. The data generated were used to produce a new and more comprehensive woodland vegetation classification system. For details, see Perrin *et al.* (2008).

Native species Species of plants and animals that arrived onto, and inhabited, the island of Ireland naturally since the end of the last Ice Age. They are of particular biodiversity value, having existed alongside other native flora and fauna over thousands of years. Also referred to as 'indigenous species'. For NFI purposes (DAFM, 2018), "the species list of natives trees recorded is based on the list of species eligible for inclusion in Ireland's Native

Woodland Scheme."

Native woodland Woodland dominated by native species of trees and other native plants.

Native Woodland Scheme A support package available under the Forestry Programme 2014-2020 to encourage the appropriate restoration and expansion of native woodlands in Ireland. The package comprises two separate 'elements': the Native Woodland Conservation Scheme and the Native Woodland Establishment Scheme (the latter represented by Grant & Premium Categories 9 and 10 under the general Afforestation Scheme). The package, originally launched in 2001, is implemented by the Forest Service in partnership with Woodlands of Ireland, the National Parks & Wildlife Service, the Heritage Council, Inland Fisheries Ireland and other native woodland stakeholders.

Natura 2000 site An encompassing term that applies to Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). The Natura 2000 Network comprises nature protection areas in the territory of the European Union, established to protect Europe's most valuable and threatened species and habitats, as listed under both the Birds Directive and the Habitats Directive.

Natural Heritage Area (NHA) An area considered important for the habitats present or which holds species of plants and animals whose habitat needs protection. NHAs are legally protected from damage under the Wildlife Amendment Act (2000). Currently, fully-designated NHAs encompass a number of raised and blanket bogs. Sites containing other habitats have been identified as proposed NHAs (pNHAs), but this is a non-statutory designation. In addition, the Geological Survey of Ireland (GSI) is compiling a list of geological / geomorphological sites in need of protection through NHA designation.

Natural regeneration The establishment of new trees and shrubs, and woodland, from seed arriving naturally (by animals, wind, water, etc.) onto the site from overhead sources within the woodland or from outside sources (typically adjoining or nearby, and occasionally distant). Defined under the Forestry Act 2014 as the generation of trees from natural seed fall

Natural woodland Woodland dominated by native tree species and which has developed without human assistance or interference. It is generally held that little, if any, woodland in Ireland is entirely natural, as almost all woodland has been influenced by human activity. The term 'semi-natural woodland' is more often used.

Nature Reserve An area of high biological importance designated for protection under the Wildlife Act. All nature reserves are also designated as Special Areas of Conservation / proposed Natural

Heritage Areas. All woodland nature reserves are on State land.

Non-vascular plant A plant without a vascular system. Non-vascular plants include mosses, liverworts and lichens.

Old growth stand A stand that has attained a great age with minimal human disturbance and consequently, exhibits unique ecological features and high biodiversity.

Old woodland See Long-established woodland.

Opportunists See Ruderals.

Ownership Specifies land ownership.

Overmature forest A forest retained beyond its normal rotation length, resulting in the presence of large trees.

People's Millennium Forests Project A project undertaken to restore 16 native woodlands throughout Ireland, to mark the new Millennium. As part of the restoration process, a tree was planted for every household in the country. The project, which also included various promotional and educational measures, was sponsored by the AIB Bank and the Forest Service, and managed by Coillte in partnership with Woodlands of Ireland. See www. millenniumforests.com for details.

Pioneers Tree species that are the first to naturally colonise open sites. Examples in Ireland include birch and common alder.

Plant Health Directive EU Council Directive 2000/29/EC on protective measures against the introduction into the EU of organisms harmful to plants or plant products and against their spread within the EU. A new Plant Health Regulation (Regulation (EU) 2016/2031 of the European Parliament of the Council) was introduced in 2016, repealing and replacing Council Directive 2000/29/EC. This new Regulation will apply from the end of 2019.

Pole stage A forest at a stage where it could be thinned or in the early stages of thinning.

Pollarding The practice of cutting a tree to leave a permanent trunk typically 2-4 metres in height and supporting a mass of branches above the reach of browsing animals.

Post-establishment stage A recently established forest that is not at free growing stage.

Pre-thicket stage The forest is established, but the green branches are not yet touching.

Priority habitats A subset of those habitats listed

in Annex I of the Habitats Directive. Priority habitats are habitats that are in danger of disappearance and whose natural range falls mainly within the territory of the European Union. These habitats are of the highest conservation status and require measures to ensure that their favourable conservation status is maintained. Priority habitats in relation to native woodland in Ireland include bog woodland, residual alluvial forests, yew woods and limestone pavement, which can include scrubby facies comprising (*inter alia*) hazel and ash.

Private (grant aided) Private afforested land which was or is in receipt of grant and / or premium over the period 1980 to present.

Private (other) Private forest land which was not established with grant aid since 1980. This category includes estate planting and natural succession land.

Protected area A collective term applied to any area of land and / or water legally designated in order to protect and maintain biological diversity and associated natural and cultural resources. Examples include Natura 2000 sites (Special Areas of Conservation and Special Protection Areas), Natural Heritage Areas, Nature Reserves and National Parks.

Protected habitats or species A collective term applied to specific habitats and species of flora and fauna protected by the EU Birds and Habitats Directives, and by relevant national legislation, e.g. Wildlife Acts, Flora Protection Orders.

Provenance The location from which seeds or cuttings are collected. The designation of Regions of Provenance under the Forest Reproductive Material Directive is used to help nurseries and growers select suitable material. The term is sometimes confused with 'origin', which is the original natural genetic source.

Public Forest land owned by the Irish State, e.g. Coillte, National Parks & Wildlife Service, Bord na Móna.

Qualifying Interest The particular species or habitat for which a European site has been designated.

Reforestation Defined under the Forestry Act 2014 as the restocking by planting, natural regeneration or coppicing of an area from which trees have been felled or otherwise removed.

Refuge area See Minimal intervention area.

Replacement The abrupt conversion of a non-native forest to native woodland, through clearfell and subsequent reforestation (*via* replanting and / or natural regeneration) with appropriate native species.

Replant To deliberately restock with trees an area from which trees have been felled, removed or otherwise destroyed, or to restock such other land as may be agreed with the Minister of Agriculture, Food & the Marine, but does not include restocking by means of natural regeneration (Forestry Act, 2014).

Restoration The process of assisting the recovery of an ecosystem that has been degraded.

Restoring Priority Woodland Habitats in Ireland LIFE Project A 4-year project targeting the restoration of 550 ha of priority woodland types (as per Annex I of the Habitats Directive), which have been impacted in various ways by human activities in the past. The project involved nine sites throughout Ireland, all owned and managed by Coillte. The project was jointly funded by Coillte and the EU LIFE-Nature programme (as LIFE05 NAT/IRL/000182). See www.woodlandrestoration.ie for details.

Rideline A permanent, unsurfaced strip through a woodland, maintained as open space to facilitate access and management (including deer control). Ridelines also represent important biodiversity features, and this value can be enhanced further through careful positioning, design and management (e.g. the staggered cutting of vegetation within the open habitat).

Ring-barking A silvicultural treatment involving the removal of the bark and vascular tissue (typically using a small axe) from around the entire circumference of a standing tree, for the purpose of killing it *in situ*. Applications within the native woodland context include the elimination of individual or small groups of non-native trees, and the creation of standing deadwood.

Riparian area Land directly adjacent to the edge of streams, rivers and lakes, representing the intermediate zone between the aquatic and terrestrial environments, and having its own distinctive hydrological characteristics and habitats (e.g. gallery woodland). Riparian areas are generally regarded as the land between the water's edge and the upper level of normal flooding.

Ripping A form of cultivation used to prepare certain sites for afforestation, to break up hardened soil layers for the purpose of improving soil drainage for establishing trees.

Ruderals Species of plants that colonise disturbed ground. They occur locally within woodlands where the soil has been disturbed, such as along freshly-tracked ridelines, on recently felled areas, and around animal excavations. Also referred to as 'opportunists'.

Saproxylic organisms Organisms that depend on dead and decaying wood at some point in their life

cycle.

Scarification A type of forestry operation associated with efforts to encourage natural regeneration within a woodland or on a recent clearfell site. It involves lightly breaking through the ground vegetation to expose the soil to the germinating seed of trees and shrubs.

Scrape mounding A form of cultivation used to prepare a site for afforestation, whereby a small mound of topsoil is piled up, into which the tree is then planted. This creates an adjacent pit, the function of which is to aid drainage. Scrape mounding involves minimal site disturbance and creates a vegetation-free planting position, thereby reducing competition during the first growing season. However, the pit can collect standing water and can make access dangerous and difficult. This form of cultivation should be avoided on peaty soil and if used, the pit should be as shallow as possible.

Scrub Refers to vegetation types where the dominant woody elements are shrubs, i.e. woody perennial plants, reaching a height of more than 0.5 m and less than 5 m in height at maturity and without a definite stem and crown. Term often regarded as being disparaging towards these habitats, and is being increasingly replaced by the term 'low-lying woodland'.

Selection A CCF silvicultural system in which felling and regeneration are distributed over the whole stand and over time, with individual large trees or small groups of trees selected for felling in any single intervention. Its application results in a continuous series of age classes and diameters.

Semi-natural woodland Woodland that resembles natural woodland cover, dominated by native trees and shrubs but considerably altered by human activity. Stands originating from previous planting and / or coppice may be termed 'semi-natural' if they are now regenerating naturally.

Shade tolerant species Species of trees and other plants that are able to survive at low light levels beneath a woodland canopy.

Shaping A silvicultural treatment involving the early pruning of strong side branches and forked leaders, to promote strong leader development in a young broadleaf tree. Typically undertaken to promote stem quality for future wood production. Also referred to as 'formative pruning'.

Shelterwood A CCF silvicultural system that aims to secure natural regeneration under the shelter of older trees, which are then removed by successive cuttings to allow the young trees to grow on to maturity.

Significant effect A project may have a significant effect on a Natura site if it (*inter alia*):

- reduces the area of an Annex 1 habitat, the habitat of an Annex II species, or the overall Natura site;
- damages the physical quality of the environment (e.g. water quality & supply, soil compaction) within the Natura site;
- causes serious or ongoing disturbance to species or habitats for which the Natura site is selected (e.g. increased noise, human activity);
- results in direct or indirect damage to the size, characteristics or reproductive ability of populations within the Natura site; or
- interferes with mitigation measures put in place for other plans or projects.

Silviculture The science of establishing and / or managing a woodland or forest to achieve a certain objective or range of objectives. It is based on a detailed knowledge of the current characteristics of the tree population within the woodland, and how these will react over time to various influences, both natural and artificial (e.g. thinning).

Small pole stage Forest where the canopy has fully closed and the lower branches are dead.

Special Area of Conservation (SAC) A prime wildlife conservation area considered to be important at a European as well as an Irish level, designated under the Habitats Directive. Also referred to as a 'Natura 2000 site'.

Special Protection Area (SPA) An area of significance for the conservation of habitats which are important for birds and have been designated under the EU Council Directive 79/409/EEC on the conservation of wild birds (or 'Birds Directive'). Also referred to as a 'Natura 2000 site'.

Spiral guard A device fitted around the base of a newly planted tree, to prevent stem damage from rabbits and hares.

Stage 1 A term often applied to AA screening.

Stage 2 A term often applied to Appropriate Assessment.

Stand A discrete unit of woodland, as distinguished by a common characteristic or range of characteristics such as age or species. Woodlands are commonly divided into stands, for management purposes.

Stem injection A method of applying herbicide to control unwanted woody species (e.g. invasives such as rhododendron and cherry laurel), involving the direct injection of the compound into the stem(s) of individual plants. Typically only suitable if treating older growth with larger diameter stems.

Stump application A method of applying herbicide to control unwanted woody species (e.g. invasives such as rhododendron and cherry laurel), involving

the direct application of the compound to the freshlycut stump of individual plants.

Sustainable Forest Management (SFM) "The stewardship and use of forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national and global levels, and that does not cause damage to other ecosystems." (From the Ministerial Conference on the Protection of Forests in Europe, Helsinki, 1993.)

Thicket A close, visually impenetrable stand of young trees and / or shrubs.

Thicket stage Within a silvicultural context, the stage in the emergence of a new woodland canopy whereby the canopy has closed over but the lower branches are still mainly green.

Thinning Defined under the Forestry Act 2014 as the removal from a forest in accordance with good forest practice of excess or diseased trees, or trees of poor quality in order to improve the growth, health and value of the remaining trees. For NFI purposes (DAFM, 2018), defined as the "Periodic removal of trees in a stand which are competing with those better trees which are expected to form the final crop. The object is to benefit the final crop trees, and to get income from the thinnings before they die." Thinning can also be undertaken to achieve other objectives, such as the promotion of the ground layer or the understorey, to enhance biodiversity.

Timber A piece of wood, typically a plank or beam, prepared for use in building, carpentry, etc. Defined under the Forestry Act 2014 as the wood produced by a tree, whether or not the tree is standing.

Topsoil The uppermost layer of the soil, in which most of the nutrient cycling and biological activity takes place.

Transformation The process of changing from an even-aged stand structure to a multi-aged stand structure, using continuous cover forestry. Within the native woodland context, transformation can be described as the gradual conversion (over a number of years or decades) of a non-native and predominantly even-aged forest to an uneven-aged native woodland, through the use of CCF.

Transplant A tree seedling or cutting that has been transplanted at least once in the nursery.

Tree A woody plant, with a single or multiple stems (trunks), that lives for many years and is typically capable of growing to over 5 metres in height (or 4 metres on waterlogged soil). Defined under the Forestry Act 2014 as a free standing woody

perennial plant whose species has the potential to have a more or less definite crown and be capable of reaching a minimum height of 5 metres at maturity and includes a sapling and the species of birch and hazel.

Tree guard See Tree shelter.

Tree shelter A tube placed over individual trees immediately after planting, and secured to a stake. Its purpose is to create a favourable micro-climate to promote establishment and early growth, and / or to protect against grazing (often referred to as a 'tree guard' in this context). Within native woodland management, tree shelters are often used when restocking an existing native woodland or to protect against deer.

Understorey The layer of vegetation, usually comprising shrubs and / or regenerating trees, growing beneath the canopy of a woodland or forest, but above the field layer. Within a silvicultural context, the term also applies to trees within the lower canopy level.

Understorey planting The planting of individual or small groups of trees of shade tolerant species beneath small gaps within an existing woodland canopy, for the purpose of rejuvenating the woodland and / or altering its species composition.

United Nations Convention on Biological Diversity International convention (1992) on the protection of global biodiversity. Its implementation in Ireland is set out in the National Biodiversity Plan, developed by the Department of Culture, Heritage & the Gaeltacht, with cross-sector input.

Vascular plant A plant having a vascular system of conducting tissues, e.g. ferns, conifers and flowering plants.

Vegetation management The control of competing grasses and herbaceous plants around the base of a young tree, to suppress competition for water, nutrients and light, and to aid establishment.

Vermicompost A substance made from organic matter (such as farmyard manure or vegetable waste) that has been broken down by earthworms. When applied at planting, it can promote the uptake by young tree roots of existing nutrients in the soil, through fungal associations, thereby representing a possible alternative to fertiliser inputs on sensitive sites.

Veteran tree A tree of exceptional age and / or a tree surviving past full maturity, typically exhibiting crown retrenchment. Such trees – whether native or otherwise – are important for forest biodiversity, as they provide a range of habitats for invertebrates,

birds and other animals (e.g. deep fissured bark, broken snags, cavities, dead branches). Also, veteran trees are often of cultural and / or landscape value. Also referred to as 'ancient tree'.

Water Framework Directive (2000/60/EC) An EU Directive requiring all Member States to protect and improve water quality in all waters so as to achieve 'Good' status. It was given legal effect in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I.722 of 2003). The Directive applies to rivers, lakes, groundwater and transitional coastal waters. It requires the preparation of management plans on a river basin basis and specifies a structured method for developing these plans. The Water Framework Directive is linked to a number of other EU directives, including those relating to the protection of biodiversity, primarily the Birds and Habitats Directives. See www.catchments. ie for details.

Water setback See Aquatic buffer zone.

Wildlife Acts The Wildlife Act 1976 and the Wildlife (Amendment) Act 2000, together with the European Communities (Birds & Natural Habitats) Regulations 2011 (S.I.477 of 2011), form the most important legislation underpinning biodiversity and nature conservation in Ireland. Provisions include (inter alia): the control of certain activities that may adversely affect wildlife; a mechanism to give statutory protection to Natural Heritage Areas; and measures to enhance the conservation of wildlife species and their habitats. See www.npws.ie/legislation/irish-law for details.

Windblow See Windthrow.

Windrowing A forestry operation whereby tree tops and branches left behind after clearfell (typically) and extraction are gathered by machine into rows or piles onsite, to facilitate access for reforestation.

Windthrow A natural process whereby trees are uprooted and blown over by wind. The risk of windthrow can be exacerbated by various factors, e.g. the inappropriate thinning of a mature evenaged crop of Sitka spruce on an exposed peat site. (Related processes include wind rocking and wind snap.) Also referred to as 'windblow'.

Wood The collective term for the hard woody parts of a tree that can be recovered and used for a range or products, including building material and fuel.

Woodland dynamics The processes in which woodlands and forests develop and expand (or contract) over time, as constituent trees and tree species are influenced by each other, by the physical and climatic factors of the site, and by human intervention.

Woodland generalists Species of plants and animals characteristic of woodland habitats but which may also occur outside woodlands.

Woodland specialists Species of plants and animals that are adapted to living in, and requiring the characteristic habitats of, woodland. Some of these species may be unable to live outside woodlands, and others may be confined to ancient woodland.

Woodlands of Ireland A not-for-profit company with charitable status, established in 1998 to promote the conservation, expansion and sustainable development of native woodlands. Funded and supported by the Forest Service, National Parks & Wildlife Service and the Heritage Council. See www. woodlandsofireland.com for further information.

Yield Class An index used to describe the potential productivity of an even-aged stand of trees. It is based on the maximum mean annual increment of cumulative timber volume achieved by a given species growing on a given site and managed according to a standard management prescription. It is measured in units of cubic metres per hectare per year.



