

# River Feale



BASELINE STUDY

Summary Report

*This summary report has been produced from a baseline study carried out by Malachy Walsh Partners on behalf of West Limerick Resources, IRD Duhallow and North East West Kerry Development.*



IRD Duhallow



MWP



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# Introduction

The River Feale rises near Rockchapel (North West Cork) in the Mullaghareirk Mountains and flows west for 75km (46 miles) through the towns of Abbeyfeale in Limerick and Listowel in Kerry before entering the sea south of Ballybunion. This study was initiated by West Limerick Resources, IRD Duhallow, and North East West Kerry Development (NEWKD) and was developed as a LEADER co-operation project. The aim of the study was to establish the baseline conditions and the existing environment and pressures in the upper catchment and main stem of the river as far as Listowel. It was conducted in 2019 and 2020\*. COVID-19 restrictions delayed the completion and production of this report, which is intended to point the way for the three companies to take further action as outlined in the conclusions.

*\*Some data used in this report was obtained from reports and plans that have subsequently been updated. For example, we have since entered the third cycle of the River Basin Management Plan and a new Birds of Conservation Concern report has also been published since this report was conducted.*

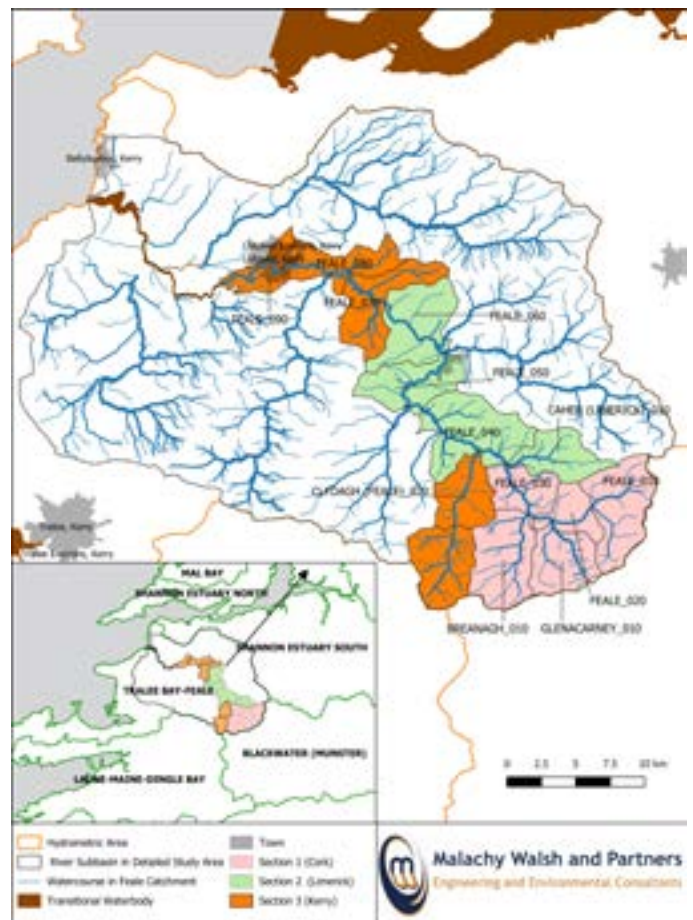


The River Feale flows through County Cork, Limerick and Kerry

The River Feale catchment is designated as a Special Area of Conservation (SAC) under the EU Habitats Directive for the protection of a number freshwater habitats and species. The relevant part of the catchment is described in this report in terms of hydrology, geology, land use, fish

stocks, biodiversity, conservation objectives and current management practices, with the key impacts on the river highlighted. The focus area for this project is the cross-county upper catchments of the Feale, including the main channel from its source near Rockchapel downstream as far as Listowel, as well as a number of tributaries, including three that are deemed 'at risk' of not achieving their water quality objectives under the EU Water Framework Directive (WFD). The waterbody units relevant to this project are outlined by county below:

- Section 1 (Cork (IRD Duhallow)) - Feale 010, Feale 020, Feale 030, Glencarney 010 and Breanagh 010
- Section 2 (Limerick (West Limerick Resources) - Feale 040, Feale 050, Feale 060 and Caher 010
- Section 3 (Kerry (NEWKD)) - Feale 070, Feale 080, Feale 090 (as far as Listowel) and Clydagh 010, Clydagh 020



Map of the study area

A healthy water catchment provides high-quality drinking water and supports activities such as agriculture, recreational angling and water sports. It also supports local ecosystems and enables the plants, animals, fish and insects that depend on clean water to thrive and flourish. Much of the River Feale is in a healthy condition and is meeting its objectives under the Water Framework Directive. However, some areas within the Feale catchment have been deemed of being 'at risk' of failing to meet their water quality objectives due to the presence of significant pressures that need to be addressed in order for water quality to improve. While there are a multitude of pressures in every waterbody, significant pressures are those that need to be addressed in order for water quality to improve. The main impacts in the catchment area are as a result of agricultural, domestic, forestry and urban activities. The areas most at risk of failing to meet their water quality objectives are prioritised for management measures such as the creation of buffer zones, the planting of riparian trees and vegetation, the eradication of invasive species, and reducing/eliminating pollution intensity.

The pre-development co-operation project between the three development companies will serve as an inter-regional pilot scheme, building knowledge and working towards the development of an integrated catchment management approach for the River Feale. The longer-term goal is that a locally led scheme / EIP / LIFE projects would be established by these companies for the wider community living and working in the River Feale catchment.

# Methodology

## How was the study done?

### Desktop Study

A detailed desktop review of the River Feale catchment was undertaken. The aim of this study was to gather the most recently available information on the geology, land-use, water quality and fish in the Feale. Environmental information on the study area was also obtained through consultations and meetings through relevant bodies and stakeholders. Maps were created on a geographic information system (GIS) platform.

## Biological Sampling

Benthic macroinvertebrates (bottom dwelling insects visible to the naked eye) were used as water quality indicators at one site in each sub-basin. Kick-samples were conducted, and invertebrate samples were live-sorted on the river bank and identified, with the relative abundance of macroinvertebrates recorded at each site.

## Water Quality

The Quality Rating (Q) system in use by the EPA was used to obtain a water quality value (Q-Value) for each site assessed. This method categorises invertebrates into one of five groups depending on their sensitivity to pollution. Q values range from Q1 being of the poorest water quality, and Q5 representing pristine/unpolluted water conditions. Where water chemistry data are available, this has been used in the assessment.

## Classification and mapping of habitats of potential conservation value and concern

The main channel of the River Feale and the lower reaches of some of its tributaries overlap with the Lower River Shannon SAC and as such are deemed of conservation value for a number of species. A number of other habitat classifications and species were surveyed in the study area, including; river hydromorphology; semi-natural and high biodiversity areas along watercourses; floating river

vegetation; habitat suitable for salmonid spawning and nursery; habitat suitable for juvenile lamprey; otters and other protected terrestrial mammals; habitat suitable for bats; and high river banks that are suitable nesting sites for sand martin or kingfisher nests. Habitats that have been managed or developed to prioritise the protection and enhancement of Natura 2000 areas, particularly through agri-environmental schemes under the Rural Development Programme, were also recorded and mapped.

## Identification and mapping of significant threats and pressures

Significant threats and pressures to the catchment were identified during the walkover survey to detect point and diffuse sources of pollutants, excessive erosion and sedimentation, riparian and aquatic invasive species, and areas at immediate risk. When a site is designated as an SAC, threats and pressures are identified and ranked as high, medium or low. The threats and pressures that are identified as affecting the Lower River Shannon SAC are assumed to also affect the study area. These include medium ranking threats pressures such as grazing, fertilisation and urban development, as well as low ranking threats and pressures such as invasive species and paths, tracks and cycling tracks.

Features that were mapped in order to identify threats and pressures included the locations of invasive species, with an emphasis on young, individual, newly dispersed invasive plants, as early detection is important in their control.

## Sub-basin Management Priority

In order to gain an understanding of how nutrient pollution reaches water bodies in the study area, information on water flow patterns was combined with land use. This allowed identification of the areas in the sub-basin that contribute the most amount of nutrient pollution to water bodies. These areas are referred to as critical sources

areas and locating them allows appropriate management techniques to be targeted to have the best effect on reducing pollution entering water bodies.

Each subbasin was ranked in order of significance so that management measures could be prioritised to ensure the most efficient delivery of water quality improvements. Factors considered during the ranking process include the volume of water a subbasin contributes to the overall catchment, the vulnerability of a subbasin to pollution, the quality of habitat for juvenile salmon, the habitat value for species of special conservation interest, and a variety of other risk factors.

# Results

## Hydrology

Hydrology is the science concerned with the occurrence and circulation of water in all its forms. Water that enters the study area as rainfall or otherwise can follow two loosely defined pathways; water can travel over land or through the near-surface layers of soils, to stream and river channels (hydrological); the remainder penetrates deeper into the ground and becomes part of the groundwater resource (hydrogeology/groundwater hydrology).

## Groundwater Hydrology

The study area, measuring 1780.8 km<sup>2</sup>, overlies the Abbeyfeale Groundwater Body (GWB). The majority of the GWB comprises a 'Locally important aquifer that is moderately productive only in local zones', underlying Listowel there is a band of 'Poor Aquifer - Bedrock that is generally unproductive', and to the west of this is a 'Regionally Important Aquifer - Karstified (diffuse)'. There is also a gravel aquifer along the main channel of the River Feale between Abbeyfeale and Listowel. The bedrock in the study area consists sedimentary rock, including limestones, sandstones and shales. Most of the groundwater flow occurs in the upper levels of the aquifer, with the main discharges being into streams that cross and cut into the bedrock units. Springs and seeps occur at the stream heads and along their course. Due to the shallow groundwater flow in the study area the groundwater and surface waters are closely linked.

## Surface Hydrology

The catchment of the Feale River drains parts of North Kerry, West Limerick and Northwest Cork. The River Feale rises near Rockchapel in the Mullaghareirk Mountains and flows northwest where it is joined by the Clydagh and Owveg Rivers. The Feale then flows through Abbeyfeale, where it is joined by the Allaghoun and Oolagh Rivers. The Feale is then met by the Smearlagh River, which drains the central and eastern parts of the Stack's Mountains, before flowing westward through Listowel, collecting the Rivers Galey and Brick and finally flowing out to sea 3 km south of Ballybunion.

The River Feale is a spate river; this means that its water level rises and falls rapidly. The flashy nature of the river is exacerbated when the soils in the catchment are already waterlogged. Other than heavy rainfall, other factors affecting the flow in the river include drainage of land, and urban expansion that is encroaching onto the river's floodplains. This leads to an increased flood risk upstream and downstream as the flood storage capacity is reduced. The River Feale has a tendency to overtop its banks along the main channel of the river between Abbeyfeale and Listowel. The productive pasture seen along this stretch of the river is due to the nutrient rich soils that have been deposited during flood events.

The watercourses in the study area gain in size and volume as they move downstream. Dry weather flows are low which indicates that there are low levels of groundwater storage in the catchment, meaning rivers are unable to maintain flows during dry summer months.

Flow has been constricted by an arterial drainage scheme carried out in the 1950s. The area affected by the scheme is downstream of the N69 in Listowel largely outside the study area, including the transitional reach of the Feale. During communication with angling clubs, it was pointed out that the flow pattern of the River Feale and its larger tributaries has changed dramatically in recent decades with the river now rising and falling much quicker than in the past. This has reduced the duration of optimal fishing time with the rivers returning to normal flows at a faster rate. Before this the river would have remained higher for longer after peak flow, a favourable condition for angling.

River flows are important ecologically as they are a factor in processes such as upstream fish migration. Fish will not migrate upstream when flows are either too high or too low, with sea trout having a slightly wider tolerance to flow than salmon. As different flow levels create different combinations of habitat quantity and habitat quality, it is important to understand how these interactions occur and the conditions that favour fish migration.

## Hydromorphology

The watercourses in the study area generally follow the physical characteristics of upland/eroding streams, occurring on steep gradients, with high energy flows leading to high levels of erosion and sediment transport. The rivers in the study area typically progress from steep topography in the headwaters, reducing in the middle reaches and running relatively flat in their lower reaches.

Hydromorphology is identified as a significant pressure in the Feale\_090 subbasin located before the river enters the sea at Ballybunion. This is due to the drainage scheme undertaken by the OPW in the 1950s. The OPW has a statutory responsibility to maintain this scheme, so these works are likely to remain ongoing and continue to affect the river processes in the study area. Where the river has been separated from its floodplain by hard engineering works downstream of Listowel, the connection between the river and the surrounding groundwater has been lost. This has a negative impact on biodiversity as this connection contributes to the exchange of water, nutrients and organic matter, which moderates stream temperatures and creates unique habitat for aquatic organisms. Bank structure and stability, as well as the biodiversity value of bank top vegetation have been negatively impacted by this drainage scheme. Several barriers to continuity along the river's main channel also exist in the form of weirs installed for fisheries development and river monitoring.



Scartleigh Weir

Urban development, including the construction of a number of embankments and anti-erosion measures have

led to the severing of the connection between the river and its floodplains, and have restricted the river's natural ability to shift its course. This propensity to shift course was demonstrated in 2016 when the river burst its banks during a flood and cut a new course across fields upstream of Abbeyfeale, with significant works required to redirect the river to its previous course.

A high level of 'naturalness' is maintained in the upper reaches of the river and its tributaries, with semi-natural land-uses leading to good substrate diversity and good bank structure and stability. Many river channels in these areas have not been encroached on by development; or been affected by drainage or invasive alien species.

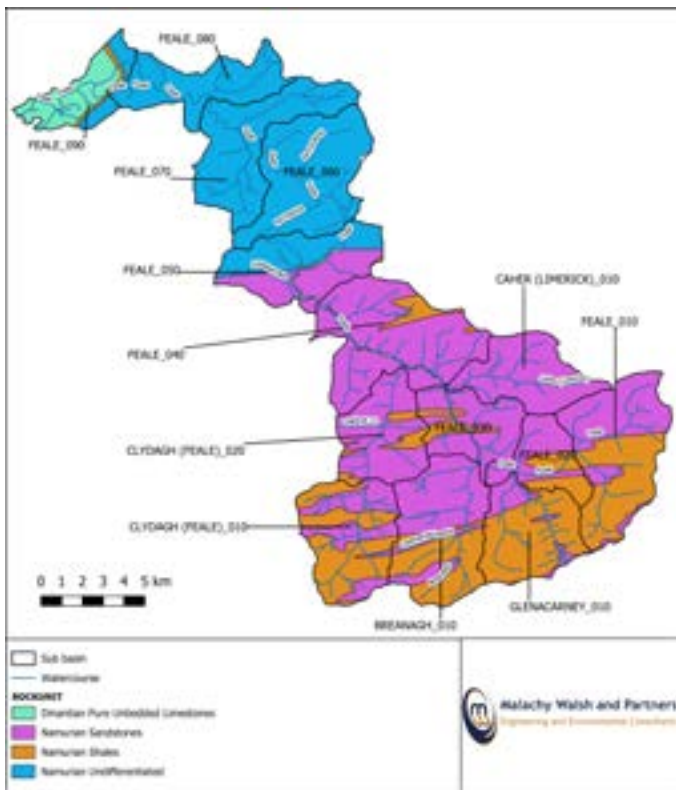


*A high level of 'naturalness' is maintained in the upper reaches of the river and its tributaries*

## Geology and Soils

The main subsoil type in the study area consists of Namurian Sandstone and Shale Till. In the uplands to the south and south-east of the study area, blanket peat is dominant, while the lower lying parts of the study area are predominately alluvial deposits, with some blanket peat present in the northern section of the study area. Subsoil thicknesses range from 1m to more than 30m, with the majority being of less than 12m. Thickness generally increases to the north and west, and are thinner in the upland areas. Soil depth determines the maximum rooting depth available to plants and any restrictions within the soil may limit rooting depth. 80% of plants water needs are sourced through the uppermost levels of the soil where the root network is at its densest.





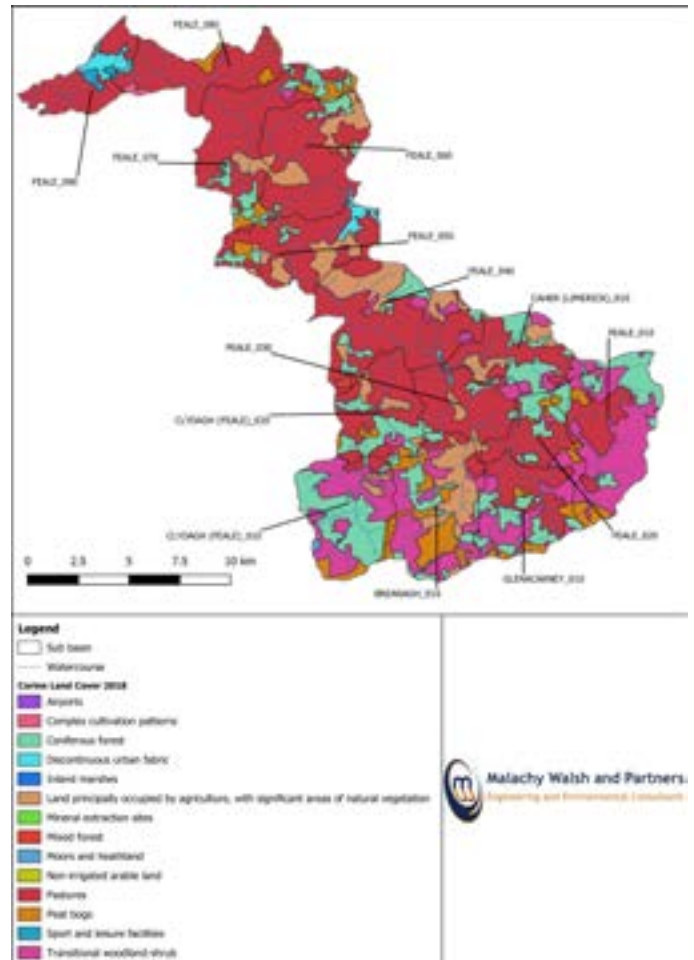
Rock Units



Soil Map

## Land Use and Associated Pressures

There is a variety of land-uses present in the study area, with the catchment in the lower reaches of the study area occupied mostly by agriculture, predominately pasture, and the upper elevations of the study area occupied by commercial forestry plantations, scrub/transitional woodland and peat bogs.



Land-use in the study area

## Forestry

The principle aim of the commercial forestry plantations in the uplands of the study area is commercial timber production. Most of these areas would have been made up of blanket bog before planting took place with mostly Sitka Spruce and some Lodgepole Pine and Larch. These species are all non-native, and are planted in blocks of even-aged trees at small spacing. Pre-planting works typically involve the use of excavators to form linear mounds that run downhill parallel to the slope. This drainage regime simulates increased erosion in the upper reaches of rivers by increasing flow velocity and exposing bare peat.

Forestry has been previously identified as a significant pressure in parts of the Feale catchment, as activities including clear felling, construction of forest roads and fertilisation of young trees generally result in heavy siltation and excess nutrients in surface waterbodies. Ecological impacts in a number of sub-basins in the study area have been attributed to forestry, including sediment loss and periodic spikes in chemical and organic fertilisers. Clear felling of forestry has been shown to lead to large amounts of phosphorus pollution in freshwaters, as the trees store phosphorus in their green needles that remain on site after clear felling.



*Forest roads can result in heavy siltation and excess nutrients in surface waterbodies*

Derogation for the use of the pesticide cypermethrin for the control of the large pine weevil in Forest Stewardship Council (FSC) certified forest plantations in Ireland was granted for the period 1<sup>st</sup> March 2016 to 1<sup>st</sup> March 2021. The large pine weevil is the most serious pest of conifer plantations in Ireland, which damages young trees by feeding on their bark. No effective alternative treatment for the protection of young trees has been found yet. Cypermethrin is a designated substance under EU legislation due to its high toxicity and the danger it poses to aquatic life. It is a highly active compound and poses extreme risk to fish and aquatic invertebrates. Strict limits on the concentrations of cypermethrin allowable in freshwaters are in place, and studies have shown that in the absence of adequate buffers these limits can be exceeded in watercourses that are near commercial forestry plantations. For this reason, the lack of sufficient buffers in the study area are identified as a cause for concern.

Due to Ireland's intention to increase afforestation levels as part of its climate plan, with the majority of this consisting of short rotation conifer plantations, it is likely that the pressures from forestry in the uplands of the study area will increase over the next 20 years. It is possible that a proportion of lands supporting semi-natural habitats in the study area could be assigned for conifer plantation. This would likely lead to a decline in biodiversity value in these areas due to the degradation of habitat and surface water quality.

The most significant forestry impact observed during this study related to a peat slide near Mount Eagle. A large amount of peat consisting of shallow rafts with upright trees was displaced. The total area of the peat landslide was approximately 15 ha, and is suspected to have occurred due to recent heavy rainfall combined with the physical changes on the peat brought about by commercial forestry operations. It is estimated that hundreds of tonnes of peat slurry have been mobilised and transported into the River Clydagh and downstream. During a site visit as part of this study, it was clear that the Tooreennascarty Stream, a tributary of the Clydagh River, had recently transported large volumes of peat, as evidenced by peat deposited on its banks above the current water line. The peat slide is likely to have had serious negative consequences on biodiversity. Increased sediment loads in rivers, that can also be caused by forestry operations such as ground preparation and road building, can lead to increased sedimentation of salmonid breeding and nursery areas. This sediment also acts to facilitate transport of other pollutants such as hydrocarbons and synthetic fluids through surface waters. This sediment infiltrates the gravel into which fish lay their eggs, reducing the supply of oxygenated water to the eggs decreases the eggs' chances of survival. Streams draining areas of closed canopy conifer forest have also been shown to have high measures of acidity, affecting aquatic macroinvertebrates as demonstrated by reduced numbers of acid sensitive organisms caught in these streams during sampling.



*It is estimated that hundreds of tonnes of peat slurry have been mobilised and transported into the River Clydagh and downstream as a result of the peat slide near Mount Eagle*



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Commercial forestry plantations in the study area are largely planted on upland blanket bogs, where the key impacts include lowering of water levels in the peat in response to artificial drainage, water demand for tree growth, and interception of water by the forest canopy. The lowering of the water table can lead to an increase in the density of the peat and a lowering of the forest floor. Mature forestry sites in the catchment generally show no remaining vegetation associated with blanket bogs, except in small areas of open bog that were left unplanted. These could be contributory factors in the decrease of the water

reserve in the Feale catchment, as manifested by faster flooding and faster abatement of floods in recent decades.

### **Agriculture**

The dominant land-use in the study area is 'pasture'. This is principally used for the production of milk, with some beef and a small proportion allocated to sheep production. Most of the land in the lower ground of the study area has been agriculturally 'improved', is intensively managed through fertilisation and reseeding, and is grazed heavily or used for silage production. These grasslands are typically species poor, mostly consisting of monoculture grasslands and rye-grass leys planted as part of an arable rotation. Agriculture is the most frequently recorded significant pressure affecting water bodies that are failing to meet their objectives under the WFD.



*Land drainage for agricultural purposes can result in pollution of watercourses*



*Land drainage for agricultural purposes can result in pollution of watercourses*

Since Ireland joined in the EU in 1973 there has been a dramatic change in pastoral practices in the study area, but since the aforementioned abolition of milk quotas in 2015 the trend of intensification has accelerated. This has led to an upsurge in reseeded, land drainage and land reclamation within the study area in an effort to increase yields. The removal of considerable lengths of hedgerows has also occurred, reducing the ecological connectivity of the landscape, and increasing the velocity and erosive power of overland flow. Many farm holdings have been amalgamated and turned into larger farms, with internal hedgerows and field boundaries removed, leaving only those bordering neighbouring farms or public roadways remaining. The modern prevailing method of hedgerow management, involving heavy-duty mechanical cutters is considered to have assisted in the spread of invasive species in the study area. There has been a considerable increase in the agricultural area and intensity in the study area over recent years, which reflects the national trend. The number of agricultural holdings in counties Cork, Kerry, and Limerick has reduced, while the average size of these holdings has increased. According to the CSO the value of goods produced, and the operating surplus of the agri-sector nationally increased consistently between 2010 and 2015.

Agriculture is having a wide variety of ecological impacts, due mainly to the release of suspended sediment and excess nutrients into watercourses. Poaching and overgrazing close to river banks leads to erosion and the collapse of the banks, while excess nutrients from the runoff of silage effluent, synthetic fertilisers and slurry impact the water quality of watercourses. The expansion of the land area under agriculture, the conversion of grasslands to species-poor monocultures, and the removal of buffers and hedgerows has reduced the natural habitat available for wildlife as well as resulting in pollution of freshwaters. In the Feale catchment, loss of phosphorus to water courses, overstocking and overgrazing have been identified as the most pertinent issues relating to agriculture. The use of the herbicide MCPA is also an issue in the catchment. MCPA is a selective herbicide used to control rushes, and due to the generally wet soils in the study area giving rise to favourable growing conditions for rushes, there are

high levels of usage in the catchment. The concentrations of MCPA allowed in drinking water is regulated based on EU legislation, and the Abbeyfeale public water supply sourced from the River Feale has had pesticide levels six times higher than the permitted amounts.

### Waste Water Treatment Plants (WwTPs)

The objective of waste water treatment is to collect the waste water generated within communities and remove polluting material so that the treated water can be released safely back into the environment. If not properly treated, waste water can pollute our waters and create a public health risk. Irish Water is the national water utility responsible for all public waste water works, and their operation is regulated by the EPA who specify how Irish Water must operate and manage waste water discharges. There are stringent conditions attached to wastewater discharges to ensure they do not negatively impact the environment, however some WwTPs in the study area are outdated and require upgrading.



*Location of wastewater treatment plants within electoral divisions within the study area*

Environmental incidents that arise from WwTPs are reported to the EPA in accordance with the conditions of the licence to operate the WwTP. Some incidents may arise for which a record is kept by Irish Water, but reporting to

the EPA is not mandated by the conditions of the licence, for example if an incident does not cause a negative impact on environmental performance.

Most urban areas in Ireland are drained by combined sewer systems that transport stormwater and wastewater in the same pipe. During high flows events, such as after heavy rainfall, the capacity of these sewers may be exceeded resulting in untreated water being discharged through Storm Water Overflows. This is a source of pathogens and a public health concern.

#### *Mountcollins WwTP*

The Mountcollins WwTP (A0223-01) provides primary and secondary wastewater treatment and discharges to the River Feale. Based on the certificate of authorisation application, the design capacity for the current waste water treatment plant for the agglomeration is unknown and the discharge point was covered with river water when the premises was visited.

#### *Brosna WwTP*

The Brosna waste water treatment plant processes the quantity of wastewater produced by (population equivalent (p.e.)) 319 people. The WwTP provides primary treatment using equipment with a design capacity of 250 p.e., and it discharges to the Clydagh River. An assessment produced by Kerry County Council outlined the fact that the plant is overloaded, and proposed upgrades that would enable the plant to meet future demands and comply with the required regulatory standards. The discharge from the plant was found to be having a negative effect on the water quality in the Clydagh river.

#### *Abbeyfeale WwTP*

Abbeyfeale waste water treatment plant has a capacity equivalent to the waste water produced by 2,860 people, with this capacity not expected to be exceeded in 2022. The plant was not compliant with the ammonia limit set in its waste water discharge licence, and had seven reportable instances during 2021, but regardless of this it has been determined that the discharge from the plant does not have an observable negative impact on water quality.

#### *Duagh WwTP*

The Duagh WwTP provides primary treatment with a design capacity of 570 p.e., and is currently processing a p.e. of 289. The plant discharges into the Islandboy Stream.

#### *Listowel WwTP*

Listowel WwTP provides a capacity for secondary treatment of wastewater from 12,500 pe. This capacity is not expected to be exceeded in 2022, and the monitoring of the plant meets the required standards. The plant had no reportable incidents in 2019.

#### *Rockchapel WwTP*

This wastewater treatment plant currently serves a pe of 150, with a design capacity of 150 p.e. The plant provides secondary treatment and discharges to the River Feale.

### **Water Treatment Plants (WTPs)**

There are three water treatment plants in the study area at Brosna, Abbeyfeale, and Listowel, all operated by Irish Water. It has been reported that the River Feale provides drinking water for 25,000 people.

Water naturally contains many pollutants, principally plant nutrients (phosphates and nitrates), sediment, and synthetic pollutants such as pesticides. Polluted water can be home to many disease causing organisms (bacteria, viruses, parasites) that can lead to diseases such as cholera, typhoid fever, hepatitis and dysentery. The treatment of water required to make it safe for consumption is a complicated, multi-stage process, and if any of these stages are not completed correctly, they can have a negative effect on subsequent stages. This creates a high likelihood of error in the water treatment process, and any incorrectly treated water poses an environmental risk if it is discharged back to local watercourses.

The WTPs in the study area all abstract water directly from rivers, and have discharges back into the river at a point further downstream. The Abbeyfeale and Listowel WTPs are on the River Feale, while the Brosna WTP is on the Clydagh River. In the case of the Abbeyfeale WTP, there is evidence of siltation on the riverbed downstream of this discharge pipe.

### Domestic Dwellings

The number of domestic dwellings with septic tanks or domestic waste water treatment systems varies geographically across the study area. Distribution follows a pattern generally similar to altitude, with the highest population densities at low elevations in larger towns such as Listowel and Abbeyfeale, and lowest population density at the areas of highest elevation.

Owners of these systems are responsible for the running of their own individual wastewater system, meaning the system must be maintained and regularly de-sludged. The nutrients contained in septic tank sludge include nitrogen, ammonium, phosphorus, potassium, and sodium, as well as contaminants that are dangerous to public health, including pathogens, faecal bacteria, viruses, detergents, toxins, solvents, fats, oil, and grease. Most pathogens take 100 days to die off, but due to the constant supply of new pathogens, sludge is unlikely to be free of pathogens meaning septic tank sludge is more harmful than animal slurry, and the spreading of it to land is more tightly controlled.

Given soil characteristics, poor percolation, and susceptibility of certain areas within the study area to nutrient over-enrichment, septic tanks in the study area pose a risk to local water quality, particularly when in the vicinity of watercourses. Many septic tanks overflow directly to drains, streams and river with minimal treatment.

### Peat Extraction

Peat drainage and extraction impacts on water quality and river habitat in the study area through the release of ammonium and fine suspended sediment, the physical alteration of habitats, and also affects the hydromorphology of rivers. Peat extraction was previously more widespread in the catchment, but now only occurs at small scale.

### Other Pressures

A number of other pressures were observed throughout the study area. Some examples are listed below:

- Dumping is an issue throughout the study area, with the dumping of volatile materials (such as chemicals or car batteries) near watercourses of particular concern to water quality, and inert materials leading to sedimentation or obstruction

of river substrates

- The removal of vegetation from areas during construction works also leaves large amounts of sediment exposed, which can easily be transferred into watercourses by heavy rain



*Dumping is an issue throughout the study area*

### Water Quality

The water quality status of waterbodies in Ireland is subject to a number of human pressures. In the Feale catchment, excess nutrients, mainly phosphorous and ammonium, are the dominant issue in river water bodies. In half of these cases, there is also impact from another pressure, including chemical, microbiological, organic, acidification and hydromorphological pressures. Poor habitat quality is significant in the Feale catchment due to high levels of fine sediment, land drainage, forestry activities, peat harvesting, erosion and applications of fertilisers.

Phosphorous losses are typically from wastewater discharges and agricultural run-off on poorly drained soils. The main effects of nutrient pollution on water quality are a reduction in dissolved oxygen and nutrient enrichment, known as eutrophication. Water quality assessment of surface waters in Ireland is based on data collected from both physico-chemical and biological surveys. Physico-chemical surveys involve taking river water samples and analysing them for specific parameters as well as examining samples of sediment from the bed of the river or stream. Biological monitoring of rivers is based on the relationship between water quality and the relative abundance and composition of the macroinvertebrate communities in the

sediment of rivers and streams. The greater the diversity, the better the water quality.

Biological water quality scores in the study area generally indicate high and good water quality status, with the exception of the lower reaches of the River Feale from Finuge to where it enters the sea.

Physico-chemical measurements for Ammonia and Phosphate are taken at the same monitoring stations as biological sampling is done. Based on data collected between 2015-2020, none of the monitoring stations detected unsatisfactory water quality in relation to the mean measurements of these nutrients. In relation to ammonia, the maximum threshold value was exceeded on occasion at a number of measuring stations, indicating problems in these sub-catchments. Ammonia occurs naturally in rivers due to the decomposition of nitrogen rich organic matter, and through excretion by fish and other aquatic organisms. Natural levels of ammonia are very low, and when levels are artificially elevated through human process including agriculture and wastewater treatment, negative impacts on water quality and biodiversity occur. Phosphorous does not occur naturally from geological sources, and is considered to be the limiting nutrient for plant growth. The main cause for elevated levels in freshwater is through runoff from agricultural land and farm yards, which can have a detrimental effect on aquatic life. Based on the data, only 1 subcatchment had mean phosphate values above the threshold for satisfactory water quality. Two subcatchments exceeded the maximum threshold for phosphate levels, with one having a maximum value nearly 100 times greater than the threshold.

## Biodiversity

There are a number of protected habitats, flora and fauna which occur in the study area, that are designated under the EU Habitats Directive and the EU Birds Directive, as well as national legislation, the Wildlife Act 1976 and the Wildlife (Amendment) Act 2000. The NPWS is required to monitor and report on habitats and species protected under the Habitats Directive, and in its 2019 assessment it found that 85% of sites are in unfavourable conservation status, with 46% of habitats demonstrating ongoing declining trends. The negative effects of climate change will continue to increase in

the absence of global efforts to not only reduce greenhouse gas emissions, but also to restore habitats, such as peat and wetlands, which act as carbon stores. Other pressures on Ireland's biodiversity are as a result of government policies and market forces, these include agricultural intensification, inappropriate afforestation and land abandonment.

## Lower River Shannon Special Area of Conservation

The Lower River Shannon Special Area of Conservation (SAC) is a large site that covers the lower reaches of the Shannon River from Lough Derg, and which also includes most of the Rivers Feale and Clydagh, and the lower reaches of the Caher River. This site is designated for the conservation of fourteen habitats and seven species, eight of which occur in the study area. The activities and impacts identified as exerting conservation pressure on the SAC, all are classified as medium level threats, including agriculture, urbanisation, and development, or low-level threats, including non-native species, forestry, and removal of beach materials.

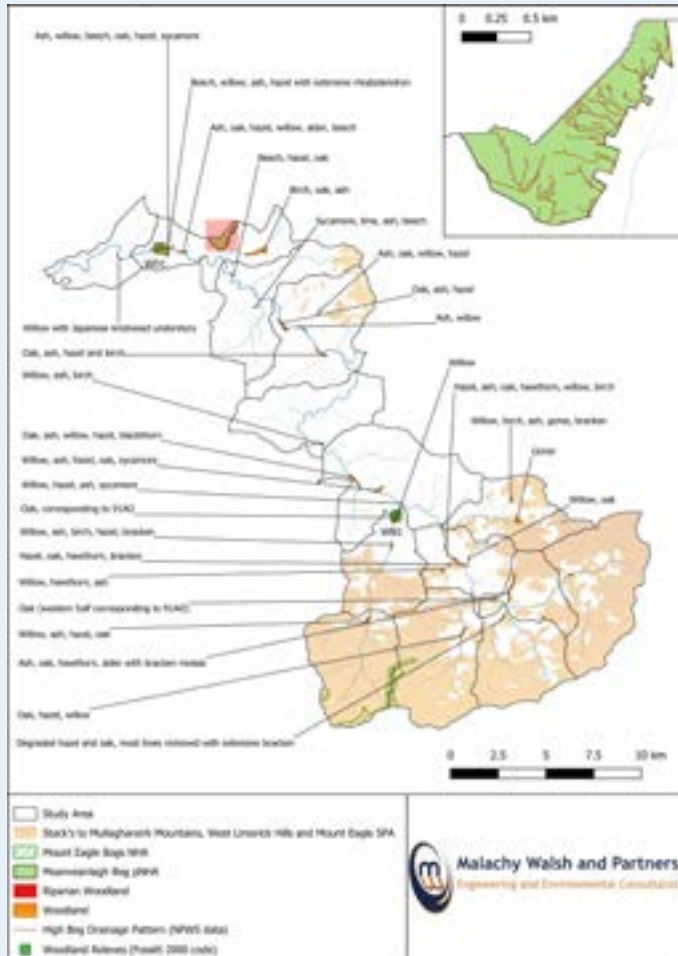
A number of habitats are included in the designation of Lower River Shannon SAC due to presence of characteristic plant species. Some of these habitats are also present in the Feale Catchment, and their presence shows zonation throughout the catchment in relation to habitat preferences of individual species. Many Irish rivers have been heavily modified, resulting in the accumulation of fine silt and sediment that provides rooting medium for plants. Where certain aquatic plant species are abundant indicates a damaged river ecosystem with lower levels of biodiversity and conservation value. This was observed in a heavily modified section of the River Feale.

The Habitats Directive and the Birds Directive designate sites as Special Areas of Conservation (SAC) for the protection of flora and fauna, or Special Protection Areas (SPA) for the protection of bird species respectively. The government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

## Other Designated Areas and Important Sites

Other designated areas and protected sites occur in the study area, including Moanveanlagh Bog, Mount Eagle Bogs, which are both proposed Natural Heritage Areas

(pNHA), and the Stacks to Mullaghreirks, West Limerick Hill and Mount Eagle SPA, which is designated for the protection of the Hen Harrier.



Woodland and bogs within the study area

**Habitats and Flora**

The waterbodies in the study area are classified as “Eroding/Upland Rivers” according to the Fossitt Guide definition of habitats in Ireland. This category includes natural water courses that are naturally eroding and have minimal deposition of fine sediment. Fast flowing and turbulent water in the catchment is responsible for these characteristics. A wide variety of plant species are associated with this type of habitat, including many types of liverworts that occur on the banks and the instream substrates of water courses. Emergent plants, and plants that require saturated soils are also associated with this habitat classification, and a large variety of these are present in the study area.



*Liverworts occur along some banks of shaded fast flowing headwater streams of the Feale*

Artificial linear water bodies and wet channels have increased significantly in the study area due to land drainage and reclamation works. Newly opened drains and drainage ditch maintenance within the study area are seen to be not only sources of sediment, but also conveyors of pollutants and nutrients to important watercourses into which they flow.

Other habitats that occur in the study area are reed and large sedge swamps, that occur as a narrow linear strip along river margins, typically along straight stretches or on the inside of gentle river bends.

Wetland habitats such as blanket bog, wet heath, and wet grassland were once widespread in the study area, but have significantly reduced due to land drainage and afforestation. These habitats provide important ecosystem services including water retention and filtering, and support high biodiversity. Woodland habitats of high conservation value occur at several locations in the study area where there are steep banks and steep sides adjacent to watercourses. “Oak-birch-holly woodland”, as classified by the Fossitt guide occurs in many of these areas, has a corresponding designation under Annex I of the Habitats Directive. This habitat is dominated by native broadleaf trees, with a canopy that allows light to reach the ground, supporting a diverse understory of shrubs, grasses and mosses.



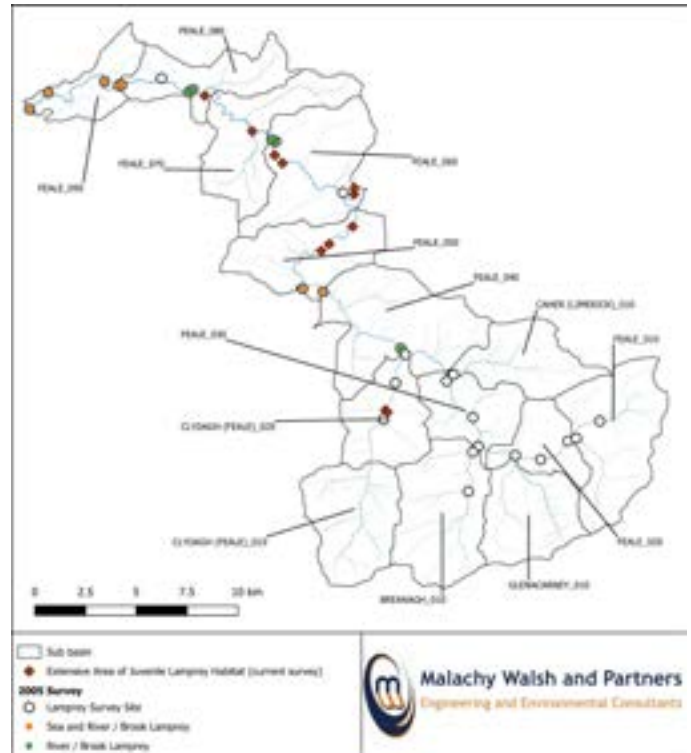
## Fauna

### Freshwater Pearl Mussel

The Feale catchment is identified as an important area for Freshwater Pearl Mussel and currently supports a small population. The Freshwater Pearl Mussel is a large, long-lived bivalve mollusc that requires rivers of high water quality, with clean, stable gravel beds to survive and reproduce. It is a protected species under Irish and EU legislation. As filter feeders, the Freshwater Pearl Mussel is extremely sensitive to pollution and poor water quality can lead to oxygen deprivation or toxic poisoning. The main negative pressures identified as having an effect on their populations are reduced water quality, increased siltation of riverbeds, and physical interference with their habitats. The use of Roundup pesticide is also harmful to Freshwater Pearl Mussel populations as it is acutely toxic to glochidia and juvenile mussels.

### Lamprey

There are 3 indigenous species of Lamprey in Ireland, Sea Lamprey, Brook Lamprey and River Lamprey, all of which occur in the study area. A survey of juvenile lampreys in the Feale catchment in 2005 found lampreys present at 12 of the 20 sites surveyed, with none recorded upstream of the Clydagh confluence due to a lack of suitable habitat. Lampreys require a gravel dominated streambed for spawning, and a sand and silt dominated bed for a nursery habitat. These habitats are usually found in slower moving sections of a watercourse. Sea Lamprey and River Lamprey spend part of their life cycle at sea, returning to freshwater habitats to spawn. The introduction of structures such as weirs into rivers present an obstruction to this migration and prevent lamprey returning to the spawning grounds. Congregations of Sea Lampreys can often be seen downstream of the weir at Listowel where they are preyed upon by otters. Brook Lamprey are the smallest of the three lamprey species native to Ireland, and spends its entire lifecycle in freshwater. They can inhabit smaller pools and occur closer to headwaters than the other two lamprey species.



Lamprey survey sites and habitat within the study area

### Salmon

The watercourses in the study area support populations of Atlantic Salmon, which is a protected species under the EU Habitats Directive and the Bern Convention. Most salmon spend one winter at sea before returning to their spawning streams to breed. Salmon require streams of high gradient with clean gravel beds to spawn. These can be found in the upper reaches of the catchment, the most important areas being tributaries of the Clydagh, Breanagh, Caher, Glenacarne and Knockahorrea. The survival of salmon at sea has been identified as being of crucial importance to population size in rivers. The rate of return of adult salmon from the sea has been in decline since the 1980s, and is now at an all-time low. Pressures on salmon at sea include commercial fishing, aquaculture and predation, as well as the negative effects of climate change on their prey. Within river systems a variety of pressures exist that can affect spawning success, including alterations to physical habitat, poor water quality, predation, and fishing.



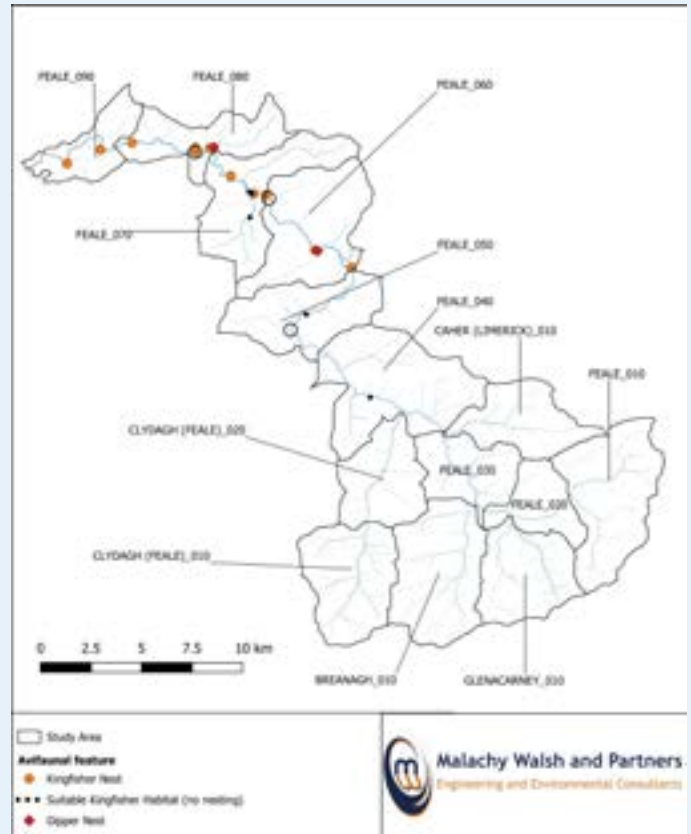
The weir at Listowel presents a potential barrier to Lamprey migration

### Other Fish

The Feale catchment also supports populations of other noticeable species of fish, including Brown Trout, European Eel, stickleback and minnow. Brown trout thrive in most waters and are well distributed across Ireland, with the headwaters in the study area providing breeding grounds for brown trout, and sea trout, the migratory form of trout. The European eel is listed as 'critically endangered' and is the subject of an EU directive with the intention of restoring its populations.

### Birds

The Stacks to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA is located in the study area. This SPA designated for the conservation of the Hen Harrier, a ground nesting species of raptor that has undergone a serious population decline over the last number of decades. This site supports the largest population of Hen Harrier of any site in the country. Short-eared Owl and Merlin are also documented as breeding within the SPA, both are species of conservation concern, as well as Red Grouse which are a red listed species of high conservation concern.



Kingfisher and Dipper nest sites identified during the study

There a number of Annex I species that occur elsewhere in the study area including the kingfisher, which nests along river banks, and whooper swans who winter in Ireland and feed in large low-lying grasslands bordering the middle and lower reaches of the River Feale. The Feale catchment is used by a number of riparian birds including dipper, grey wagtail, mallard, teal as well as migratory species such as the sand martin and swallow. Inappropriate management of rivers has had negative effects on kingfisher and sand martin, as hard engineered river works in places and excessive river bank erosion in others remove available nesting opportunities. Both of these species excavate holes in exposed river banks in which to build their nests. The siltation caused by these disturbances also affects the dipper, as siltation of the rivers prevents them access to the aquatic invertebrates that make up their diet.



*Sand Martins nesting in an eroding bank on the Feale*

A number of birds found in the study area have habitat preferences for wet areas, such as woodcock, who inhabits wet woodlands, and snipe, a wader with a preference for wet grassland and marsh. The species are amber listed, and large amounts of habitat of their preferred type has been lost in the catchment due to afforestation, land drainage and land reclamation.

### **Mammals**

Otter, an Annex II species in the Habitats Directive, is listed as a conservation interest of the Lower River Shannon SAC, and is also found throughout riparian habitats in the study area. Ireland's otter population is considered to be one of the most important in western Europe. The presence of sufficient prey and suitable sites near water bodies for shelter and breeding opportunity are key factors in determining otter population.



*Otter holts and habitat*

The study area is also home a number of bat species, all of which are protected under Annex IV of the Habitats Directive, and the Wildlife Act 1976. Woodland, hedgerows and watercourses are important features for bats in the study area, providing opportunities for shelter, breeding and foraging.

Other species of mammal detected in the study area include pine marten, stoat, badger, red squirrel, hedgehog and Irish hare, all of which are protected under the Wildlife Act.

### **Invasive Species**

Invasive non-native plant and animal species are the second greatest threat to biodiversity after habitat destruction through the study area and worldwide. They negatively impact native species, and threaten entire ecosystems by transforming their physical and biological structures. The latest assessment of invasive species in Ireland found 48 non-native species considered to be of high impact risk, and 78 deemed to be of medium impact risk.



*Both Japanese Knotweed and Himalayan Balsam growing on a stretch of the Feale*

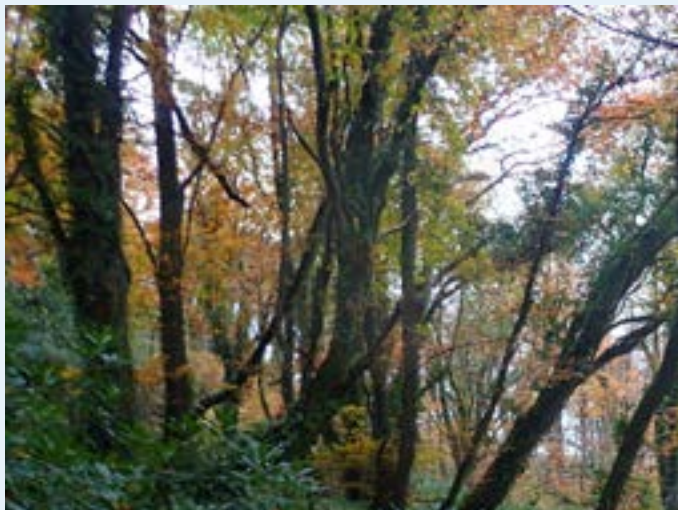
### **Japanese Knotweed**

Japanese Knotweed is classified as a high impact invasive alien plant species, and is found along the Feale between Rockchapel and Listowel, as well as the lower reaches of the Caher River. Japanese Knotweed can grow up to 2-4 metres in height, and in summer produces dense bushes with bamboo like stems and triangular leaves. It has robust roots that spread horizontally up to 7 metres away from their parent plant. The plant spreads through its roots, or

by disturbance or displacement of plant or root material, from which it will set root and grow to form new plants, allowing for rapid spread in frequently disturbed areas such as quarries and building sites. Japanese knotweed lowers biodiversity by crowding out native species and reducing species diversity, which will likely affect plant dependant species of amphibians, reptiles, birds and mammals. Japanese knotweed can also release chemicals through its roots that inhibit the growth of other plants. Under EU legislation there are controls on the movement of Japanese knotweed, and any soils etc. that contain Japanese knotweed fragments. Failure to comply with regulations can lead to prosecution.

### Rhododendron

Rhododendron is classified as a high impact invasive species. Found throughout the study area, it is a terrestrial plant that forms large dense monocultures, crowding out native species and affecting the natural process and interactions of stream and river systems. Similar to Japanese knotweed, it also produces chemicals in its roots that inhibit the growth of other species.



*Rhododendron encroaching on the understory of a woodland by the River Feale*

### Himalayan Balsam

Himalayan Balsam is a high impact terrestrial plant that is found along several watercourses in the study area. It is a major risk to biodiversity and native ecosystems, causing soil erosion on riverbanks and affecting instream communities by the addition of nutrient rich sediment to river bodies. It can alter fungal communities in the soil, that

facilitate the growth of other invasive species, an effect that can continue after the Himalayan balsam has been removed from a site.

### Other Invasive Species

A number of other invasive species are found in the study area, including high impact species such as Cherry laurel, which has effects similar to that of Rhododendron. Giant hogweed is a tall, perennial plant that measures between 3 and 5 metres in height. It forms dense stands that can prevent light reaching native species below, and its sap is phototoxic, causing severe burns to the skin when after contact with the sap, skin is subsequently exposed to sunlight.

American mink is a high impact invasive mammal species that has been reported throughout the study area. It predated a large number of native species, having a particularly severe effect on vulnerable ground nesting birds. Mink are known to practice 'surplus killing', a practice in which they kill more than they intend to eat. This can have a devastating impact in the event that mink enter enclosures containing domestic fowl. Mink are proficient swimmers and will take fish and other aquatic life.

### Commercial Fishing

Commercial fishing was an important local industry on the River Feale up until the 1950. In one year during the 1920s, 127,000 salmon were caught on the river by the local netmen. There were five fish dealers operating within the town of Abbeyfeale at the time whose livelihoods depended on salmon, as did the livelihoods of the many fishermen who supplied fish to the sellers. Until the 1950s, netting of the lower freshwater reaches of the river occurred as far as the Palace pool near the Smearlagh River confluence. Fish were then taken to the nearby railway station and picked up by the Listowel to Abbeyfeale train. Draft net fishing for sea trout and salmon used to occur in the tidal reaches of the River Feale until 2020 when it ceased due to the river not meeting its conservation limit. The commercial fishing that took place in the 20<sup>th</sup> century is likely to have had a negative impact on salmon stock in the river.

## Angling

Angling is an activity that has been associated with the River Feale for centuries. Indeed, up until the latter half of the 20<sup>th</sup> century salmon were abundant in the river and angling was a pastime practiced by a large proportion of the local population. The banks of the river were often lined with anglers, sometimes round the clock as there was stiff competition for the best perches. It was not uncommon for up to ten anglers to be fishing a single pool simultaneously. Up until the 1980s the river attracted large numbers of overseas anglers looking to fish the highly productive salmon river. There are five angling clubs that manage the rod fishing stretches of the Feale catchment, which have an average of 500 licenced salmon anglers in any given year.

The River Feale was open on a catch and release (C&R) basis for salmon fishing on the 1<sup>st</sup> March 2020 and closed on the 30<sup>th</sup> September 2020. Anglers were required to use single of double barbless hooks, and worms and prawns were prohibited for all fishing. In 2020, all salmon or sea trout measuring over 40cm (fork length) had to be returned alive to the waters of the River Feale. The national bag limit of three sea trout per day applies and these must all be under 40cm. Brown trout fishing is allowed only when using single or double barbless hooks with a ban on the use of worms.

The spring salmon fishing starts from the season opening and continues through to about mid-April. The grilse run starts in mid-June and continues until the end of July, with the peak occurring after the draft nets come off the River Cashen during the last two weeks of July. There is also an excellent run of bigger autumn fish from mid-August through until the season end. Sea trout (known locally as white trout) fishing is also very good on the Feale from early May until the end of the season, with a peak from mid-June into August.

## Climate Change

Climate change is a hugely important influence on ecosystems and changing climate affects ecosystems in a variety of ways. For instance, warming may force species to migrate to higher latitudes or higher elevations where temperatures are more conducive to their survival. Similarly, as sea levels rise, saltwater may intrude into freshwater systems forcing some species to relocate, creating imbalances in the food web. Since species differ in their ability to adapt, asynchronies can develop that can increase the vulnerability of species.

Ecosystems can serve as natural buffers from extreme events such as wildfires, flooding and drought. Climate change and human modification of the environment may restrict an ecosystem's ability to temper the impacts of extreme conditions, increasing its vulnerability to damage. As regards the study area at the River Feale, if drainage of the watercourses was to be carried out, the area may be left vulnerable to erosion should the frequency of heavy rains increase due to climate change. The uncontrolled erosion of riverbanks and riparian areas along the River Feale, as well as the loss of soil from fields may result in artificially increased sediment loads. From this, siltation of the transitional reaches of the watercourse further downstream would likely incur significant impacts to the river's estuarine ecosystems. Climate change and shift in ecological conditions are also likely to encourage the spread of pathogens, parasites, diseases and non-native biota, with potentially serious effects on agricultural and aquatic ecosystems.

# Priority Areas for Action

'Good ecological status' is a key term within the EU Water Framework Directive – the policy framework through which European freshwaters are managed. Each EU member state is required to conserve and restore their country's waterbodies to a 'good ecological status' by 2027. The identification of significant pressures is a key dependency so that monitoring programmes and a programme of measures for remediation can be designed. The Feale PAA includes six water bodies, two of which are located in the study area:

- The Clydagh\_20 flows in a northerly direction into the main channel of the Feale River at the village of Brosna
- The Feale\_80 and Feale\_90 comprise the last freshwater section of the main Feale River and flow west into the Upper Feale Estuary just below Listowel town.

These waterbodies are currently at risk of failing to meet their objective of 'good ecological status' under the WFD. Ecological status is determined by the monitoring of aquatic invertebrates, that are sensitive to changes in river systems such as flow, siltation, acidification and nutrients. EPA biological monitoring is usually undertaken when flows are likely to be relatively low, surveys during this period are therefore likely to coincide with worst expected conditions in those reaches affected by waste inputs, due to the dilution capacity of the river being at its minimum. The upland parts of the catchment are generally less developed than lowland areas so action in the higher parts of the catchment is probably more beneficial, as prevention of water quality impacts will likely be easier than remediation. Lower population densities in these regions also mean that domestic wastewater is less of a pressure. The recommended approach for achieving WFD compliance in the study area is to implement measures in geographic top-down approach, beginning with the protection of upland streams and headwaters.

# Recommendations and Discussion

*Integrated catchment management (ICM) is about bringing people and organisations together at the right scale in order to achieve effective management solutions to water quality issues for the benefit of all stakeholders. It incorporates legislative requirements with community aspirations, and integrates the environmental, economic and social issues within a catchment into a coherent catchment management strategy. Landscape quality can only be restored and preserved by conscious design and comprehensive and sustained action. The landscape of the River Feale and its watercourses cannot be satisfactorily protected solely by a managerial elite; of more importance is the informed stewardship of local communities whose own heritage they are preserving. Emphasis should be placed on the involvement of local communities, whose characteristic long-term self-interest and place-specific knowledge need to be supplemented with enhanced self-awareness and deeper environmental understanding.*

## Agriculture

The predominant catchment wide pressure in the study area was found to be agriculture; farms and associated tracks were identified as significant sources of silt and nutrients. The risk of water quality degradation is increased by artificial drainage and proximity to highly sensitive waterbodies. Diffuse agricultural runoff (i.e. runoff caused by activities that take place over a large area such as slurry spreading, pesticide use and land improvements) is responsible for 90% of total phosphorus in the study area.

Environmental problems relating to agriculture are difficult to resolve due to their complexity in the public policy system. Farm advisors facilitate farmer discussion groups, and these can be used to build communication between farmers, regulators and the environmental community. Pilot agri-environmental programmes, including the use of pilot/demonstration farms should be investigated for the study area as they demonstrate the realities of schemes and foster peer-to-peer learning. Better enforcement of compliance is also required, in combination with improved channels of communication regarding the environmental

impacts of certain practices. The Common Agricultural Policy (CAP) has a “two-pillar structure” consisting of Pillar I and Pillar II. Pillar 1 concerns issues of direct payments to farmers and market measures. In the latest revision of CAP, all Pillar I payments are to be made on the condition that 25% of land is dedicated to directly benefitting biodiversity, climate and water quality. This follows the concept that subsidies should not only maintain farm income security, but should also ensure the public good.

As of January 2021, farmers are required to prevent direct run-off from farm roadways to watercourses, including all water bodies and drains that can carry water, even if only at certain times of the year. Farm advisors should urgently inform all farmers of this requirement to ensure implementation of this measure. The reduction of N and P in sensitive areas should also be prioritised, and can be done by consultation with Pollution Impact Potential (PIP) maps available online from the EPA. Green architecture schemes such as tree planting can be used to break these pollution pathways and prevent nutrients reaching sensitive watercourses. A number of other recommendations have been made based on field surveys, that include:

- Fords (crossing points for cattle and machinery, that disturb substrates) should be discouraged.
- Hard engineering works (placement of boulders or rock armour) should not be introduced to water courses.
- The growing of willow should be encouraged along eroding banks
- Drains should be of low slope and have vegetation allowed to grow to reduce the risk of erosion.
- Drains and watercourses should be protected by fencing, to prevent bank damage by livestock and to protect riparian buffers.
- Pesticide use should be avoided along riparian areas and it can enter watercourses and facilitate the growth of invasive alien species (IAS).
- Reseeding if required should be carried out at the start of the growing season to minimise soil loss by erosion during winter months.
- Cattle drinkers should be encouraged instead of allowing livestock direct access to watercourses.



- Low intensity farming with minimal fertiliser use promotes a diverse grassland that supports greater biodiversity, improves soil structure, is healthier for livestock, less prone to soil loss and is ultimately more cost effective and sustainable for farmers.
- Field enlargement should be discouraged as it removes hedgerow habitat, a key ecological feature that provides a range of benefits to water quality, biodiversity, livestock, agriculture and heritage.

## Forestry

The Forestry Standards Manual published by the Department of Agriculture, Food and the Marine (DAFM) should be followed during all forestry operations in the study area. Riparian set back zones should be implemented to protect riverbanks and provide a buffer from pollutants entering watercourses. Planting, cultivation and drainage should be avoided in these zones, and machinery access should be restricted, only occurring for maintenance of boundaries. Forestry roads should be designed with the intention of minimising impact, especially in areas of peat bog, where bog slippage caused by forestry roads is a major risk. Sediment traps and aquatic buffer zones should be in place to reduce sediment loss to watercourses during forestry activities, especially clear-felling. The use of pesticides should be reduced, with recommendations for the use of cypermethrin implemented. Integrated pest management approaches should be used in order to minimise the requirement for pesticide use.

In some peat bogs, active peat formation may recommence after felling if suitable restoration measures are implemented. However, damage to the fabric of the peat means that the original state of the peat is unlikely to be regained. Monoculture plantations of fast-growing tree species have been shown to be less resilient to pests, wildfire and other disturbances than wild forests. Going forward, mixed forests of native species that produce valuable timber such as oak and hazel should be considered in the study area.

## Hydromorphology

The lower section of the main Feale River is in an unsatisfactory physical condition, with hard engineering and bank works disrupting river behaviour, and physical structures such as weirs preventing fish passage and migration. Changes to these structures to ease fish migration is deemed necessary at Scartleigh Weir, and should be performed in accordance with best practice.

## Waste Water Treatment

The WwTP in Listowel requires further examination, along with any associated sewer overflows. If there is an ecological impact from the plant, the capacity of the river at Finuge Bridge to buffer the discharges from the plant should be assessed.

Wastewater treatment and disposal systems serving single houses in rural areas should follow the code of practice developed by the EPA to protect water quality. This establishes an overall framework of best practice in relation to the development of these systems in rural unsewered areas. Countryside dwellers should be made aware of the requirement to maintain domestic wastewater systems and guidance on this should be provided.

## Water Treatment

As part of the National Federation of Group Water Schemes (NFGWS) source protection pilot project, a guidance document has been produced titled *A Framework for Drinking Water Source Protection*. This Framework provides a methodological approach to evaluating pressures on water quality within a drinking water catchment, so that an informed decision can be made as to whether 'protection' or 'improvement' will be required. This guidance document should be consulted at the next stage.

## Invasive Species

To comply with the regulations that make it an offence to spread, or cause the spread of, Japanese Knotweed, mechanical hedge cutter operators will be required to complete a course to render them qualified for the task.

Only persons who have completed this course should be allowed to operate cutting machinery, areas infested with IAS could then be identified through an online reporting system so that corrective action can be taken. Construction and other works involving excavations and the movement of earth should be carried out in line with measures designed to prevent the spread of IAS. IAS issues are widespread in the Feale catchment, and eradication efforts should work from the top of the catchment down. Effort must also be directed towards awareness of invasive alien plant species such as Japanese Knotweed.

### Angling

The practice of catch and release (C&R) in salmon rod fisheries has become increasingly common due to the decline in salmon abundance in the North Atlantic over the past two decades. It has been shown that salmon survival after C&R is high. Continued operation of the Feale as a C&R fishery can provide information on salmon stock status while not significantly impacting on salmon survival. Instream development works should be discouraged, and the use of soft engineering such as the growing of willow should be used to protect eroding banks. Encouraging citizen science amongst the angling and wider community may also be an effective way to monitor water quality in the catchment.

# Concluding Statement

An implementation plan for the above recommendations is necessary to maximise the ecosystem services provided by the watercourses in the Feale catchment and to increase the natural capital asset. Ecosystem services refer to the contributions (goods and benefits) of nature to human well-being. Fresh waters contribute a disproportionately high amount of life-supporting ecosystem services despite covering less than 3% of the Earth's surface. Among the many ecosystem services provided by Irelands rivers are water for consumption, food production and industrial uses, assimilation of pollutants until that capacity is exceeded, flood protection (by capturing, holding and distributing water), recreation (e.g. angling, kayaking), sense of place and many other non-material benefits.

A targeted approach towards maintaining or improving water quality is required. Initiatives such as EIP and LIFE could be utilised to achieve this, with a role for LEADER in community engagement. Integrated catchment management must be applied which involves all stakeholders including landowners, farmers and communities working together to find and implement practical measures and solutions.

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