Invasive Alien Species (Plant) Survey and Management Strategy within the Lower River Shannon Special Area of Conservation (Feale River Catchment)

National Parks and Wildlife Service (NPWS)

November 2025

Contents

Figures

Tables

Appendices

Appendix 1 – Invasive Plant Species listed on Part 1 of the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations.

Appendix 2 - Detailed maps of high-impact IAS within the River Feale Catchment.

Project No.	Doc. No.	Rev.	Date	Prepared By	Checked By	Approved By	Status
24711	6002	A	November 2025	DO'B, PD	HD	HD	FINAL

MWP, Engineering and Environmental Consultants
Address: Reen Point, Blennerville, Tralee, Co. Kerry V92X2TK, Ireland

www.mwp.ie

QUALITY I.S. EN ISO 9001:2015 NSAI Certified
HEALTH & SAFETY I.S. ISO 45001:2018 NSAI Certified
ENVIRONMENT I.S. EN ISO 14001:2015 NSAI Certified
BUILDING INFORMATION MODELLING ISO 19650-2:2018 NSAI Certified
ENGINEERS IRELAND CPD ACCREDITED EMPLOYER

1. Introduction

Malachy Walsh and Partners (MWP) Engineering and Environmental Consultants were commissioned by the National Parks and Wildlife Service (NPWS) to undertake surveying and mapping of highly invasive vascular plant species within the riparian zone of the River Feale catchment within the Lower River Shannon SAC and its priority tributaries. Invasive Alien Plant Species (IAPS) represent a major and growing threat to Ireland's native biodiversity, ecosystem health and economic well-being. They are now widely recognised as the second greatest cause of biodiversity loss globally, following habitat destruction, and their impacts are increasingly evident across Irish terrestrial and freshwater environments. IAPS can alter habitat structure, disrupt ecological processes, displace native species, and degrade ecosystem services essential for flood regulation, water quality and carbon storage. In freshwater systems, their effects are often amplified by hydrological connectivity, allowing rapid downstream spread through river and drainage networks.

In Ireland, many invasive alien plant species (IAPS) were initially introduced intentionally as part of ornamental planting but have since naturalised and expanded beyond their intended settings. Their spread is further facilitated by human activities such as construction, soil movement, machinery transfer, and dumping of garden waste, as well as natural vectors including wind, water and wildlife. The ecological and economic consequences are substantial, with an estimated annual cost to Europe exceeding €12 billion, reflecting losses to agriculture, fisheries, infrastructure and ecosystem resilience.[1] Effective management within Ireland therefore relies on a coordinated, catchment-based approach that integrates prevention, early detection, rapid response, and long-term monitoring to limit their establishment and mitigate ongoing impacts on native habitats and species.

This final report outlines the findings of surveys completed for IAPS within the Lower River Shannon SAC (Feale River Catchment). A key component of this report are annotated maps showing the extent and level of infestation of IAPS within the study area.

The objective of this final report is to:

(i) provide baseline data on the occurrence of all IAPS within the study area (Feale River Catchment within the SAC);
(ii) provide information on the extent of infestation and detailed distribution mapping for High to Moderate Impact IAPS infestations within the study area.
(iii) to detail a Management Strategy for the control of High Impact IAPS within the study area, with the ultimate aim of eradication of these species from within the Feale Catchment within the SAC.

This report, therefore, represents the first phase of a long-term management and eradication programme. The aim of the management strategy is to enable and support the effective control of higher impact invasive species within the River Feale Catchment, with the eventual aim of eradication, carried out in line with measures designed to prevent the importation and/or spread of IAPS.

1.1 Legislation

The Wildlife (Amendment) Act 2023 requires all public service bodies, including government departments, agencies and local authorities to integrate biodiversity into their plans, policies and programmes Wildlife Amendment Act 2000-2023 Consolidated (npws.ie). The Wildlife Act 2023 contains provisions relating to non-native invasive species. Regarding exotic species, it is prohibited for anyone without a licence to plant or otherwise

[1] ias_recommendations.pdf Accessed on 29.10.2025

cause to grow in a wild state, in any place in the State, any species of flora, or the flowers, roots, seeds or spores of flora.

Japanese Knotweed, Himalayan Balsam and Rhododendron, are listed as invasive alien species of national concern in the First Schedule of the European Union (IAS) Regulations 2014 (SI 374 of 2024). For a full list of species see **Appendix 1** below. In addition, soils and other material containing Japanese Knotweed, and its hybrids, are classified in the Second Schedule as vector materials and are subject to the same strict legal controls. Failure to comply with the legal requirements set down can result in either civil or criminal prosecution, which very severe penalties accruing[2].

It is an offence under regulations to spread, or cause to spread, Japanese Knotweed. An offence may be avoided only if the relevant party can prove that they took all reasonable steps to avoid causing an offence under the legislation. Therefore, in compliance with these regulations, this management plan will rely solely on methodologies necessary to ensure strict compliance with the legislation.

1.2 Guidance and Relevant Literature

The following guidance documents and literature were consulted as part of the preparation of this management strategy:

- Actions for Nature 2023 – 2030, Ireland's 4th National Biodiversity Action Plan[3].
- Crushell, P., Foss, P., Hurley, C. & O'Loughlin, B. (2011). County Kerry Invasive Species Survey 2011 - Pilot Mapping Study of the River Lee Catchment, Tralee. Report prepared for Kerry County Council and The Heritage Council.
- Inland Fisheries Ireland (2016) Best Practice for Control of Himalayan Balsam (Impatiens glandulifera).
- http://invasivespeciesireland.com/
- Tweed Forum (2020) *The Tweed Invasives Project: 18 Years of Catchment-wide Control*. Tweed Forum, Scotland.
- Scottish Invasive Species Initiative (SISI) – Sheep Grazing Trial, River Deveron (2019-2022)
- *Controlling Invasive Riparian Plants in Scotland – Final Project Report (Ayrshire).* CIRB Project / SEPA / SNH. ICIRB (2014).
- 'Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads' (NRA, 2010)[4].
- 'The Management of Invasive Alien Plant Species on National Roads – Standard' (TII, 2020).
- 'The Management of Invasive Alien Plant Species on National Roads – Technical Guidance' (TII, 2020b)
- Pathway Action Plan – Soil and Stone Pathway Action Plan 2023 – 2027 (NBDC 2023).
- Water Action Plan 2024, A River Basin Management Plan for Ireland (DHLGH).
- 'Good Practice Management Japanese Knotweed (*Fallopia japonica*)' (Rapid, 2018)
- 'Good Practice Management Giant Hogweed (*Heracleum mantegazzianum*)' (Rapid, 2018)

---

[2] pdf (legislation.ie) Available 21.10.2024

[3] 4th_National_Biodiversity_Action_Plan.pdf Available 04.11.2025

[4] National Roads Authority (NRA) (2010). *Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads*. Revision 1. National Roads Authority, St. Martin's House, Waterloo Road, Dublin 4.

- 'Good Practice Management Himalayan Balsam (*Impatiens glandulifera*)' (Rapid, 2018)
- IRD Duhallow LIFE Project (2015) *Removal and monitoring of Himalayan Balsam Impatiens glandulifera – Monitoring Report (Action C10, LIFE09 NAT/IE/000220 BLACKWATER SAMOK).* IRD Duhallow, Cork.
- Lucy, F., Caffrey, J., & Dick, J.T.A. (2021). *Invasive Alien Species in the Republic of Ireland: Policy Recommendations for Their Management – Final Technical Report.* Prepared for The Water Forum (An Fóram Uisce), Ireland

1.3 Study area

The area surveyed comprised the Feale River Catchment located within the Lower River Shannon SAC and watercourses located upstream of the SAC, including but not limited to the following tributaries:

- Brick
- Galey
- Smearlagh
- Glashoreag
- Oola
- Allaghan
- Owveg
- Clydagh
- Caher
- Breanagh

The study area is encompassed within nine different sub-catchments. These comprise the Brick_SC_010, Brick_SC_020, Feale_SC_010, Feale_SC_020, Feale_SC_030, Feale_SC_040, Glouria_SC_010, Galey_SC_010 and the Galey_SC_020 sub-catchments. All watercourses in the Feale catchment corresponding to Orders 0, 6, 5, 4, and all order 3 and 2 rivers that are within the boundary of the SAC were surveyed (see **Figure 1** and **Figure 2** below).

In total, the length of river channel surveyed comprised of approximately 265 km of watercourse. The Rivers Feale, Galey and Brick at some low gradient locations have quite an extensive flood plain; therefore, OPW flood map GIS data was used to define the study area at locations prone to flooding. A minimum set-back distance of 20 m from both banks of all watercourses in the study area was surveyed. If a stand of IAPS extended beyond 20 m from the river channel, the extent of the entire stand was recorded and mapped, where visible. Any IAPS in the field of view beyond this area was also recorded and mapped.

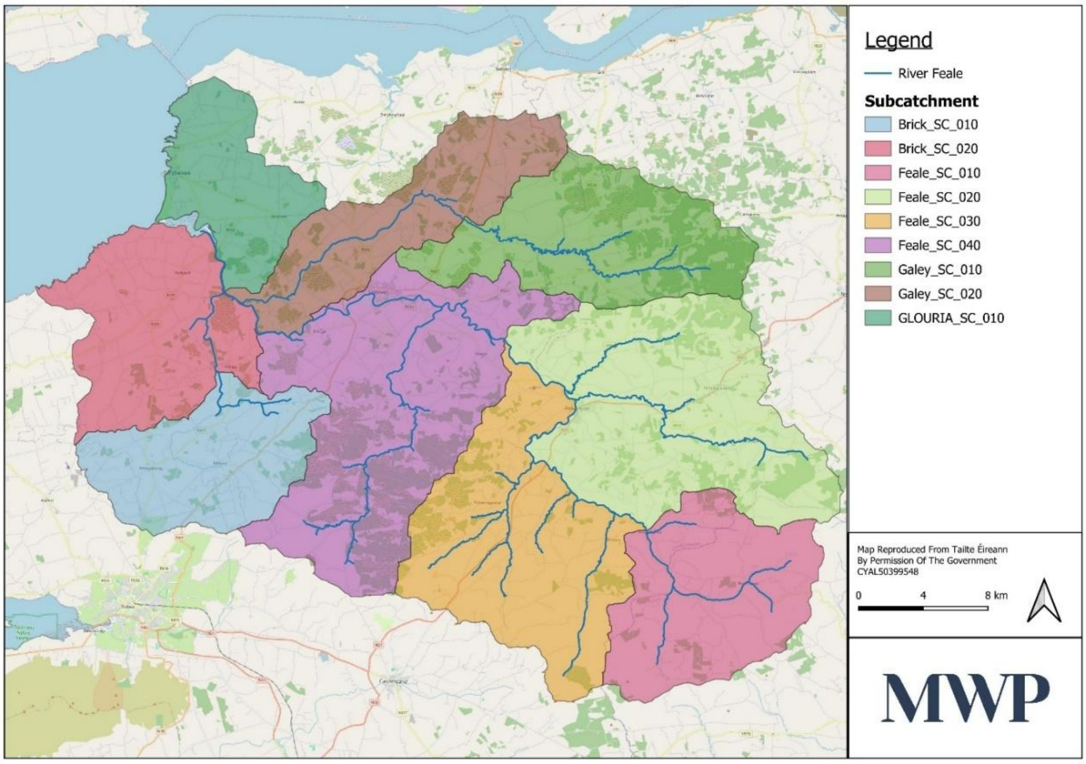

Figure 1. Study Area with relevant river sub-catchments within the River Feale Catchment.

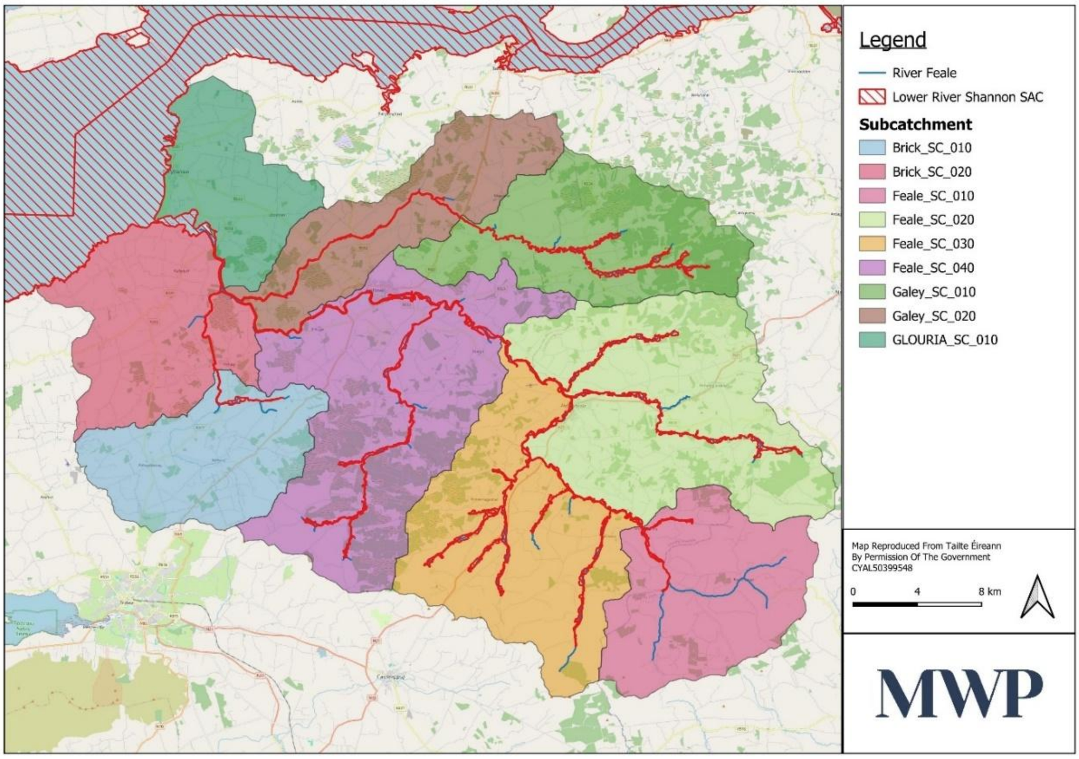

Figure 2. Study Area with relevant river sub-catchments within the River Feale Catchment overlapping with the Lower River Shannon SAC.

1.3.1 Dominant Land Uses

Land use within the River Feale catchment is dominated by agriculture, which accounts for over 90 % of the terrestrial area, primarily comprising improved pasture used for livestock grazing – based on analysis of the EPA Corine Land Cover 2018 shapefile dataset.[5] This extensive agricultural coverage reflects the long-established grassland management typical of the lowland and gently undulating terrain across the catchment.

In the upland and headwater areas, particularly along steeper gradients and where poorer soils dominate, commercial conifer plantations and areas of peat bog form a secondary land-use component. Many of the watercourses flow adjacent to or through these coniferous and peatland areas, which can influence local hydrology and water quality through altered flow regimes, nutrient dynamics, and sediment transport.

Forested and bog habitats are interspersed with small patches of transitional scrub and occasional mixed or broad-leaved woodland, while urban or built development occupies only a negligible proportion of the overall catchment. Overall, the River Feale catchment represents a predominantly pastoral and rural landscape, with limited semi-natural and forested cover concentrated mainly in upland headwaters and along riparian corridors.

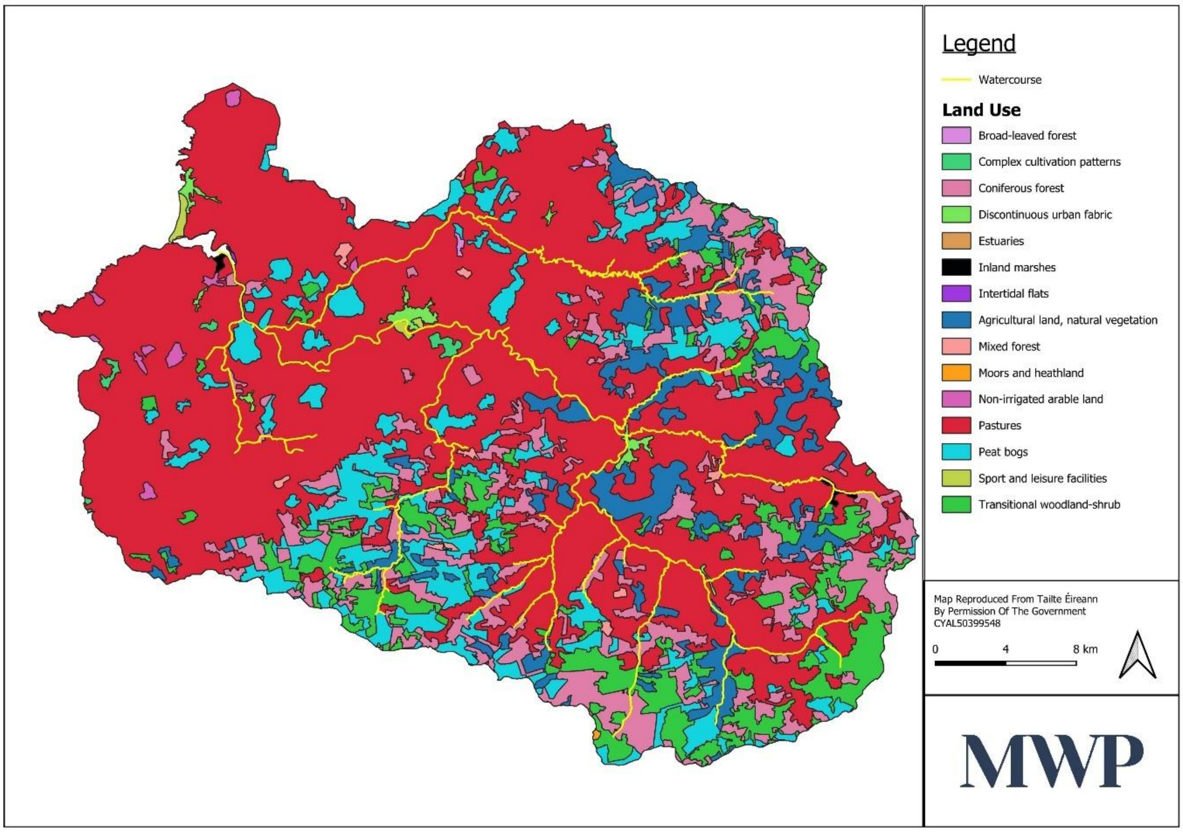

Figure 3: Land use within the River Feale catchment (Adapted from EPA Corine Land Cover 2018 shapefile).

1.3.2 Pathways for Spread of IAPS

The spread of IAPS within the River Feale catchment is strongly influenced by the catchment's predominantly agricultural landscape and the high level of interaction between people, livestock and watercourses. Agricultural

[5] https://gis.epa.ie/EPAMaps/Water Accessed on 13.11.2025

activities are widely recognised as major pathways for IAPS, with machinery, trailers, soil-moving equipment and livestock capable of transporting seeds, plant fragments or contaminated soil between fields, tracks and riparian areas (DAERA, 2018). Regular farm access to riverbanks for watering, fencing or land management further increases the likelihood that invasive plants are introduced or redistributed along river margins.

Recreational use of the catchment—including angling and informal riverbank access—provides additional vectors, as seeds and plant fragments readily adhere to boots, clothing, equipment and pets (NNSS, 2015; NatureScot, 2021).

Construction, drainage, hedge-cutting and road-maintenance works can also inadvertently disseminate invasive material where soil, spoil or vegetation is moved without appropriate biosecurity controls (DAERA, 2018). Road networks themselves act as linear dispersal routes, with seeds and fragments transported by vehicle tyres and verge-maintenance machinery (NNSS, 2015).

Finally, natural hydrological processes represent one of the most efficient pathways of all: floodwaters mobilise seeds and fragments from upstream areas and deposit them along downstream riverbanks, gravel bars and floodplains. These combined vectors demonstrate that invasive alien species can spread rapidly through routine land-use practices, underscoring the need for coordinated catchment-wide biosecurity measures and consistent engagement with farmers, contractors, recreational users and local authorities.

Table 1: Potential IAPS pathways.

Pathway	Summary	Relevance to River Feale Catchment
Agriculture	IAPS spread via contaminated soil, machinery, field vehicles, livestock movement; fragments and seeds transported between fields and riparian margins.	Highly relevant due to >90% agricultural land use; tractors and machinery frequently cross drains and river margins, creating high potential for spread of invasive species.
Recreational activity	Seeds and fragments adhere to boots, nets, angling gear, dog fur; recreational pressure increases IAPS transfer between waterbodies.	Relevant where angling access points and riverside paths coincide with IAPS presence. Potential for further spread to previously uninfested areas of the catchment.
Horticultural and Garden waste	Many IAPS originate from gardens; spread occurs through soil or plant waste dumped on banks, roadsides or field edges.	Several species (e.g. Rhododendron, Cherry laurel) originate from private gardens or estate plantings near rivers.
Construction/road maintenance	IAPS spread via contaminated fill, topsoil, spoil, or roadside strimming/ditching; vehicle movement spreads rhizomes and seeds.	Several IAPS species found along road margins.

Pathway	Summary	Relevance to River Feale Catchment
Water dispersal	Rivers transport seeds and plant fragments downstream; flood events accelerate catchment-scale spread.	Major pathway for Himalayan balsam and knotweeds; hydrological connectivity between tributaries increases downstream colonisation risk.

1.3.3 Target Species for Survey

Highly invasive terrestrial plant species were the target of the survey undertaken. These included, but were not limited to, the following high-impact species: Japanese knotweed (*Fallopia japonica*), Himalayan balsam (*Impatiens glandulifera*), rhododendron (*Rhododendron ponticum*), cherry laurel (*Prunus laurocerasus*), giant hogweed (*Heracleum mantegazzianum*) and giant rhubarb (*Gunnera tinctoria*).

Other IAPS known to occur in the catchment, and which were recorded where encountered, included bamboo (*Bambusoideae spp*.), butterfly-bush (*Buddleja davidii*), fuchsia (*Fuchsia magellanica*), Himalayan Knotweed (*Persicaria wallichii*), lesser knotweed (*Koenigia campanulate*), montbretia (*Crocosmia x crocosmiiflora*), salmonberry (*Rubus spectabilis*), snowberry (*Symphoricarpos albus*) and Spanish bluebell (*Hyacinthhoides hispanica*).

2. Survey Methodology

2.1 Desktop Study

A variety of published and unpublished material was reviewed as part of a desktop study for this report. Reports and websites that were used are listed below in Section 1.2. References are added as a footnote at the bottom of the corresponding page or listed below in Section 9.

2.2 Consultation and Engagement

Consultation and engagement was undertaken with various organisations and individuals with regard to control of IAPS and effectiveness of treatment methods. The following groups and individuals were contacted as part of this process:

- National Biodiversity Data Centre
- INVAS Biosecurity, Environmental Consultants and Invasive Species Specialists
- CIRB Invasive Species Project, CIRB Ayrshire Rivers Trust
- Loughs Agency

2.3 Field Surveys

2.3.1 Survey Methods

Field surveys were undertaken during the summer 2024 period on the following dates:

- 6th, 10th, 11th, 12th, 13th, 14th, 15th, 17th, 18th 19th, 20th, 21st, 23rd, 24th, 25th, 26th, 27th and 28th June 2024.
- 1st, 2nd, 3rd, 4th, 7th, 8th, 9th, 16th, 17th, 18th, 19th, 21st, 23rd, 24th, 29th, 30th and 31st July 2024.
- 5th, 6th, 7th, 16th, 19th, 20th, 25th, 27th, 28th, 29th, 30th and 31st August 2024.
- 2nd, 6th, 7th, 8th, 9th, 12th and 13th September 2024.

The extent of non-native and invasive plants was identified with reference to Transport Infrastructure Ireland's 2020 technical guidance document 'The Management of Invasive Alien Plant Species on National Roads – Technical Guidance' (TII, 2020)[6] and the Northern Ireland Environment Agency's *'Field Guide to Invasive Species in Ireland'* by Early *et al.* (2009)[7]. The presence of young, and sometimes individual, newly dispersed invasive plants were also recorded insofar as possible.

Surveying was carried out by at least 2 No. ecologists working together and experienced in identification of invasive plant species. One ecologist walked each bank out to 20 meters from the bank. Thigh waders and buoyancy aids were always worn as access to watercourses was required to allow ease of movement. Survey work was from upstream to downstream insofar as possible in line with best practice for prevention of spread of IAPS (see also **Section 2.3.5**). Data was recorded digitally and photographs taken.

Kayaks were used in the wider reaches of the River Feale to facilitate movement of surveyors by negotiating around impenetrable field boundaries / areas of scrub etc., but all surveying was undertaken on foot. Where an area couldn't be fully accessed, the location was recorded. Two vehicles were utilised on all survey days: one parked near the upstream extent of the particular survey reach and another near the downstream end of each individual survey reach to reduce walking distances.

The following was recorded for each stand of invasive species encountered:

- Description of each stand of IAPS (including species, density, extent and height/maturity).
- GPS location (recorded as required to facilitate mapping (polylines or polygons). Note: polygons were mapped, as required, for severely infected areas).
- Description of the location.
- Photograph(s).

Implementation of a future eradication programme was kept in mind during all surveys and target notes made of any potential constraints to works, e.g., access, distance from nearest road/access track, adverse ground conditions, signs of protected species e.g. otter couches/holts.

---

[6] https://invasives.ie/app/uploads/2024/03/ManagementofIAPSonNAtionalRoads_TII_Dec2020_GE-ENV-01105.pdf

[7] Early, J., McDowell, S., Caffrey, J., O'Callaghan, D., Meenan, K., Toomath, C., Fitzsimons, B., and Kelly, J. (2009). *Field Guide to Invasive Species in Ireland*. 2nd Edition. Northern Ireland Environment Agency (NIEA), Belfast.

Figure 4: A kayak was used in some locations to ease travel along the river system. Photo above example of use of kayak for field surveys on the River Shannon in Limerick in 2023.

A dynamic safety risk assessment (RA) was carried out in line with MWPs in-house risk assessment procedure. Surveying was carried out according to the MWP company safety statement which sets out the companies health and safety policy, and specifies the means provided to achieve that policy. Hazards and associated risks were identified and procedures for eliminating or minimising such hazards/risks were established prior to any site works commencing. The RA was updated as required as site work progressed and where any additional risks or hazards were identified. A safe system of work was developed to control risks. This was followed at times during the course of the surveys.

2.3.2 Field Surveyors

Surveying to inform this report was completed by Gerard Hayes, Maureen Kelliher, Petr Dobes and Deirdre O'Brien of Malachy Walsh and Partners. This report was prepared by Deirdre O'Brien and Petr Dobes, Ecologists with MWP.

Gerard is a Senior Aquatic Ecologist with over 13 years' experience in environmental consultancy, formerly with MWP. Gerard is a full member of the Chartered Institute of Ecology and Environmental Management, the main society in Ireland for professional ecologists, and as such he is bound by their code of professional conduct. Gerard has a diverse ecological profile, with aquatic fauna, phase 1 habitat, mammal (including bats), bird, amphibian, macroinvertebrate, and tree survey experience. He has had numerous responsibilities including report writing (EIS, EIA, EA, AA, NIS), waste assimilation capacity assessment, and ecological monitoring. His project involvement has been primarily in the areas of wind energy development, waste-water treatment plants, roads/bridges, water supply, flood defense and hydro schemes. He is co-author and/or carried out surveys for NPWS Irish Wildlife Manual Nos. 15, 24, 26, 37, 45. This included juvenile lamprey electrical fishing surveys in the Boyne, Corrib, Moy and Suir catchments, the latter which he led. He has collated field data and prepared river water quality assessment reports for EPA biological monitoring of rivers as part of Water Framework Directive (WFD) monitoring. He has been formally trained in WFD river monitoring (Environmental Protection Agency), Stage 1 and Stage 2 Freshwater Pearl Mussel Surveying (Dr. Evelyn Moorkens), aquatic macroinvertebrate identification (Freshwater Biological Association).

Maureen has over 5 years field work experience and over 2 years in ecological consultancy. She has authored and co-authored a number of dedicated protected species reports for terrestrial and aquatic species. She was involved in data collection for the Environmental Protection Agency (EPA) biological monitoring of rivers in 2022 and 2024 as part of a Water Framework Directive (WFD) water quality monitoring programme. This included the identification of aquatic macroinvertebrates, phytobenthos sampling and preservation, and River Hydromorphology Assessment Technique (RHAT) surveys and was responsible for drafting the EPA River Assessment Value Report for Hydrometric Area 25 and 06. Maureen is an accredited Stage I and Stage II surveyor for freshwater pearl mussel *Margaritifera margaritifera* and white-clawed crayfish *Austropotamobius pallipes* and has relevant survey experience throughout Munster and Leinster, including electrofishing for salmonids *Salmo* spp. and lamprey *Lampetra* spp..

Petr has been a valuable member of MWP's Ecological team since May 2023. As a qualifying member of the Chartered Institute of Ecology and Environmental Management (CIEEM), he demonstrates a strong commitment to environmental stewardship. His fieldwork experience includes invasive alien species (IAS) surveys across multiple infrastructure and conservation projects, as well as bird surveys, freshwater macroinvertebrate sampling and identification, and standard ecological methodologies such as mammal surveying and habitat mapping. He has also gained experience in conducting Appropriate Assessments (AA) and Ecological Impact Assessments (EcIA) for a range of development types. In addition, Petr has received formal training in aquatic macroinvertebrate identification (Freshwater Biological Association), Biological Water Quality Assessment using the Q-value method (Pascal Sweeney), white-clawed crayfish surveying, and Stage 1 & 2 freshwater pearl mussel surveying (Pascal Sweeney).

Deirdre O'Brien has been working periodically with Malachy Walsh and Partners since 2018 and on a full-time basis since 2019. During that time, she has carried out field work which included invasive species survey's, bird surveys, freshwater macroinvertebrate sampling and identification, (sensu Q' value assessment), collection of water samples. She has also gained experience in standard field survey methodologies including mammal surveying and habitat mapping. She has been formally trained in Stage 1 and Stage 2 freshwater pearl mussel Surveying (Dr. Evelyn Moorkens). She has acquired experience in the completion of Appropriate Assessment (AA), Natura Impact Statement (NIS) and Ecological Impact Assessment (EcIA). She has experience with general ecological report writing and has helped complete numerous reports for bird survey work and is experienced in the collation of data and in field ecology survey techniques

2.3.3 Conditions for Surveying

Surveying was carried out during normal to low water levels as high-water levels obscure visibility. In quantifiable terms, surveying only took place during flows at or below mean flow with reference to McCarthaigh (1997)[8], which equates broadly to 30%ile flow in Irish rivers. This data can be accessed with reference to the River Feale at Listowel (https://waterlevel.ie/0000023002/0001/ for the main channel of the River Feale as far as Feales Bridge on the Kerry-Limerick border. For smaller channels, the River Galey in Athea was used (https://waterlevel.ie/0000023052/0001/), as this is a good proxy for the remainder of rivers in the study area. 30%ile flow is that flow equalled or exceeded 30% of the time and lies ca. halfway between 50%ile and 95%ile flow on OPW graphs for the above hydrometric stations.

The Feale and its tributaries are spate watercourses so respond rapidly to rainfall, in that they rise and fall relatively quickly. This effect has been exacerbated in recent decades with increased land drainage density (agricultural and commercial forestry), so water levels were not a significant limitation. Weather forecasts were viewed in advance of surveying and if rivers were at borderline survey level, surveying was postponed if rainfall was predicted.

[8] MacCarthaigh (1997) Hydrological data. A listing of water recorders and summary statistics at selected gauging stations. Environmental Protection Agency, Ireland.

2.3.4 Landowner Consent

Team members carried a letter explaining the nature of the project and the reasons for the survey.

2.3.5 Biosecurity

Taking account of the fact that invasive species are an ever-present threat in our aquatic and riparian systems, it was imperative that field operations did not exacerbate the risks to the environment and to the economy that are posed by these species. Fish parasites, pathogens and diseases also represent a significant threat to the health status of our watercourses. The introduction or transfer of such pathogens or diseases has the potential to wipe out large populations of fish in affected waters or catchments. The Inspect-Remove-Clean-Dispose protocol was deployed at all stages of field work.

Inspect: all equipment that has been in a waterbody (boats, trailers, engines, outboards, dredgers, weed cutting or harvesting boats, cruisers or even clothing) or terrestrial site for attached vegetation, contaminated soil or obvious animal life before moving to another waterway, catchment or site.

Remove: any adhering plant, soil or animal material from your equipment before relocating to another watercourse, section of waterway or site. Ensure that all water is drained from your boat and equipment before transportation to another site and all soil is removed from machinery, as this may contain seed or plant fragments.

Clean: power hose all equipment. Use hot water (>60 degrees centigrade) where possible.

Dispose: of all plant material and animal material appropriately. This material should be contained in sealed bags or containers prior to removal. Do not throw them back into the water or leave them lying at the waters edge.

Listed below are procedures that all MWP staff implemented when conducting field survey work in or adjacent to surface waters:

- Each field vehicle was required to carry a ‘disinfection box’. This contained Virkon Aquatic or another proprietary disinfectant, a spray bottle, cloths or sponges, a scrubbing brush and protective gloves.
- On completion of any field operation, all equipment used was treated according to the procedures listed below. Equipment in this respect included the following:
    - boats, trailers, bins, all PPE (including boots, wellingtons, waders, wetsuits, dry suits, waterproof clothing, life jacketsetc.) and any technical or sampling apparatus used as part of the survey.
- Prior to leaving site, all equipment that came into contact with water was visually inspected for evidence of attached plant or animal material, or adherent mud or debris.
- Any attached or adherent material (fish, fish scales, vegetation and debris) was removed before leaving the site of operation.
- All water was drained from boats, and other equipment before transportation elsewhere.
- Footwear was dipped in or scrubbed with a disinfectant solution (e.g. 1% solution of Virkon Aquatic or another proprietary disinfection product) and thoroughly dried afterwards.
- All PPE was visually inspected and any attached vegetation or debris removed. Where appropriate, gear was wiped down with a cloth soaked in 1% solution of Virkon Aquatic or another proprietary disinfection product. Alternatively, a 5% solution (100 ml / 20 litre solution) of chlorine bleach was used. Rubber gloves were worn when undertaking this procedure.

2.4 GIS/Digital Mapping

Data standard guidelines for the delivery of data associated with NPWS research projects was followed for all Geographic Information System (GIS) data to enure consistency and compatibility with other NPWS datasets. The downloadable zip archive https://www.npws.ie/sites/default/files/general/npws-data-standards.zip contains a project directory tree populated with the most current versions of forms, documentation and templates which was utilised for all GIS. ESRI shapefiles remain the standard format for NPWS so this format was utilised. Shapefiles downloaded from the websites of the NPWS and EPA (designated site boundary data, watercourses) were used to generate maps on GIS platform. Desktop study GIS based map production was complimented with data collected during field studies. Maps were produced at a scale that enables specific features to be readily recognised.

Field GIS data was collected using durable smartphones and the ArcGIS Field Maps application. Site photographs were captured using high-quality smartphone camera applications and/or using an Olympus Tough TG-5 underwater camera. ArcGIS Field Maps was used to record all IAPS features in the form of routes, polygons and points of interest (POIs). The information gathered was used to prepare mapping for all higher impact IAPS encountered within the study area, including but not limited to the following high-impact species: Himalayan balsam, Japanese knotweed, Cherry laurel, Giant hogweed, Giant rhubarb and Rhododendron.

Routes, tracks and POIs were exported from Field Maps using GPX files to allow use in other applications. A database was compiled to produce a GIS layer to map all IAPS found during the survey. This enabled seamless transfer of information to be used in a variety of applications at later stages of the overall project. All geospatial data was provided in the ITM coordinate reference system.

Field walkover maps were transcribed into GIS to provide user-friendly data showing the abundance and spatial distribution of the various IAPS identified, and upon which report mapping was then produced. All data and photographs collated in the field were uploaded at regular intervals to the MWP internal server via secure VPN network connection. This served as a backup to all electronic information.

All GIS data management and outputs were managed by Ashling Fenton of MWP. Ashling has worked as a GIS professional since 2017 and has been employed as a GIS Analyst with MWP since May 2022. She possesses a strong working knowledge of database systems, data analysis, GIS software tools and SQL. Ashling has considerable experience in renewable energy developments and has contributed to a variety of projects, including supporting the transition of MWP's surveying workflows to Field Maps, as well as marine MAC/MUL applications, solar farms and wind farms.

3. Survey Results Overview

Surveys undertaken across the River Feale catchment recorded IAPS in eight of the nine sub-catchments, with no IAPS detected in Glouria_SC_010 (see **Table 2** below)

A total of six high-impact species were identified — Himalayan balsam, Japanese knotweed, cherry laurel, giant hogweed, giant rhubarb, and rhododendron — five of which (all except cherry laurel) are listed as Species of National Concern under the European Union (Invasive Alien Species) Regulations 2014 (S.I. 374 of 2024).

Four medium-impact species were recorded: salmonberry, butterfly-bush, and Himalayan knotweed, while low-impact species included montbretia, snowberry, fuchsia, lesser knotweed, bamboo, and Spanish bluebell. Of these, Himalayan knotweed, salmonberry, and Spanish bluebell are also listed under the EU IAS Regulations.

The Feale_SC_020, Feale_SC_040, and Galey_SC_010 sub-catchments supported the highest diversity of IAPS, each containing multiple high- and medium-impact species. Montbretia was the most frequently recorded species overall, while Himalayan balsam and Japanese knotweed were the most widespread high-impact IAPS. The specific distribution maps, photographs, ecological impacts, and management recommendations for each recorded species are described in detail in **Sections 4.2** to **4.8** below.

Table 2. IAPS identified within the relevant sub-catchments

Species/ Impact Rating	Sub-catchment Name								
	Brick_SC_020	Brick_SC_010	Feale_SC_010	Feale_SC_020	Feale_SC_030	Feale_SC_040	Galey_SC_010	Galey_SC_020	Galey_SC_010
Himalayan balsam/High impact		✓		✓	✓	✓	✓	✓	
Japanese knotweed/High impact	✓		✓	✓	✓	✓	✓	✓	
Cherry laurel/High impact impact			✓	✓	✓	✓	✓		
Giant hogweed/High impact		✓		✓			✓		
Giant rhubarb/High impact				✓	✓	✓			
Rhododendron High impact				✓	✓	✓	✓		
Salmonberry/Medium impact			✓		✓	✓			
Buddleja/Medium impact			✓	✓					
Himalayan knotweed/Medium impact							✓		
Montbretia/Low impact		✓	✓	✓	✓	✓	✓	✓	
Snowberry/Low impact			✓	✓	✓	✓	✓		
Fuchsia/Low impact			✓	✓		✓	✓		
Lesser knotweed/Low impact					✓				
Bamboo/Low impact						✓			

Species/ Impact Rating	Sub-catchment Name								
	Brick_SC_020	Brick_SC_010	Feale_SC_010	Feale_SC_020	Feale_SC_030	Feale_SC_040	Galey_SC_010	Galey_SC_020	Galey_SC_010
Spanish bluebell/Low impact							✓		

4. Management Strategy

As part of the initial phases of the preparation of the Management Strategy, a detailed review of all known treatment and disposal methods for High Impact IAPS of relevance to the study area was undertaken (see **Section 1.3**)

4.1 Types of Control and Management

A range of control and management techniques may be used to suppress, contain, or eradicate invasive IAPS. The suitability of each technique is dependent on species biology, site conditions, timing, accessibility, and potential impacts on non-target habitats and species.

4.1.1 Biological Control

Biological control involves the deliberate use of organisms that naturally regulate populations of the target invasive species within its native range. This approach is typically considered only for widespread, well-established species for which mechanical or chemical eradication is unrealistic or economically prohibitive.

Key considerations

- Utilises a target species' natural enemies such as specialist herbivorous insects, pathogens, parasites or predators (Blackburn et al., 2014).
- Candidate organisms are usually sourced from the invasive species' native range and have co-evolved with the host plant.
- Classical biological control focuses on highly specific herbivores, reducing the risk to non-target flora (Shaw et al., 2016).
- Agents undergo extensive host-specificity testing, population modelling, and regulatory approval before environmental release.
- Can provide self-sustaining suppression, reducing management costs over time.
- Effectiveness may vary with climate, site context, and degree of infestation.

Limitations

- Slow response time (often several years).
- Strict regulatory processes in Ireland under Regulation (EU) 1143/2014.

- Minimal applicability to sites where urgent safety (e.g. Giant hogweed) or flood-risk intervention is required.

4.1.2 Physical/Mechanical Control

Physical or mechanical control involves the direct removal, destruction, or containment of invasive plants through manual effort or machinery.

Key considerations

- Techniques include: manual pulling (pre-flowering), excavation of rhizome masses, strimming/cutting, brush removal, desiccation (air drying), and the use of geotextile membranes to exclude light.
- Appropriate for early-stage invasions, isolated plants, or small satellite populations.
- Air drying can kill many plant propagules; however, survival remains possible under cool, humid conditions, with some species tolerating >14 days in damp material.
- Physical barriers (e.g. biodegradable geotextiles) can suppress regrowth on steep banks.

Limitations

- Labour intensive and costly on large stands.
- Risk of fragmentation-mediated spread (particularly Japanese knotweed) if not undertaken by trained personnel.
- Excavation generates contaminated spoil requiring compliant disposal pathways (TII GE-ENV-01104, EPA 2022)

4.1.3 Chemical Control

Chemical control involves the application of herbicides to suppress or eradicate invasive plant species. It is most effective when used strategically, often in combination with other methods.

Key considerations

- Herbicides such as glyphosate and triclopyr are commonly used, with aquatic-approved formulations required near watercourses (Invasive Species Ireland, 2021).
- Application techniques include foliar spraying, cut-and-paint, stem-injection, and drill-and-inject, selected based on site accessibility, plant morphology, and sensitivity of surrounding habitats.
- Late-season application (August–September) is typically most effective for perennial species, ensuring translocation of herbicide to rhizomes prior to dieback (Armstrong et al., 2009).
- Spot-treatment methods minimise off-target effects and are suitable for dense stands or sensitive riparian zones.
- Only trained and licensed operatives may apply herbicides near aquatic environments in accordance with Irish law and NPWS guidelines.

Limitations

- Repeat treatments over 3–5 years are often required to fully deplete rhizome reserves or seedbanks.
- Non-target impacts on adjacent vegetation and water quality must be carefully managed.

- Weather dependency (e.g. rainfall or wind) can constrain timing and effectiveness.
- Use of herbicides may be restricted in protected habitats or catchments supporting sensitive aquatic fauna (e.g. Freshwater Pearl Mussel).

4.1.4 Integrated Control Approach

Due to differing species traits, a single treatment rarely achieves eradication. Integrated control combines:

- timed herbicide applications,
- mechanical removal of aerial biomass,
- follow-up spot treatments,
- biosecurity and access management, and
- habitat restoration (e.g., willow planting to shade balsam).

In riparian systems, integrated control is demonstrably more effective than single-method approaches. Evidence from the Tweed Invasives Project[9] indicates that *"a combination of all of these methods may be used, depending on plant density and site conditions"* (Tweed Forum, 2020), and that continual adaptation of techniques based on field performance is *"key in producing an efficient, fit-for-purpose control programme"* (Tweed Forum, 2020). A catchment-scale, partnership approach is also regarded as "a blueprint for others to follow" (Tweed Forum, 2020), underscoring the importance of coordination, multi-year monitoring, and upstream-to-downstream sequencing.

4.2 Himalayan Balsam

4.2.1 Species Description

Himalayan balsam (*Impatiens glandulifera*) is an invasive terrestrial plant species spread exclusively by seed. This annual plant (completes its life cycle in one year) can grow 2 - 3 m high and has a very shallow root system. Plants flower from June to October. The seed pods explode when mature. Seeds can be spread up to 7 m from the parent plant on land and can disperse further by water, humans and animals. Most seeds germinate after one year, although some may remain viable for a second year.

This high-impact species has thrived and spread throughout Ireland without natural predators and pathogens to compete with. This invasive species is particularly prevalent in damp areas such as along the banks of watercourses and in damp woodland, where it can form monospecific stands[10].

4.2.2 Negative Ecological Impacts

Dense stands significantly reduce native plant diversity and alter habitat structure (NNSS, 2019). Because plants are shallow-rooted and senesce entirely in winter, riverbanks are left bare and prone to erosion, increasing sediment loading and smothering downstream gravels (Greenwood & Kuhn, 2014). Flood flows readily transport

[9] TF_invasives_manual_web-FINAL.pdf Available on 05/11/2025

[10] Himalayan Balsam Control and Solutions from INVAS Biosecurity | Invasive Plant Specialists (invasivespecies.ie) Accessed 08.01.25

seeds, promoting rapid downstream colonisation. Balsam can also hinder access for survey and management teams and may increase bank collapse in livestock areas (TII, 2020).

Dense monoculture stands can also impede access for survey, inspection and routine management works, and may restrict recreational use of riverbanks[11].

4.2.3 Removal Options

Removal/eradication can be made more successful when groups work with a joined-up catchment based approach.

A multifaceted and adaptive approach will lead to the best results.

Controlling balsam often takes longer than previously suggested, making it essential to estimate project timescales conservatively.

4.2.3.1 Manual Removal

Manual control methods may work for small patches of Himalayan balsam, but larger sites and landscape-level projects will need to include herbicides in the control strategy. Combining manual and chemical methods is advised wherever possible[12].

"Balsam Bashing"

Given the nature of Himalayan balsam it is possible to eradicate it from some areas without using pesticides. This hand removal method has been termed "Balsam Bashing". It requires a concerted effort and often volunteer groups are called in to complete the task. A well organised group can come in and physically remove the plants over a two-year period.

How to successfully remove Himalayan Balsam from your riverbank

- Balsam bashing programmes should be scheduled to take place before the plant flowers and, certainly, before any seed pods are set. The ideal time is from about mid-May to the end of June.
- On river banks, plant removal operations should commence at the farthest upstream site from which the plant was recorded and work progressively downstream.
- The teams of balsam 'bashers' should be alerted to any risks or hazards that may exist in the targeted area (e.g. uneven banks, steep-sided banks, animal burrows, dense nettle or bramble beds, etc.) before pulling starts.
- Each balsam 'basher' should be equipped with strong boots or wellies, long robust trousers or leggings (to ward off the unwelcome attention of nettles or brambles), long sleeved upper garments and long durable gloves (for the same reason).
- As the plants have a very shallow root ball, they are easily removed from the soil by gently pulling. However, in order to ensure that the plant does not break when pressure is exerted on it, it is recommended that the 'basher' bends and grips the stem about 1 metre above the ground. Here, the stem is relatively thick and should not break when pulled. As the plants tend to grow in dense patches, it is often possible to remove two or more plants in the one go. The minimum of pressure is normally required to remove the root in its entirety from the ground.

---

[11] Himalayan Balsam Control and Solutions from INVAS Biosecurity | Invasive Plant Specialists (invasivespecies.ie) Accessed 08.01.25

[12] Good_Practice_Management_-_Himalayan_balsam-1.pdf Accessed 08.01.25

- Having removed the balsam plant from the ground, it should be thrown landward, away from the river, where another team will gather the plants into large piles
- The piles of Himalayan balsam plants may be left in situ beyond the bankside, if permission from the landowner is granted. They will be covered with a layer of jute or hession material in order to eliminate light. This will hasten the demise of the plant and ensure that it will not flower and set seed. (It is not uncommon for plants that have been removed fully from the soil to put all of their remaining energy into flower and seed production before they die.) The jute will rot down with the composting balsam plants. Where it is not possible to leave the plant piles in situ, they will be transported to suitable licensed composting facilities.
- As the seeds of the Himalayan balsam can remain viable for two years, it will be important that the site is visited the following year and the above repeated[13].

CASE STUDY: During the CIRB (Controlling priority Invasive species and Restoring native Biodiversity) Project large Himalayan balsam stands were sprayed to kill them off. During the course of the project it was found that a large seed bank remained, once the stand was killed off this allowed light to penetrate to the floor and a flush of new growth appeared following the first spraying. In this case 2 – 3 repeat treatments were needed. In small infestations local volunteering groups were utilised to go out and carry out "Balsam Bashing"[14].

4.2.3.2 Chemical Removal

• Herbicides can be applied by a variety of means including boom sprayers (tractor or quad mounted), weed wipers, backpack sprayers, hand lance and spot spraying.

• Selection of herbicide should depend on other crops or plants on site, environmental considerations, and meeting your management measures objectives.

• Large infestations, infestations near water, or infestations on steep slopes may be too costly or too environmentally sensitive to control by chemical means. In these situations, it is important to look at other management measure options.

Important considerations include selecting herbicide formulations that are explicitly approved for use in or near aquatic environments, such as glyphosate, in accordance with current Irish regulations and NPWS guidance. Additional factors include the presence of protected species that may be impacted, the degree of disturbance by people or livestock, and proximity to residential areas or sensitive habitats.

Seed bank longevity is about two years (though some sources suggest as long as three)[15]. Control programmes should be undertaken for the whole of this period followed by a five year monitoring programme. It may also be necessary to consider a bankside rehabilitation programme to prevent erosion. Control of this species should generally be carried out before flowering, and it is especially important to carry out any management before seeding. When clearing balsam in early summer, you will often get some new plants germinating later in the summer, so it is important to go back and repeat treatment two or three times before the winter.

4.2.3.3 Biocontrol

CASE STUDY: BIOCONTROL DEMONSTRATING AND MONITORING THE USE OF BIOLOGICAL CONTROL AGENTS

[13] Himalayan Balsam Control and Solutions from INVAS Biosecurity | Invasive Plant Specialists (invasivespecies.ie) Accessed 08.01.25

[14] CIRB on Vimeo Accessed 08.01.25

[15] Good_Practice_Management_-_Himalayan_balsam-1.pdf Accessed 08.01.25

Himalayan Balsam: The rust fungus biocontrol agent was released and monitored at 15 sites through the RAPID LIFE Project[16]. Through RAPID it was discovered that there are actually three different biotypes (same species, but with regional differences) of Himalayan balsam in England and the rust fungus used was incompatible with biotypes in the South East and South West. This means that Himalayan balsam has likely been introduced to England on at least three separate occasions. This a very useful finding and for future projects CABI (Centre for Agriculture and Biosciences International) will try to source other strains of the rust fungus that will better target these other biotypes. More information on CABI's work with Himalayan balsam is available here: www.himalayanbalsam.cabi.org.

4.2.4 Distribution within the River Feale Catchment

Himalayan balsam was the most frequently recorded high-impact invasive species within the Feale catchment, occurring in six sub-catchments. It was recorded primarily along the River Feale—particularly within the middle reaches—and also along the Galey, Oolagh, Allaghaun, Glashcooncore, and Smearlagh Rivers. Please **see Figure 5** below for an overview study area scale map and **Figure 6** for an example photograph of Himalayan balsam recorded within the Feale_SC_040 sub-catchment. It should be noted that, in relation to **Figure 5** below, the original polygons representing recorded species were too small to be visible at the map's working scale; therefore, they were enlarged for cartographic clarity to ensure visibility on the overview ('zoomed-out') maps. As a result, while the mapped data in Figure 4 may appear to indicate continuous infestations along river corridors, in reality, the recorded occurrences are sometimes localised and populations discrete, rather than occurring as continuous stands.

Detailed mapping for Himalayan balsam distribution recorded within the Feale catchment is provided in **Appendix 2.**

[16] Laymans_Report_for_RAPID_LIFE.pdf Accessed 08.01.2025

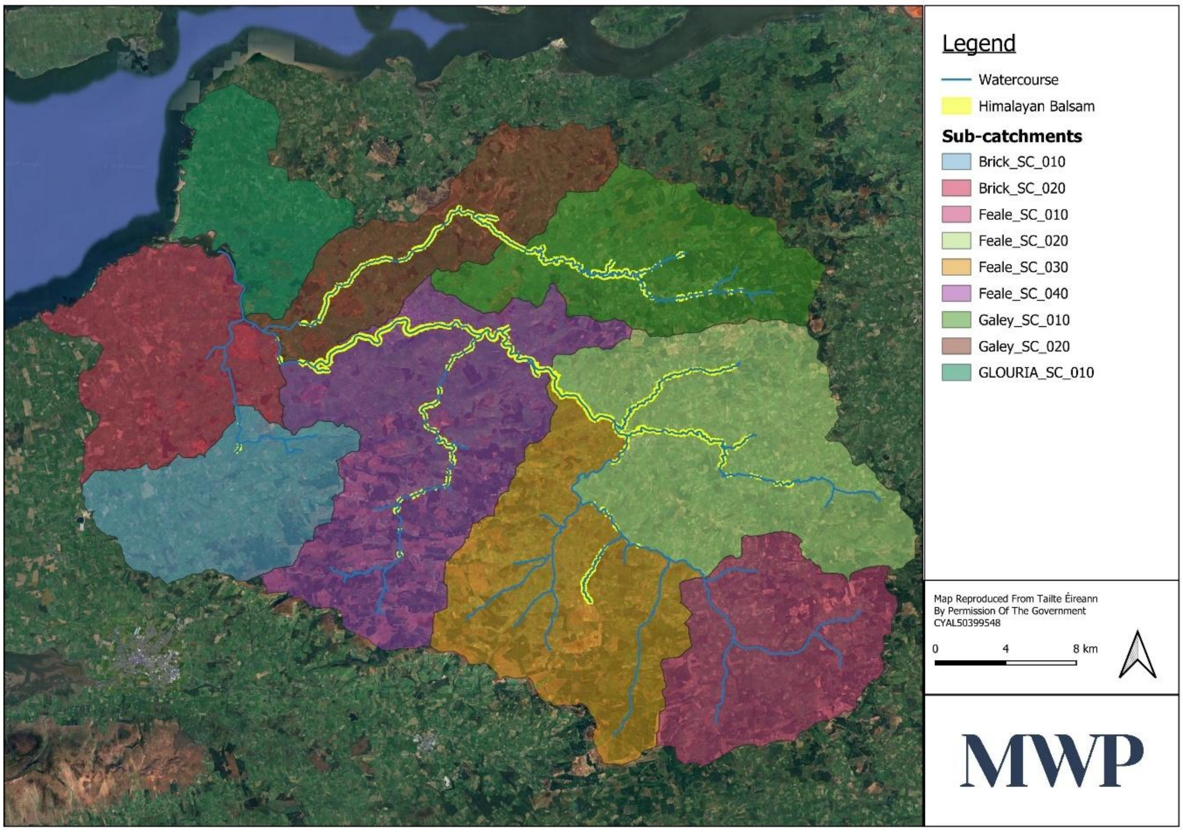

Figure 5: Overview of distribution of Himalayan balsam within the River Feale Catchment.

Given its extensive distribution and capacity for rapid spread through seed dispersal along watercourses, Himalayan balsam should be treated as a high-priority species for management within the catchment, with coordinated control measures implemented to minimise further expansion and to protect native riparian vegetation.

Figure 6: Example of Himalayan balsam heavily infested riparian site recorded within the Feale _SC_040 sub-catchment.

4.2.4.1 Recommendation for River Feale Catchment

Effective management of Himalayan balsam within the River Feale catchment will require a phased, integrated strategy that combines professional contractor intervention, community involvement and targeted landowner engagement. Access to riparian areas in this catchment is limited by private agricultural land, steep banks and variable channel widths, meaning that initial knock-down should be undertaken by trained contractors during Year 1, when infestations are largest and most challenging to reach. This approach aligns with experience from the River Tweed catchment, where large upstream clusters were first reduced by specialist teams before community-led maintenance was adopted.

In Years 2 and 3, control can be expanded to include community 'balsam bashing' groups, local farmers and landowners through structured volunteer events near settlements, public amenities and easily accessed reaches. Short workshops should be provided to ensure that participants pull plants correctly, avoid seed dispersal, recognise late-emerging cohorts and understand upstream–downstream sequencing. Farmers can contribute effectively where infestations are within fields or field margins, but require guidance on biosecurity to prevent inadvertent spread via livestock, machinery or fodder movement. From experience in the Tweed catchment, off-river sites respond particularly well to manual pulling and often require fewer annual revisits, making them rewarding targets for volunteer groups.

Control should be scheduled before flowering (typically mid-May to late June) and repeated within the same season to address staggered germination. Treatment must commence at the uppermost recorded sites in each sub-catchment and progress downstream to minimise re-infestation. Smaller satellite patches, which act as seed sources, should be prioritised early in the programme.

Herbicide should be reserved for densely colonised or inaccessible reaches and applied only by trained operatives using aquatic-approved products under licence. However, findings from the Tweed catchment demonstrate that eradication using chemical control alone is difficult to sustain at catchment scale, as Himalayan balsam can germinate over an extended period, requiring multiple return visits per season and complicating early detection due to the small size of new plants. While herbicide can suppress Himalayan balsam along riparian corridors, it is therefore costly and time-consuming to use as a sole eradication method, and must be combined with manual removal and repeat visits. Repeated treatment over multiple seasons (minimum two) is required to exhaust the seedbank, followed by a five-year monitoring programme.

Disposal of Plant Material

Cut, pulled or sprayed plants should ideally be left on site to minimise risk of spread through transport, but care must be taken to prevent regrowth or seed production. Plants bearing seed heads must not be moved or composted in the open.

- Small quantities: Spread plants thinly in exposed locations away from the water's edge so roots dry out quickly. Avoid piling, as this can allow re-rooting.
- Larger quantities: Pile plants securely under a tarpaulin or jute cover to exclude light and allow decomposition. Subject to regulatory approval, burial may be an option—plant and soil material should be buried at least 1 m below ground level and compacted to exclude air and light.
- Seed-bearing material: If covering or burial is not feasible, on-site burning may be undertaken under the relevant waste-exemption authorisation and with approval from the local authority or the Environmental Protection Agency (EPA).
- Off-site transport: Where off-site disposal is unavoidable, material must be treated as controlled waste and taken only to a licensed waste-disposal facility.

Post-Control Restoration and Aftercare

Following eradication, soil that may contain Himalayan balsam seed should not be disturbed or reused until the year after no new seedlings are observed. Treated areas will be vulnerable to erosion and recolonisation, particularly along exposed riverbanks. To reduce these risks, a meadow or riparian grass mix should be sown immediately after the first treatment, with mowing maintained for 2–3 years to suppress late germination. Where erosion risk is high, fast-rooting native species such as *Salix* spp. should be planted to stabilise soil and promote natural regeneration.

Biological control using rust fungus remains experimental in the UK and Ireland, with mixed success across biotypes. It may offer long-term suppression but is not currently recommended as a primary tool in the River Feale catchment.

This phased approach—beginning with professional suppression, followed by community stewardship and ongoing monitoring—will ensure consistent upstream-to-downstream pressure, effective biosecurity, and the long-term protection of riparian biodiversity within the River Feale catchment.

Table 3: Recommended delivery model options for Himalayan balsam control within the River Feale catchment.

Delivery Model	Strengths	Limitations	Recommended Use
Contractors	Trained, insured, and competent in difficult terrain; can access steep or hazardous	Higher cost; limited availability within seasonal windows.	**Year 1** initial suppression at priority upstream sites and extensive, inaccessible stands.

Delivery Model	Strengths	Limitations	Recommended Use
	riverbanks; efficient knock-down of large stands.		
Community Groups	Cost-effective; supports local stewardship; suitable for easily accessed reaches near towns and paths.	Require supervision and training; variable capacity; safety considerations.	**Years 2–3** follow-up pulling and removal on accessible banks, parks, and amenity areas.
Farmers/Landowners	Daily proximity to infestations; good site knowledge; rapid response to regrowth on margins.	Biosecurity risk via machinery, livestock, and fodder; limited awareness of correct pulling technique.	**Ongoing** control on field margins, drains, and tributaries following brief training and guidance.

4.3 Japanese Knotweed

4.3.1 Species Description

Japanese knotweed is a rhizomatous, herbaceous perennial introduced from East Asia that forms dense stands typically 2–4 m tall (Bailey & Conolly, 2000). In summer it produces dense thickets of purplish, bamboo-like stems with large, triangular leaves, while above-ground canes die back in winter but remain structurally persistent, providing limited cover for native vegetation (NNSS, 2015). The species regrows annually from extensive creeping rhizomes and can regenerate from fragments as small as a few millimetres (Brock et al., 1995). Rhizomes can spread laterally up to c. 7 m from the parent plant, and extend vertically to depths of around 3 m, with deeper penetration reported in disturbed ground or where imported material has been placed.

4.3.2 Negative Ecological Impacts

Japanese knotweed significantly lowers biodiversity by outcompeting native plants. Riparian habitats invaded by knotweed exhibit reduced invertebrate abundance, species richness and biomass as well as lower plant diversity compared to uninvaded sites. This then can have a negative impact on amphibians, birds, reptiles and mammals that rely on these habitats (Gerber et al., 2014). Knotweed has also been shown to exert allelopathic effects, releasing chemicals that inhibit the growth of native riparian plants like nettles (*Urtica dioica*) (Moravcová et al., 2011). Furthermore, its leaf litter in streams alters species composition within aquatic ecosystems (Lecerf et al., 2007).

In Ireland and the UK, Japanese knotweed can damage built infrastructure by exploiting weaknesses in masonry, retaining walls, paths and flood embankments, and can accelerate bank instability along river corridors (Environment Agency, 2013; TII, 2020a). Its resilient rhizome system can penetrate cracks in hard surfaces, block drainage systems and exacerbate erosion following winter dieback (Environment Agency, 2013). Vegetation contributes to riverbank roughness, helping dissipate hydraulic energy during spate events; however, winter dieback of Japanese knotweed removes this protective vegetative layer, increasing local shear stress and accelerating bank erosion (Caffrey, 1999).

4.3.3 Removal Options

The Code of Practice for the management of Japanese knotweed has been developed by experts in the control of this species and is informed by the successes and failures of multiple Japanese knotweed management programmes in the United Kingdom, including guidance from the Environment Agency, the Invasive Non-Native Specialists Association (INNSA), the Property Care Association (PCA), and recommendations from organisations such as Invasive Species Ireland. Therefore, the guidance provided represents the best available guidance on the different treatment options.

The following outlines a number of recognised treatment/management options available for developers, consultants and contractors.

- Herbicide treatment: (in situ) over a period of time, usually between 3-5 years. Treatment and monitoring required.
- Stockpiling/bunding: excavation and movement of Japanese Knotweed material to an area within a site where it will not be disturbed. Creation of a bund, and subsequent monitoring and treatment with herbicide.
- Burial on site: excavation of Japanese Knotweed material with burial at another part of the site at an appropriate depth (5m), encapsulated in root membrane to prevent re-growth. Monitor and treatment of any re-growth.
- Root barrier membrane: prevention of horizontal and vertical growth of Japanese Knotweed by installing a vertical and/or horizontal membrane barrier.
- Screening/sifting: excavation of Japanese Knotweed material and screening (sieving) the material. The soil is classed as controlled waste and may be used on site but must be located where it will not be disturbed. This soil will then need to be monitored for at least two growing seasons and any re-growth treated with herbicide as per the stockpiling treatment above, or dug out (usually manually), before control can be considered complete. Contaminated material is removed/disposed of safely and correctly.
- Removal to landfill: excavation and transport of Japanese Knotweed material to a licensed landfill using haulage vehicles. Monitoring of the area will still be required and, although all rhizome material should have been removed, any re-growth treated with herbicide

4.3.3.1 Chemical Removal

The chemical control options outlined below are recognised methods for the treatment of Japanese knotweed within riparian environments. These approaches are based on practical field experience and are supported by national good-practice guidance issued by the Environment Agency, the Invasive Non-Native Species Secretariat (NNSS), Invasive Species Northern Ireland (Good Practice Management Guide, 2018), Transport Infrastructure Ireland (TII, 2020), and specialist industry bodies such as the Invasive Non-Native Specialists Association (INNSA) and the Property Care Association (PCA). The recommendations also draw on the Root-Barrier Guidance Note (2019) and relevant legislative requirements under the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2011). These approaches are suitable for use by developers, consultants and contractors with appropriate herbicide certification and authorisation for work near watercourses.

- Foliar Spray Application:
  Application of aquatic-approved glyphosate-based herbicides directly onto foliage during late summer to early autumn, when downward translocation to rhizomes is maximised. Suitable for mature, accessible stands; typically repeated annually over 3–5 growing seasons. Care is required to avoid spray drift into watercourses or onto non-target vegetation.

- Stem Injection:
  Direct injection of concentrated herbicide into mature canes using a calibrated injector gun. Highly

selective, minimising impacts on neighbouring vegetation and reducing the risk of off-target contamination. Particularly useful along watercourses, near sensitive habitats, and in mixed-vegetation settings. Usually undertaken when stems are ≥10 mm in diameter.

- Cut-Stem Application (Plug/Drip):
  Stems are cut close to the base and herbicide gel or liquid is applied to the freshly cut surface, enabling uptake into the vascular tissue. Appropriate where stems are too dense, short or small for injection. Minimises drift risk in narrow riparian corridors.
- Knotweed Wiper / Weed-Wiper Techniques:
  A contact-based application method used where foliar spraying presents drift risk (e.g., narrow riparian margins, proximity to water). Herbicide is transferred directly to foliage using a treatment pad or device, minimising off-target impacts.
- Sequential Chemical Suppression (Phased Reduction):
  Gradual chemical control over successive seasons to avoid sudden exposure of bare soil on unstable riverbanks. Helps reduce bank-slumping and erosion risk following dieback of dense stands.
- Spot Treatment of Regrowth:
  Targeted follow-up applications to emerging shoots and satellite plants, particularly along banks following high-flow events. Essential for preventing recolonisation via transported fragments.
- Dormant-Season Stem Spray (Limited Situations):
  Application during late autumn after senescence in situations where access is difficult during peak growth season. Less effective than summer applications; typically used only as supplementary treatment.
- Combined Chemical Protocols (Hybrid Approach):
  Integration of foliar spraying and stem injection in alternating years to improve penetration into extensive rhizome networks. Recommended for mature stands with high cane density.

Chemical treatment should be repeated over a minimum of 3–5 years, with annual monitoring to identify late regrowth. Lack of visible growth is not confirmation of eradication, as rhizomes may remain viable below ground.

All herbicide applications near water must be undertaken by trained and certified operatives using aquatic-approved formulations. In the Republic of Ireland, removal, disturbance and transport of Japanese knotweed requires a licence from the National Parks and Wildlife Service under the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2011). Written consent or consultation may also be required where works occur within or adjacent to designated sites (e.g., SACs, SPAs).

4.3.3.2 Biocontrol

CASE STUDY: BIOCONTROL DEMONSTRATING AND MONITORING THE USE OF BIOLOGICAL CONTROL AGENTS

Biocontrol The RAPID LIFE Project[17] has supported CABI's work on biological control of Japanese knotweed (*Fallopia japonica*) across England. The biocontrol agent used by CABI for control of Japanese knotweed is a psyllid insect (*Aphalara itadori*). It is a knotweed specialist and sucks sap from the leaves, damaging the plant. More information on CABI's work with Japanese knotweed can be found here: www.cabi.org/japaneseknotweedalliance. Psyllids were released and monitored at 13 sites across England

[17] Laymans_Report_for_RAPID_LIFE.pdf Accessed on 18.10.2024

through the RAPID LIFE Project. The psyllids have struggled with overwintering due to England's cold, damp weather, so for future releases, CABI are considering other psyllid strains better adapted to this kind of climate.

4.3.3.3 Alternative Control Methods

Thermo-electric treatment refers to the application of high temperatures to above-ground tissues using specialist heat delivery systems such as superheated steam, boiling water, infrared burners or propane torches (Shaw et al., 2016). These methods cause rapid desiccation and cell collapse in treated canes and foliage, effectively suppressing above-ground biomass. However, current evidence indicates that thermal applications do not achieve lethal temperatures at the depth of the rhizome network, even when repeated (Jones et al., 2018; CABI). Japanese knotweed rhizomes frequently extend >50 cm beneath substrates, including alluvial soils and gravel/cobble banks (TII, 2020).

While thermal methods may temporarily reduce stem density, they should be considered short-term suppression tools only, not eradication solutions (INNSA, 2018). Their application along riparian corridors introduces additional risks including disturbance of viable rhizome fragments and increased dispersal during high-flow events (Environment Agency, 2016), as well as localised bank instability or burning hazards (Shaw et al., 2016). The repeated energy inputs required to maintain suppression make the approach economically inefficient at catchment scale (Jones et al., 2018).

Consequently, thermo-electric treatments are not recommended as a primary management strategy within the River Feale Catchment. They may be used in very limited situations where temporary non-chemical top-kill is required (e.g., access clearance, restricted herbicide licensing windows), but must be followed by recognised herbicide or controlled excavation approaches to prevent re-establishment (TII, 2020).

4.3.4 Distribution within the River Feale Catchment

Japanese knotweed was the second most frequently recorded high-impact invasive species within the Feale catchment, identified in six sub-catchments (see Table 1).

It is distributed throughout the River Feale, from the lower to the upper reaches, and is particularly abundant along the Smearlagh River and Allaghaun River. Additional occurrences were noted along the Owveg River, Clydagh River, and Knockfinnisk Stream. Please see Figure 7 for an overview study area scale distribution map and Figure 8 for a photograph of Japanese knotweed recorded in the Galey_SC_010 sub-catchment.

Detailed mapping for Japanese knotweed distribution recorded within the Feale catchment is provided in Appendix 2.

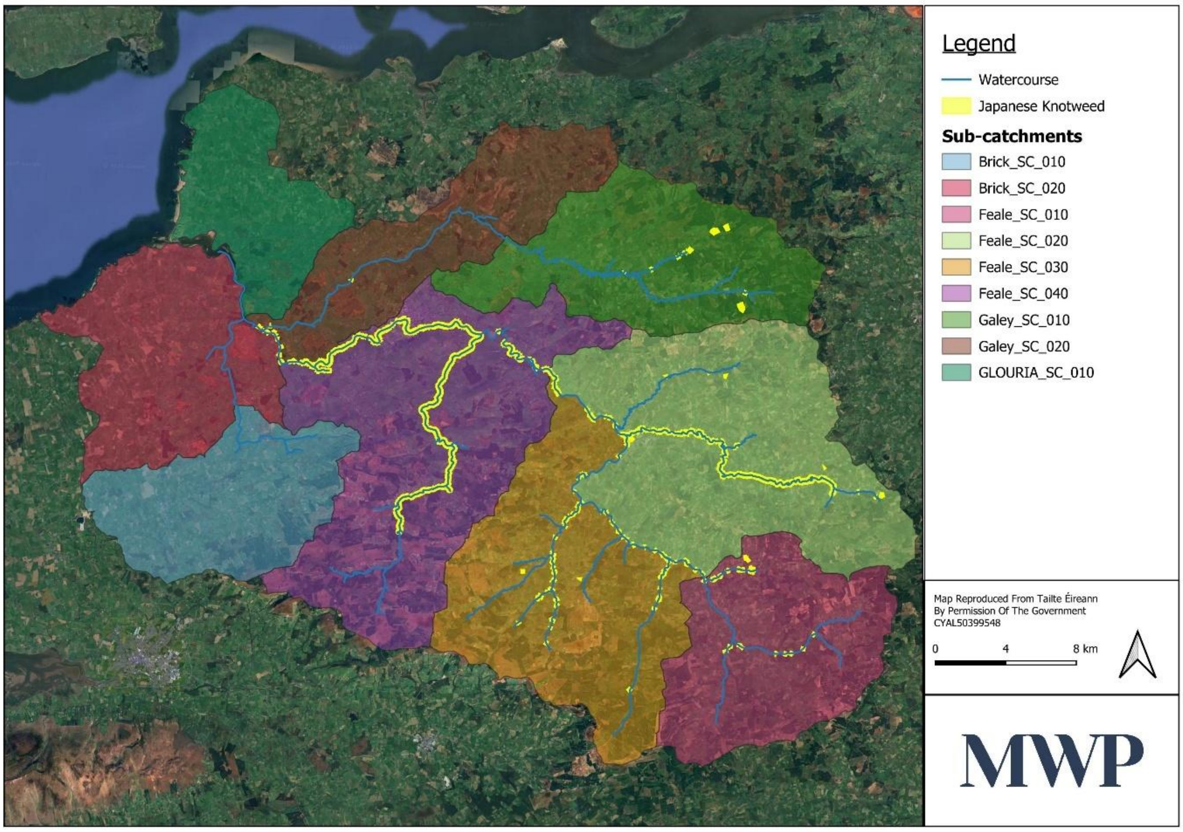

Figure 7: Distribution of Japanese knotweed within the River Feale Catchment.

Owing to its extensive rhizome network, rapid vegetative spread, and potential to damage riparian habitats and infrastructure, Japanese knotweed should be treated as a high-priority species for control within the catchment, requiring sustained, coordinated management to contain its spread and reduce its long-term impact on riverbank stability and biodiversity.

Figure 8: Japanese knotweed stand recorded within the Galey_SC_10 sub-catchment.

4.3.4.1 Recommendation for River Feale Catchment

Effective control of Japanese knotweed within the River Feale catchment will require a long-term, coordinated programme focused on gradual suppression rather than rapid eradication. Experience from the Tweed Invasives Project demonstrates that meaningful reduction across a river network can be achieved only where actions are consistently delivered upstream-to-downstream over multiple seasons, with all landowners participating under a single coordinated framework (Tweed Forum, 2020). In practice, this means annual visitation of known sites, routine follow-up of previously treated stands, and the maintenance of accurate spatial records of all infested areas.

Initial treatment should prioritise dense, well-established stands located on flood-prone banks, where rhizome exposure can accelerate erosion and contribute to downstream dispersal during high flows. Contractors holding Pesticide Application qualifications (QQI 5N1797 / QQI 5N0731)[18] should undertake primary treatments, particularly in difficult terrain or where stands are extensive. Once infestations have been reduced to scattered patches, responsibility can transition to landowners and trained local operatives, as was successfully achieved in later phases of the Tweed programme. This shift reduces long-term reliance on contractors and builds local stewardship, which is essential for sustained suppression.

The use of glyphosate-based products remains the most reliable method for riverine knotweed control, delivered via targeted foliar spraying, cut-and-spray techniques, or stem injection in sensitive habitats. However, the Tweed

[18] Professional pesticide application in Ireland requires completion of the nationally accredited QQI pesticide-application modules—QQI 5N1797 (Boom Sprayer Pesticide Application) and QQI 5N0731 (Hand-Held Pesticide Application)—as set out by the Department of Agriculture, Food & the Marine (DAFM, 2015).

experience highlights the importance of correct dilution: concentrations that are too strong can scorch foliage without affecting the rhizome, while concentrations that are too weak risk inducing resistance. Treatment should occur late in the growing season (August–September) when systemic translocation to rhizomes is highest. All herbicide use adjacent to watercourses must comply with Irish legislation, including consent under the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477/2011), and may require licensing from the National Parks and Wildlife Service prior to application.

Annual mapping is a critical component of knotweed management. The Tweed project demonstrated that simple area-based mapping becomes ineffective as infestations contract and become sparser; at this stage, recording the GPS location of every individual stem is required to prevent re-establishment. Fixed-point photography should be adopted from Year 1 to provide visual evidence of progress and to support stakeholder communication. Sites classified as "inactive" should continue to be monitored for at least five years, given documented cases of late rhizome reactivation.

It is also important to anticipate biosecurity pathways. Lessons from the Tweed catchment indicate that disturbance associated with construction, utility works and riverbank access can spread rhizome fragments into new areas. Accordingly, soil handling protocols, on-site containment, and machinery hygiene measures should be embedded in construction environmental management plans throughout the catchment.

While excavation-based methods such as stockpiling, screening and burial can be used on development sites, they are rarely suitable along active riverbanks due to erosion risk, access constraints, and the potential dispersal of contaminated material. The Tweed project found that herbicide-led reduction, supported by native vegetation recovery, yielded the most efficient outcomes along riparian corridors.

Finally, sustained budgetary planning is essential. Costs will initially decline as density reduces but will eventually plateau, because the same ground must be revisited annually even when few stems remain. The Tweed experience shows that cessation at this plateau results in rapid resurgence, undermining decades of investment. Therefore, a long-term, catchment-level funding mechanism, combined with annual landowner engagement, will be required to protect ongoing gains.

Table 4: Chemical treatment techniques with respective strengths and limitations.

Technique	Strengths	Limitations	Recommended Use
Foliar Spray	Cost-effective; efficient for mature, dense stands; strong systemic translocation late summer.	Risk of drift to water or non-target plants; requires suitable weather and access.	Primary suppression of large stands where non-target vegetation is limited and safe access is available.
Stem Injection	Highly selective; minimal drift; effective near sensitive habitats; targets rhizome directly.	Labour-intensive; requires stems ≥10 mm diameter; slower on large areas.	Close to watercourses, native vegetation, public amenity areas, or in mixed-species riparian swards.
Cut-stem Application	Targeted dosing; avoids drift; suitable when canopy height/structure prevents injection.	Requires access to each stem; repeat treatment often required; some regrowth risk.	Narrow riparian margins, dense mixed vegetation, areas with controlled access where foliar spray is unsuitable.

4.4 Giant Hogweed

4.4.1 Species Description

Giant hogweed is recognised as one of the most invasive plant species found in Britain and Ireland today. The high nutrient soils and warmer climate allows seeds to germinate rapidly and this has led to it becoming extremely invasive[19]. It is a tall (2-5 m when mature)[20] perennial herb with a pale-yellow roots. It can take a plant 3-5 years to reach maturity, flower, set seed and die with plants producing up to 50,000 seeds per plant. When these enter waterways, they can be transported great distances to colonise new areas[21]. This plant has become established in Ireland and is found to be locally abundant, naturalised and invasive (Reynolds, 2002).

4.4.2 Negative Ecological Impacts

This plant can form dense stands which can reduce the number of other plants species within the area it is growing in (Thiele & Otte, 2007). When these plants die back in winter the exposed bare soil can be eroded easily along riverbanks. This can have a negative impact on salmonid spawning as the soil influx can create unsuitable gravel substrates (Caffrey, 1999). Dead leaves can also cause blockages in water courses[22].

Giant hogweed poses a significant human health concern as the sap can cause phytophotodermatitis within 24-48 hours after exposure. This can, in severe cases, cause blistering of the skin and localised hyper-pigmentation which can last for months and even years (Thiel & Otte, 2007). Due to this and its ability to from dense stands it restricts access to rivers for leisure or inspection purposes.

No significant insect or pathogen control has been identified for this plant.

4.4.3 Removal Options

4.4.3.1 Chemical

Given the health risks, treatment must be carried out by a professionally trained operator. Giant hogweed seeds can remain viable for up to 15 years, but this is more the exception than the rule with the majority dying after three years.

A four-year eradication program should follow the following steps:

- Strict adherence to health and safety and appropriate PPE must be worn.
- An approved herbicide applied to all plants in spring and autumn.
- The site must then be monitored and any live plants sprayed.

---

[19] Giant Hogweed Control and Solutions from INVAS Biosecurity | Invasive Species Specialists & Environmental Consultants Accessed 09.01.25

[20] Heracleum mantegazzianum (giant hogweed) | CABI Compendium Accessed 09.01.25

[21] Giant Hogweed Control and Solutions from INVAS Biosecurity | Invasive Species Specialists & Environmental Consultants Accessed 09.01.25

[22] Species Profile Browser · Species Profile Accessed 09.01.25

- If and when any further live plants flower, the flower heads should be removed and burned.[23]

4.4.3.2 Biocontrol

CASE STUDY: MACDUFF GRAZING TRIALS (2019 – 2022)[24]

Sheep grazing (biocontrol) – evidence from the River Tweed district (Macduff, River Deveron). The Scottish Invasive Species Initiative (SISI) ran a four-year grazing trial in riparian woodland at Macduff on the River Deveron (2019–2022) to test whether a managed flock could suppress giant hogweed without herbicides. NatureScot reported that the trial effectively reduced the spread of giant hogweed, with monitored plots showing declining plant occurrence where grazing pressure was maintained (and adjusted to avoid overgrazing of natives). Operational lessons included: start with conservative stocking and fine-tune livestock units (LUs) through the season (the Macduff trial reduced annual grazing pressure from c. 0.3 to 0.07 LU ha^{-1} over successive years to maintain control while protecting non-target vegetation); fence and sign access routes; provide water/shade; and retain annual monitoring to catch escapes or seed heads beyond browsing height.

The approach proved most suitable in fenced, manageable blocks with limited public interaction and where dense, shade-tolerant hogweed made herbicide application difficult. SISI emphasises that grazing is a site-specific, supplementary tool—effective for repeated depletion of plant vigour—but still requires periodic inspection for late-emerging or tall flowering plants that may need manual removal.

4.4.4 Distribution within the River Feale Catchment

Giant hogweed was recorded in three sub-catchments within the Feale catchment, with the majority of records concentrated along the Ballincraheen Stream in the Brick_SC_010 sub-catchment. Additional occurrences were identified along the Allaghaun River and the Galey River. For an overview study area scale distribution map see **Figure 9** and **Figure 10** for a photograph of Giant hogweed recorded in the Galey_SC_010 sub-catchment.

Detailed mapping for giant hogweed distribution recorded within the Feale catchment is provided in **Appendix 2.**

[23] Giant Hogweed Control and Solutions from INVAS Biosecurity | Invasive Species Specialists & Environmental Consultants Accessed 09.01.25

[24] Sheep grazing management guidance | Scottish Invasive Species Initiative (SISI) Accessed 06.11.2025

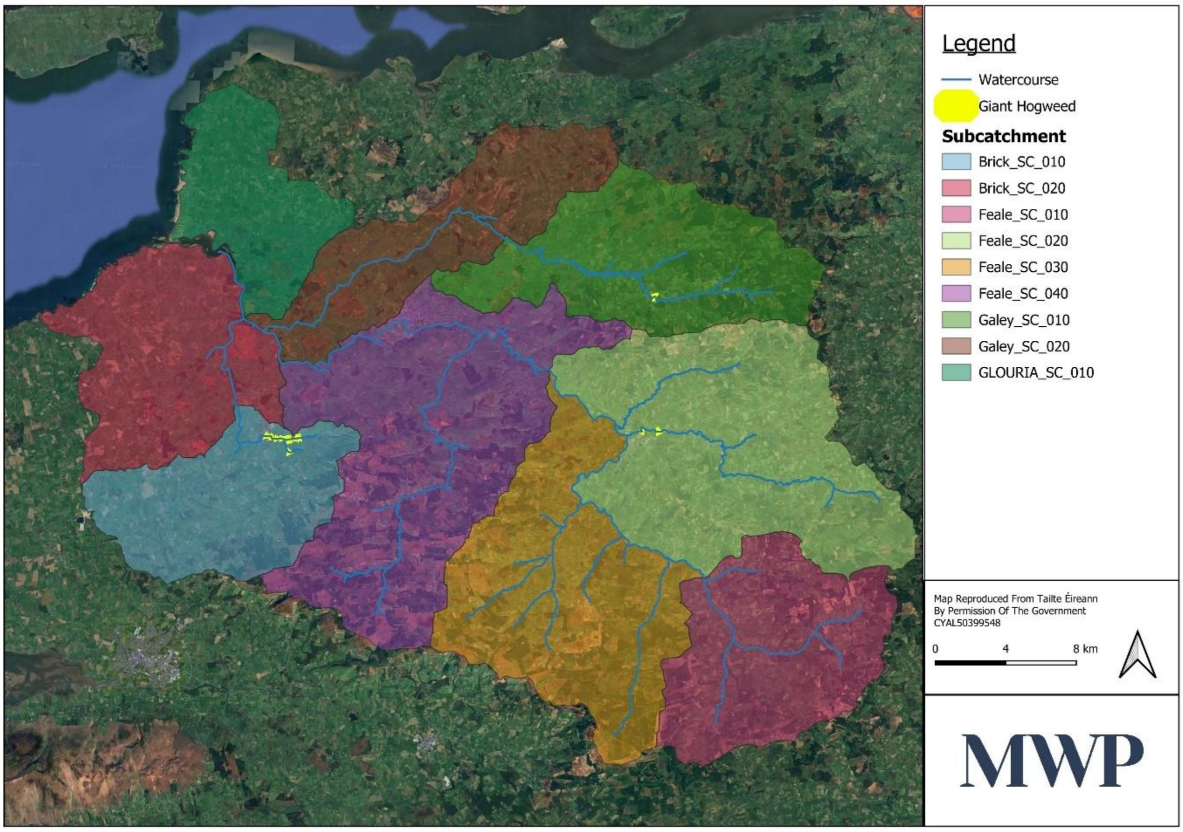

Figure 9: Distribution of Giant hogweed within the River Feale catchment.

Although its current distribution is highly localised, the population along the Ballincraheen Stream should be prioritised for treatment to prevent downstream spread through seed dispersal. Given its limited extent elsewhere in the catchment, giant hogweed is not considered a high-priority species at present, but continued monitoring and early intervention remain essential to ensure it does not expand into new riparian areas within the catchment.

Figure 10: Giant hogweed stand recorded within the Galey_SC_10 sub-catchment.

4.4.4.1 Recommendation for river Feale Catchment

Effective management of giant hogweed within the River Feale catchment will require a coordinated, long-term strategy combining chemical, selective mechanical and potentially biological control measures. The principal control method should involve the targeted application of aquatic-approved glyphosate herbicides by certified contractors between May and early July, before flowering and seed set, using foliar spray or stem-injection techniques depending on site access and proximity to watercourses.

The Tweed Invasives Project (Tweed Forum, 2020) demonstrated that large-scale success against giant hogweed requires a catchment-wide, upstream-to-downstream framework, in which every known plant is treated and revisited annually. Treatment must focus first on mature flowering plants to prevent seeding, followed by repeated spraying of emerging seedlings in subsequent years. The project also highlighted that multi-year herbicide programmes—typically three to five consecutive seasons—are essential to deplete the persistent seedbank, and that cessation of control too early results in rapid reinfestation. Full foliar coverage during spraying was found to be critical, as partial application left plants viable. Within the Feale catchment, similar principles should apply: dense upstream infestations should be prioritised initially, followed by annual downstream progression and rigorous mapping using GPS or fixed-point photography to monitor outcomes.

In smaller or isolated infestations, selective root-cutting below the crown can be effective if undertaken before flowering, but mechanical disturbance such as strimming or flailing should be avoided due to the risk of sap exposure and fragment dispersal. In suitable agricultural areas, controlled sheep grazing offers a valuable supplementary tool once major infestations have been reduced. Evidence from the Scottish Invasive Species Initiative (SISI) trial on the River Deveron (2019–2022) demonstrated that sustained grazing significantly weakened hogweed stands and prevented flowering, with seasonal adjustment of stocking rates to protect native vegetation. Within the Feale catchment, a grazing programme could be particularly beneficial in later years where farmers or landowners already keep sheep, provided that sites are securely fenced, signed, and monitored. Grazing should begin in early spring and continue through midsummer, supplemented by manual removal of tall flowering stems beyond browsing height.

Following suppression, treated banks should be stabilised through natural regeneration or replanting with native riparian species such as *Salix spp*. to reduce erosion and recolonisation potential. Lessons from the Tweed also demonstrated that once herbicide control reduced dense infestations, natural vegetation recovery often stabilised banks without the need for major replanting.

Long-term success in the Feale catchment will depend on sustained follow-up, strict biosecurity, and continuous coordination between NPWS, local authorities and participating landowners. A dedicated catchment-wide database of treated sites, coupled with multi-year funding and farmer participation, will be essential to ensure consistent control, prevent reinfestation and achieve lasting reduction of giant hogweed populations along the River Feale and its tributaries.

Table 5: Recommended treatment techniques for giant hogweed.

Technique	Strengths	Limitations	Recommended Use
Foliar Spray	Proven, efficient method for large infestations; effective before flowering; supports catchment-scale coordination.	Requires certified operatives and NPWS consent; drift risk to non-target plants; multiple years of follow-up needed.	Primary treatment for extensive infestations along accessible riverbanks; apply May–July prior to seed set.
Stem Injection	Highly targeted; minimal risk of drift; suitable near sensitive habitats or public paths.	Labour-intensive; slower for large stands.	Use for individual or small groups of plants close to watercourses, infrastructure or public-access areas.
Selective Root-Cutting (Below Crown ~15 cm)	Immediate removal of individual plants; avoids chemical use.	Labour-intensive; unsuitable for large dense stands; sap-exposure hazard.	Small or isolated infestations where chemical use is restricted and access allows safe removal
Controlled Sheep Grazing (Biocontrol)	Sustainable follow-up control; suppresses regrowth and prevents flowering; low chemical input.	Requires fencing, stock availability, and supervision; less effective on steep banks or public areas.	Later-phase management where landowners already keep sheep; spring–summer grazing with ongoing monitoring

4.5 Giant Rhubarb

4.5.1 Species Description

This is large herbaceous perennial plant with rhubarb like leaves that can grow up to 2 m across (Stace, 1997). The nature of its growth means it can outcompete native plants and significantly changes the seed bank community. In areas where giant rhubarb (*Gunnera tinctoria)* is present it can represent 53 - 86% of the seedlings and additionally alters the seed bank so that it is dominated by agricultural weeds (Gioria & Osborne, 2009).

It is widespread in Ireland but relatively localised. *Gunnera* can grow in a variety of habitats, such as waterways, roadsides grassland, quarries, bog, heath, coastal cliffs and agricultural fields (Reynolds, 2002).

4.5.2 Negative Ecological Impacts

Giant rhubarbs massive leaves enable it to out-shade other herbaceous plants and grasses. It spreads rapidly by rhizome and seed to form extensive mono-typic stands and can block drainage ditches, streams and obstruct access (NRA, 2010). When the plants die back the exposed riverbanks are left vulnerable to erosion. On rivers it causes erosion to banks, exposing them to fast running water after die-back in winter[25].

4.5.3 Removal Options

4.5.3.1 Manual

Manual removal of *Gunnera* is suitable for small or recently established infestations where access allows safe excavation and where chemical control is either impractical or undesirable due to environmental sensitivity. Individual plants or small clusters can be removed using shovels or mattocks, ensuring that the entire rhizome and crown are excavated, as even small fragments are capable of regenerating if left in situ (Armstrong et al., 2009; Invasive Species Northern Ireland, 2024). All flowering heads should be removed and securely contained to prevent seed dispersal, as the species produces abundant, highly viable seed that can readily spread via watercourses or soil movement (Invasive Species Ireland, 2021). Excavation is most effective during the growing season (late spring to early summer) when plants are fully emerged and rhizomes are more easily located. Following removal, disturbed soil should be compacted and stabilised, and native riparian vegetation such as *Salix* spp. or *Phalaris arundinacea* established to prevent erosion and recolonisation. Sites must be monitored within one year of the initial removal to detect any regrowth from residual rhizomes or seedlings, with follow-up inspections and spot removal continued annually for at least three years to ensure effective control (Williams et al., 2005; Invasive Species Northern Ireland, 2024).

Excavated material, including rhizomes and any contaminated soil, must be handled as controlled waste under the Waste Management Acts. Disposal by deep burial is recommended where feasible (Armstrong et al., 2009), while Mayo County Council (undated)[26] advises alternative on-site treatment options such as leaving excavated plants to decay within sealed black plastic sheeting or allowing material to dry and subsequently burning it under controlled conditions).

4.5.3.2 Chemical

Chemical control represents one of the most effective methods for managing extensive stands of giant rhubarb, particularly along riparian corridors where excavation is not feasible or may increase erosion risk. Giant rhubarb can be effectively controlled using the application of glyphosate-based herbicides, which have demonstrated significant suppression when applied at the correct timing and concentration (Armstrong et al., 2009; Invasive Species Ireland, 2021). Application should take place just before plant die-back, typically between August and September, when the leaves remain green and systemic translocation of herbicide to the rhizome is most efficient (Williams et al., 2005). Multiple treatments are usually required, as viable rhizome fragments may persist following initial control; therefore, sites must be monitored annually and re-treated as necessary to prevent regrowth (Williams et al., 2005).

For large or mature plants, the cut-and-paint method is recommended—cutting the leaf stalks and immediately applying glyphosate to the exposed tissue—while the drill-and-inject method can be used by drilling several holes

[25] Gunnera Tinctoria Control and Solutions from INVAS Biosecurity | Invasive Plants Specialists

[26] Page-2-7-Gunnera-Leaflet-(1).pdf

into the rhizome and filling them with herbicide to ensure deep penetration (Armstrong et al., 2009; Invasive Species Ireland, 2021). These targeted approaches minimise off-target effects and are particularly suitable for use near watercourses or within designated conservation sites. Herbicide application must employ aquatic-approved formulations and be carried out by trained, certified operatives under licence and with prior consent from the National Parks and Wildlife Service, in accordance with the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477/2011). All treated areas should be re-inspected annually to confirm plant die-back, and revegetation with native riparian species is advised to stabilise soil and reduce recolonisation potential.

4.5.4 Distribution within the River Feale Catchment

Giant rhubarb was recorded on five occasions within the River Feale catchment, occurring in the sub-catchments Feale_SC_020, Feale_SC_030, and Feale_SC_040. Three of these records were located along riverbanks — two on the lower reaches of the River Feale and one in the upper reaches within a private garden adjacent to the river. An additional bankside record was identified along the Allaghaun River. Two further records were located beside roads, approximately 200 m from the Clydagh River and along a farm track in proximity to the Glashacooncore River. For an overview study area scale distribution map see **Figure 11** and see **Figure 12** for a photograph of giant rhubarb recorded in Feale_SC_030 sub-catchment.

Detailed mapping for giant rhubarb distribution recorded within the Feale catchment is provided in **Appendix 2.**

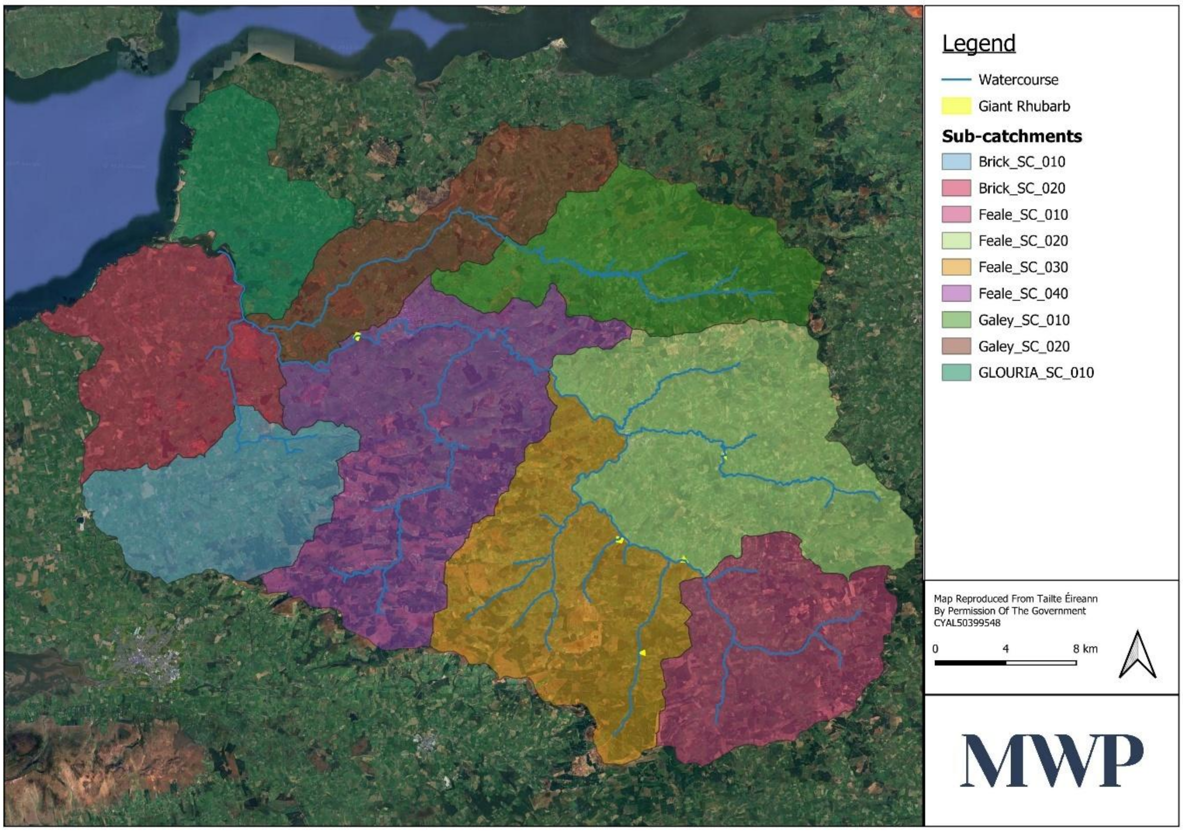

Figure 11: Distribution map for giant rhubarb within the River Feale catchment.

The management of giant rhubarb should focus on rapid localised eradication and long-term containment. The objective should be to remove all known occurrences while preventing further spread through early detection, appropriate disposal, and annual monitoring.

Figure 12: Giant rhubarb recorded within the Feale_SC_30 sub-catchment.

4.5.4.1 Recommendations for River Feale Catchment

The management of giant rhubarb within the River Feale catchment should prioritise rapid, localised eradication and long-term containment, given its very limited and isolated distribution. The primary goal should be to remove all known occurrences while preventing further spread through early detection, correct disposal, and annual follow-up monitoring.

Eradication should focus on the four known sites (fifth site is located in private garden) using aquatic-approved glyphosate herbicides, applied in late summer (August–September) before leaf dieback, when herbicide translocation to rhizomes is greatest. Treatments should be carried out by trained, licensed contractors using foliar spray, cut-and-paint, or drill-and-inject techniques, depending on site access and proximity to watercourses. Given the low infestation levels, two to three annual treatments are expected to achieve full suppression, followed by annual inspections for at least five years to confirm eradication and detect any rhizome regrowth.

In smaller or sensitive sites, manual excavation remains a practical and effective option. Plants should be carefully dug out, ensuring full removal of rhizomes and crowns. All excavated material must be handled as controlled waste under the Waste Management Acts, and disposed of via deep burial, sealed black plastic decay, or controlled drying and burning (Armstrong et al., 2009; Mayo County Council, undated). Disturbed soils should be stabilised and replanted with native species such as *Salix* spp. or *Phalaris arundinacea* to reduce erosion and recolonisation risk.

As several recorded occurrences lie on private riparian farmland, early engagement with landowners will be essential to ensure appropriate treatment, disposal and follow-up monitoring. Landowners should be provided with biosecurity guidance to prevent accidental spread via machinery, livestock or soil movement. In addition, records located along roadways and farm tracks should be treated and removed in coordination with the Local Authority (e.g., Kerry County Council) to ensure proper disposal and to prevent further spread through roadside maintenance or soil disturbance.

Although giant rhubarb is not considered a primary IAPS of concern in the River Feale catchment, its eradication at this early stage is highly feasible and should be pursued proactively. A site-led, precautionary approach focused on immediate removal, annual surveillance, and strong cooperation between NPWS, local authorities, and landowners will prevent the species from becoming more widely established within the catchment

Table 6: Recommended techniques for giant rhubarb.

Technique	Strengths	Limitations	Recommended Use
Manual Excavation (Shovel or Mattock)	Immediate removal of rhizomes; avoids herbicide use; suitable for isolated plants; effective in sensitive areas.	Labour-intensive; regrowth possible if rhizomes not fully removed; requires safe access.	Preferred method for small or single plants along field drains, road verges, or private gardens; ideal for the three riverside and roadside locations.
Cut and Paint	Highly targeted; reduces drift risk; suitable near sensitive habitats, infrastructure, or watercourses.	Labour-intensive; requires immediate application after cutting; less practical for dense or tall stands.	Primary chemical control for mature plants on steep or unstable banks where excavation could cause erosion.
Drill and Inject (Rhizome injection)	Directly targets rhizome; minimal off-target impacts; highly effective for isolated mature plants.	Time-consuming; requires skill and specialised equipment; not suitable for large infestations.	Individual plants or small clusters near water or high-sensitivity areas.
Foliar Spray	Efficient for accessible medium-sized stands; covers canopy effectively; proven long-term control.	Drift risk to non-target vegetation; must use aquatic-approved herbicide; repeat treatments likely.	Secondary control method at riverside clusters where safe access allows full foliar coverage.

4.6 Rhododendron

4.6.1 Species Description

Rhododendron is a densely branched evergreen shrub that can grow up to 5m tall, with distinctive mauve/purple flowers (Stace, 1997). It can reproduce both by seed and vegetatively by layering its branches where they touch the ground. After 12 years, a naturally seeded plant can set seed and can produce > a million seeds (Cross, 1975). This is a common and widespread plant that can grow in various habitats including peatland, woodland, grassland and even in sandy soil, however it is not commonly found in urban areas (Reynolds, 2002; Stace, 1997). Rhododendron seedlings favour disturbed areas and have been found to have difficulty establishing in land dominated by native vegetation (Hulme, 2009).

4.6.2 Negative Ecological Impacts

Rhododendron is an extremely invasive plant species, particularly in the more humid western parts of Ireland forming dense impenetrable thickets (Maguire *et al.,* 2008). This in turn reduces native biodiversity at these infested sites.

Rhododendrons dense growing pattern means it can crowd out native plants and form monocultures (Barron, 2007). This impacts on community level processes of rivers and streams where it grows (Hladyz et al., 2011). Rhododendron may also be able to supress the growth of native species by the production of alleopathic chemicals in soil in which it is present (Hulme, 2009). It is also a host for another invasive *Phytophthora ramorum* (Sudden oak death), which can negatively impact numerous species of tree (though not Oak) (Brennan et al., 2008). Honey made from nectar from rhododendron may also be toxic to humans (Hulme, 2009). The cost of controlling this species in the UK cost ~£560 per ha in 2001 (Dehnen-Schmutz et al., 2004).

4.6.3 Removal Options

The same management practices can be carried out for both Rhododendron and Cherry laurel.

Removal program follows three phases:

- Phase 1/preliminary clearance – year 1;
- Phase 2/advance clearance and ensure effectiveness of phase 1 - year 1-3;
- Phase 3/maintenance every 6 – 8 years after year 8 (Higgins, G.T. 2008).

4.6.3.1 Manual and Chemical Treatment

Rhododendron regrows vigorously when cut. As a result, some method of stump killing or removal is always necessary. Any untreated cut stump will regrow and in most cases flower within 3-4 years. Treatment programmes can be divided into 3 main stages: initial removal, control of stems and roots, and follow up (Maguire *et al.,* 2008).

<u>Initial removal</u>

Rhododendron can be cut down at any time of year; the herbicide glyphosate can also be applied throughout the year, however May to October inclusive is a sub-optimal period. Of principle concern when cutting and/or moving vegetation or surrounding soil is the movement of viable seeds. As such the optimal time for cutting is outside the flowering and fruiting period.

Stems should be cut as close to the ground as possible using a chainsaw or hand tools. This material can then be chipped and removed from site to prevent reinfestations. The chipped material can be reused to provide a weed barrier around garden plants (Maguire *et al.,* 2008).

<u>Control of stems and roots</u>

The removal of above ground growth will not prevent regrowth as rhododendron will regrow from cut stems and stumps. There are four recommended methods to achieve successful management after the initial cut and removal:

1. Digging the stumps out. The effectiveness of this technique is increased by removing all viable roots. This can be done manually depending on the size of the infestation. To avoid regrowth, stumps should be turned upside down and soil should be brushed off roots.

2. Direct stump treatment by painting or spot spraying freshly cut low stumps with a herbicide immediately after been cut. Glyphosate (20% solution), tryclopyr (8% solution) or ammonium sulphate (40% solution) are known to be effective during suitable weather conditions i.e. dry weather. The herbicide concentrations used and timings of applications vary according to which chemical is used. Use of a vegetable dye is recommended to mark treated stumps and all stumps should be targeted. A handheld applicator will help avoid spray drift onto surrounding non-target species. Specific manufacturers guidelines should be adhered to when using herbicides.

3. A variation on the stump treatment method is stem injection, using a 'drill and drop' methodology, whereby, if the main stem is cut and is large enough for a hole to be drilled into it, the hole can be used to facilitate the targeted application of glyphosate (25% solution). The main drawback is that the dead plant may persist in situ for 10-15 years therefore it may not be the preferred method in this site.

4. Stump regrowth and seedlings can be effectively killed by spraying regrowth with a suitable herbicide, usually glyphosate. Best practice spraying protocols should be carefully followed. General broadcast spraying is not as effective as stump spot treatment and has the potential to impact on surrounding non-target species. Rhododendron leaves are thick and waxy, for herbicide treatment to be effective each individual leaf needs be thoroughly wetted with herbicide to kill the plant (Maguire *et. al.,* 2008).

Follow up

Follow up treatment and maintenance if required every 6 – 8 years after year 8.

4.6.4 Distribution within the River Feale Catchment

Rhododendron was recorded on 128 occasions within the River Feale catchment. The species was most frequently observed along the Clydagh River and Galey River, particularly in their upper reaches, as well as along the River Feale upstream of Listowel, where it occurs in several concentrated clusters. Additional occurrences were recorded along the Knocknacurra, Smearlagh, and Oolagh Rivers, with a small number of sporadic records also found elsewhere along the River Feale main channel. For an overview study area scale distribution map see **Figure 13** and see **Figure 14** for a photograph of rhododendron found in Feale_SC_030 sub-catchment.

Detailed mapping for Rhododendron distribution recorded within the Feale catchment is provided in **Appendix 2.**

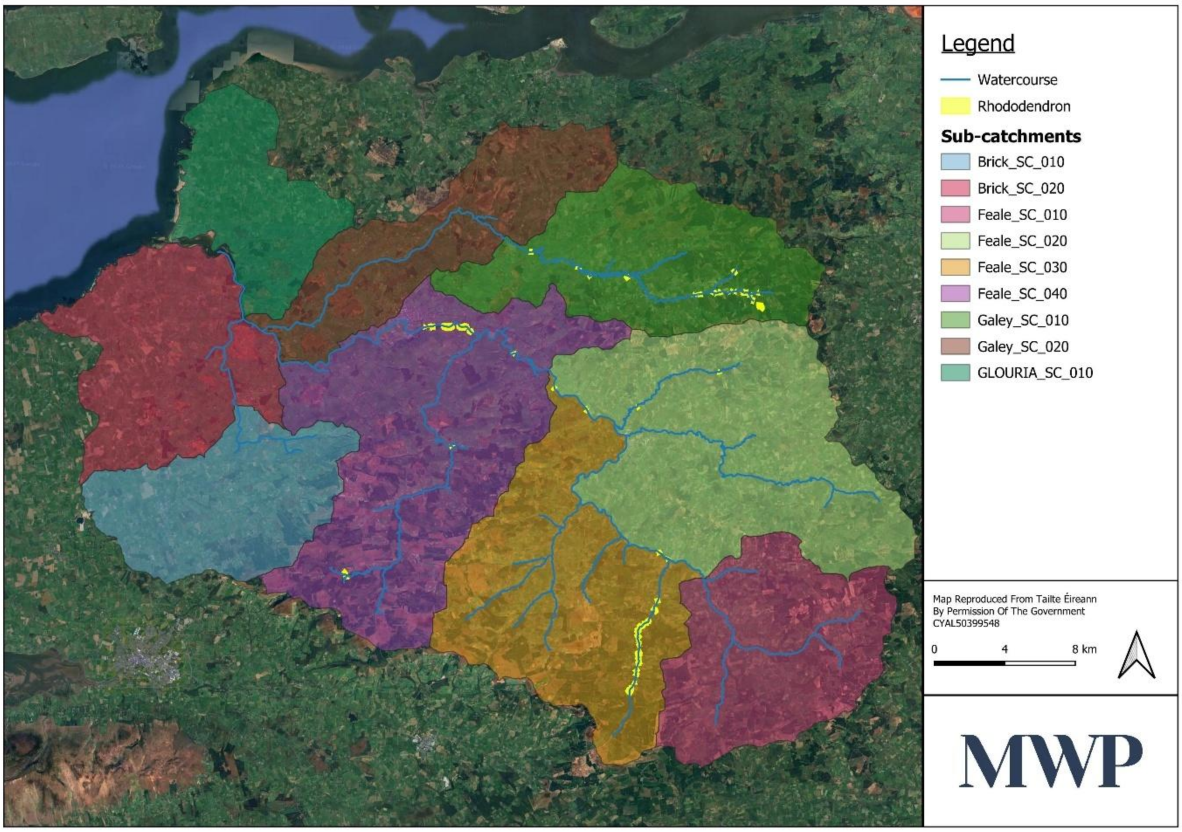

Figure 13: Distribution of Rhododendron within the River Feale catchment.

Figure 14: Rhododendron recorded within the Feale_SC_30 sub-catchment.

4.6.4.1 Recommendations for River Feale Catchment

Although rhododendron is recognised as a high-impact invasive shrub in terrestrial and woodland habitats, its direct influence on river processes is generally lower than that of riparian species such as Himalayan balsam, Japanese knotweed and giant hogweed, which directly destabilise banks and alter sediment dynamics. Most documented impacts of rhododendron occur within woodland and shaded riparian margins, where it forms dense thickets that suppress native ground flora, inhibit natural regeneration, and alter soil chemistry through litter accumulation and acidification (Maguire et al., 2008). These effects reduce overall biodiversity and, while direct hydromorphological or aquatic impacts are limited (Stockan & Fielding, 2013), rhododendron can significantly degrade alluvial wet woodland by displacing native understorey species and preventing natural succession, thereby undermining the conservation status of this priority habitat and qualifying interest within the Lower River Shannon SAC.

Accordingly, while rhododendron may not require intensive riparian intervention throughout the entire catchment, it should be prioritised for control in areas within or adjacent to the SAC, particularly where it threatens alluvial wet woodland, a qualifying interest of the Lower River Shannon SAC.

Elsewhere, control should be undertaken opportunistically, especially where rhododendron overlaps with treatment zones for higher-impact IAPS. Management efforts should focus on the containment and phased reduction of established stands, rather than widespread clearance, with particular attention given to upstream infestations in the Clydagh and Galey catchments to reduce further encroachment into riparian zones. Control should follow best practice protocols: cut-stump application of glyphosate or triclopyr, followed by multi-year monitoring for regrowth (Maguire et al., 2008).

4.7 Cherry Laurel

4.7.1 Species Description

Cherry laurel is an evergreen shrub, that can grow up to 10m tall (Stace, 1997) forming dense thickets. It’s leaves contain poisonous cyanide (Maguire et al., 2008). It can be found in a variety of habitats including bogs, grassland, and artificial habitats, it is however common in woodland (Stokes et al., 2004). Laurel spreads vegetatively by suckering and layering, seeds may also be spread by birds (Reynolds, 2002).

4.7.2 Negative Ecological Impacts

Cherry laurel forms dense thickets, shading out native ground flora and preventing the regeneration of trees and shrubs (Maguire et al., 2008; Reynolds et al., 2017). It’s tough, cyanogenic leaves decompose slowly, releasing phenolic compounds that acidify soils and suppress microbial activity, reducing nutrient cycling and soil fertility (Kelly et al., 2016). These conditions result in simplified understorey structure and poor habitat quality for native invertebrates, birds and small mammals (Reynolds et al., 2017). The plant’s fruits are readily dispersed by birds, enabling rapid colonisation along woodland edges and riparian corridors, while its ability to resprout from cut stumps allows it to persist and outcompete native vegetation (Maguire et al., 2008; NNSS, 2015).

4.7.3 Removal Options

The management of cherry laurel broadly follows the same principles as those applied to Rhododendron, as both are evergreen woody shrubs that regenerate vigorously from cut stumps and roots. However, a number of practical distinctions influence treatment choice and sequencing. As with rhododendron, effective control requires a three-stage approach consisting of initial removal, chemical stump treatment and long-term follow-up monitoring to prevent regrowth. Plants should be cut close to ground level during the dormant period, outside the flowering and fruiting season, and all freshly cut stumps treated immediately with an appropriate herbicide such as glyphosate or triclopyr to prevent coppicing (Maguire et al., 2008). This step is essential, as untreated stumps typically reshoot within months and quickly form dense thickets.

The leaves are thicker and waxy, rendering foliar spraying less effective; therefore, direct cut-stump application is the preferred control method (CABI, 2017). Burning of cut material is not recommended due to the release of toxic cyanogenic compounds when the leaves are incinerated (NNSS, 2015). Instead, chipped or cut material should be left to decay under cover or composted securely on site. Laurel tends to occur on drier banks and shaded woodland edges rather than the wetter, acidic habitats typically favoured by rhododendron, so site access and ground conditions often allow for more mechanical removal (Reynolds et al., 2017). Treated sites should be revisited annually for at least three years to address regrowth and new seedlings. Replanting or natural regeneration of native woodland or riparian species should be encouraged to restore structure and prevent recolonisation. Overall, while Cherry laurel can be controlled using similar techniques to Rhododendron, its faster coppicing response, bird-mediated dispersal and toxic leaf chemistry require closer monitoring, careful disposal and more frequent retreatment to ensure effective long-term suppression (Maguire et al., 2008).

4.7.4 Distribution within the River Feale Catchment

Within the River Feale catchment, cherry laurel was recorded most frequently in the Feale_SC_030 and Feale_SC_010 sub-catchments, particularly along the Clydagh River and upper Feale reaches, with occasional occurrences in Feale_SC_020, Feale_SC_040 and Galey_SC_010. For an overview study area scale distribution map see **Figure 15** and see **Figure 16** for a photograph of cherry laurel found in Feale_SC_030 sub-catchment.

Detailed mapping for Cherry laurel distribution recorded within the Feale catchment are provided in **Appendix 2.**

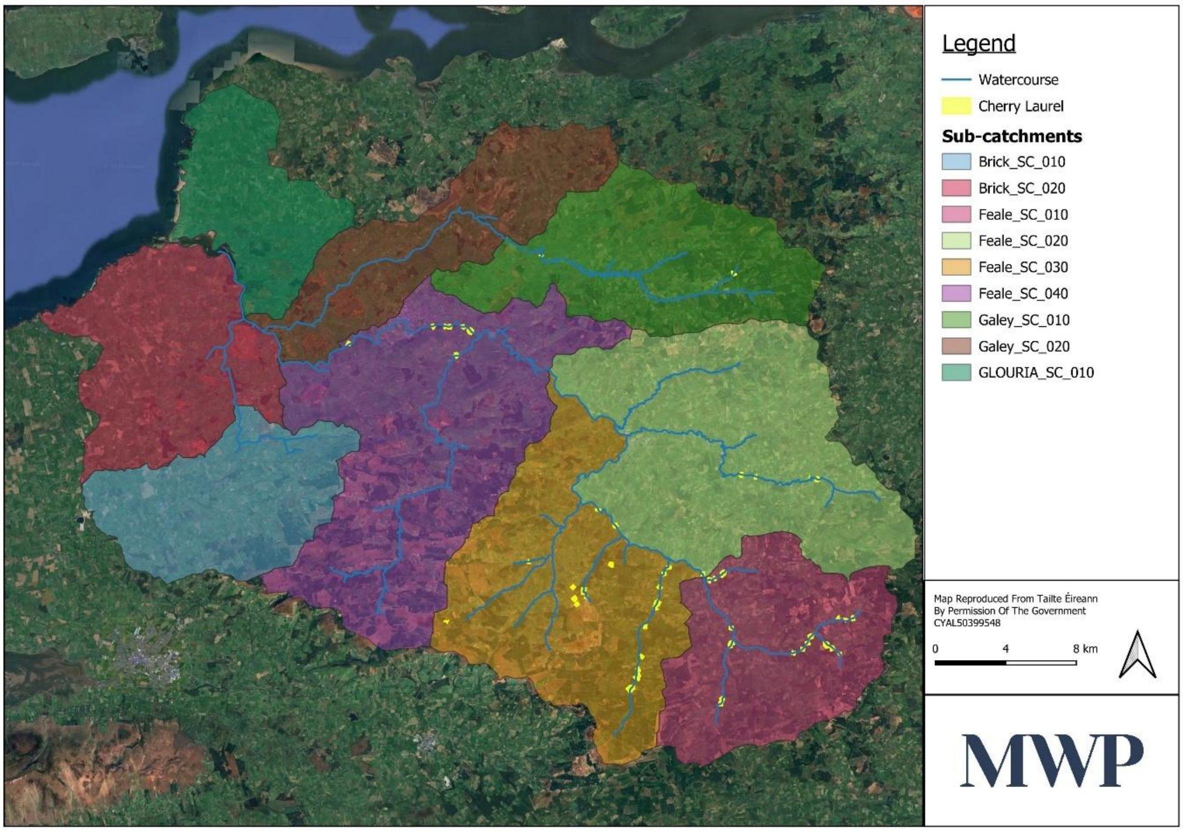

Figure 15: Distribution of Cherry laurel within the River Feale catchment.

Given its restricted distribution and limited influence on riverbank stability or hydromorphology, cherry laurel should be treated as a secondary management priority, with control integrated into broader woodland restoration and IAPS containment programmes, while primary resources are directed toward species with greater riparian impact potential.

Figure 16: Cherry laurel recorded within the Feale_SC_030 sub-catchment.

4.7.4.1 Recommendation for River Feale Catchment

Although cherry laurel is widely recognised as a high-impact invasive shrub within woodlands, the evidence base for direct aquatic or hydromorphological impacts remains limited. Most riparian IAPS management programmes prioritise species such as Himalayan balsam, Japanese knotweed and giant hogweed for their well-documented roles in bank erosion, sediment mobilisation and in-channel habitat alteration, while cherry laurel is generally treated as a secondary woodland-edge invader, primarily affecting shade levels, soil chemistry and regeneration within riparian woodlands rather than river processes (Maguire et al., 2008). This approach reflects wider UK and Scottish practice, where catchment-scale IAPS strategies—such as the Clyde and Ayrshire INNS Strategy (NatureScot, 2019) and the Tweed Invasives Project (Tweed Forum, 2020)—have focused control on high-impact riparian plants, with cherry laurel addressed only opportunistically as part of woodland restoration works.

4.8 Other invasive plant species encountered

Nine other invasive plant species were encountered and recorded within the study area during the survey period. For distribution maps of these species (except montbretia), see **Figure 17**, below.

- Bamboo (*Bambusoideae spp.*)
- Butterfly-bush (*Buddleja davidii*)
- Fuchsia (*Fuchsia magellanica*)

- Himalayan knotweed (*Persicaria wallichii*)
- Lesser knotweed (*Persicaria campanulate*)
- Montbretia (*Crocosmia x crocosmiiflora*)
- Salmonberry (*Rubus spectabilis*)
- Snowberry (*Symphoricarpos albus*)
- Spanish bluebell (*Hyacinthoides hispanica*)

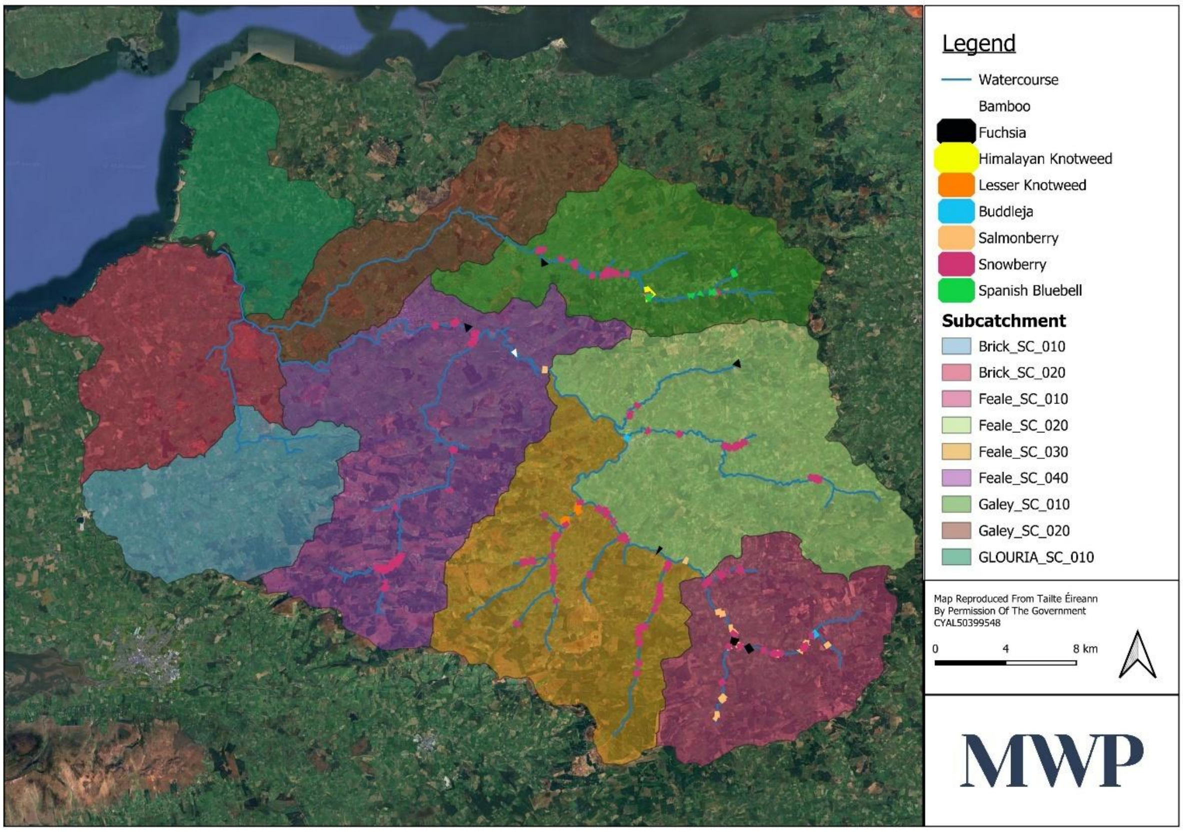

Figure 17: Distribution of medium impact and low impact invasive species (except montbretia) within the River Feale catchment.

4.8.1 Bamboo

Bamboo (several species in the subfamily Bambusoideae) is a fast-growing, rhizomatous perennial that can form dense monocultures through underground spread, often several metres from the original planting (Invasive Species Northern Ireland, 2024). Its rapid vegetative growth and dense clump formation allow it to crowd out native plants, while its substantial and persistent litter layer further suppresses germination and growth of surrounding vegetation (Invasive Species Northern Ireland, 2024). Some bamboo species may also emit allelopathic chemicals that inhibit the growth of other plants (Invasive Species Northern Ireland, 2024). Once established, bamboo can be difficult to control or fully remove because the rhizome network is expansive and persistent.

Only a single occurrence of Bamboo was recorded within the Feale_SC_040 sub-catchment, located along the main channel of the River Feale, see **Figure 18**, below.

Figure 18: Bamboo observed along the River Feale in Feale_SC_040 sub-catchment.

4.8.2 Butterfly-bush

Butterfly-bush is a deciduous shrub native to China and Japan, introduced across Europe as an ornamental plant and now naturalised throughout Ireland and the UK. It produces large quantities of lightweight, wind-dispersed seeds that readily colonise disturbed and nutrient-poor substrates, including walls, quarries, railway embankments and riverbanks (NNSS, 2015). The species thrives in open, well-drained conditions, where it can rapidly form dense thickets that outcompete native early-successional vegetation. In riparian environments, butterfly-bush often establishes on exposed alluvium, gravel bars and flood embankments, where its shallow root system provides limited soil cohesion and can contribute to bank instability when plants are uprooted during high flows (EPPO, 2020).

Although valued by pollinators, butterfly-bush can reduce overall native floral diversity and alter successional pathways by suppressing the regeneration of native shrubs and trees (Salisbury et al., 2017). Dense stands may also impede access for river management and maintenance operations. The species is classed as an invasive alien plant in several European countries and is listed by the NNSS as an established invasive species of concern in Britain

Butterfly-bush was recorded on only two occasions within the catchment: once in the Feale_SC_010 sub-catchment, at the upper reaches of the River Feale beside the church car park in Rockchapel (see **Figure 19**, below), and once in the Feale_SC_020 sub-catchment, along the River Feale near Abbeyfeale.

Figure 19: Butterfly-bush recorded at church carpark in Rockchapel, next to River Feale in Feale_SC_010 sub-catchment.

4.8.3 Fuchsia

Fuchsia is a deciduous shrub native to South America that has become widely naturalised in the west of Ireland and parts of the UK, especially in mild, high-rainfall coastal areas. Originally introduced as an ornamental hedging plant, it has escaped cultivation and now occurs frequently along roadsides, field margins and riparian corridors. The species reproduces both by seed and through vegetative layering, forming dense thickets that can exclude native herbaceous and shrubby vegetation (Reynolds, 2002).

In riparian environments, fuchsia can stabilise banks through its fibrous root network, but dense stands reduce native plant diversity and alter habitat structure. Its prolific flowering and shading can suppress natural regeneration of willow and alder communities, particularly in sheltered river valleys (CABI, 2022). Once established, fuchsia can withstand cutting and moderate flooding, making eradication difficult without repeat intervention. Although not regarded as a high-impact riparian invasive species compared with Himalayan balsam or Japanese knotweed, it can locally dominate marginal habitats and displace native flora where left unmanaged.

A total of six fuchsia records were documented within the River Feale catchment. Two occurrences were recorded in the Feale_SC_010 sub-catchment along the River Feale, with a further two in Feale_SC_020 along both the River Feale and the Oolagh River (see **Figure 20**). The remaining two records were noted along the River Feale in the Feale_SC_040 sub-catchment and along the Galey River in Galey_SC_010.

Figure 20: Fuchsia along the Oolagh River in Feale_SC_020 sub-catchment.

4.8.4 Himalayan Knotweed

Himalayan knotweed is a robust perennial herb that spreads vegetatively, forming dense colonies of erect reddish-brown stems up to 120 cm (and occasionally 180 cm) in height, with lanceolate to elliptic-lanceolate leaves and branched flower spikes. It thrives in a wide range of habitats – including disturbed ground, roadsides, forest margins and riparian zones – and is recognised as a “widely spread species” in Northern Ireland, subject to stringent management measures. The species is highly invasive because of its rapid growth, ability to out-shade native vegetation and its capacity to regenerate from relatively small fragments of stems or rhizomes. It causes serious ecological impacts by suppressing native flora, reducing species richness and altering habitat structure; it is also notoriously difficult and expensive to control.[27]

Only a single record of Himalayan knotweed was identified within the Feale catchment, located along the upper reaches of the Galey River in the Galey_SC_010 sub-catchment.

[27] Invasive Species Northern Ireland Accessed on 11/11/2025

Figure 21: Himalayan knotweed along Galey River in Galey_SC_010 sub-catchment.

4.8.5 Lesser Knotweed

Lesser knotweed is generally considered to be non-invasive owing to its limited dispersal ability, although it can become abundant in gardens. It spreads over short distances by stolons. It does not reproduce by seed in Ireland or the United Kingdom. Dispersal of rhizomes is the main mechanism of dispersal, usually deliberately, but on riverbanks and roadsides this can occur naturally or accidentally. In towns throughout Great Britain and generally established in the wild only in the west, the species is sparsely distributed in Ireland, with most records occurring in the south from the southwest to the southeast, and additional scattered occurrences in the west, north and northwest[28].

Nine records of Lesser knotweed were documented within the Feale catchment, all occurring along the lower reaches of the Owveg River in the Feale_SC_030 sub-catchment (see **Figure 22**). As the species is highly localised and all records are clustered within a small area, these sites should be monitored regularly to detect any early signs of spread and to enable rapid response if expansion occurs.

[28] Species Profile Browser · Species Profile Accessed on 11/11/2025

Figure 22: Lesser knotweed along the Owveg River in Feale_SC_030 sub-catchment.

4.8.6 Montbretia

Montbretia is a hybrid perennial between *C. aurea* and *C. pottsii*, native to South Africa and introduced to Europe in the late nineteenth century as a garden ornamental. It has since naturalised widely across Ireland and western Britain, particularly in mild, high-rainfall regions. The species grows from corms and stolons, forming dense clonal stands up to 0.6 m tall with arching, sword-like leaves and orange-red flowers in late summer (Preston et al., 2002).

Although not as aggressive as other riparian IAPS, montbretia can outcompete native ground flora, especially in damp grasslands, road verges and stream margins. Its dense growth suppresses lower vegetation, reducing species richness and altering local plant community structure (Reynolds, 2002). Along riparian corridors, it can spread vegetatively through fragmentation or soil movement during flood events, occasionally forming near-monocultures that displace native herbs and bryophytes (Preston & Croft, 1997). However, unlike Japanese knotweed or Himalayan balsam, Montbretia does not generally destabilise riverbanks or alter hydromorphological processes.

Reproduction occurs almost exclusively vegetatively, as the hybrid is sterile and produces no viable seed. Spread therefore depends on the movement of corms and stolons through soil disturbance, machinery, or informal dumping of garden waste. In Ireland, it is now among the most widespread low-impact invasive plants, typically requiring localised management only where it dominates sensitive wetland or riparian habitats.

Montbretia was the most frequently recorded invasive alien species within the Feale catchment, occurring in seven sub-catchments (see **Table 1**). It is widely spread within the River Feale and found in most of its tributaries (see **Figure 23** below). Although it is widespread, this low-impact species poses relatively limited ecological or hydromorphological risk compared with higher-impact riparian invaders such as Japanese knotweed or Himalayan balsam. Accordingly, montbretia should not be a primary focus of the catchment's IAPS management plan but should instead be subject to periodic monitoring and localised control where it dominates sensitive riparian or wetland habitats.

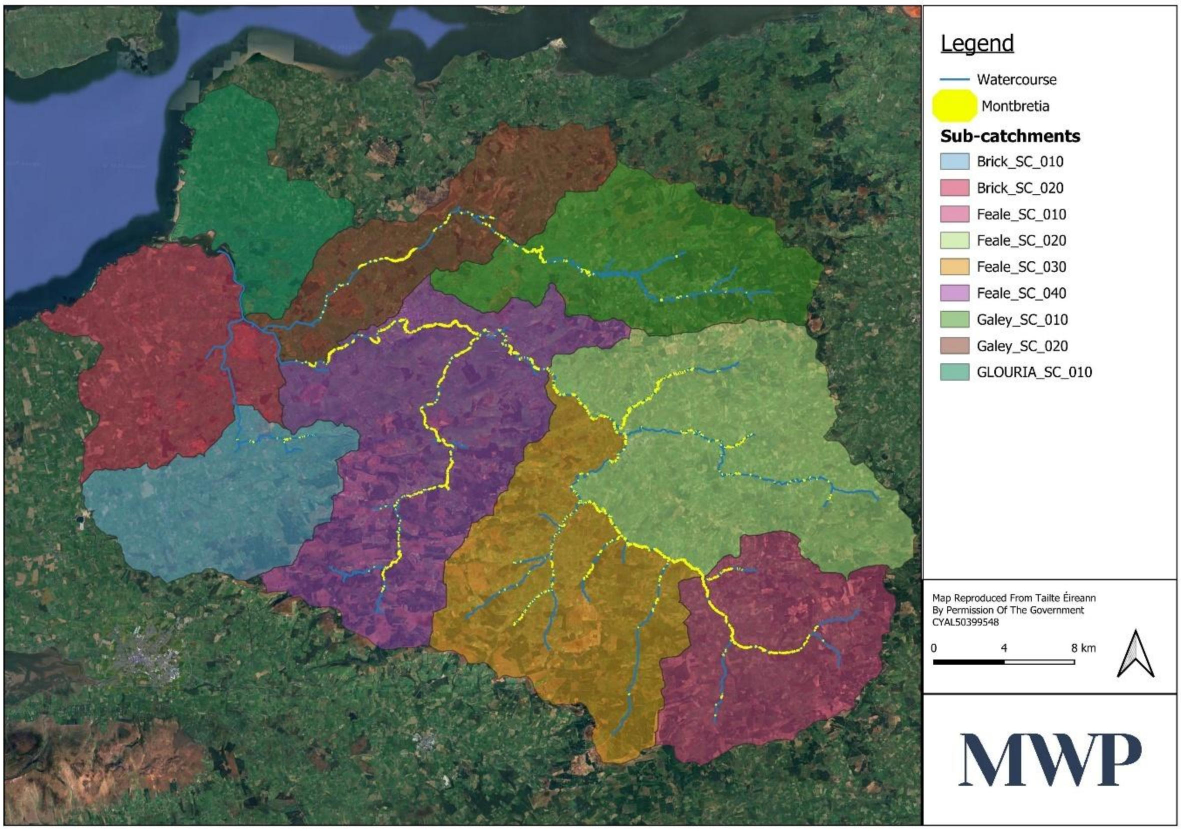

Figure 23: Distribution of Montbretia within the River Feale catchment.

Figure 24: Montbretia along the River Feale in Feale_SC_010 sub-catchment.

4.8.7 Salmonberry

Salmonberry is a vigorous, suckering shrub native to North America, now naturalised in woodland, hedgerow and river-bank habitats. The plant grows to 1–4 m tall, with trifoliate, toothed leaves and glossy yellow- to orange-red raspberry-like fruits which ripen between May and July. It spreads vegetatively through rhizome extension, suckering and layering of arching stems, and can form large thickets that outcompete native companion species and inhibit regeneration of trees and shrubs.[29]

Most salmonberry records occur within the Feale_SC_010 sub-catchment, primarily along the upper reaches of the River Feale, the Breanagh River, and one location near Knockahorrea East. Additional occurrences were recorded along the River Feale within the Feale_SC_030 (see **Figure 25**, below) and Feale_SC_040 sub-catchments.

[29] NIEA-ID-Guide-Rubus-spectabilis-Salmonberry.pdf Available on 11.11.2025

Figure 25: Salmonberry along the River Feale in Feale_SC_030 sub-catchment.

4.8.8 Snowberry

Native to North America Habitat: Hedgerows, riverbanks, estates and older or abandoned gardens.

Snowberry is a deciduous shrub that can grow to a height of 2 m. It was introduced to UK in the 1800s and was widely used as dense cover for game birds. *S. albus* has whippy, bright brown, shiny branches. Leaves usually 1.5 – 5cm long (can grow up to 7cm long), are rounded but occasionally lobed and are in an opposite arrangement. From spring to the summer, clusters of tiny bright pink, bell-like flowers 6mm long, appear at the ends of the branches. These are followed in late summer by waxy-looking, white berries which are up to 1.5cm in diameter. Snowberry spreads through suckering, in the right conditions the root system (rhizome) can grow rapidly and out-compete native plants. Once established *S. albus* can form dense thickets and suppress the growth of native plants and prevent access. Berries are poisonous to humans. Due to its ability to grow rapidly, snowberry has been used as hedging, and to stabilise riverbanks and prevent erosion, which provided a corridor for further spread[30].

Snowberry was widely recorded across the Feale catchment, with a total of 189 occurrences documented within the Feale_SC_010, Feale_SC_020, Feale_SC_030, Feale_SC_040, and Galey_SC_010 sub-catchments. The species is sporadically distributed throughout the middle and upper reaches of the River Feale, but occurs at notably higher densities along the Clydagh, Owveg, Smearlagh, and Galey Rivers, where it often forms densely distributed thickets along riparian margins.

[30] NIEA-ID-Guide-Symphoricarpos-albus-Snowberry-V3-Oct24.pdf (invasivespeciesni.co.uk) Available 17.10.2024

Figure 26: Snowberry densely distributed along the River Feale in Feale_SC_020 sub-catchment.

4.8.9 Spanish Bluebell

The Spanish bluebell is a non-native bulbous plant in Ireland, originally introduced as an ornamental and now established in a limited number of wild sites, primarily in the southeast and south of the country. It frequently forms hybrids with the native common bluebell (*Hyacinthoides non-scripta*), producing *H. × massartiana*, which is fertile and believed to pose a threat to the genetic integrity of native bluebell populations. Although the Spanish bluebell is capable of establishing in woodland, roadside and riparian habitats, its spread is regarded as limited, primarily because seed dispersal is weak and expansion depends largely on human-mediated soil or bulb movement. For this reason, the species is classified in Ireland as "Established – Low risk of impact", indicating that while it merits monitoring and prevention of further spread, it currently does not present the same level of ecological or fluvial threat as invasive species such as Japanese knotweed or Himalayan balsam.[31]

The Spanish bluebell was recorded only within the Galey_SC_010 sub-catchment, occurring primarily along the Galey River and also along the Knockfinnisk Stream.

[31] Microsoft Word - Hyacinthoides hispanica (Spanish Bluebell and Hybrid) Available 11.11.2025

Figure 27: The Spanish bluebell along the Galey River in Galey_SC_010 sub-catchment.

5. Monitoring

Long-term monitoring is essential to ensure the effectiveness of invasive plant management and to prevent re-establishment within the River Feale catchment. Each high-impact species requires a tailored follow-up schedule based on its biology, dispersal mechanism, and control method used. Monitoring should include GPS-referenced mapping, fixed-point photography, and detailed site records of treatment progress, allowing trends in regrowth or recolonisation to be tracked over multiple seasons. Table 7 below summarises the recommended monitoring frequency and duration for each high-impact species following initial control.

Table 7: Overview of High impact species recorded, their control priority status, and recommended monitoring strategy post treatment.

Species	Priority	Monitoring/Follow up
Himalayan balsam	High/catchment wide eradication	• Revisit 2-3 times per season. • Repeat annually for 3-5 years. • 5-year post control monitoring with photographic and GPS record

Species	Priority	Monitoring/Follow up
Japanese knotweed	High/catchment wide eradication	• Annual mapping of all stems. • Repeat treatment for 3-5 years. • Minimum 5-year monitoring after final treatment.
Giant hogweed	Medium/targeted local containment	• Annual site checks for 3-5 years. • Record all treated plants. • Maintain mapped dataset.
Giant rhubarb	Medium/targeted local containment	• Annual inspections for at least 5 years. • Ensure follow up treatment of regrowth. • Restore cleared sites with native vegetation.
Rhododendron	Medium/targeted local containment	• Follow up every 6-8 years. • Treat regrowth promptly. • Monitor for recolonisation.
Cherry Laurel	Low/targeted local containment	• Annual revisit for 3 years. • Remove regrowth and seedlings.

6. Further management measures:

- Measures for the prevention and eradication of invasive species should be incorporated into agri-environment schemes.
- The dissemination of information to the public and the engagement of stakeholders, particularly in the commercial sector, should be prioritised by developing online, educational and scientific resources, and by targeted public awareness campaigns.
- The use of native species in amenity planting and stocking and related community actions to reduce the introduction and spread of non-native species should be encouraged.
- Mechanical hedge cutter operators should be required to complete a short, certified invasive species course to render them qualified for the task. An offence may be avoided only if the relevant party can prove that they took all reasonable steps to avoid causing an offence under the legislation. There are many stands of IAPS that are not highlighted by signage and IAPS are spreading extensively.

The issue of IAPS is widespread in the Feale catchment. Some reaches of the Allaghaun and Smearlagh Rivers are badly infested with Japanese knotweed. As recommended by the group 'Feale Biodiversity', the eradication of IAPS along rivers should be from the top down.

Stakeholder engagement would be required prior to developing a management strategy including:

- Representatives of angling clubs including Brosna-Mountcollins, Abbeyfeale, Tralee & District and Listowel.
- Department of Agriculture, Food and the Marine (forestry and agriculture)

- Local Authority Waters Programme offices of Cork, Kerry and Limerick, and the Southwest Catchment Assessment Team
- Environmental Protection Agency
- Local Authorities of Cork, Kerry and Limerick
- Coillte
- Office of Public Works (OPW)
- Local Agricultural Sustainability Support and Advisory Programme (ASSAP) Teagasc advisors

7. Discussion

Within the River Feale catchment—part of the Lower River Shannon SAC—effective management of invasive alien plant species (IAPS) is essential to protect the ecological integrity of designated habitats and the qualifying interests they support. To safeguard these sensitive features, the overarching objective must be the progressive eradication or sustained suppression of IAPS, delivered through a coordinated, catchment-wide effort involving NPWS, local authorities, farmers and community groups. Collaboration at this scale is critical: without shared responsibility and consistent action across sub-catchments, reinvasion pathways will persist, and gains in priority areas will be rapidly undermined.

High-priority IAPS, such as Himalayan balsam and Japanese knotweed, require immediate, catchment-wide eradication efforts due to their ability to rapidly spread along river corridors, destabilise banks, suppress native vegetation and increase sedimentation pressure on sensitive habitats. A multi-year control programme led initially by trained contractors—followed by community and landowner involvement—is essential, with strict upstream-to-downstream sequencing, seasonal repeat visits, full GPS mapping and a minimum of five years of follow-up monitoring.

Medium-priority IAPS, including Giant hogweed and Giant rhubarb, are currently localised and therefore highly eradicable at this stage. Both species pose risks through seed or rhizome-driven spread and can significantly degrade riparian habitats if allowed to expand. Immediate eradication through targeted herbicide application, manual excavation where appropriate, compliant disposal and structured multi-year follow-up will prevent their establishment at larger scales.

Low-priority IAPS, such as Rhododendron, Cherry laurel, Montbretia, Snowberry, Fuchsia, Himalyan knotweed, Bamboo, Lesser knotweed and Spanish bluebell, present limited direct risk to river processes and SAC hydromorphology. These species should be monitored and managed opportunistically where they hinder native riparian restoration or show localised expansion. Most require only targeted, small-scale intervention rather than catchment-level programmes.

Across all IAPS groups, long-term success will depend on robust biosecurity, annual mapping, fixed-point photography and the development of an early-detection and rapid-response protocol focused on high-risk pathways such as agricultural machinery, construction works, angling access, roadside verges and flood events. A shared, catchment-wide framework is essential to prevent new introductions, ensure continuity of effort and maintain protection of the SAC and its qualifying interests.

8. Conclusion

The River Feale catchment supports a range of ecologically sensitive habitats and protected species within the Lower River Shannon SAC, yet it faces increasing pressure from invasive alien plant species. This management plan outlines a prioritised, catchment-wide strategy focusing on the eradication of high-impact IAPS species, containment of localised threats of medium-impact IAPS species and long-term monitoring of low risk IAPS species. Success will depend on early intervention, robust biosecurity, restoration of cleared areas, and above all, collaboration with landowners, local communities and statutory bodies. Sustained, coordinated action will be essential to protect the ecological integrity of the catchment and prevent further spread of invasive species.

9. References

Actions for Nature 2023–2030 (2023) Ireland's 4th National Biodiversity Action Plan. Department of Housing, Local Government and Heritage, Dublin.

Armstrong, N., Osborne, B. & Roche, J.R. (2009) 'Gunnera tinctoria: Ecology, impacts and control strategies', Biology and Environment: Proceedings of the Royal Irish Academy.

Bailey, J.P. & Conolly, A.P. (2000) 'Prize-winners to pariahs – a history of Japanese knotweed s.l. (Polygonaceae) in the British Isles', Watsonia, 23.

Barron, S. (2007) The Ecology and Management of Rhododendron ponticum in Irish Woodlands. Coillte Teoranta, Dublin.

Blackburn, T.M., Pyšek, P., Bacher, S., Carlton, J.T., Duncan, R.P., Jarošík, V., Wilson, J.R.U. & Richardson, D.M. (2014) 'A unified classification of alien species based on the magnitude of their environmental impacts', PLoS Biology.

Brennan, J., Gilligan, C. & O'Halloran, J. (2008) Phytophthora ramorum in Ireland. Department of Agriculture, Dublin.

Brock, J.H., Wade, M., Pysek, P. & Green, D. (1995) Plant Invasions: General Aspects and Special Problems. SPB Academic Publishing, Amsterdam.

CABI (2017) Prunus laurocerasus Invasive Species Compendium. CAB International, Wallingford.

CABI (2022) Fuchsia magellanica: Invasive Species Compendium. CAB International, Wallingford.

Caffrey, J.M. (1999) Invasive Species in Irish Waterways. Marine Institute, Galway.

CIRB Project / SEPA / SNH (2014) Controlling Invasive Riparian Plants in Scotland – Final Project Report (Ayrshire). CIRB Project / Scottish Environment Protection Agency / Scottish Natural Heritage.

Cross, J.R. (1975) 'Biology and control of Rhododendron ponticum L. in the Killarney oakwoods, SW Ireland', Proceedings of the Royal Irish Academy.

Crushell, P., Foss, P., Hurley, C. & O'Loughlin, B. (2011) County Kerry Invasive Species Survey 2011: Pilot Mapping Study of the River Lee Catchment, Tralee. Report prepared for Kerry County Council and The Heritage Council.

DAERA (2018) Invasive Alien Species in Northern Ireland: Advice and Guidance. Department of Agriculture, Environment and Rural Affairs, Belfast.

Dehnen-Schmutz, K., Perrings, C. & Williamson, M. (2004) 'Controlling Rhododendron ponticum in the British Isles: an economic assessment', Journal of Environmental Management.

DHLGH (2024) Water Action Plan 2024: A River Basin Management Plan for Ireland. Department of Housing, Local Government and Heritage, Dublin.

Early, J., Bradley, K. & McNeill, G. (2009) Field Guide to Invasive Species in Ireland. Northern Ireland Environment Agency, Belfast.

Environment Agency (2013) Managing Japanese Knotweed on Development Sites. Environment Agency, Bristol.

EPPO (2020) EPPO Global Database: *Buddleja davidii*. European and Mediterranean Plant Protection Organization.

GB Non-native Species Secretariat (2011) *Koenigia campanulata* Species Information. NNSS, UK.

Gerber, E., Krebs, C., Murrell, C., Moretti, M., Rocklin, R. & Schaffner, U. (2014) 'Exotic knotweeds (Fallopia spp.) negatively affect native plant and invertebrate assemblages in European riparian habitats', Biological Conservation.

Gioria, M. & Osborne, B.A. (2009) 'The impact of Gunnera tinctoria on soil seed bank communities', Journal of Plant Ecology.

Greenwood, P. & Kuhn, N.J. (2014) 'Does the invasive plant, Himalayan balsam (*Impatiens glandulifera*), promote soil erosion along rivers', Journal of Hydrology.

Higgins, G.T. (2008) Rhododendron ponticum Control: Technical Guidance. Forestry Commission Scotland.

Hladyz, S., Åbjörnsson, K., Giller, P.S. & Woodward, G. (2011) 'Impacts of an alien riparian shrub on aquatic macroinvertebrates', Freshwater Biology.

Hulme, P.E. (2009) 'Trade, transport and trouble: managing invasive species pathways in an era of globalisation', Journal of Applied Ecology.

Inland Fisheries Ireland (2016) Best Practice for the Control of Himalayan Balsam (*Impatiens glandulifera*). Inland Fisheries Ireland, Dublin.

Invasive Species Ireland (2021) *Gunnera tinctoria* Species Account and Guidance. Invasive Species Ireland, Belfast.

Invasive Species Northern Ireland (2024) *Gunnera tinctoria* Management Guide. DAERA, Belfast.

INNSA (2018) *Invasive Non-Native Specialists Association: Best Practice Guidance*. INNSA, UK

Jones, D., Bruce, G. and Fowler, S. (2018) 'Optimising knotweed management strategies: treatment efficacy and regrowth', *Invasive Plant Science and Management*,

IRD Duhallow (2015) Removal and Monitoring of Himalayan Balsam – Monitoring Report (Action C10). IRD Duhallow LIFE Project, Cork.

Kelly, S., Sheppard, A. & Purvis, G. (2016) 'Leaf litter chemistry and soil biodiversity impacts of invasive Cherry Laurel', Forest Ecology and Management.

Lecerf, A., Patfield, D., Boiché, A., Riipinen, M.P., Chauvet, E. & Dobson, M. (2007) 'Leaf traits and decomposition in natural streams', Freshwater Biology.

Lucy, F., Caffrey, J. & Dick, J.T.A. (2021) Invasive Alien Species in the Republic of Ireland: Policy Recommendations. Prepared for An Fóram Uisce.

Maguire, D., Kelly, J. & Brady, K. (2008) Best Practice Guidelines for the Control of Rhododendron ponticum. NPWS, Dublin.

Mayo County Council (undated) Guidance on the Control and Disposal of Gunnera tinctoria. Mayo County Council, Castlebar.

McCarthaigh, M. (1997) Flow Measurement in Irish Rivers. Office of Public Works, Dublin.

Moravcová, L., Pyšek, P., Jarošík, V. & Pergl, J. (2011) 'Getting the right traits', Journal of Applied Ecology.

NBDC (2023) Pathway Action Plan – Soil and Stone 2023–2027. National Biodiversity Data Centre, Waterford.

NatureScot (2021) Biosecurity for Outdoor Recreation Users. NatureScot, Inverness.

NNSS (2015) Biosecurity Guidance for Water Users. Great Britain Non-native Species Secretariat.

NNSS (2019) Himalayan Balsam Information. Great Britain Non-native Species Secretariat.

NPWS (2023) Wildlife (Amendment) Act 2000–2023 (Consolidated). NPWS, Dublin.

NRA (2010) Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads. National Roads Authority, Dublin.

Preston, C.D. & Croft, J.M. (1997) Aquatic Plants in Britain and Ireland. Harley Books, Colchester.

Preston, C.D., Pearman, D.A. & Dines, T.D. (2002) New Atlas of the British and Irish Flora. Oxford University Press, Oxford.

Rapid LIFE (2018) Good Practice Management: Giant Hogweed. Rapid LIFE Project.

Rapid LIFE (2018) Good Practice Management: Himalayan Balsam. Rapid LIFE Project.

Rapid LIFE (2018) Good Practice Management: Japanese Knotweed. Rapid LIFE Project.

Reynolds, S.C.P. (2002) A Catalogue of Alien Plants in Ireland. National Botanic Gardens, Glasnevin.

Reynolds, W.N., Lyons, M. & O'Callaghan, M. (2017) 'Ecological impacts of Prunus laurocerasus in Irish woodlands', Irish Naturalists' Journal, 35, pp. 55–63.

Root Barrier Association (2019) Root Barrier Guidance Note. Root Barrier Association, UK.

Salisbury, A., Armitage, J., Bostock, H. & Perry, J. (2017) 'The ecology and management of *Buddleja davidii'*, Urban Forestry & Urban Greening.

Scottish Invasive Species Initiative (SISI) (2019–2022) Sheep Grazing Trial, River Deveron. SISI/NatureScot.

SEPA (2018) Riverbank Vulnerability and Invasive Non-native Plants. Scottish Environment Protection Agency, Stirling.

Shaw, R.H., Tanner, R., Djeddour, D. & Cortat, G. (2016) 'Classical biological control of Fallopia japonica', EPPO Bulletin.

Shaw, R.H., Bryner, S. and Tanner, R. (2016) 'The life history and biocontrol potential of Japanese knotweed'

Stace, C.A. (1997) New Flora of the British Isles. 2nd edition. Cambridge University Press, Cambridge.

Stokes, K., O'Neill, K. & McDonald, R.A. (2004) Invasive Species in Ireland. Report to EHS and NPWS.

Thiele, J. & Otte, A. (2007) 'Impact of Heracleum mantegazzianum', Weed Research.

TII (2020) The Management of Invasive Alien Plant Species on National Roads – Standard. Transport Infrastructure Ireland, Dublin.

TII (2020b) The Management of Invasive Alien Plant Species on National Roads – Technical Guidance. Transport Infrastructure Ireland, Dublin.

Tweed Forum (2020) The Tweed Invasives Project: 18 Years of Catchment-Wide Control. Tweed Forum, Scotland.

Williams, P.A., Timmins, S.M. & Clarkson, B.D. (2005) 'New Zealand's approach to managing invasive species', Plant Protection Quarterly.

Appendix 1

Invasive Plant Species listed on Part 1 of the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations.

Regulation 16(1)

Part 1 Plants

(1)	(2)	(3)
Common name	**Scientific name**	**Geographical application**
American skunk-cabbage	*Lysichiton americanus*	Throughout the State
A red alga	*Grateloupia doryphora*	Throughout the State
Brazilian giant-rhubarb	*Gunnera manicata*	Throughout the State
Broad-leaved rush	*Juncus planifolius*	Throughout the State
Cape pondweed	*Aponogeton distachyos*	Throughout the State
Cord-grasses	*Spartina* (all species and hybrids)	Throughout the State
Curly waterweed	*Lagarosiphon major*	Throughout the State
Dwarf eel-grass	*Zostera japonica*	Throughout the State
Fanwort	*Cabomba caroliniana*	Throughout the State
Floating pennywort	*Hydrocotyle ranunculoides*	Throughout the State
Fringed water-lily	*Nymphoides peltata*	Throughout the State
Giant hogweed	*Heracleum mantegazzianum*	Throughout the State
Giant knotweed	*Reynoutria sachalinensis*	Throughout the State
Giant-rhubarb	*Gunnera tinctoria*	Throughout the State
Giant salvinia	*Salvinia molesta*	Throughout the State
Himalayan balsam	*Impatiens glandulifera*	Throughout the State
Himalayan knotweed	*Koenigia polystachya*	Throughout the State
Hottentot-fig	*Carpobrotus edulis*	Throughout the State
Japanese knotweed	*Reynoutria japonica*	Throughout the State

Appendix 2

Detailed maps of high-impact IAS within the River Feale Catchment.

Giant Hogweed Maps

Figure A 1: Giant hogweed distribution on Ballincraheen and Leampreghane in Brick_SC_010 sub-catchment.

Figure A 2: Giant hogweed on Galey River just outside Athea in Galey_SC_010 sub-catchment.

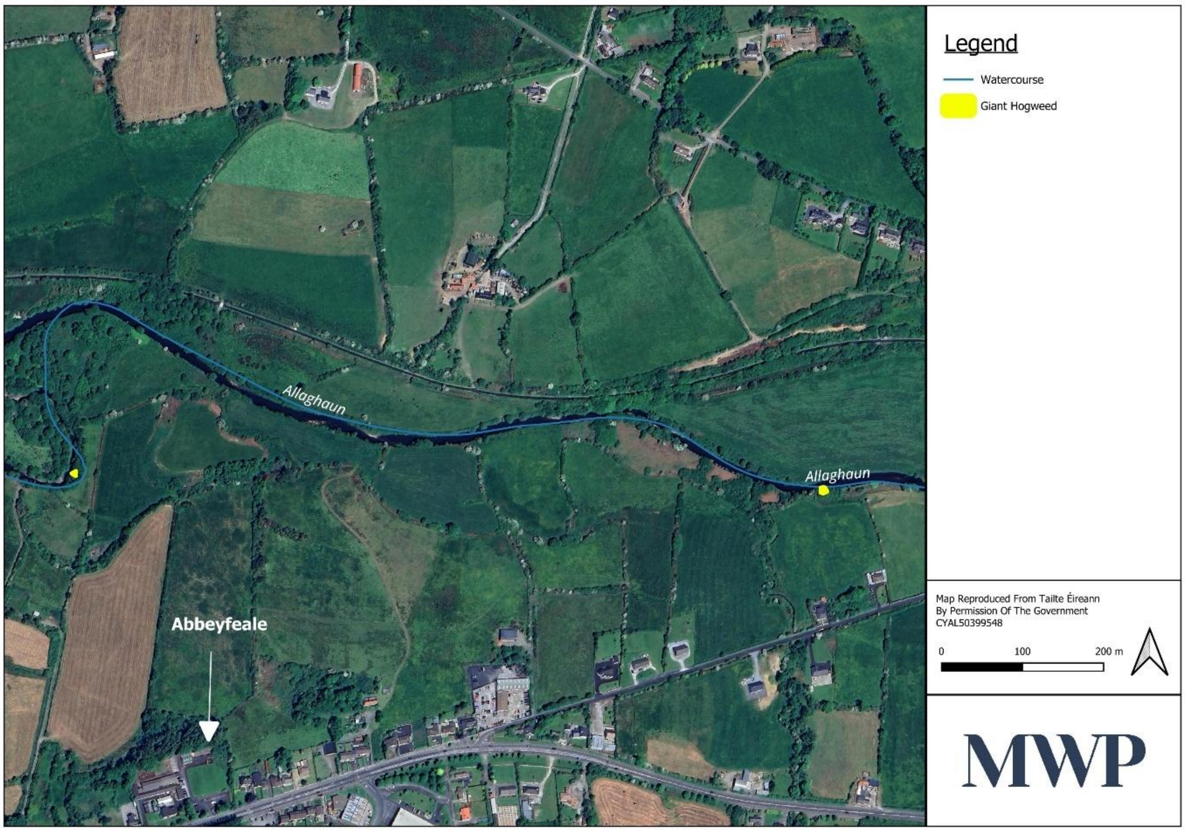

Figure A 3: Giant hogweed on Allaghaun River in Abbeyfeale area in Feale_SC_020 sub-catchment.

Giant Rhubarb Maps

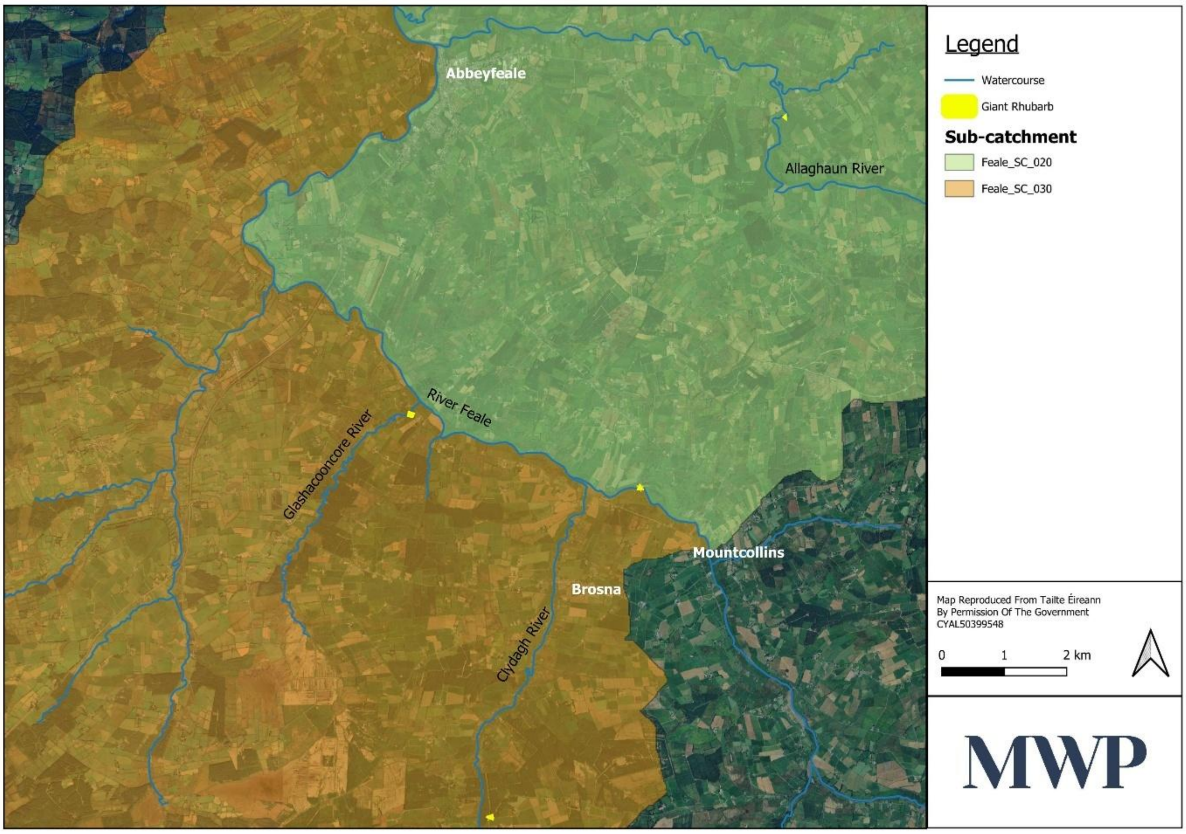

Figure A 4: Giant rhubarb distribution in sub-catchments Feale_SC_020 and Feale_SC_030.

Figure A 5: Giant rhubarb location on the River Feale in Feale_SC_040 sub-catchment.

Rhododendron Maps

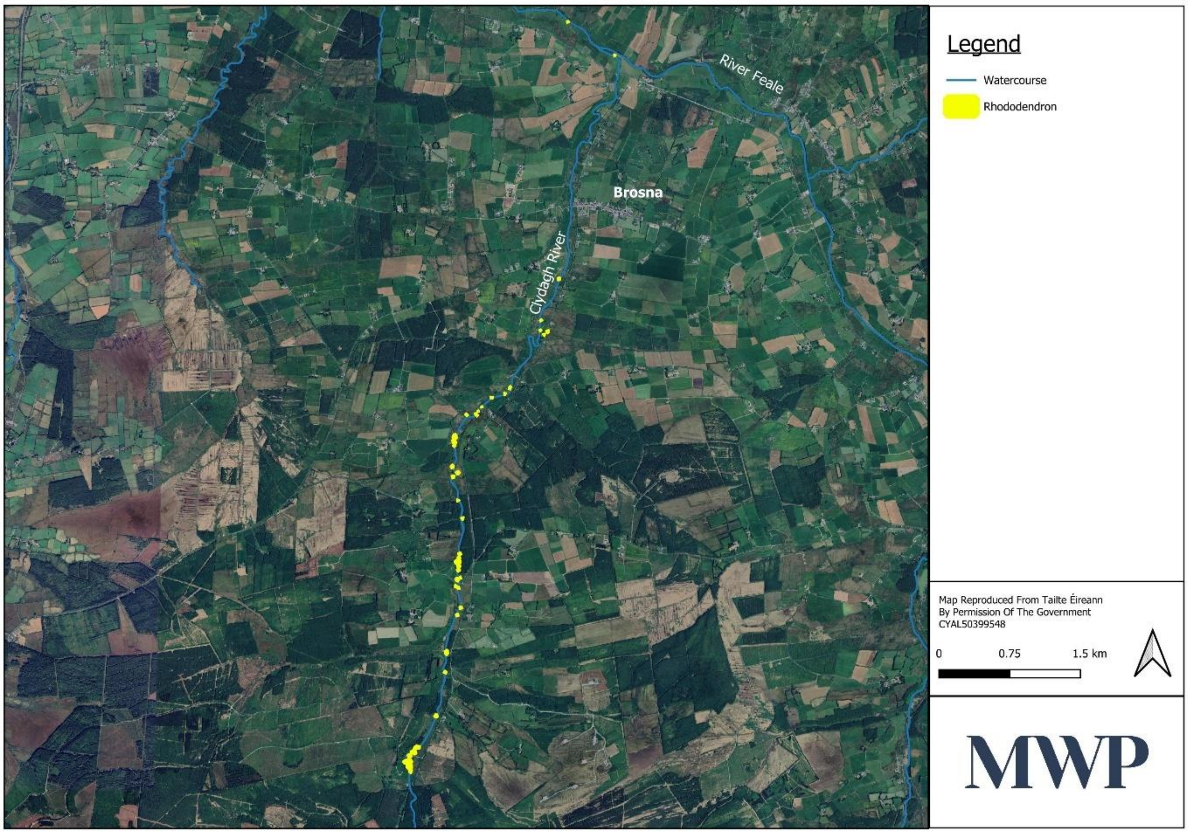

Figure A 6: Rhododendron distribution along the Clydagh River and one stand along the River Feale in Feale_SC_030.

Figure A 7: Rhododendron distribution on River Feale upstream of Listowel in Feale_SC_040.

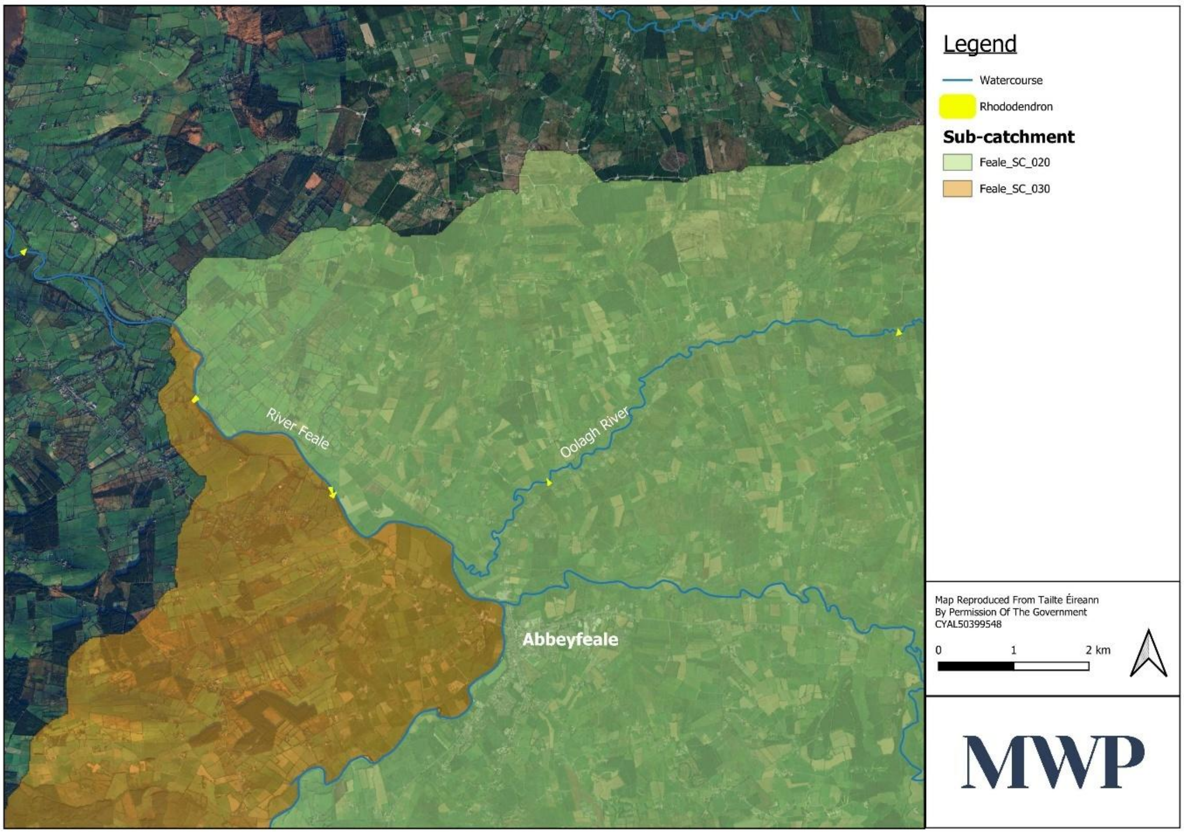

Figure A 8: Rhododendron distribution along the River Feale and Oolagh River in Feale_SC_020 and Feale_SC_030 sub-catchment.

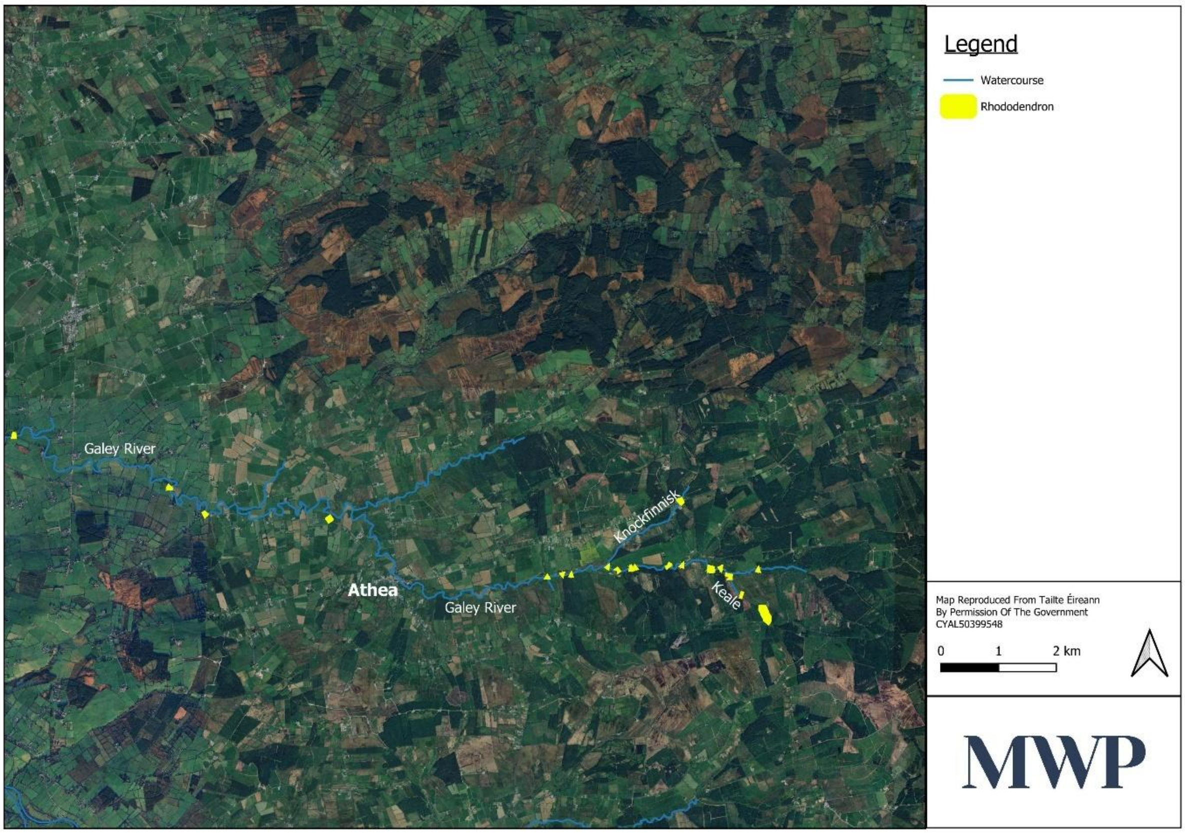

Figure A 9: Rhododendron distribution along the Galey River and its tributaries Knockfinnisk and Keale in Galey_SC_010.

Figure A 10: Rhododendron distribution along the Smearlagh River, Glashoreag River and its triburbutary Knocknacurra in Feale_SC_040.

Cherry Laurel Maps

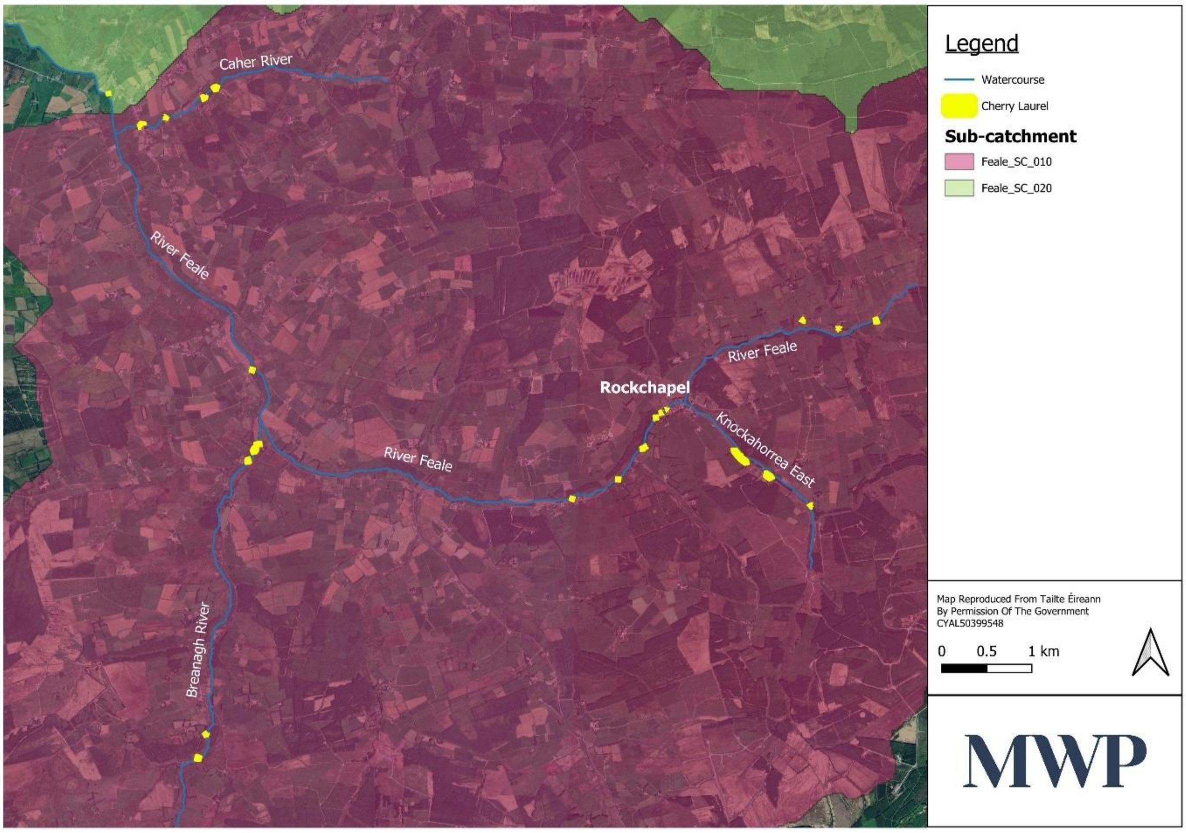

Figure A 11: Cherry laurel distribution in Feale_SC_010 and Feale_SC_020.

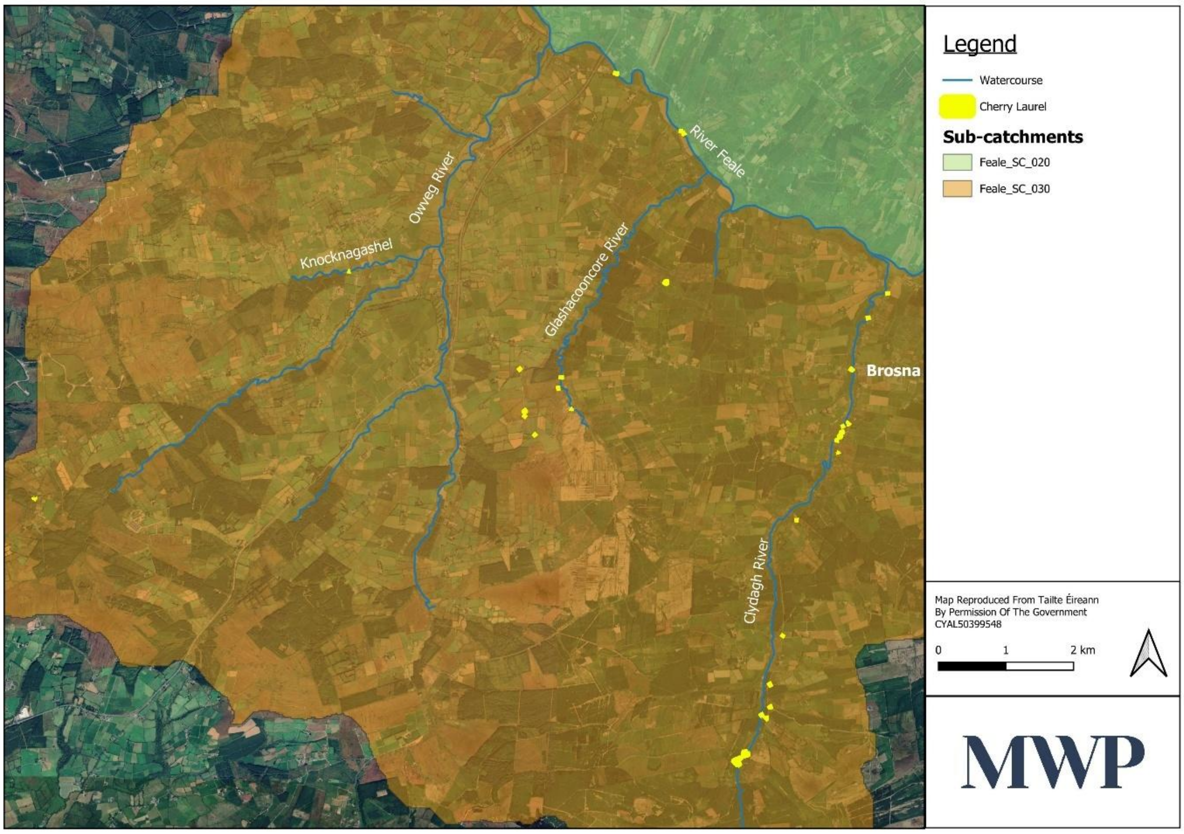

Figure A 12: Cherry laurel distribution within Feale_SC_030 and Feale_SC_020.

Figure A 13: Cherry laurel distribution along the Allaghaun River in Feale_SC_020 sub-catchment.

Figure A 14: Cherry laurel distribution along the River Feale and the Smearlagh River in Feale_SC_040.

Figure A 15: Cherry laurel distribution along the Galey River and and its tributary Knockfinnisk in Galey_SC_010.

Japanese Knotweed Maps

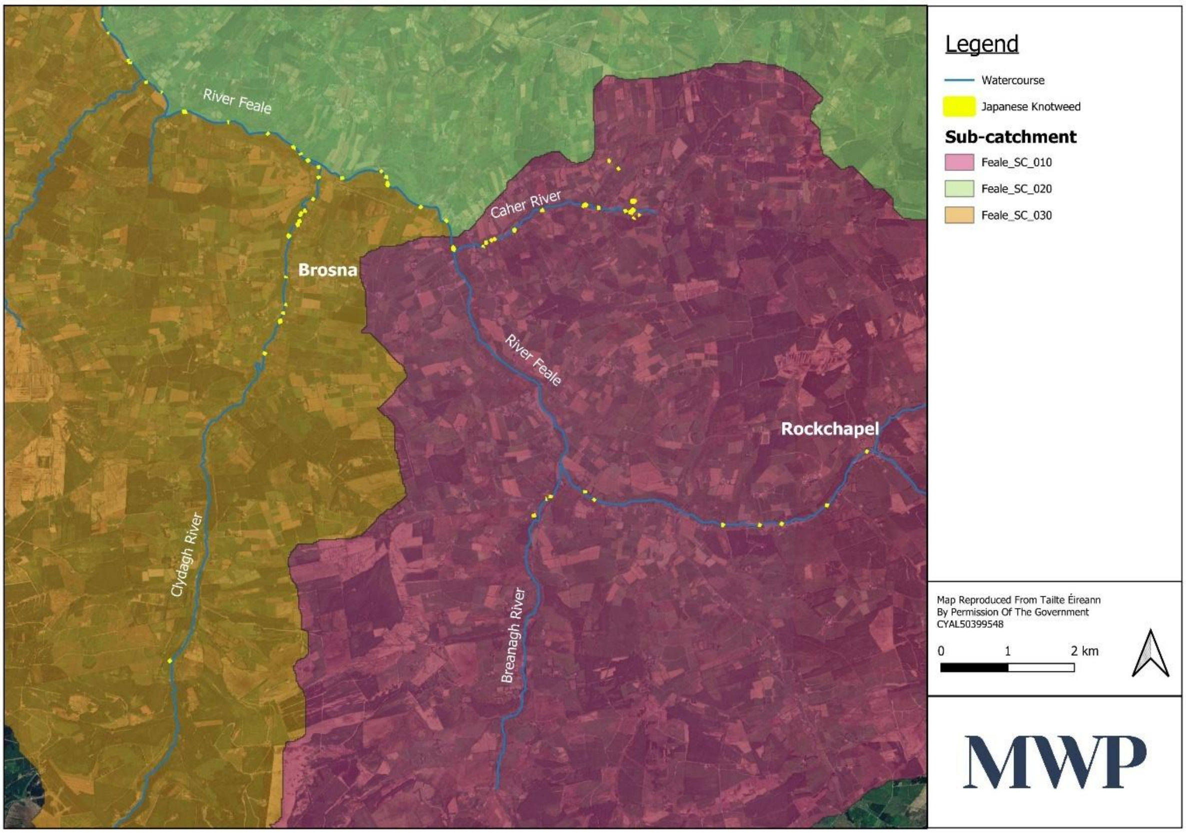

Figure A 16: Japanese knotweed distribution along the upper reaches of River Feale, Clydagh River, Caher River and Breanagh River within sub-catchments Feale_SC_010, Feale_SC_020 and Feale_SC_030.

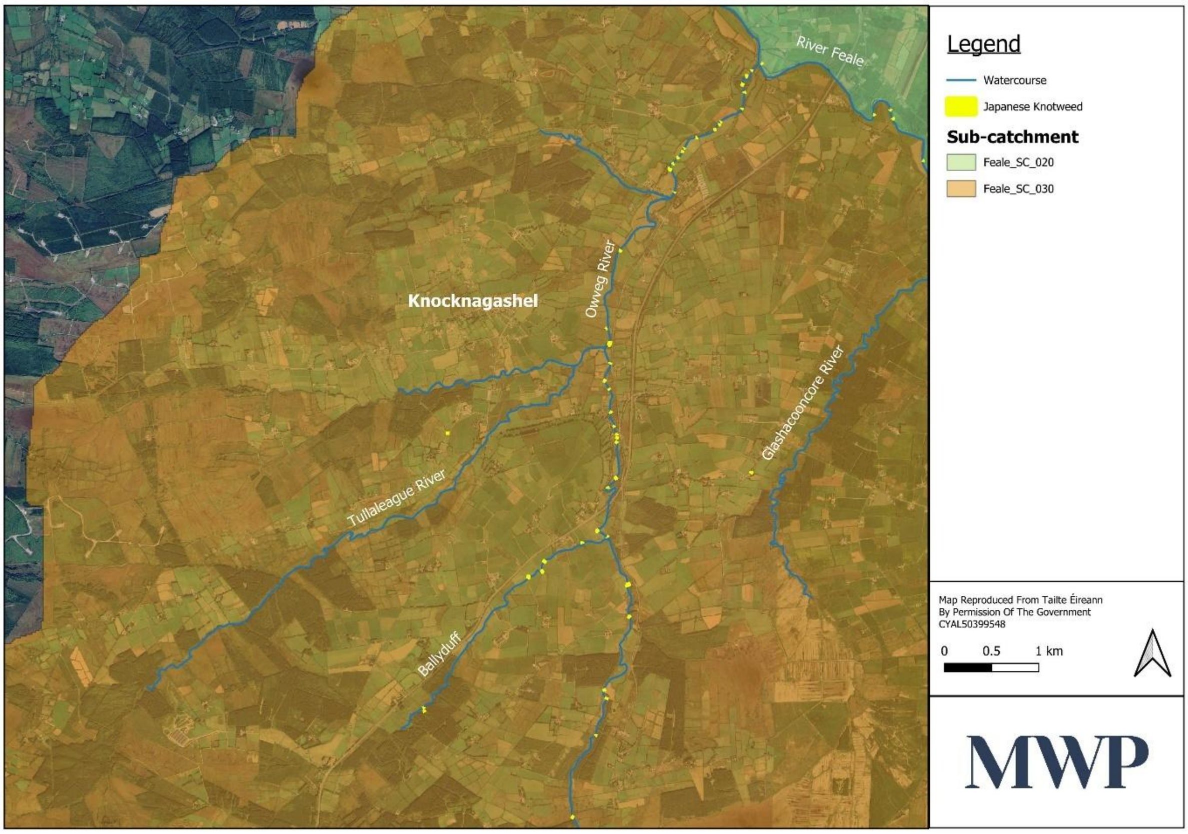

Figure A 17: Japanese knotweed distribution along the Owveg River and its tributaries within Feale_SC_030 and River Feale in Feale_SC_020 sub-catchment.

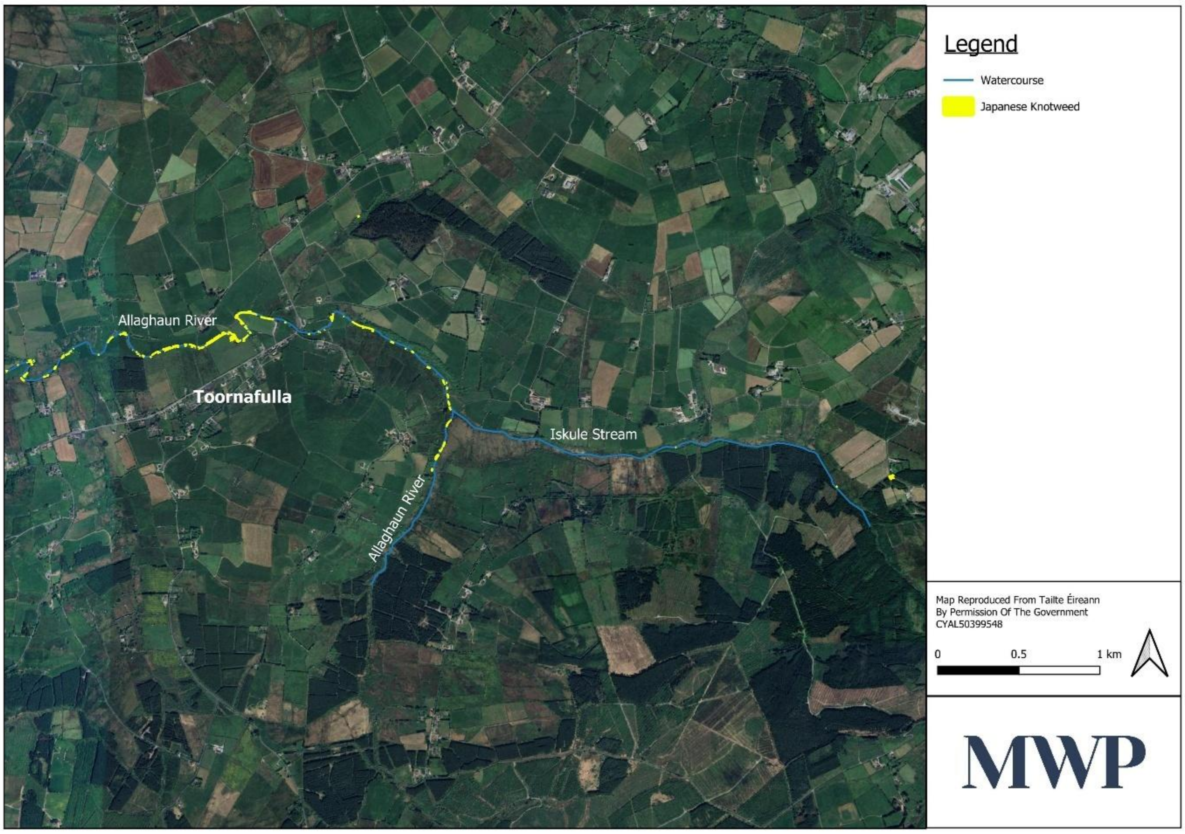

Figure A 18: Japanese knotweed distribution in upper reaches of Allaghaun River and Iskule Stream in Feale_SC_020.

Figure A 19: Japanese knotweed distribution along the Allaghaun River and Eeghaun Stream in Feale_SC_020 sub-catchment.

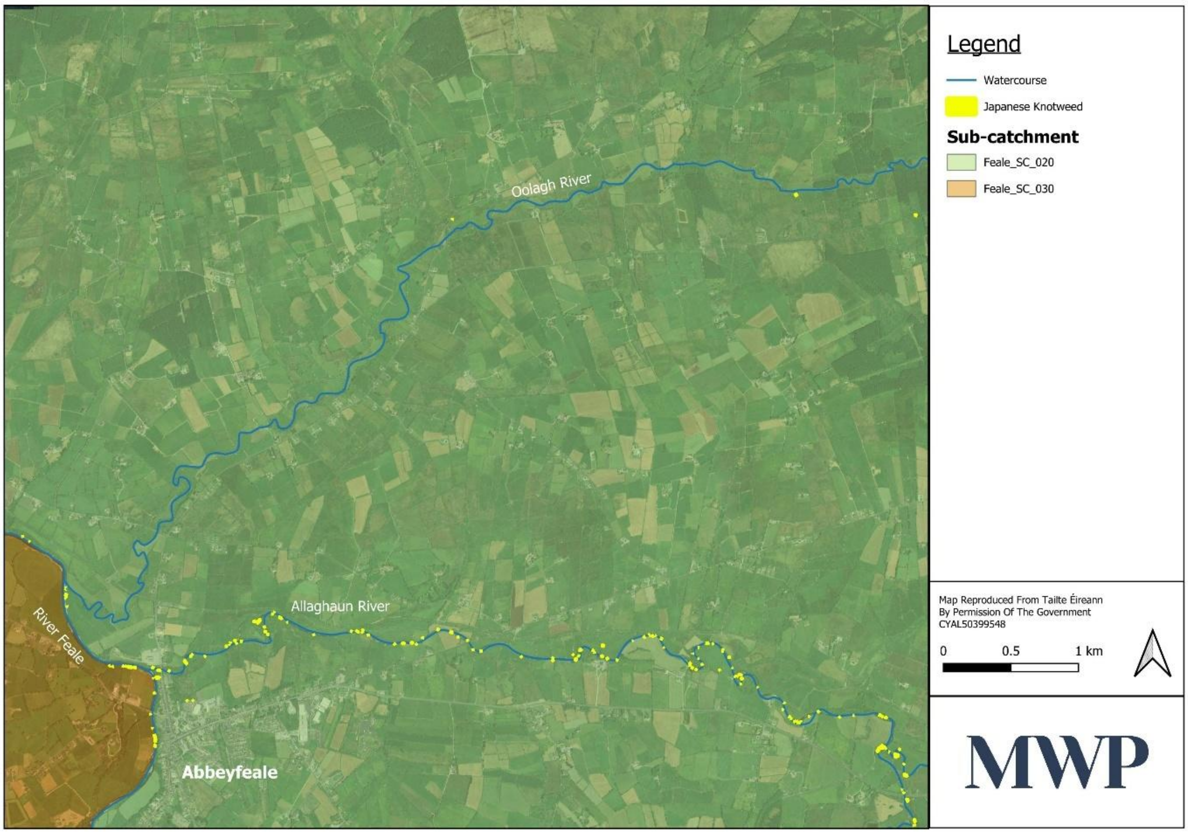

Figure A 20: Japanese knotweed distribution along the lower reaches of the Allaghaun River, Oolagh River in Feale_SC_020 sub-catchment and the River Feale in Feale_SC_030 sub-catchment.

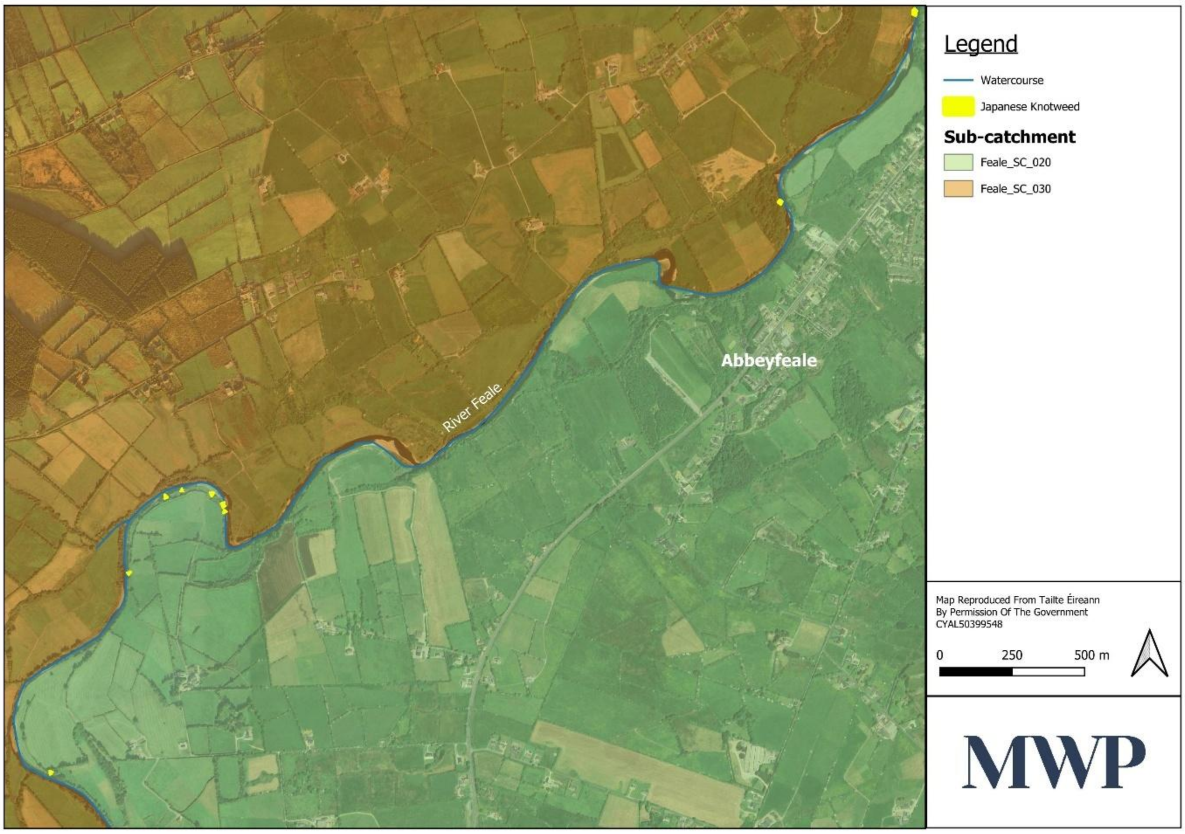

Figure A 21: Japanese Knotweed distribution along the River Feale within Feale_SC_020 and Feale _SC_030 sub-catchment.

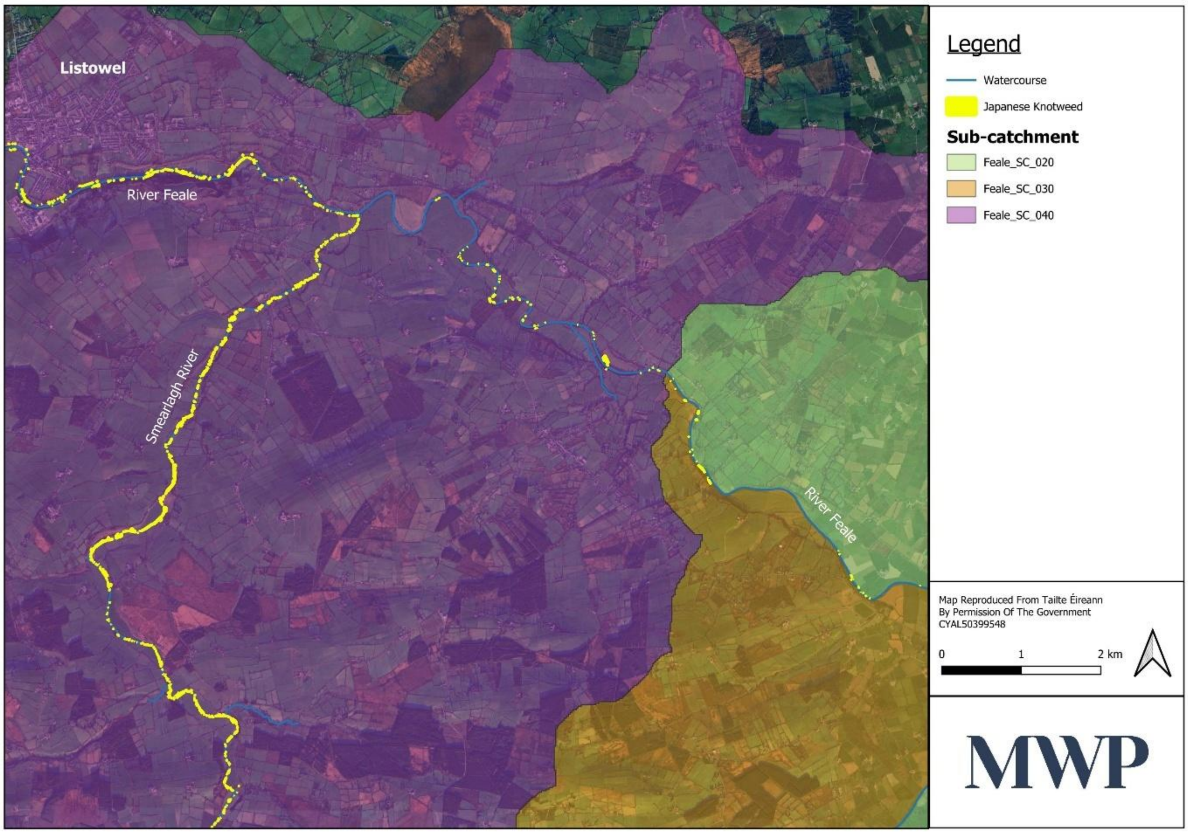

Figure A 22: Japanese distribution along the lower reaches of the Smearlagh River in Feale _SC_040 and River Feale in Feale_SC_020 and Feale_SC_030.

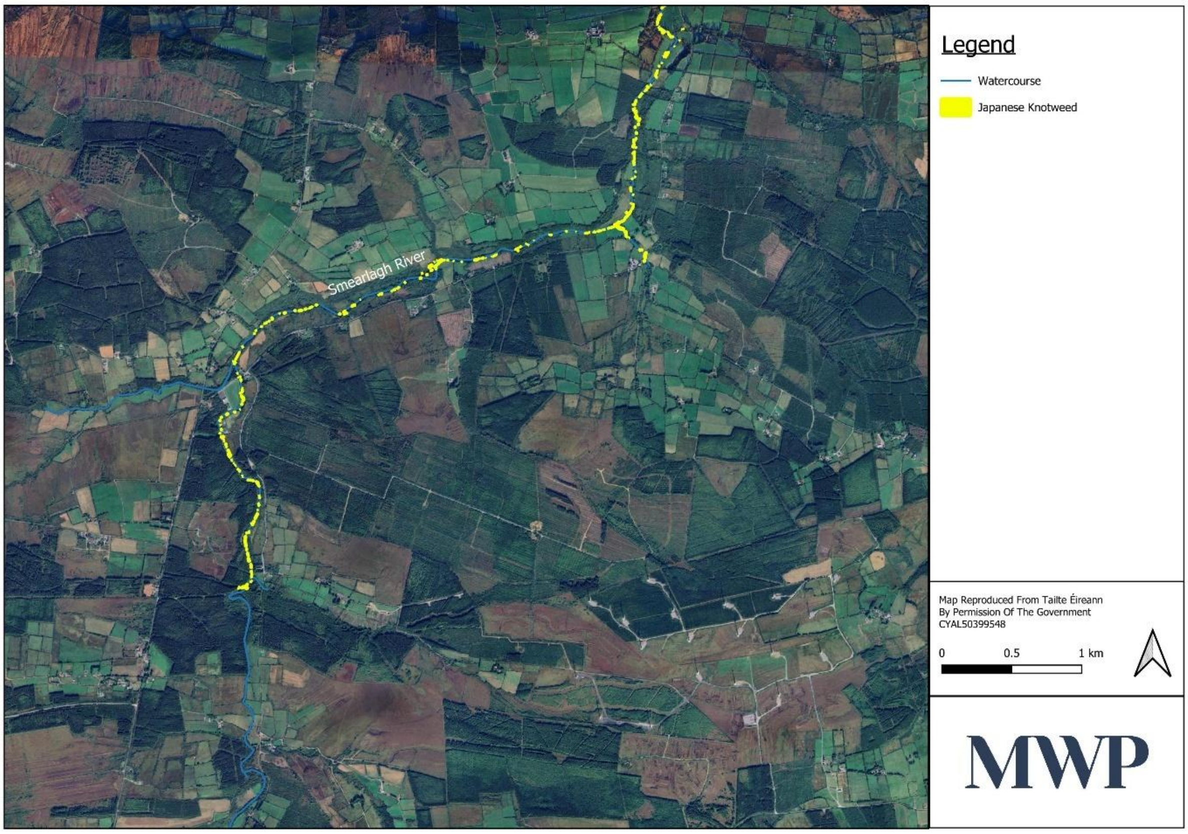

Figure A 23: Japanese knotweed ditribution in upper reaches of the Smearlagh River.

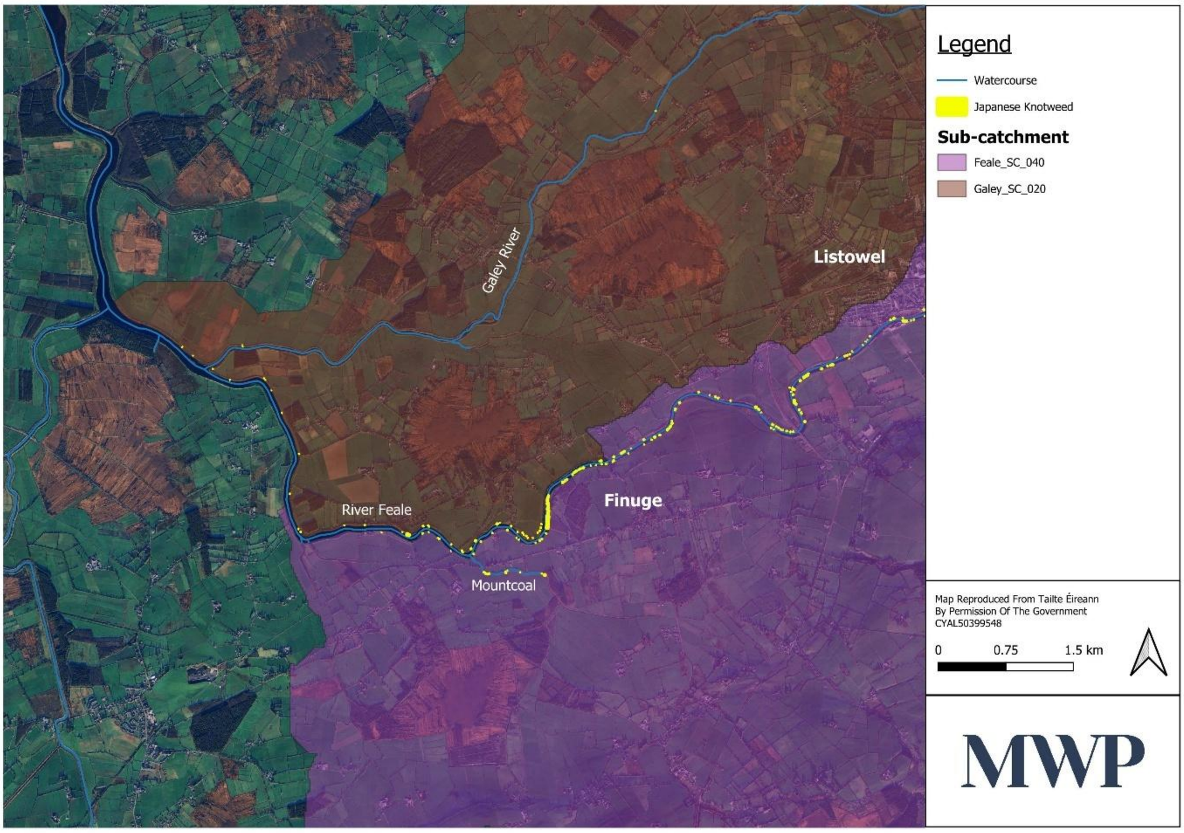

Figure A 24: Japanese knotweed distribution along the lower reaches of the River Feale in Feale_SC_040 sub-catchment and lower reaches of the Galey River in Galey_SC_020 sub-catchment.

Figure A 25: Japanese knotweed distribution in upper reaches of the Galey River and its tributary Knockfinnisk in Galey_SC_010 sub-catchment.

Himalayan Balsam Maps

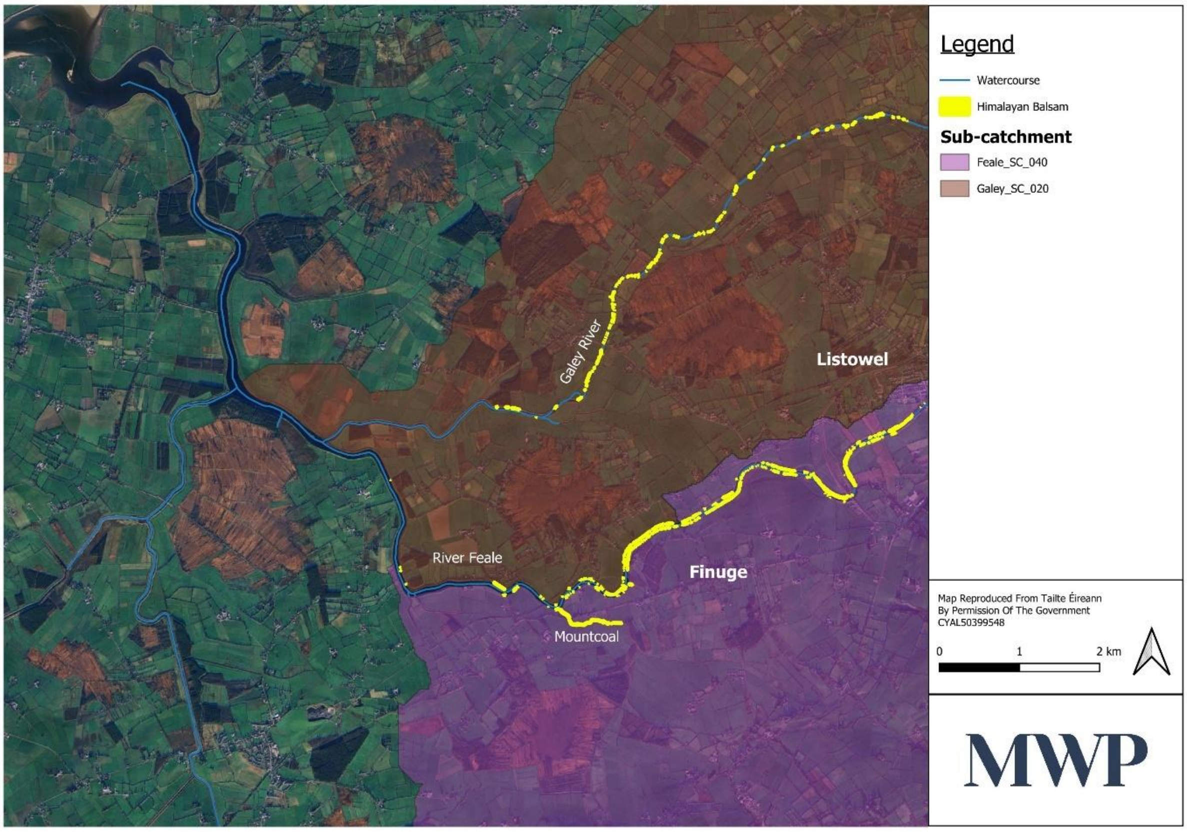

Figure A 26: Himalayan balsam distribution along the lower reaches of the River Feale in Feale_SC_040 sub-catchment and along the lower reaches of the Galey River in Galey_SC_020 sub-catchment.

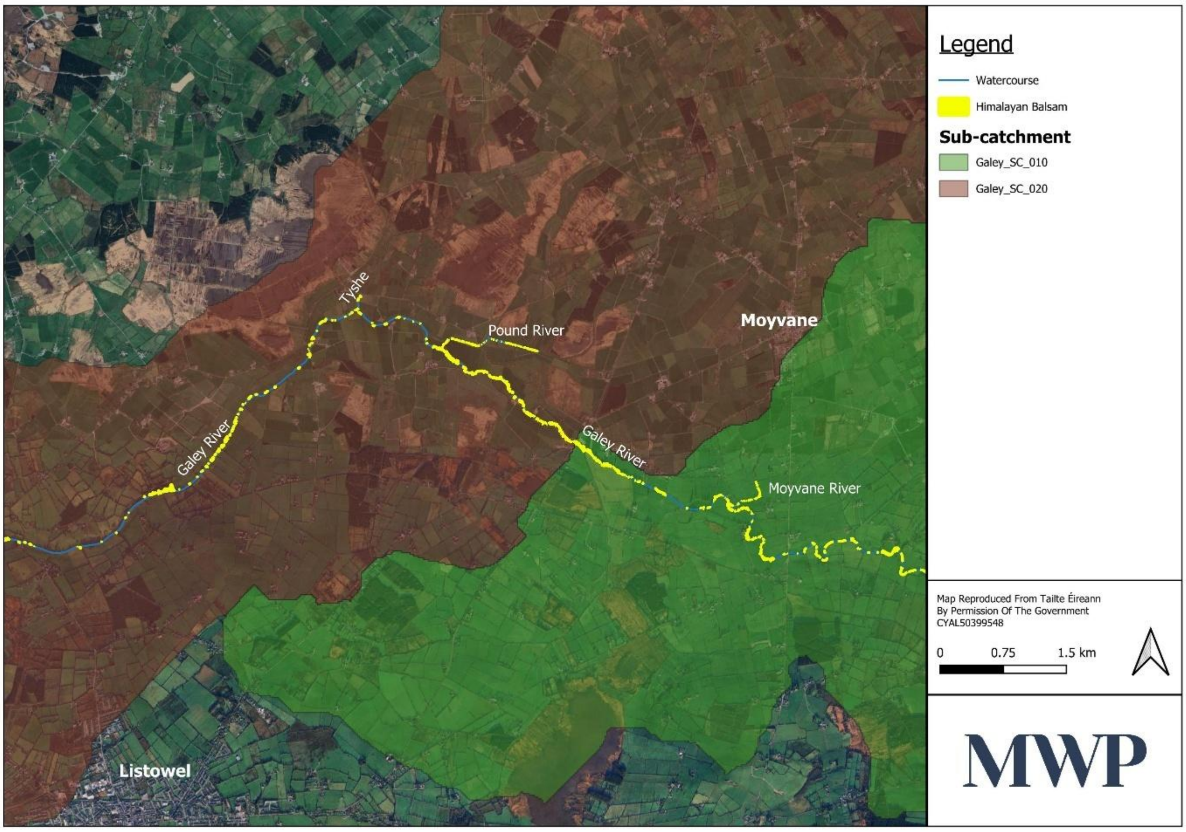

Figure A 27: Himalayan balsam distribution along the middle reaches of the Galey river and its tributaries Tyshe, Pound River and Moyvane River in sub-catchments Galey_SC_010 and Galey_SC_020.

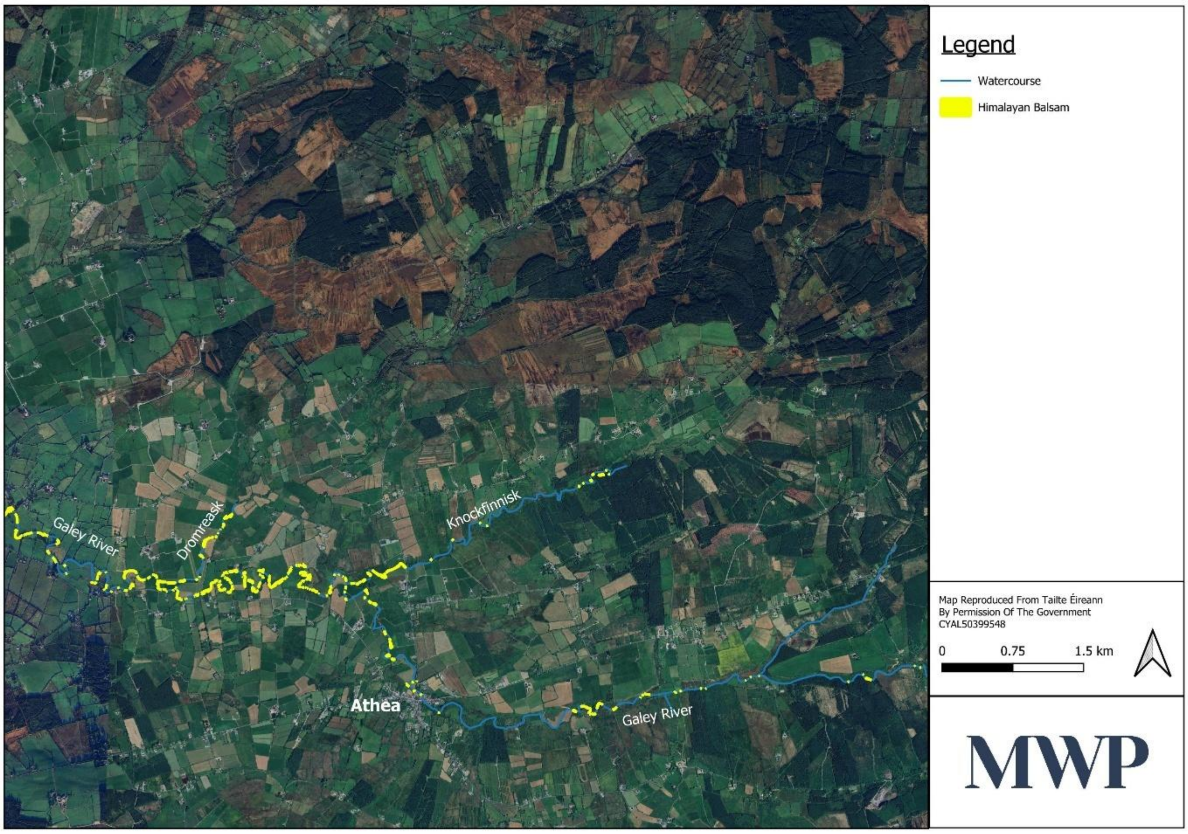

Figure A 28: Himalayan balsam distribution in upper reaches of the Galey River and its tributaries Knockfinnisk and Dromreask in Galey_SC_010 sub-catchment.

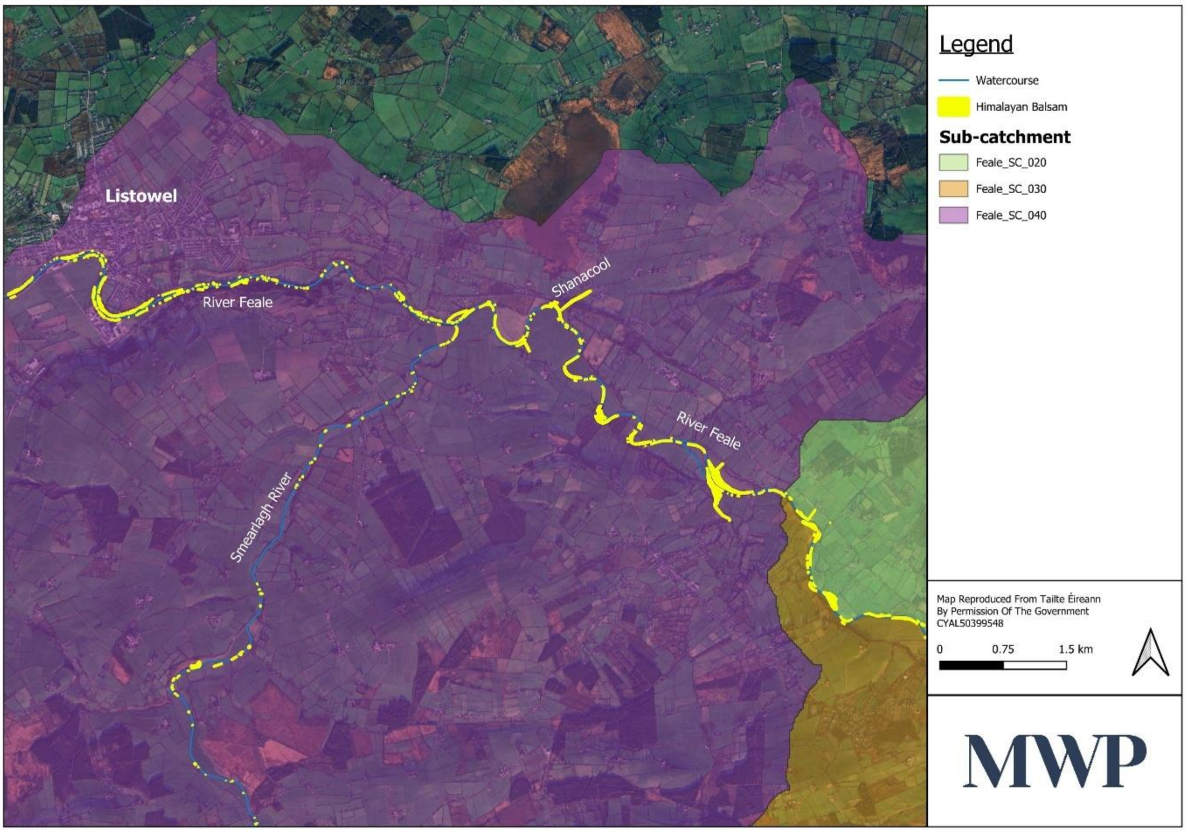

Figure A 29: Distribution along the River Feale in Feale_SC_020, Feale_SC_030 and Feale_SC_040 and its tributaries Smearlagh River and Shanacool in Feale_SC_040.

Figure A 30: Himalayan balsam distribution along the middle and upper reaches of the Smearlagh River in Feale_SC_040 sub-catchment.

Figure A 31: Himalayan balsam along the Brick River in Brick_SC_010 sub-catchment.

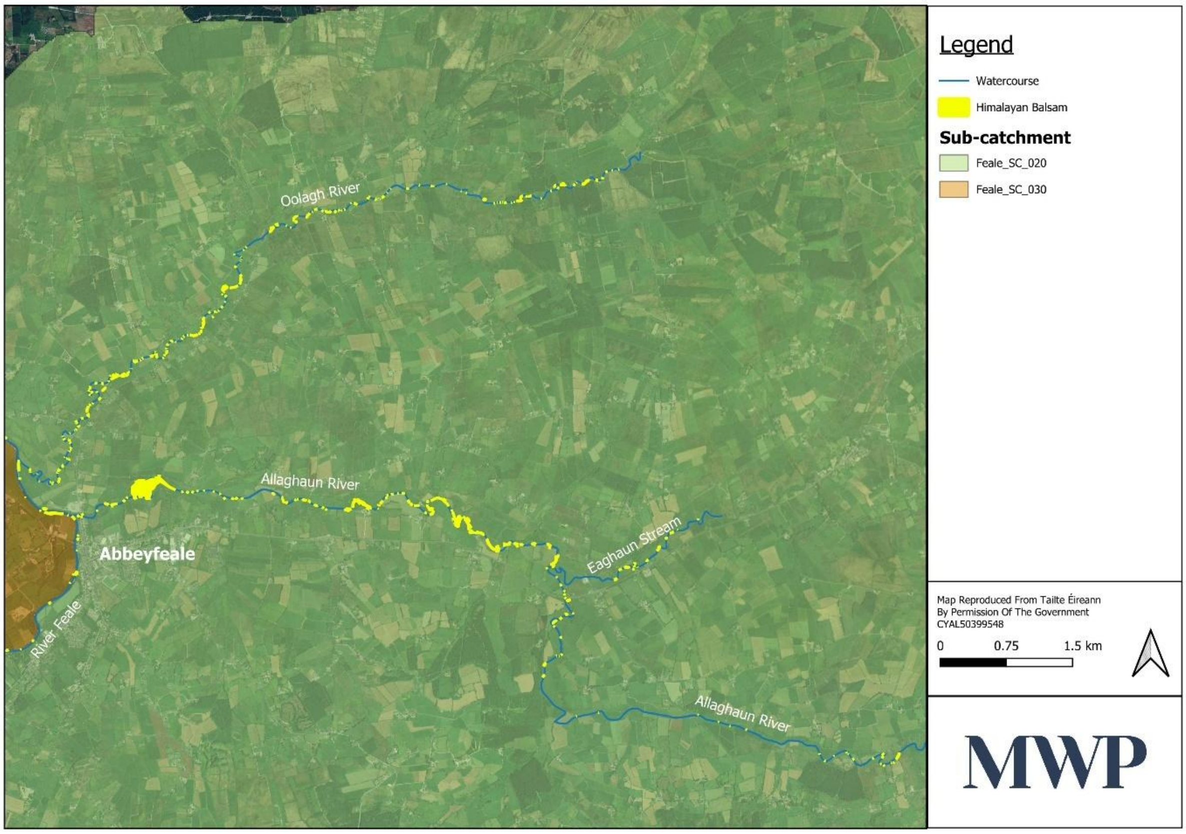

Figure A 32: Himalayan balsam distribution along the Allaghaun River, the Oolagh River in Feale_SC_020 and River Feale in Feale_SC_020, Feale_SC_030 sub-catchments.

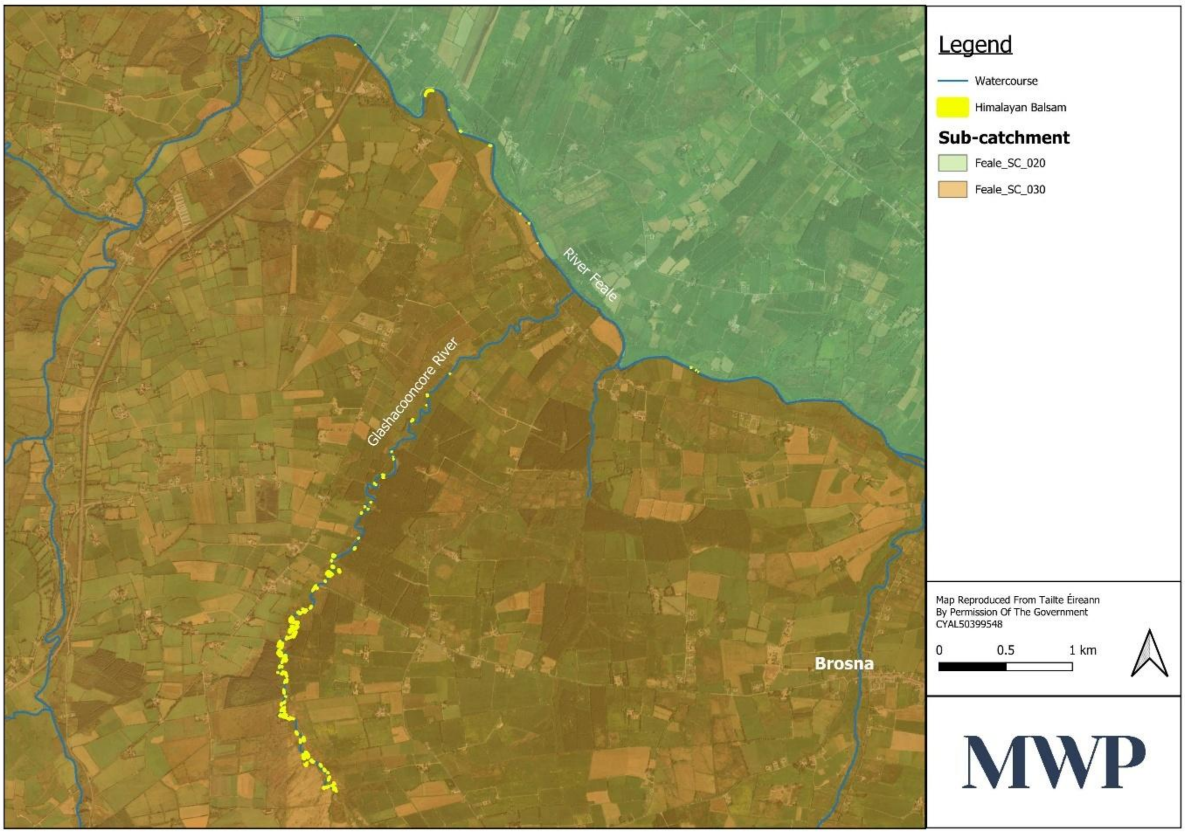

Figure A 33: Himalayan balsam distribution along the Glashacooncore River in Feale_SC_030 and along River Feale in Feale_SC_020 and Feale_SC_030 sub-catchments.

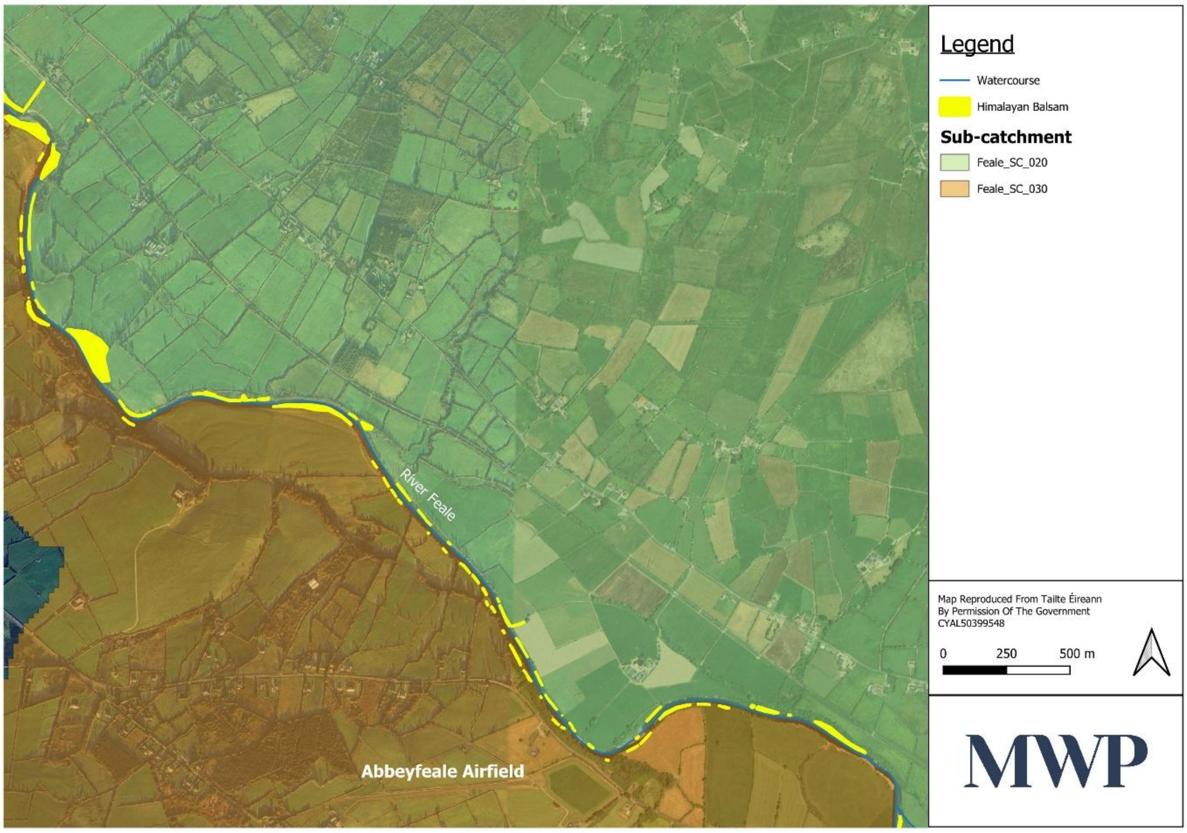

Figure A 34: Himalayan balsam distribution along the River Feale in Feale_SC_020 and Feale_SC_030 sub-catchments.