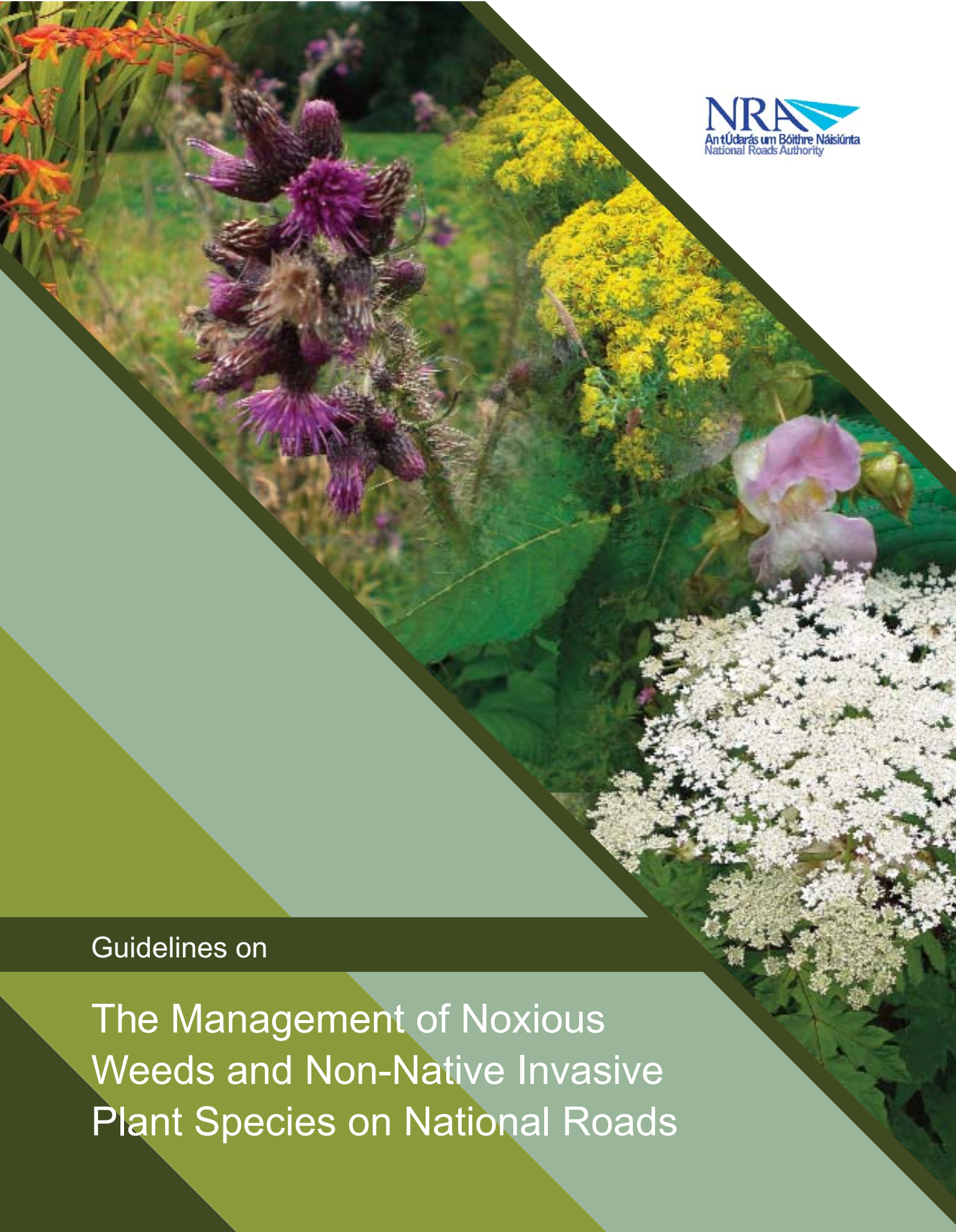

NRA
An tÚdarás um Bóithre Náisiúnta
National Roads Authority

Guidelines on

The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads

Revision 1, December 2010

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The focus of this document is to provide guidance on how noxious weeds and non-native invasive species are treated on national road schemes. While the document alludes to various precautionary measures that should be addressed when undertaken various activities, e.g., using chemical sprays, it is important that the requirements of the following documentation is complied with:

1) Safety, Health and Welfare at Work Act, 2005;

2) Safety, Health and Welfare at Work (Construction) Regulations, 2006;

3) Chapter 8 of the Traffic Signs Manual;

4) Guidance for the Control and Management of Traffic at Road Works;

5) Safety, Health and Welfare at Work (General Application) Regulations, 2007;

6) Safety, Health and Welfare at Work (Chemical Agents) Regulations, 2001; and

7) European Communities (Authorisation, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003.

In addition, it is also recommended that the Health and Safety Authority's 2007 Code of Practice for the Safety, Health and Welfare at Work (Chemical Agents) Regulations is consulted.

Compliance with the Plant Protection Products Regulations

Regulation 4(1) of the European Communities (Authorization, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003, (hereinafter referred to as the Plant Protection Products Regulations) (S.I. No. 83 of 2003) provides that 'A person shall not **[…]** use the **[plant protection product]** or cause or permit another person to use the product unless these Regulations are complied with.' **Regulation 6 indicates,** inter alia**, that a person shall only use a plant protection product:**

1. in compliance with conditions established under the authorisation;

2. in compliance with conditions stated on the label;

3. within the field of application of the plant protection product;

4. in accordance with the principles of 'good plant protection practice';* and

5. where possible, in accordance with the principles of integrated control. #

[Notes:

* 'Good plant protection practice' is defined under Regulation 2(1) of the Plant Protection Regulations to mean the responsible use of plant protection products in accordance with the guidelines issues from time to time by the Minister.

#Paragraph 10.1 of Appendix 13 of the Plant Product Protection Regulations defines 'integrated control' as follows:

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The term integrated control is defined as the rational application of a combination of biological, biotechnological, chemical, cultural or plant-breeding measures whereby the use of chemical plant protection products is limited to the strict minimum necessary to maintain the pest population at levels below those causing economically unacceptable damage or loss.]

Regulation 34 (1) of the Regulations provides:

A person who fails to comply with any Regulation under these Regulations shall be guilty of an offence and shall be liable on summary conviction to a fine not exceeding €3,000, or to imprisonment for a term not exceeding 6 months, or to both.

It is, therefore, essential that the Plant Protection Products Regulations are complied with at all times.

Further guidance in relation to the appropriate use of plant protection products is available from:

Pesticides Control Service,
Department of Agriculture, Food and Fisheries
Laboratories,
Backweston Campus,
Young's Cross,
Celbridge.
Email: **pcs@agriculture.gov.ie**
Telephone: +353-1-6157552

Further information is also available from the Pesticides Control Service website **(http://www.pcs.agriculture.gov.ie/Default.htm)**.

It should be noted that some plant protection products used in other countries to treat noxious weeds and non-native invasive species are not authorised for use in Ireland. For example, plant protection products containing Picloram are often used, due to their effectiveness, in the treatment of Japanese knotweed. However, currently (December, 2010), no plant protection products containing Picloram are approved in Ireland. **Equally, many of the common methods of application used to treat non-native invasive species are not covered by the Irish conditions of authorisation or conditions of use reflected on approved labels. Indeed, some of the methods outlined in this document, particularly in relation to the control of non-native invasive species, do not comply with the Irish conditions of authorisation or conditions of use reflected on approved labels. Where it is hoped to use such methods or, indeed, unauthorised herbicides, the Pesticides Control Service should be contacted. It may be that the use of such methods and herbicides can be approved under derogation procedures provided in the Plant Protection Regulations**. For example, Regulation 16 allows for an **'[e]***xtension of the field of application of a plant protection product.'* Regulations 24 and 25 provide for trial authorisations and permitting respectively. Also, the Pesticides Control Service have a facility to approve 'off label' use of plant protection products. Again, it must be stressed that the herbicides used and the method of use must always be in compliance with the law.

Acknowledgements

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Mr. Dara O'Shea, Pesticides Control Service of the Department of Agriculture, Fisheries and Food; Mr. John Early, Northern Ireland Environment Agency; Ms. Lisa Dolan, Environmental Research Institute and Department of Zoology, Ecology and Plant Science, University College Cork; Dr. E. Caroline Mhic Daeid; Dr. Úna Fitzpatrick, the National Biodiversity Data Centre and the National Parks and Wildlife of the Department of Environment, Heritage and Local Government in developing this document.

Disclaimer

While every care has been taken to ensure that the content is accurate, the National Roads Authority and any contributing third party shall have no legal responsibility for the content or the accuracy of the information so provided or for any loss or damage caused arising directly or indirectly in connection with reliance on the use of such information.

1 Introduction

This document provides guidance on the management of noxious weeds and non-native invasive plant species on national road schemes.

Due to the legislative requirements to control the spread of noxious weeds and non-native invasive plant species, it is important that any activities associated with the planning, construction and operation of national road schemes comply with the requirements of the Noxious Weeds Act, 1936, and the Wildlife (Amendment) Act, 2000.

There is increasing awareness and concern over the threat non-native invasive plant species pose to Ireland's indigenous biodiversity and national legislation governing the control of these plant species is currently being revised. Ireland also has international obligations under a number of conventions and within the EU Habitats Directive to address non-native invasive species issues.

As non-native invasive species have the potential to significantly impact national biodiversity, obstruct signage and sightlines at junctions and damage road infrastructure, the National Roads Authority (NRA) is providing guidance for the treatment of the predominant species likely to be encountered during the planning, construction and maintenance of national road schemes.
In the absence of current national legislation addressing the issues associated with non-native invasive species, it is important to consult with the National Parks and Wildlife Service in advance of undertaking any treatments for such plant species. Numerous non-native invasive plants have established in Ireland over the last century, many arising as escapees from cultivation such as rhododendron, montbretia and giant rhubarb. Many of the plants we classify as invasive are those that have evolved to grow in nutrient-poor or highly dynamic environments and so have the capacity to survive and indeed thrive in disturbed environments.

Many are also problematic due to their capacity to reproduce asexually by fragmentation of a rootstock (e.g. Japanese knotweed) or through massive seed production (e.g. giant rhubarb). The vigorous growth typically displayed by non-native invasive species out-competes native vegetation and results in mono-typic stands. In conjunction with the loss of floral diversity, faunal diversity is also significantly reduced both at the macro and micro level.

Chapter 2 of this document outlines the legislative background to noxious weeds and non-native invasive species while Chapter 3 addresses procedures for assessing the presence/risks of noxious weeds and non-native invasive species at the environmental impact assessment stage and the pre-construction phase of national road schemes. Chapter 4 provides guidance on the control and management of noxious weeds and non-native invasive species during site clearance and the construction of national road schemes while Chapter 5 provides control and management guidance during the operation of such schemes. Finally, the identification, ecology and physical and chemical control measures for noxious weeds and non-native invasive species are outlined in Chapters 6 and 7, respectively.

2 An overview of legislation and background to the issues

The introduction and spread of noxious weeds and non-native invasive species is a growing problem in Ireland.

2.1. Road Schemes, Noxious Weeds and Non-Native Invasive Species

The introduction and spread of noxious weeds and non-native invasive species is a growing problem in Ireland. Many activities, including the construction of road projects, can or have the potential to contribute to the spread of such plants. It is vital that practical measures to control the presence and spread of noxious weeds and invasive plants are incorporated into the planning, construction practices and maintenance regimes of national road schemes.

Road schemes may act as a pathway for the spread of noxious weeds and non-native invasive species, enabling their spread along the road corridor and therefore, impacting on the landscape and native biodiversity. Machinery, construction equipment and soil/gravel/stones used in the construction of a new road scheme can introduce new species and disperse species to new areas. The disturbance of vegetation during road maintenance can disperse seeds and plant fragments (by wind and on vehicles). Strimming of vegetation during road maintenance activities presents the greatest potential for spreading plant material. Of particular importance are works taking place near watercourses.

Many of the non-native invasive species of most concern in Ireland are freshwater plants (see www.invasivespeciesireland.com for further details) and plant fragments can be spread downstream following disturbance or be accidentally transported along with construction materials.

Early identification and management of noxious weeds and non-native invasive species can significantly reduce the resources needed to minimise the spread of these species. The aim of these guidelines is to provide the information needed for personnel involved in road schemes to effectively manage the problem while ensuring their own activities do not contribute to the further establishment of these species.

2.1.1. Noxious Weeds

Noxious weeds, most of which are native plants of disturbed ground, impact adversely on agriculture. They may compete for space with tillage or forage crops, harbour pests or diseases, or be injurious to livestock or human beings. Some species produce seed which are wind-distributed and can remain viable in the soil/gravel/stones for many years, while several spread by vegetative means and can re-sprout from fragments after cultivation or attempted clearance.

It is important to note that, as native species, noxious weeds are part of our natural biodiversity and are utilized by a range of invertebrate and bird species. The natural habitat of these plants is disturbed ground making them prime opportunist colonizers of over-grazed or cultivated land. The management objective for these native species should be control and not complete eradication in order to prevent them from dominating road verges and thus becoming major reservoirs from which surrounding land may become infested. The loss of such species will also result in the loss of species that depend on them as a food source. Creeping thistle *(Cirsium arvense)* for example, is a food plant for over twenty species of

2 An overview of legislation and background to the issues

butterfly and moth, with four species of moth depending on the genus Cirsium as their sole food pant. Thistle seed is also an important food resource for goldfinch. Ragwort *(Senecio jacobea)* has four species of moth dependant on it including the day-flying cinnabar moth. There is anecdotal evidence of a reduction in the population of cinnabar moths in the United Kingdom where aggressive control methods have all but eliminated ragwort from roadside landscapes.

2.1.2. Non-Native Invasive Species

Non-native plant species are defined as those species that have been introduced, either intentionally or unintentionally, outside their natural range. Many of these species live in harmony with our native species causing no adverse impacts. A few non-native species though, such as those plant species that are detailed in this document, become what is known as 'invasive' as they thrive in our habitats and out-compete our native flora and fauna. They not only have negative environmental impacts but they can also adversely impact on recreational activities and have serious associated economic costs. Non-native invasive plants are so-called as they typically display one of the following characteristics or features:

1) Prolific reproduction through seed dispersal and / or re-growth from plant fragments,

2) Rapid growth patterns, and

3) Resistance to standard weed control methods.

They have in common the ability to spread aggressively by seed or vegetative means, particularly in open or disturbed sites. They can produce large colonies which threaten biodiversity by over-whelming native plant communities. Typically, they do not provide a habitat for native fauna and so these may be lost too. When a non-native species displays invasive qualities and is not managed it can potentially: (Dolan 2004).

1) Out-compete native vegetation, affecting plant community structure and habitat for wildlife,

2) Cause damage to infrastructure including road carriageways, footpaths, walls and foundations (see Figure 1),

3) Result in soil erosion and collapse of river banks through exposure of the soil during winter when plants dieback,

4) Have an adverse effect on landscape quality through a loss of naturalness, aesthetics and regional identity.

5) Impact on road safety by blocking sightlines at junctions and road signage in general.

Box 1 outlines examples of the impacts of non-native invasive species on native habitats and species.

Figure 1: Japanese Knotweed breaking through a paved surface (Photo: Mike Dodd)

2 An overview of legislation and background to the issues

" Box 1

Examples of the Impacts of Invasive Species on Native Habitats and Species

Examples:

The impact of rhododendron on native oak woodland in various parts of the country (Kerry, Cork, Donegal, Wicklow etc.) has been well documented. The rhododendron forms a dark evergreen sub-canopy blocking all light to the understorey. The natural suite of woodland plants and their associated invertebrate biota is lost from infested areas and the natural regeneration of oak ceases. Without control, as the existing oak trees reach senility and die-back naturally, the woodland will transform into a thicket of rhododendron.

Many invasive plant species thrive along river banks including giant hogweed, Himalayan balsam and Japanese knotweed. These three species are often found together where they effectively out-compete the native riparian vegetation. As these plants dieback during the winter, the soils become exposed and the riverbanks subject to erosion and collapse. This in turn gives rise to instream siltation which can clog the spawning gravels of salmonids and other fish, result in direct mortality of the internationally rare and protected freshwater pearl mussel, and result in the further spread of the invasive plants downstream.

It should be noted that non-native invasive species are also commonly referred to as alien or exotic species.

2.2. The Legislative Framework

2.2.1 Noxious Weeds

Current legislation in Ireland pertaining to noxious weeds dates from 1936 when the Noxious Weed Act was enacted (repealing the Weeds and Agricultural Seeds (Ireland) Act, 1909). The Act aimed to enforce the control of particular weed species by individual landowners or managers by placing the onus of control on them. The owner, occupier, user or manager of lands on which noxious weeds are growing is liable, upon conviction, to a fine. Section 3 of *the Act states "Where any noxious weeds are growing on any land the responsible person in respect of such land or if there are two or more such persons, each of them severally, shall be guilty of an offence under this section and shall be liable on summary conviction thereof to a fine not exceeding twenty pounds".* In the case of the verges, medians and other landscaped areas of public roads, the local authority charged with the maintenance of such roads is responsible under the Act.

Following the enactment of the Act, a number of Orders were made relating to specific plants, and these are as follows:

- Noxious Weeds (Thistle, Ragwort, and Dock) Order, 1937 (S.I. No. 103 of 1937);
- Noxious Weeds (Common Barberry) Order, 1958 (S.I. No. 120 of 1958);
- Noxious Weeds (Male Wild Hop Plant) Order, 1965 (S.I. No. 189 of 1965); and
- Noxious Weeds (Wild Oat) Order, 1973 (S.I. No. 194 of 1973).

2 An overview of legislation and background to the issues

The Noxious Weeds (Thistle, Ragwort, and Dock) Order, 1937, (S.I. No. 103 of 1937) does not detail the specific species for which control is mandatory. The interpretation by Fleming J. (2008) of the Department of Agriculture, Fisheries and Food defines the noxious species as the spear thistle *(Cirsium vulgare)* and the creeping or field thistle *(C. arvense)*, common ragwort *(Senecio jacobea)* and two species of dock, the curled dock *(Rumex crispus)* and the broad-leaved dock *(Rumex obtusifolius)*. It should be noted that there are numerous other species of thistle, ragwort and dock that are not classified as noxious weeds. These other species are typically less invasive or problematic than the classified species and may be confined to specific habitat types or geographical regions such as Oxford ragwort *(Senecio squalidus)* which is confined primarily to walls and waste places in Dublin and Cork, or marsh ragwort *(S. aquaticus)* which occurs in wet grassland and marshes.

2.2.2 Non-Native Invasive Species

The Wildlife Acts, 1976 and 2000, contain a number of provisions relating to non-native invasive species covering several sections and subsections of the Acts. With regard to exotic species, it is prohibited without licence to plant or otherwise 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. The Minister may also issue regulations prohibiting possession or introduction of any species of wild bird, animal or flora, or any part, product or derivative of such wild bird, wild animal or wild flora which may be detrimental to native species. A review of legislative provisions is currently being undertaken on the island of Ireland and new regulations are likely to be forthcoming. Therefore, the legislative context is likely to change in the coming years.

Ireland has also ratified a number of international conventions that oblige the Government to address the issues of non-native invasive species including the Convention on Biological Diversity, the Bern Convention and the International Plant Protection Convention. In addition, there are obligations under the EU Habitats Directive to address any threats to the conservation status of the various habitats and species listed for protection under the Directive. There are a significant number of non-native invasive plant species in Ireland and it was not possible to include detailed information for all of them in this guidance document. Those species selected for inclusion are those which have been shown to have an adverse impact on landscape quality, native biodiversity or infrastructure; and are likely to be encountered during road schemes. These are:

- Japanese Knotweed *(Fallopia japonica)*;
- Giant Hogweed *(Heracleum mantegazzianum)*;
- Himalayan Balsam *(Impatiens glandulifera)*;
- Giant Rhubarb *(Gunnera tinctoria)*;
- Montbretia *(Crocosmia x crocosmiflora)*;
- Winter Heliotrope *(Petasites fragrans)*;
- Old Man's Beard *(Clematis vitalba)*;
- Common or Pontic Rhododendron *(Rhododendron ponticum);* and
- Buddleia *(Buddleja davidii)*.

2.3. Control Options

Control of both noxious weeds and non-native invasive species can be broken into either physical methods or chemical treatment. Physical methods include cutting, digging or excavating, hoeing and pulling by hand. Chemical treatment may involve the application of herbicide either by targeted spraying or direct application to the individual plant by wiping or direct injection.

Control options for the various species are dealt with individually in Sections 6 (noxious weeds) and 7 (non-native invasive species).

3 Assessing the presence/risks of Noxious Weeds and Non-Native Invasive Species at the EIA and pre-construction phase of National Road Schemes

As part of the Environmental Impact Assessment (EIA) process for the planning of a proposed new national road project, the presence and abundance of noxious weeds and non-native invasive species of plant should be noted as part of the general species composition data recorded.

During habitat mapping, details of the presence of noxious weeds or non-native invasive species should be recorded on data recording sheets (A sample data recording sheet and outline management plan is presented in Appendix 1) with the location and extent of infestation plotted on a map at a scale of 1:5,000 or less. Details of the scale of infestation should be recorded using a three-point abundance scale of high, medium or low infestation (where high equates to 30% or greater cover, medium equates to 10–30%, and low is less than 10%). In order to improve the national database on the distribution of non-native invasive species, records should be submitted to the National Biodiversity Data Centre through the Invasive Species in Ireland website (see Submitting Invasive Species Records to the National Invasive Species Database).

Large infestations in particular, of noxious weeds should be identified as requiring specific treatment during the site clearance and topsoil-stripping phase of construction (see Section 4.1). All infestations of non-native invasive species should be noted as requiring specific treatment because if left unattended, they have the potential to cause significant problems in the future. Where infestations extend outside of the road footprint, the risk for re-infestation following control is high and this should be noted accordingly. Appropriate control measures should be prescribed within the Environmental Impact Statement (EIS) and should detail:

- the area requiring treatment;
- the type of treatment required;
- an assessment of the risk of re-infestation from surrounding land.

The potential risks associated with the future spread of the particular plant may need to consider the potential for re-infestation of the road margin from adjacent lands and how activities undertaken during the project may spread non-native invasive species to adjacent areas or along the proposed route. The specific management requirements to control the future spread of the weeds should be addressed within the mitigation section of the EIS, which will subsequently be reflected in the contractual documents and the Environmental Operating Plan (EOP) for the scheme.

Many sites may have multiple noxious weeds and/or non-native invasive species requiring different management methods over different timeframes. A management plan for noxious weeds and non-native invasive species should be drawn up detailing the control and management measures being undertaken at the site (see Appendix 1). This is particularly important if Japanese knotweed is present. The plan should identify a point of contact for noxious weeds and non-native invasive species to ensure effective communication of the issues to all contractors as well as ensuring compliance with relevant guidelines and Codes of

3 Assessing the presence/risks of Noxious Weeds and Non-Native Invasive Species at the EIA and pre-construction phase of National Road Schemes

Practice. The management plan should set out a clear process for eradicating, controlling and containing these species, including: an implementation schedule; records of treatments undertaken; and locations where materials are disposed of.

4 Control and management of Noxious Weeds and Non-Native Invasive Species during site clearance and construction of roads

When the site becomes available to the contractor for fencing and commencement of site clearance, areas identified as requiring specific treatment within the EIS should be demarcated and the designated control measures implemented at the earliest possible stage to reduce the risk of spread along the scheme or beyond the landtake.

Any additional lands that have been temporarily acquired for the construction of a scheme should also be subjected to a similar level of assessment and treatment for noxious weeds and non-native invasive species as those lands inside the fence line. During the construction of a road scheme, raw materials e.g., rock, topsoil, sands and gravel may be imported from a range of different locations. It is important that all such locations e.g., quarries, gravel pits etc., are assessed for the presence of noxious weeds and non-native invasive species in advance of removing any material from such sites.

Priority should be given to reducing the risk of seed transfer by preventing the plants from flowering and to reducing the risk of material transfer by instigating appropriate controls on movement of machinery and soil/gravel/stones in the infected area.

A systematic approach should be taken to clearance and control of noxious weeds and non-native invasive species ensuring that the use of tracked machinery is limited in infested areas and vehicles and equipment are cleaned between sites. This will minimize the risk of reintroducing contaminated soil/gravel/stones, seeds or plant fragments into treated areas. The outline management plan for noxious weeds and non-native invasive species presented in Appendix 1 provides a template for strategic management which should commence with a thorough assessment of the plants distribution within the lands in question. Following this, the approach to control and preventing the further spread of the plant can be elaborated depending on the species, extent of infestation and other variables including:

- the scale and extent of infestation (including whether confined to the road footprint or not);
- the species in question;
- the sensitivity of the local environment;
- the growth stage, etc.

Care should be taken to choose the most appropriate method for the specific circumstances of each site. In particular, chemical control of noxious weeds may risk damaging adjacent rare or valuable flora and fauna in sites of special conservation interest or in adjacent waterbodies. Where infestation occurs in lands adjacent to the road scheme, control along the road verges may prove ineffective due to the constant re-colonization of material from the adjoining lands.

Where chemical treatment is required, the use of such chemicals should be undertaken in accordance with the product label and Good Plant Protection Practice. In keeping with *A Guide to Landscape Treatments for National Road Schemes in Ireland* (NRA 2006a), the use of herbicides should be minimized and application

4 Control and management of Noxious Weeds and Non-Native Invasive Species during site clearance and construction of roads

should be targeted rather than broad-spread application. Where there is a need to use herbicides in and around waterbodies, it is imperative that only herbicides specifically approved for such use are used and that they are used in line with the manufacturers' specifications.

Those involved in the application of herbicides/pesticides must be competent to do so and, consequently, must have sufficient training, experience and knowledge in the area of herbicides/pesticides application. It is important that all staff involved in the application of herbicides/pesticides have received appropriate training, which may include achieving competency certification in the safe use of herbicides/pesticides through a National Proficiency Tests Council registered assessment centre or achieving an appropriate FETAC award in this area.

4.1. Soil Management and Storage

Control of noxious weeds and non-native invasive species on national road schemes during the construction phase requires adherence to an appropriate and effective soil management plan (See Section 5.5 in *A Guide to Landscape Treatments for National Road Schemes in Ireland* (NRA, 2006a)). Where the presence of non-native invasive plants goes unchecked, contamination of soil stores can occur, which, can result in the unintentional spread of the plant over a wide area during spreading and final shaping of soils in preparation for landscape treatments. In circumstances where soils/gravel/stones are imported from outside the compulsory purchase order (CPO) lands , appropriate pre-construction surveys, recorded on the data recording sheet presented in Appendix 1 should be carried out to determine the presence of noxious weeds or non-native invasive species at the site of extraction. If such plants are found to be present at the site of extraction, soil should not be imported from this location due to the risk of spreading these species. In situations where Japanese knotweed is identified on the site it may not be possible to use soil stores due to contamination. Soils containing Japanese knotweed will need to be treated or disposed of appropriately.

The disturbance of soils can result in the release of nutrients which can give rise to a flush of weed species such as thistles or docks, whose seeds have lain dormant in the soil. Where this arises during soil storage, appropriate control measures should be instigated prior to the soil being used in the completion of the landscaping element. This may entail the regular topping of weed growth to prevent flowering and seed-set thereby restricting the potential for further dispersal. Where soil stores are due to be in place for extended periods (greater than one year) they should be seeded with grass (a non-perennial ryegrass mix or sterile ryegrass) which will reduce the potential for weed germination and prevent degradation of the soil by maintaining microbial action. Periodic topping is recommended, as germination of noxious weeds is likely to occur to some extent. A facility for monitoring and implementation of weed control form part of the Soil Management Plan. This will necessitate the visual inspection or monitoring of soil stores by personnel capable of identifying the various plant species at the seedling stage. Monitoring should commence four weeks after the laying down of the soil store or re-laying of the soil during landscaping. Thereafter, monitoring should be undertaken monthly during the growing period (April to September) or every 2 months during the dormant period (October to March) for the first year and subsequently on an annual basis (for the period of the landscape defects rectification period).

4 Control and management of Noxious Weeds and Non-Native Invasive Species during site clearance and construction of roads

4.2. Landscaping and Landscape Contractor Maintenance

Under no circumstances should the planting of non-native invasive species be recommended in the Landscape Mitigation Masterplan for a national road scheme. All plant species selected for use in landscape treatments should be checked against the Invasive Species Ireland website (http://www.invasivespeciesireland.com/).

In accordance with the standard Works Requirements, the Landscape Contractor will generally be required to maintain and manage the landscape treatments during the Defects Rectification Period (normally 3 years), once all landscaping works have been completed. The maintenance regime should provide for the continued management of any noxious and non-native invasive plant species which were present during construction works and/or which may arise post construction. The contractor should also abide by the *Horticulture Code of Practice* (Invasive Species Ireland 2008) which identifies a range of actions that should be undertaken to reduce the risks from non-native invasive species.

All vehicles and equipment that have been used in control operations should be cleaned once control work in that section has been completed. On leaving each individual site, any tracked machinery, excavators (including buckets), trailers, dumper trucks, etc., should be thoroughly cleaned within a designated area to prevent the spread of material. It is important to remove soil which may contain seeds and plant fragments which otherwise could be transported along the road corridor as works are being undertaken. This also includes footwear, tools, etc.

4.3. Disposal of Material

Where cut, pulled or mown noxious weed or non-native invasive plant material arises, its disposal should not lead to a risk of further spread or pose a risk of poisoning to livestock in the case of ragwort. Particular care should be taken near watercourses as water is a fast medium for the dispersal of plant fragments and seeds. Material that contains flower heads or seeds should be disposed of either by composting or burial at a depth of no less than 0.5m in the case of noxious weeds, or by incineration (having regard to relevant legislation, including: Section 32 of the Waste Management Act, 1996 to 2008; Section 4 of the Air Pollution Act, 1987; and relevant local authority byelaws) or disposal to licensed landfill in the case of non-native invasive species. The taproots of docks and roots of creeping thistle are not suitable for composting or shallow burial, requiring disposal to landfill, incineration or burying at a depth of no less than 1.5m (practical only during the construction phase). It should be noted that particular care is required in relation to the disposal of non-native invasive species and, in particular, to the disposal of Japanese knotweed. Where burial is being used to dispose of Japanese knotweed, the material should be buried to a depth of 5m and overlain with a suitable geotextile membrane. All disposals should be carried out in accordance with the Waste Management Acts.

5 Control and management of Noxious Weeds and Non-Native Invasive Species during maintenance of National Roads

The control of noxious weeds and non-native invasive species should be undertaken in three distinct phases:

Phase 1: Undertake a detailed assessment;
Phase 2: Implement the appropriate control measures;
Phase 3: Undertake post control monitoring.

5.1. Phase 1: Assessment

An assessment of the presence of noxious weeds or non-native invasive species should be undertaken to guide the selection of control measures and the appropriate risk management requirements (see Appendix 1). A suitably qualified person, with experience in identifying noxious and non-native invasive weed species in all growth phases, should undertake the assessment. This assessment will provide data on the species present, scale of infestation, age of plants and physical site conditions which will facilitate determining the most appropriate control measure. It should also record any previous attempts at control or eradication detailing the success or failure of the measures applied. This data will facilitate the development of a systematic control programme, which, due to the invasive nature of the various non-native invasive species, may require a long term commitment. This requirement in terms of planning and resources needs to be accommodated within the contractual and management arrangements for the particular scheme.

The assessment should also take account of the presence and location of any planting or landscaping on the section of road in question, as well as any sensitive ecological receptors (e.g. watercourses, species-rich grassland, designated conservation areas, etc.) that may be in the immediate vicinity. Consideration will also need to be given to whether there is potential bird nesting habitat in the vicinity where control is being undertaken during the bird nesting season (1st March to 31st August).

In circumstances where designated conservation areas (including Natura 2000 sites, Natural Heritage areas, proposed Natural Heritage Areas, Nature Reserves and National Parks etc.) adjoin the roadside. Local authorities are advised to consult with the local National Parks and Wildlife Ranger in advance of undertaking any controls in such areas.

Figure 2 presents an overview of the assessment procedure and factors determining the choice of control measure employed.

5 Control and management of Noxious Weeds and Non-Native Invasive Species during maintenance of National Roads

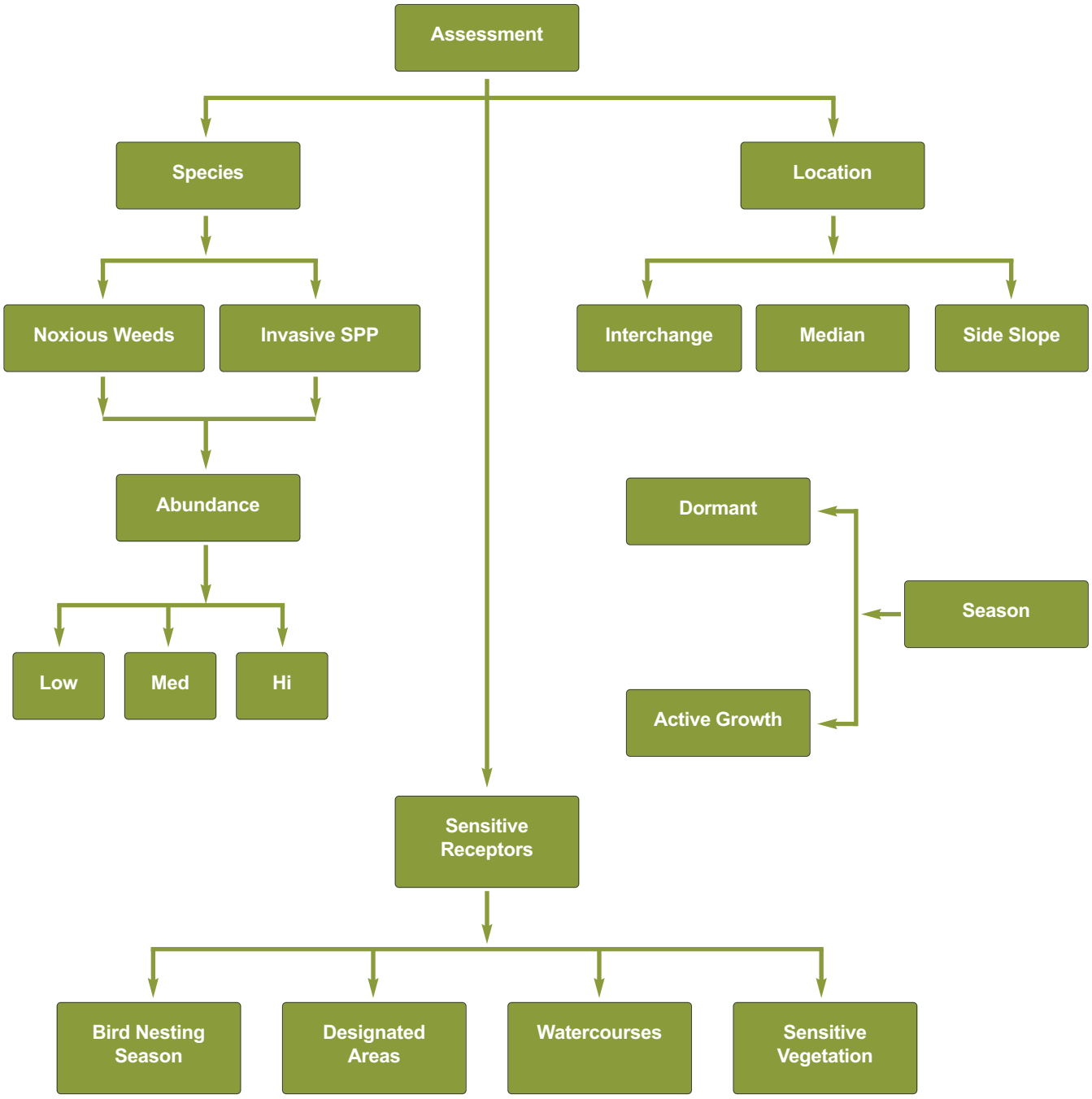

Figure 2: Overview of the Assessment Procedure and Factors influencing choice of Control Option

5 Control and management of Noxious Weeds and Non-Native Invasive Species during maintenance of National Roads

5.2. Phase 2: Implement the Appropriate Control Measures

The decision to use a particular type of treatment in the control of noxious weeds and non-native invasive species will always be made on a case-by-case basis. Whilst there should generally be a preference for physical control methods, chemical control may in some cases be more appropriate.

In situations where it is deemed that chemical treatments are the most appropriate, then all chemicals should be used in compliance with the product label and in accordance with Good Plant Protection Practice as prescribed in the European Communities (Authorization, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003 (S.I. No. 83 of 2003).

In general, the application of herbicides and pesticides should not be undertaken: in windy weather where there is a risk of spray drift occurring; during or preceding rainfall, which can result in the chemical being washed off; or, during periods of particularly cold weather, which can reduce the plants ability to uptake the chemical. When chemicals are being used it is important to refer to the Official Register of Plant Protection Products in Ireland (www.pcs.agriculture.gov.ie). This website specifies the list of approved products and the crops/situations for which they are approved. Control measure options are presented on a species by species basis in Section 6.

As the flowering period for the most species is from June onwards, control measures should optimally be initiated during spring (late February to late May) to prevent plants flowering and thus setting seed. Application of herbicides close to the flowering period of a plant may not prevent the plant from developing viable seed.

The approach to weed control and the specific requirements vis-à-vis health and safety will vary according to where one wishes to control weeds, e.g. embankments, verge, median, interchanges, etc. National road cross-sections vary considerably. For example, the current standard Type 1 Dual Carriageway (D2AP) cross-section generally includes a 2:1 embankment (where in cut or fill), a 2.0m grass verge adjacent to the hard shoulder and a hard central reserve with concrete median barrier. Older standard cross sections typically contained wide grassed medians to which wire-rope crash barriers were generally retro-fitted. Grade separated junctions will generally incorporate roundabouts and will generally have a combination of grassland and landscape planting with fringing crash barriers.

Traditionally, the central reserves of Irish motorways and dual carriageways have been grassed and consequently can be subject to infestation by noxious weeds. Treatment of noxious weeds in the central reserve is complicated by the presence of wire rope and other barriers and anti-dazzle screens. More recent construction however, incorporating a paved narrow median, eliminates the problem of noxious weeds. Grade separated junctions may incorporate roundabouts and crash barriers and will generally have a combination of grassland and landscape planting.

Road verges are accessible from the road carriageway or hard shoulder, for the treatment of noxious weeds. Traffic management for road verge treatment is likely to be more onerous in the absence of a hard shoulder. The standard road cross section will include sections of cut and fill, with typical 2:1 side slopes. Difficulties with access will, in many situations, preclude the use of machinery to treat noxious weeds or non-native invasive species on cut and fill slopes.

5 Control and management of Noxious Weeds and Non-Native Invasive Species during maintenance of National Roads

In all situations, a risk assessment should be undertaken to identify the hazards at the particular site and to facilitate planning of the noxious weed or non-native invasive plant control and traffic management design in accordance with Chapter 8 (DoT 2008) of the *Traffic Signs Manual*(DoT 1996) and the *Guidance for the Control and Management of Traffic at Road Works* (LGMSB 2007).

5.2.1. Soil/Scree Slopes and Embankments

Side slopes on roads will vary in height according to the extent of cut or fill, but will generally have a gradient of two horizontal to one vertical. Chemical weed control on standard side slopes can be undertaken using hand-operated lances fed from a vehicle-mounted bowser. It is important to ensure that such treatments are targeted and every effort made to avoid chemical spread onto neighbouring plants. The vehicle will be able to operate within the hard shoulder. Where infestation levels are low (i.e. 10% or less cover) use of knapsack sprayers may be more efficient.

Where weed control is required on slopes greater than 2:1, specific measures may be required to facilitate access. Such slopes are normally rock-cuttings or rock faces. Some rock faces can be very inaccessible and they can support the growth of non-native invasive species such as Buddleija and *Rhododendron ponticum*.

The use of machinery on such slopes is typically not an option and physical control methods or herbicide application may require the use of self-arrest or belay systems by personnel. In areas of rock cutting where the surface is uneven and the potential for loose rock is present, an anchored tender should belay the operator from the top of the slope. The belay equipment required is similar to that used in tree-surgery with the operator wearing a harness to which is attached a static rope. As abseiling requires the operator to control their own descent, this does not leave them with both hands free to operate a knapsack sprayer or swiper.

On steep uniform slopes that are under grass or trees and shrubs, spiked boots or fitted crampons will enable the operator to traverse the slope with greater control than in standard working footwear. The requirement for a belay in such situations will depend on the characteristics of the site.

5.2.2 Central Reserves or Medians

The configuration of barriers, landscaping and the width of the central reserve or median, in conjunction with the scale of infestation by the particular weed, will dictate what type of control measure is most appropriate in the central reserve. Physical control by cutting, topping or pulling may be undertaken using hand-operated machinery or hand tools. It should be noted that handpulling or cutting are not suitable control measures in the treatment of Japanese knotweed and giant hogweed. Chemical weed control in central reserves may be undertaken using vehicle-mounted or knap sack sprayers or weed-wipes.

5.2.3. Grade Separated Junctions or Interchanges

As with central reserves or medians, the configuration of barriers, landscaping and scale of infestation will determine the approach to be adopted to weed control at grade separate junctions or interchanges. A similar pproach to that adopted for central reserves or medians is recommended.

5.2.4. Immediate and Wider Verge areas

Regular mowing of verges as part of the standard road maintenance programme ensures that noxious weeds are unlikely to be a problem because mowing keeps the

5 Control and management of Noxious Weeds and Non-Native Invasive Species during maintenance of National Roads

plants in check and prevent flowering. While lane closures are not typically required during mowing of verges, appropriate traffic management using advance warning signage or vehicles should be in place.

Prior to the undertaking of any mowing activities on the immediate and wider verge areas, it is important to ensure that there is an absence of non-native invasive species.

It should be noted that mowing or strimming Japanese knotweed is not appropriate as it will only exacerbate the problem. Mowing of giant hogweed is also not suitable as it creates an increased risk of the toxic sap spreading onto the mower operator.

5.3. Phase 3: Undertake Post-Control Monitoring

Monitoring of the control measures should be undertaken approximately six to eight weeks after treatment to determine the success of the measures used. Further follow up may be needed to ensure complete eradication. It should be noted that certain types of noxious weeds, and in particular ragwort, are highly robust species and in certain situations can be difficult to control, particularly where it has not been managed for a number of years. As a result, it may be necessary to use a variety of control methods over an extended period to reduce populations. Similarly follow up treatment for several years (around five years) will be required for Japanese knotweed and giant hogweed due to the soil seed bank of giant hogweed and the extensive underground rhizome of Japanese knotweed not fully taking up the herbicide resulting in regrowth. Noxious weeds may also have a seed bank, which will also need extended treatment.

Following control of large areas of noxious weeds or non-native invasive plants, disturbance of the soil may give rise to a flush of seedling germination. To avoid this scenario, bare soil should be mulched (covered with a natural or synthetic barrier such as wood chip, straw, geo-textile, etc.) and planted at the earliest opportunity with an appropriate replacement vegetation to stabilize the soil and deter subsequent re-invasion. On the issue of planting regard should be had to the NRA's (2006a) *A Guide to Landscape Treatments for National Road Schemes in Ireland a*nd Invasive Species Ireland's (2008) *Horticulture Code of Practice.*

Figure 3: Ageing Spear Thistle – Down

6 Noxious Weeds Identification, Ecology and Control Measures

The following two chapters provide details on a plant-by-plant basis covering the identification, ecology and a synopsis of control measures for the various noxious weeds and non-native invasive species.

The choice of control will depend on the scale of infestation, the age of the plants, their location and accessibility on the road, their proximity to sensitive neighbouring vegetation or habitat and the time of year. The decision to use a particular type of treatment in the control of noxious weeds and non-native invasive species will always be made on a case-by-case basis. The NRA's policy is that the use of natural resource inputs (water, fertilizers, herbicides, pesticides, etc.) should be minimised and, therefore, there should generally be a preference for physical control methods. Notwithstanding this preference, chemical control may, in some cases, be deemed more appropriate.

Where chemicals are identified to be used as a control measure, priority should be given to those with the least potential to impact on the environment. All plant protection products should be used in accordance with the product label and Good Plant Protection Practice (see Appendix 3 – Recommendations for Using Herbicides). In accordance with *A Guide to Landscape Treatments for National Road Schemes in Ireland* (NRA 2006a), the Landscape Contractor should minimise the use of herbicides by spot treatment, if appropriate and only where required.

In general, chemical application is optimally undertaken using wipes or hand-held lances where application can be directed to the target plant. In general, the application of herbicides and pesticides should not be undertaken: in windy weather where there is a risk of spray drift occurring; during or preceding rainfall, which can result in the chemical being washed off; or, during periods of particularly cold weather, which can reduce the plants ability to uptake the chemical. When chemicals are being used it is important to refer to the Official Register of Plant Protection Products in Ireland see "www.pcs.agriculture.gov.ie". This website specifies the list of approved products and the crops/situations for which they are approved. Again, it is important to note that all plant protection products should be used in accordance with the product label and Good Plant Protection Practice.

6.1. Spear Thistle *(Cirsium vulgare)*

6.1.1. Identification and Ecology

- The spear thistle is a member of the Asteraceae or daisy family, which is characterised by its production of dozens of small flowers (or florets) in a massed head giving the impression of a single large flower.
- Spear thistles are biennial plants (living for 2 years only), which grow from 70–150cm in height.
- The leaves are wavy and deeply pinnatifid with small prickles on the upper surface and white and cottony below. The leave tip ends in a stout prickle.
- The flower heads are few, formed on a globular and giant involucre, with a tuft of deep purple florets (25–30mm across).

6 Noxious Weeds Identification, Ecology and Control Measures

- Flowering occurs during July to August after which seeds are formed with a pappus of long, soft feathery hairs, which allows for ready dispersion by the wind, the plants only means of spread.

- Spear thistles are common in pasture, roadsides and waste ground throughout the country.

6.1.2. Means of Control

Since spear thistles do not produce a spreading root system, it is possible to control them by hand hoeing individual plants and small patches provided the growing point and the top 20 to 40mm of the tap-root are removed. Cutting or slashing when the plants are in the late bud or early flower stage (before mid-July), may help to reduce seed production. However, because spear thistles tend to mature over an extended period, this method of control is of limited value. Moreover, in years when there is adequate soil moisture, thistles are likely to recover and re-grow.

For effective chemical control, the thistles must be growing actively. In most winters when the temperature falls to near freezing, spear thistles become dormant and are very much less susceptible to herbicides. Susceptibility increases again with the onset of spring. When practicable, spraying should be completed before the centre flowering stem develops (i.e. up to the end of June). Although spear thistle remains reasonably susceptible even up to flowering, treatment at this late stage involves the use of more active forms of the herbicides and of higher application rates. The use of a wiper applicator, where appropriate and possible and if the thistle population is reasonably uniform in size, can overcome most of the problems arising from treatment of mature plants. Plant protection products containing MCPA or 2,4-D amine should be applied to give a light overall wetting of the plant in the seedling or rosette stages.

Figure 4: Spear Thistle – Flower

Once plants have started to shoot, plant protection products containing 2,4-D ester is more effective than the amine form of the chemical.

6 Noxious Weeds Identification, Ecology and Control Measures

Table 1: Summary of Physical and Chemical Control Measures for **Spear Thistle**

Physical Control

Method	Season	Follow-up	Comment
Hand hoeing	**Before mid-July.**	Must remove the top 20–40mm of the root crown.	As spear thistle does not produce a spreading root system it is possible to control by hand hoeing individual plants and small patches provided the growing point and the top 20 to 40mm of the tap-root are removed.
Cutting or slashing	**Before mid-July** – when plants are in late bud or early flower stage.	Of limited value except in small infestations.	May help to reduce seed production but is however of limited value as spear thistles mature over an extended period and if soil moisture is adequate thistles are likely to recover and re-grow.

Chemical Control

Chemical	Season	Follow-up	Comment
MCPA or 2,4-D amines	**Spring to end June** – in the seedling or rosette stages.	Wiper applicator.	Plant protection products containing MCPA or 2,4-D amine should be applied to give a light overall wetting of the plant in the seedling or rosette stages.
2,4-D	**Early summer** – when plants have begun to shoot flowering stem.	Wiper applicator or spot spray.	Once plants have started to shoot, plant protection products containing 2,4-D ester are more effective than the amine form of the chemical.

All Plant Protection Products should be used in accordance with the product label and with Good Plant Protection Practice as prescribed in the European Communities (Authorization, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003 (S.I. No. 83 of 2003). It is an offence to use Plant Protection Products in a manner other than that specified on the label.

Figure 5: Spear Thistle – Flower and Foliage (Photo: Mike Dodd)

Figure 6: Spear Thistle – Foliage

Figure 7: Spear Thistle – Rosette

6 Noxious Weeds Identification, Ecology and Control Measures

6.2. Creeping or Field Thistle *(Cirsium arvense)*

6.2.1. Identification and Ecology

- The creeping thistle, also a member of the Asteraceae, is a perennial plant that spreads readily with its creeping root system. The plant forms upright stems up to 100cm in height.
- The leaves are deeply pinnatifid with toothed and very prickly margins, pale green above and white below.
- The creeping thistle is dioecious with separate male and female plants; male flowers are slightly larger than females (15–20mm across). The florets in both are dull lilac.
- Seeds are similar to that of the spear thistle and dispersed by the wind.
- Creeping thistles are abundant in dry pastures and along roadsides. As the name suggests, they are capable of spread by their underground root system as well as by seed dispersal.

6.2.2. Means of Control

Cultivation is not an effective means of control for creeping thistle, as the roots are simply cut to fragments capable of regeneration thus giving rise to an increased infestation. Cutting of flower stems before opening of the flower buds will prevent seed spread for that particular season and repeated cutting at the same growth stage over several years may 'wear down' an infestation.

Although the top growth of creeping thistle is susceptible to many herbicides, long-term control is difficult to obtain, as it is with most deep-rooted perennials.

Figure 8: Creeping Thistle – Early Growth

Figure 9: Creeping Thistle – Flower

Figure 10: Creeping Thistle – Foliage

6 Noxious Weeds Identification, Ecology and Control Measures

Plant protection products containing MCPA have been found to be suitable for controlling deep rooted plants and effective against creeping thistle. Because it acts fairly slowly, the correct spray timing is essential to get good translocation down into the thistle's root system.

Plant protection products containing MCPA applied during the early bud stage (as the flower bud is forming – typically mid-May to mid-June) will kill the aerial parts of the plant, but repeat treatments the following year may be necessary for complete control.

Table 2: Summary of Physical and Chemical Control Measures for **Creeping Thistle**

Physical Control

Method	Season	Comment
Hand hoeing	(Not effective)	N/A
Cutting or slashing	**Before mid-July.**	Cutting is not an effective means of control for creeping thistle, as the roots are simply cut in to fragments capable of regeneration thus giving rise to an increased infestation. Cutting is effective mainly in preventing seeding and cutting of flower stems before opening of the flower buds will prevent seed spread for that particular season and repeated cutting at the same growth stage over several years may "wear down" an infestation.

Chemical Control

Chemical	Season	Application	Comment
MCPA	**Mid-May to mid-June –** in the early bud stage – may require follow-up in following year.	Wiper applicator.	Although the top growth of creeping thistle is susceptible to many herbicides, long-term control is difficult to obtain, as it is with most deep-rooted perennials. Plant protection products containing MCPA have been found to be suitable for general use. Because it acts fairly slowly, the correct spray timing is essential to get good penetration down into the thistle's root system. Plant protection products containing MCPA applied during the early bud stage (as the flower bud is forming – typically mid-May to mid-June) will kill the aerial parts of the plant, but repeat treatments the following year may be necessary for complete control.

All Plant Protection Products should be used in accordance with the product label and with Good Plant Protection Practice as prescribed in the European Communities (Authorization, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003 (S.I. No. 83 of 2003). It is an offence to use Plant Protection Products in a manner other than that specified on the label.

6 Noxious Weeds Identification, Ecology and Control Measures

6.3. Common Ragwort *(Senecio jacobea)*

6.3.1. Identification and Ecology

- Ragwort, another member of the Asteraceae (also known as ragweed and buachalan buidhe) is a stout biennial or short-lived perennial (where topped regularly as in lawns).
- It forms a rosette of leaves in its first year and in the second year produces a robust stem up to 130cm in height on which the flowers are produced.
- The leaves are deeply pinnatifid with the lower segments toothed. As a member of the Asteraceae, the plant produces masses of little florets in a striking yellow flower head born terminally in a dense corymb (or flat-topped cluster).
- The seeds (or achenes) have a tuft of simple hairs that enables seed dispersal by wind.
- Ragwort is a common plant of pasture, waste ground, sandhills and roadsides.
- Ragwort is toxic to cattle, horses, deer, goats, pigs and chickens, though sheep appear less affected by it. The poisonous substances in ragwort are toxic alkaloids (Jacobine, Jacodine and Jaconine) which cause the liver to accumulate copper, causing ill heath and death. The toxicity of the poisons does not diminish following the death of the plant and ragwort in hay or silage remains toxic.

6.3.2. Means of Control

Pulling by hand is suitable for limited areas and is best undertaken when the ground is moist after recent rainfall. The plant is best pulled after it has sent up its flowering stalk but before seed set. Alternatively, cutting at the early flowering stage (pre-seed set) will reduce the risk of spread but does not destroy the plant and may result in the plant becoming more vigorous in the following year. In both instances, as seedlings and first year plants in the rosette stage will not be targeted, it is necessary to undertake pulling or cutting in 2 consecutive years to ensure control. As cut or pulled plants retain their poison, thus posing a serious risk to grazing animals, and may also still set seed, they should be removed and burned, or disposed to landfill.

Figure 11: Common Ragwort likely distribution in meadow land (Photo: Mike Dodd)

No single herbicide treatment will completely eliminate a ragwort infestation due to successive germinations of the weed. Treatment with selective herbicides can be made to the plant rosettes (plants in their first year) optimally in late spring (April – May) or early autumn (mid-August to mid-October) before frost damages the foliage. The most effective plant protection products for the control of ragwort are those containing 2,4 D, but these are broad spectrum herbicides and will affect a number of other plant species. While spraying can be undertaken at any time of year for plants in their second or flowering year, it is optimally undertaken in March to May or while the flowering shoot is developing and the plant is in active growth. MCPA-based plant protection products also offer effective herbicide control for spot treatment of ragwort.

Figure 12: Common Ragwort – Flower and Foliage

Figure 13: Common Ragwort – Flower and Foliage

Figure 14: Common Ragwort – Rosette

6 Noxious Weeds Identification, Ecology and Control Measures

Table 3: Summary of Physical and Chemical Control Measures for **Ragwort**

Physical Control

Method	Season	Comment
Cutting or slashing	Before flowering: Optimally **mid-June**. Effective mainly in preventing seeding.	Requires follow up in the following year. Although it may reduce seed population it can promote perennialization of ragwort, which will come back the following year more vigorously. Cut or pulled plants retain their poison thus posing a serious risk to grazing animals and may still set seed. Where there is a potential danger of animals coming into contact with the cut ragwort, it should be removed and burned, or disposed of to landfill.
Hand Pulling	**Early summer** before flower heads mature. Best done following recent rain.	Requires follow up in following year. Gloves must be worn. Best results when soil is wet. Very dependant upon spotting plants and some may be missed. Cut or pulled plants retain their poison thus posing a serious risk to grazing animals and may still set seed. Where there is a danger of animals coming into contact with the cut ragwort, it should be removed and burned, or disposed of to landfill.

Chemical Control

Chemical	Season	Application	Comment
2,4 D	To rosettes For young plants (Year 1) **in April – May or mid-August to mid-October** For adult plants (Year 2) **March – May**	Wiper application or spot treatment.	Wiper applicator or spot treatment. Plant protection products containing 2,4 D offer the most effective means of control. Using herbicides to control ragwort is very effective if the correct timing and rates of application are used. 2,4D is a broad-spectrum herbicide and will affect a number of other plant species. Autumn application must be done before frost damages the foliage.
MCPA	As for 2,4 D	Wiper application or spot treatment.	Wiper applicator or spot treatment. Using herbicides to control ragwort is very effective if the correct timing and rates of application are used.

All Plant Protection Products should be used in accordance with the product label and with Good Plant Protection Practice as prescribed in the European Communities (Authorization, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003 (S.I. No. 83 of 2003). It is an offence to use Plant Protection Products in a manner other than that specified on the label.

6 Noxious Weeds Identification, Ecology and Control Measures

Figure 15: Curled Dock

Figure 16: Curled Dock – Foliage

Figure 17: Broad-Leaved Dock (Photo: Mike Dodd)

6.4. Curled Dock *(Rumex crispus)*

6.4.1. Identification and Ecology

- The curled dock, a member of the Polygonaceae family, is a robust, glabrous (lacking hairs) perennial with a well-developed tap-root system.
- It grows to 100cm in height and forms a short-branched, upright plant with distinctive lanceolate, wavy-edged leaves reaching 15cm in length.
- The small greenish, flowers are produced in a terminal panicle (or loosely branched spike) and produce triangular nut-like seeds.
- The withered stalks of the curled dock remain standing well into the spring.
- Curled docks are common in pasture, along roads, on shingle shores and in waste ground throughout the country.

6.5. Broad-Leaved Dock *(Rumex obtusifolius)*

6.5.1. Identification and Ecology

- The broad-leaved dock, also a member of the Polygonaceae family, is a robust, glabrous plant similar in structure to the curled dock but growing to 120cm and with significantly broader leaves.
- Both species are capable of hybridizing and while the hybrids may produce less or no seed, they are generally much more vigorous than either parent.
- The leaves of the broad-leaved dock are large, slightly oblong with crenate (scalloped) edges and square bases.

6 Noxious Weeds Identification, Ecology and Control Measures

- The panicles (flower stems) are erect, leafless and stiff. The flowers are small and green, with ensuing small, reddish brown nuts.

- The broad-leaved dock is abundant throughout the country in pasture, roadsides and waste places and thrives in high nitrogen environments and where there is heavy treading by stock or machinery.

6.5.2. Control of Docks

Both dock species produce many seeds that can remain viable in soil for decades. The plants can also be spread from fragments of the taproot which can produce new plants if they contain a dormant bud. Physical control of either species of dock is practical only on a limited scale. Specific hand tools have been designed (e.g. www.lazydogtoolco.co.uk) to extricate the extensive and forked taproot intact. Hand-pulling of the shoots before they have set seed can be effective on days when the soil is moist, but care needs to be exercised to avoid leaving fragments of root behind. Regular topping of the foliage may slowly wear the taproot down but does not appear to be present a reliable control method, though it will prevent seed set.

Chemical treatment for mature dock plants can be achieved by a number of plant protection products containing asulam, fluroxypyr, dicamba, 2,4-D, triclopyr or thifensulfuron. Control of seedlings (carried out within a few weeks of germination) can be achieved with plant protection products containing MCPB, MCPA or Mecoprop.

A combination of glyphosate/dicamba can be used selectively for large plants using a wiper applicator. Treatment should be carried out when docks are well grown and flowering stems are at least 500mm in height as the success of this treatment depends on being able to wipe a reasonable length of the docks' stems.

Spraying is optimally undertaken during the period May to August while the plants are growing vigorously but have not yet set seed. Cutting or topping should not be carried out for at least 2 weeks after spraying to allow the herbicide to be fully translocated into the root.

Control using plant protection products containing Asulam should be undertaken in warm weather during April – May before flowering shoots are developed, or during late August – September. In heavy infestations, a second spray may be required.

6 Noxious Weeds Identification, Ecology and Control Measures

Table 4: Summary of Physical and Chemical Control Measures for **Curled and Broad Leaf Docks**

Physical Control

Method	Season	Follow-up	Comment
Pulling by hand	After shooting flower stalk **(June-July)**. Best done following recent rain.	Requires follow-up in following year.	Effective only in small infestations. Hand-pulling of the shoots before they have set seed can be effective on days when the soil is moist, but care needs to be exercised to avoid leaving fragments of root behind.
Cutting or topping	Regularly before flowering **(mid-June)**.	Requires follow-up in following year.	Effective mainly in preventing seeding though continued topping will wear down taproot. Cutting or topping should not be carried out for at least 2 weeks after spraying to allow the herbicide if used to fully penetrate into the root.
Hand-hoeing	Not effective except for seedlings.		

Physical control of either species of dock is practical only on a limited scale. Specific hand tools have been designed (www.lazydogtoolco.co.uk) to extricate the extensive and forked taproot intact.

Chemical Control

Chemical	Season	Application	Comment
Asulam, Fluroxypyr, dicamba, 2,4-D, triclopyr or thifensulfuron	**May to August –** prior to seed set.	Wiper applicator or spot treatment.	For mature dock plants.
Glyphosate / dicamba	**May to August –** On well-grown plants (>0.5m height).	Wiper applicator.	For large plants. Treatment should be carried out when docks are well grown and flowering stems are at least 500mm in height as the success of this treatment depends on being able to wipe a reasonable length of the docks' stems.
MCPB, MCPA or Mecoprop	Control of seedlings carried out within 3–4 weeks of germination.	Wiper applicator or spot treatment.	For control of seedlings.
Asulam	**April to May –** before flowering shoots or late **August to September.**	Wiper applicator or spot treatment in warm weather. Second spray may be required for heavy infestations.	

All Plant Protection Products should be used in accordance with the product label and with Good Plant Protection Practice as prescribed in the European Communities (Authorization, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003 (S.I. No. 83 of 2003). It is an offence to use Plant Protection Products in a manner other than that specified on the label.

7 Non-Native Invasive Species Identification, Ecology and Control

7.1. Japanese Knotweed *(Fallopia japonica)*

It is recommended that readers also refer to the Environment Agency's (n.d.) *Managing Japanese knotweed on development sites - the knotweed code of practice* when dealing with Japanese knotweed issues.

7.1.1. Ecology and Distribution

Japanese knotweed is a member of the Polygonaceae (docks and rhubarb family), native to Japan and northern China. It has however, become widely distributed throughout Europe, North America, Canada, New Zealand and Australia. The plant is subject to some taxonomic confusion due to a combination of numerous synonyms and its capacity for hybridization between closely related species. In Ireland, the species is known as *Fallopia japonica* (Houtt.) (with the synonyms *Reynoutria japonica* and *Polygonium cuspidatum*). Giant knotweed (*Fallopia sachalinensis*) is also widespread in Ireland but is not found to the same extent along roadsides as Japanese knotweed. Hybrids between Japanese knotweed and giant knotweed also occur (*Fallopia X bohemica*), though thus far appear limited in distribution. The hybrid is a particularly large plant upto 3m tall. The closely related Himalayan knotweed (*Persicaria wallichii or Polygonum polystachium*) (see **Figure 19**) occurs occasionally along roads in parts of the country; it rarely exceeds 1.5m in height.

Only female plants have been recorded in Ireland and while seeds are sometimes produced, these are hybrid and rarely survive. Indeed the entire population appears to be a single female clone (Montgomery n.d.). Dispersal typically occurs through rhizome fragments being transported in soil by humans or to a lesser extent, through passive mechanical means such as in floodwaters. Dispersal is also achieved through vegetative reproduction

Figure 18: Japanese Knotweed – Foliage

from plant fragments.The plant typically occurs along roadsides, riverbanks and waste ground in Ireland where it forms dense, monotypic stands. During the winter, the brown stalks remain standing even though the plant dies back to the rootstock.

Japanese knotweed causes a range of problems due to its prolific and dense growth habit including blocking sight-lines on roads, damage to paving and structures, erosion of riverbanks and flood defence structures, damage to archaeological sites, loss and displacement of native habitats and species. Japanese knotweed is widespread throughout Ireland and is spreading rapidly (see **Figure 22** for current distribution).

7.1.2. Identification

- Japanese knotweed is a robust, herbaceous perennial plant with hollow, bamboo-like stems. It forms yellow cream flowers in late June or August. Its leaves are approximately the size of a human hand. Its hollow bamboo-like stems are green with red spots during summer, which turn brown during winter. It forms red side shoots off the main stem and its leaves are arranged in a zig-zag pattern.

Figure 19: Himalayan Knotweed – Foliage

Figure 20: Japanese Knotweed – Winter Stems

Figure 21: Japanese Knotweed – Foliage and Flowers

7 Non-Native Invasive Species Identification, Ecology and Control

- The plant is frost-sensitive and dies back in winter though the stems remain standing.
- Fallopia japonica grows from 120–300cm in height with leaves 7–12cm long with a square-cut base, while Fallopia sachalinensis grows from 150–300cm in height and has cordate (i.e. notched or indented at the base) leaves up to 30cm in length.
- A hybrid between the two species occurs which has increased vigour and produces even larger leaves. The root system is extremely extensive (extending 15 to 20m in length) and acts as a storage organ allowing for rapid growth in spring.
- The plant requires high light levels and the burst of growth in spring prevents other plants from out-shading it.

7.1.3. Control

It is recommended that a person with sufficient training, experience and knowledge in the control of non-native invasive species should be employed to assist in the planning and execution of control measures in relation to Japanese knotweed.

Readers are advised to refer to the British Environment Agency's (n.d.) *Managing Japanese knotweed on development sites - the knotweed code of practice* for information on Japanese knotweed and in devising control measures for Japanese knotweed.

Due to its invasive nature, Japanese knotweed control has been the subject of considerable research and investigation. The primary objective of control should be total eradication by targeting the underground rhizome and not simply the aerial parts. It should be noted that none of the methods outlined below guarantee eradication.

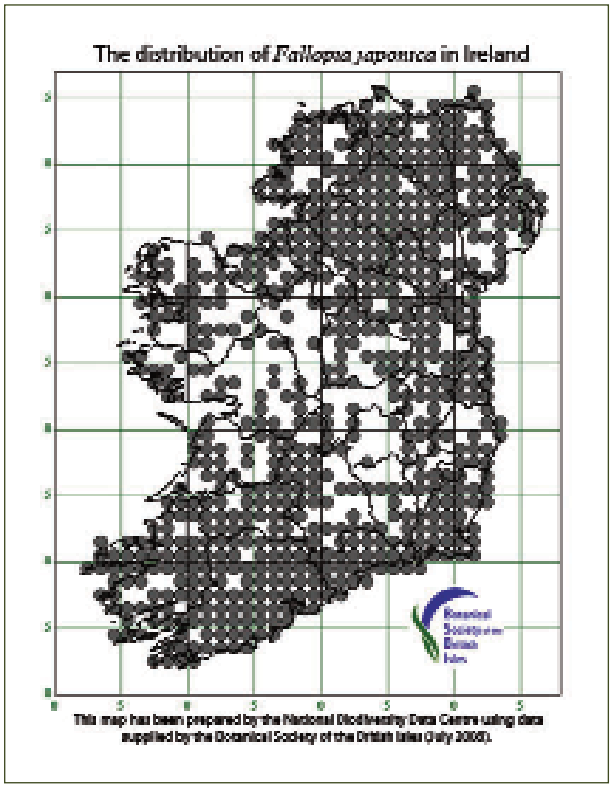

Figure 22: Distribution of Japanese Knotweed (National Biodiversity Data Centre, July 2008)

Japanese knotweed is highly invasive and extremely difficult to eradicate completely. **All control measures will require follow-up to ensure complete eradication which should be undertaken for a minimum of two growing seasons (and up to five growing seasons) after control.**

The approach to control will depend on several factors including the scale of the infestation, the topography and terrain of the site, the proximity of watercourses or other sensitive receptors (such as protected flora), the funds available, etc. Current control measures are limited to a combination of physical and chemical means and chemical means alone, though biological control is actively being researched and a number of predatory organisms from the plant's native range are being investigated as potential control agents. However, according to current

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research, it appears that biological control agents will only stunt the plant's growth and that conventional control measures will have to be used alongside biological controls. Earlier in this document (at page 23) it was stated that when deciding on the choice of treatments to be applied for the control of noxious weeds and non-native invasive species on national road schemes, priority should generally be given to the use of physical methods. However, in the case of Japanese knotweed, the use of physical methods, on their own, are extremely unlikely to control Japanese knotweed. In all cases, chemical treatment, either on its own or in combination with physical treatment, will be required. Indeed, recent research indicates that a combination of physical and chemical treatments may be more effective than chemical treatment alone in controlling Japanese knotweed.

In controlling Japanese knotweed, preference should, where feasible, be given to treating Japanese knotweed in its original location (Environmental Agency n.d., p.26). According to the Environmental Agency (n.d., p.26), '*you should only consider excavating Japanese knotweed as a last resort, unless it is part of an on-site treatment method.'* In essence, one should only excavate Japanese knotweed where construction necessitates it.

It is vital to accurately map the distribution of Japanese knotweed on a site as the area of infestation can extend 7m horizontally (and up to 3m in depth) from the nearest growth and the extent of the underground rhizomes should be mapped by digging a series of test pits. All treatments will require follow up monitoring and a management plan should be drawn up which sets out the programme of control measures and monitoring. The development of a management plan for the control of Japanese knotweed is highly recommended, as total control will require input over successive years. A draft outline management plan is presented in **Appendix 1**, which can be adopted for use as required.

Table 5 presents a summary of current control measures.

Physical and Chemical Control – Combined Treatment Methods

In using these methods, great care is needed to ensure plant material is not spread.

As indicated above, research has shown that a combination of physical and chemical treatments may be more effective than chemical treatment alone in controlling Japanese knotweed.

The Environment Agency (n.d., p. 18) indicates that combining digging and spraying is effective in reducing the time needed for chemical control. By digging and breaking up the rhizome, the aim is to stimulate leaf production leaving the plant more vulnerable to treatment with a plant protection product.

The Japanese knotweed canes should first be cut using a cutter, hook or scythe. The cane should be carefully set aside on a suitable membrane surface until they have dried to a deep brown colour and are certain to be dead; or, can be double-bagged and disposed of at a licensed waste facility, where: (a) the facility have been informed in advance of the nature of the waste material; (b) the facility is licensed to accept this material; and, (c) the facility is prepared to accept the material. The canes may also be disposed of by 'deep burial' (see below). Again, the Waste Management Acts, 1996-2008, must be complied with. These Acts will require, *inter alia*, that a waste haulier employed to haul waste material is authorised by a waste collection permit or is exempt from such a requirement. Readers are referred to the NRA's *Guidelines for the Management of Waste from National Road Construction Projects* (2008d, p. 26) in this regard.

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A wheeled excavator may then be used to scrape the top 25cm of topsoil, containing the surface crown and rhizomes, into a pile. The exposed ground is then cultivated to a depth of at least 50cm and the piled material is then re-spread over the cultivated area. This process may be carried out during the winter months, if care is taken not to compact wet soil, which may increase runoff and spread Japanese knotweed across the site. **Note that effective site hygiene is essential.**

This process will stimulate the rhizome to produce a higher density of stems, leaving the plant more susceptible to treatment with a plant protection product (see chemical control methods outlined below).

Another combined treatment method that may be used is the cut and inject technique. The National Trust in the UK has developed a cut and inject technique that is particularly suitable for use on sites with sensitive associated flora. The effectiveness of this technique has been assessed through research by the University of Exeter (2007). The technique involves the cutting of the mature Japanese knotweed stems shortly before senescence (senescence refers to the biological processes of a living organism approaching an advanced age, which, in the case of Japanese knotweed, typically occurs with the first frosts in late October or November). Stem cuts should be approximately 200mm above the base of cane, preferably approximately 40mm above a node. The cut cane should be carefully set aside and disposed of appropriately. A measured dose of plant protection product is then applied into the hollow stem cavities. Reference to the University of Exeter's (2007) standard methodology is advised. In subsequent years, the stems may not be sufficiently large to inject. In such cases, spot application of plant protection products containing glyphosate will be required.

Again, it is essential that all plant protection products are used in accordance with the plant product label and with Good Plant Protection Practice as prescribed in SI 83 of 2003.

Excavation and Containment/Disposal

A number of methods have been developed to deal with Japanese knotweed control in development sites which are all based on mechanical excavation of the rhizome material and its subsequent containment either at depth, within an impermeable membrane, or its disposal off-site. Again, the use of these methods should be avoided where possible. Where feasible, preference should be given to treating Japanese knotweed in its original location (Environmental Agency n.d., p.26). Excavation should only be considered where construction requires it.

When excavation and containment/disposal control methods are deemed necessary it is essential that good site hygiene practices are employed to reduce the risk of contaminating other areas of the site. Measures employed may include: fencing off and signing areas of infestation; not using tracked vehicles in the infested areas; pressure washing vehicles exiting infested areas in designated wash-down areas; and, ensuring adequate supervision.

In considering excavation and containment/disposal control methods, regard must be had to the Waste Management Acts, 1996 to 2008, and to the NRA's *Guidelines for the Management of Waste from National Road Construction Projects* (2008d). It should be noted that, *inter alia*, a waste licence or a waste facility permit may be required for the containment/disposal of excavated material.

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Excavation

When planning an excavation it is important to determine the extent of rhizome infestation. Rhizome growth may extend up to 7m horizontally from the nearest growth. Generally, rhizomes will not penetrate deeper than 3m from ground level, with more recent infestations penetrating to a lesser depth. A person with sufficient training, experience and knowledge in the control of non-native invasive species should be employed to determine the extent of material to be excavated.

The Environmental Agency (n.d., p. 26) suggests that at least two weeks prior to excavation, the Japanese knotweed should be treated with a non-persistent herbicide (certain plant protection products containing glyphosate are non-persistent). It is important to note that certain plant protection products have a specified period of 'activity,' which will be described on the product label and which will dictate when the product can be applied. Choosing the right herbicide is very important. The herbicide must not be capable of causing groundwater contamination. **Under no circumstances should a persistent herbicide be used when excavation and containment/disposal techniques are being considered. To use a persistent herbicide in such circumstances would potentially cause the material to be classified as 'hazardous waste.'** The haulage and disposal of 'hazardous waste' material is extremely expensive. If any doubt remains as to the safety of the herbicide used or approach adopted, the supplier of the product should be contacted.

Excavation and 'Deep Burial'

Excavated material containing Japanese knotweed material, cut canes, etc., may be 'deep buried' on site. This involves burying the material on-site to a depth of **at least** 5m. Once buried, the Japanese knotweed material should then be covered with a root barrier membrane layer before being in-filled to 5m deep with inert fill or topsoil.

Again, the provisions of the Waste Management Acts, 1996 to 2008, must be considered and complied with. The location of the buried material should be accurately mapped and recorded. It is also recommended that permanent signs be erected to inform people of the nature and quantity of the buried waste. Future owners of the land must be advised as to the position and content of the buried material.

Excavation and Disposal to Landfill

The Environmental Agency indicates that excavation and disposal to landfill is the method of last resort (Environmental Agency n.d., p.29). Disposing of contaminated soil to landfill: is extremely expensive; uses up valuable landfill capacity; and, involves large-scale haulage.

Great care is required to ensure that no material is lost when the excavated material is being transported. For small quantities, the material can be 'double-bagged' in heavy duty waste bags. For larger quantities, the waste can be moved in skips lined and covered with appropriate membranes. The material can then be disposed of at a licensed waste facility, where: (a) the facility have been informed in advance of the nature of the waste material; (b) the facility is licensed to accept this material; and, (c) the facility is prepared to accept the material. The canes may also be disposed of by deep burial (see above).

Again, the provisions of the Waste Management Acts, 1996 to 2008, must be complied with. These Acts will require, *inter alia*, that a waste haulier employed to haul waste material is authorised by a waste collection permit or is exempt from such a requirement.

7 Non-Native Invasive Species Identification, Ecology and Control

Chemical Control

A review of chemical control methods for Japanese knotweed was undertaken by Kabat *et a*l (2006). While a number of chemicals were found to be effective against the plant, many of these were undesirable due to their non-selective nature, persistence or toxicity to aquatic ecosystems.

The current most widely recommended chemical for Japanese knotweed control is glyphosate which breaks down in the soil relatively quickly. Glyphosate does, however, because of its broad spectrum nature, have the disadvantage of being potentially damaging to non-target plants. Great care is, therefore, necessary in applying this herbicide. As with all plant protection products, it should be used in compliance with the product label and in accordance with Good Plant Protection Practice as prescribed in the European Communities (Authorization, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003 (S.I. No. 83 of 2003). Plant protection products containing glyphosate should be applied in late September or early October. However, it is further advised that the plants be treated early in the growing season (May) to stunt the growth of the plant, consequently reducing the amount of viable above-ground material and the height of the stand.

For small infestations, plant protection products containing 2,4-D Amine can be used. 2,4-D Amine has the advantage of being selective and specific to broadleaved plants. However, in general, it has a greater persistency when compared to Glyphosate. Plant protection products containing 2,4-D Amine should be applied in May with a follow up treatment in late September or early October.

Care is required in the selection of the appropriate plant protection product and method of application. In making this selection regard should be had to, *inter alia*: the abundance of the Japanese knotweed; the location of the stand; the proximity and nature of sensitive receptors; and, the season. Only certain plant protection products are approved for use in or near water. Not all plant protection products are selective in nature. And, the persistency of plant protection products varies. The method of application should be as targeted as possible, having regard to all other factors. Again, plant protection products should be used in compliance with the product label and in accordance with Good Plant Protection Practice. With all forms of chemical control in relation to Japanese knotweed follow-up treatment will be required in subsequent years.

7 Non-Native Invasive Species Identification, Ecology and Control

Table 5: Summary of Physical and Chemical Control Measures for **Japanese Knotweed**

Physical and Chemical Control - Combined Treatment Method

Method	Season	Follow-up
Combined digging and spraying.	Digging and spreading can take place in winter, chemical control as described below.	Chemical control may be required over five years.
Cut and inject technique.	**Late October or November.**	Chemical control may be required over five years.

Physical and Chemical Control

Method	Season	Follow-up
Chemical control followed by excavation.	Chemical control when Non-persistant herbicide is 'active'. Excavation two weeks later.	Monitor site of excavation regularly.
'Deep burial.'	Following excavation.	Monitor site of burial regularly.
'Disposal to landfill.'	Following excavation.	N/A.

Chemical Control

Method	Season	Follow-up
Glyphosate-based Plant Protection Product.	**May** and **late September/early October.**	Chemical control may be required over five years.
2,4-D Amine-based Plant Protection Product.	**May** and **late September/early October.**	Chemical control may be required over five years.

All Plant Protection Products should be used in accordance with the product label and with Good Plant Protection Practice as prescribed in the European Communities (Authorization, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003 (S.I. No. 83 of 2003). It is an offence to use Plant Protection Products in a manner other than that specified on the label.

7 Non-Native Invasive Species Identification, Ecology and Control

7.2. Giant Hogweed *(Heracleum mantegazzianum)*

7.2.1 Ecology and Distribution

Giant hogweed (*Heracleum mantegazzianum*) is a member of the carrot family (*Apiaceae*) and bears a close resemblance to the native and widespread hogweed *(H. sphondylium*). It is native to the Caucasus Mountains in south-west Asia. Giant hogweed is highly invasive due to its vigorous early-season growth, tolerance of shade and flooding, in combination with its efficient production and spread of seeds (several thousand seeds per flower head). Spread is by seed. The plant is highly tolerant of disturbed sites and can out-compete other vigorous weed species due to its height. As the plant frequently colonises along river banks, its can increase the risk of soil erosion as it dies back in winter leaving bare soil which its shallow root system does not bind efficiently.

The stem and undersides of the leaves of giant hogweed are coated with fine hairs that contain a phototoxic sap that renders skin sensitive to ultraviolet light. The slightest contact with the plant can result in the release of sap which then gives rise to severe and painful blistering of the skin. The reaction may take up to 24 hours to occur and may result in permanent recurrent phytophotodermatitis – a type of dermatitis that flares up in sunlight. As the plant hairs are extremely fine and brittle, they can pierce light clothing. In the event of contact with the sap, the skin should be covered to prevent exposure to sunlight and washed immediately with soap and water. Full protective clothing including masks or safety glasses and hood should be worn when undertaking any type of control.

Figure 23: Giant Hogweed – Plant

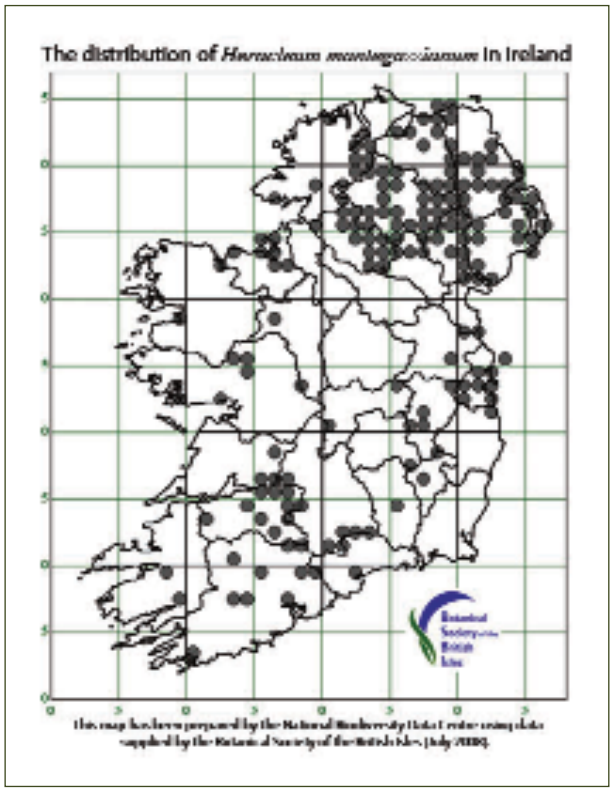

Figure 24: Distribution of Giant Hogweed (National Biodiversity Data Centre, July 2008)

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7.2.2. Identification

- Giant hogweed is characterized by its size and can grow to 3–5m in height producing large umbels (flower heads) of small white flowers up to 0.5m across.
- It is usually biennial, forming a rosette of leaves in the first year before sending up a flower spike in the second. The plant typically dies after flowering and setting seed.
- Giant hogweed has a ribbed, purple-spotted, hollow stem with dark green, deeply lobed leaves up to 2m in length.
- It is distinguishable from the native hogweed (*H. sphondylium*), which does not have hairs on its stem, with less dissected leaves and is smaller in all its parts.
- Within Ireland, giant hogweed is locally widespread though still absent from much of the central part of the country and is frequently encountered in waste ground, along rivers and streams, and in woodland fringes.

7.2.3. Control

The control of giant hogweed should aim to eradicate the plant entirely or at minimum, prevent the plant from producing seed. As seed may remain viable for 15 years, control will require continued input over several years to be complete. Soil within 4m of established plants is likely to contain vast numbers of seed from previous years flowering and should not transferred to other parts of a site unless as part of a control measure. The majority of seeds however, are contained within the top 5cm of soil and will only persist for 1–2 years (Booy & Wade 2007).

Figure 25: Giant Hogweed – Seeds (Photo: Mike Dodd)

Figure 26: Giant Hogweed – Flowers

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Figure 27: Giant Hogweed – Foliage

Such soil and all vegetative material should not be stock-piled within 10m of any watercourse due to the risk of material being transferred by water. The use of tracked machines should be limited in contaminated areas to prevent the transfer of vegetative material and seed-laden soil around the site within the tracks. On leaving the site, any tracked machinery should be thoroughly cleaned within a designated area to prevent the spread of material. Giant hogweed material and infected soil should be stored on top of a membrane of fabric in a designated area for appropriate disposal. On completion of the clearance, this area should be subsequently monitored for re-growth during the spring to autumn period and appropriate treatment undertaken as necessary.

Due to its phototoxic sap, a risk assessment should be prepared in advance of attempts at any control measures. All operatives engaged in giant hogweed control and personnel working on the site should be made fully aware of the phototoxic nature of the plants sap and its potential to result in permanent recurrent phytophotodermatitis. Personnel engaged in controlling Giant Hogweed should wear complete protective clothing. Haulage contractors involved in transporting infected material to landfill and the landfill operators should similarly be made aware of the risks. Infected material being transferred from the site should be covered to avoid accidental spread during transport.

Where control has been implemented, it will be necessary to re-vegetate the soil following treatment to prevent erosion and to reduce the incidence of giant hogweed seeds germinating. Establishing a good sward of grasses will reduce the rate of recolonisation. Monitoring of the site and subsequent follow-up control of hogweed seedlings will be required for a minimum of 5 years following treatment or after any soil disturbance at the site. Table 6 presents a summary of control measures for giant hogweed.

Physical Control

All personnel engaged in control should be made aware of the serious health, safety and environmental risks associated with the plant and provided with complete protective clothing. Young plants can be readily pulled or teased out of the soil using hand tools. This is best undertaken when the soil is moist following recent rain and care should be taken to extract the plants intact. Where plants are larger than approximately 1.5m, the upper part can be cut back and the lower part of the stem used to lever the roots out. The central crown of the root must be removed to prevent the plant regenerating; small fibrous side roots cannot send up new plants. Where plants are well-established, continuous germination of seedlings will occur following the removal of mature plants and periodic removal of these will be required to ensure control. Seed heads on old stems should be removed by individually bagging seed heads and cutting to prevent accidental spread of seeds. Seedlings are best left for a few weeks to establish before removal as they are easier

7 Non-Native Invasive Species Identification, Ecology and Control

removed. Follow-up removal will be required for a period of at least 5 years to ensure complete control. Subsequent soil disturbance in the area however, may give rise to a new flush of seedlings.

Mowers, strimmers or weed-whackers should not be used as they: tend only to stimulate additional budding on the root crown; do not reduce the plants rigour; and, can flail sap onto operators and through clothing.

Chemical Control

The use of chemical herbicides for giant hogweed control is effective but will require follow-up treatment to deal with seedling re-growth even where the initial infestation has been controlled. The most effective chemical for the control of giant hogweed is glyphosate. Foliar sprays of glyphosate are suitable for large infestations, but as the chemical is broad-spectrum, it will kill all sprayed plants. Injection into the stem of the plant approximately 30cm above the ground with 5ml of a 5% v/v solution can be used where spot treatment is required.

Where a site contains sensitive vegetation, giant hogweed is best controlled by injecting herbicide into the stem or using a weed swipe. Foliar spray application should be undertaken before the flowering stem has fully elongated in mid-spring during periods of mild, dry weather. Where control is being undertaken later in the year after stem elongation, the stems should be cut back to ground level and the re-growth sprayed.

Table 6: Summary of Physical and Chemical Control Measures for **Giant Hogweed**

Physical Control

Method	Season	Follow-up
Removal using appropriate hand tools and Full P.P.E.	**Spring** following recent rain.	Follow-up to deal with seedlings for 5 years.

Chemical Control

Chemical	Season	Follow-up
Glyphosate	Foliar spray in **mid-spring** before stem elongation. Otherwise, cut back and spray re-growth. Stem injection during growing season.	Foliar spray, wiper applicator, spot treatment or stem injection.
2,4-D	Foliar spray in **mid-spring** before stem elongation. Otherwise, cut back and spray re-growth. Stem injection during growing season.	Wiper applicator or spot treatment.

All Plant Protection Products should be used in accordance with the product label and with Good Plant Protection Practice as prescribed in the European Communities (Authorization, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003 (S.I. No. 83 of 2003). It is an offence to use Plant Protection Products in a manner other than that specified on the label.

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7.3. Indian or Himalayan Balsam (*Impatiens glandulifera*)

Figure 28: Indian or Himalayan Balsam

7.3.1. Ecology and Distribution

Himalayan balsam is a member of the busy Lizzie family (*Balsaminacea*) and as its name suggests, is native to the Himalaya region of Asia. It was introduced as a garden plant in the mid-1800's (Royal Horticultural Society 2008a) and quite swiftly became established along waterways and in other damp places by means of its prolific seed production. It is an annual plant forming dense upright stands approximately 1m tall where it effectively out-competes surrounding herbs and grasses. It is tolerant of shade and does very well in the canopy of riparian woodland. In the autumn it dies back leaving the ground bare and vulnerable to erosion.

7.3.2. Identification

- Himalayan balsam is an erect and glabrous (hairless) plant with a brittle, reddish stem, which can grow up to 2m in length. The broadly lanceolate and toothed leaves are 10–20cm in length and arranged oppositely or in whorls of three.
- The plant produces an abundance of white to pink/purple, flowers in racemes, which are followed by club-shaped seedpods.
- When ripe, the pods open explosively propelling the small black seeds up to seven meters from the mother plant, which gives it a considerable edge in colonizing new ground. In addition, the seeds can remain viable for up to 18 months and are readily dispersed in water.
- Germination commences in February and flowering commences by June extending into October.
- Within Ireland, Himalayan balsam is widespread throughout the country though has not yet colonized extensively in the central plain.

7.3.3. Control

Control measures for Himalayan balsam should aim to prevent flowering and are therefore essentially undertaken before the commencement of flowering in June. Where flower production can be prevented, eradication may still take over 5 years. **Table 7** presents a summary of control measures for Himalayan balsam.

Physical Control

Mechanical control is only likely to be effective where good access is available and the ground smooth enough to permit either mowing or cutting back. Where accessible,

7 Non-Native Invasive Species Identification, Ecology and Control

plants can be cut, mown or strimmed back to ground level before flowering in June. Do not cut earlier as this promotes greater seed production in any re-growth. Unless the plant is cut to below the lowest node, it will re-spout. Regular mowing will control the plant provided the frequency of mowing is regular enough to prevent sprouting and flower formation. Repeat annually until complete control is attained. As plants are very shallow-rooted, they can also be easily pulled by hand. Hand pulling will require a follow up pull in August due to new seeds sprouting. Vegetative material can be disposed of by composting unless seeds are present, in which case the material should be disposed of to licensed landfill or burnt.

Chemical Control

Chemical control of Himalayan balsam is readily achieved with the use of glyphosate or 2,4-D amine, which should be applied during active growth in late spring but late enough to ensure that germinating seedlings have grown sufficiently to be covered by the spray. Glyphosate is systemic and can be applied as a foliar spray where extensive infestations occur. However, it is a broad-spectrum herbicide and care should be taken where sensitive species are also present. In such cases, application can be made by weed-wiper. 2,4-D amine is effective against many broad-leaved weeds but does not affect grasses which may be important in stabilizing soils. It may therefore be a preferable choice to glyphosate in certain situations.

Repeat treatments or other means of controlling seedling germination will be required for a period of five or more years. Monitoring of the site will be required in mid-spring and mid-summer to assess the occurrence of seedlings and determine appropriate control.

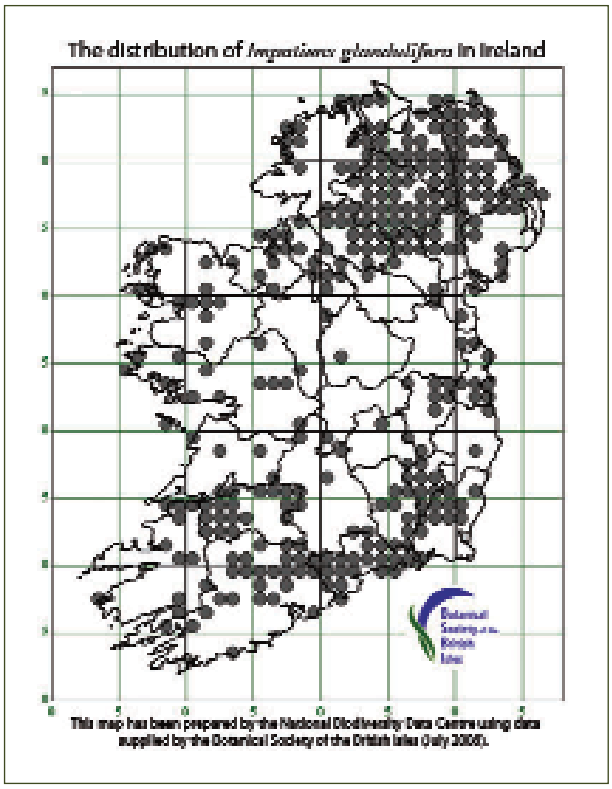

Figure 29: Distribution of Himalayan Balsam (National Biodiversity Data Centre, July 2008)

Figure 30: Himalayan Balsam – Flowers and Foliage

7 Non-Native Invasive Species Identification, Ecology and Control

Table 7: Summary of Physical and Chemical Control Measures for **Himalayan Balsam**

Physical Control

Method	Season	Follow-up
Hand pulling	Pre-flowering following recent rain.	Regular follow-up to deal with seedlings.
Mowing or cutting	Before flowering in **June**. Mowing required regularly for control.	Regular follow-up to deal with seedlings.

Chemical Control

Chemical	Season	Follow-up
Glyphosate	During active growth in late spring **(Late April to May)**.	Foliar spray, wiper applicator or spot treatment.
2,4-D amine	During active growth in late spring **(Late April to May)**.	Foliar spray, wiper applicator or spot treatment.

All Plant Protection Products should be used in accordance with the product label and with Good Plant Protection Practice as prescribed in the European Communities (Authorization, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003 (S.I. No. 83 of 2003). It is an offence to use Plant Protection Products in a manner other than that specified on the label.

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7.4. Giant Rhubarb *(Gunnera tinctoria)*

7.4.1. Ecology and Distribution

Giant rhubarb *(Gunnera tinctoria)*, a member of the *Gunneraceae* family (not related to the familiar garden rhubarb), is a native of Chile that was probably first introduced to Ireland as a garden plant. It has naturalized particularly well along the milder and wetter western seaboard where conditions are comparable to its former range (see **Figure 32**) growing on coastal cliffs, wet and damp meadows, boggy ground, roadsides and along waterways.

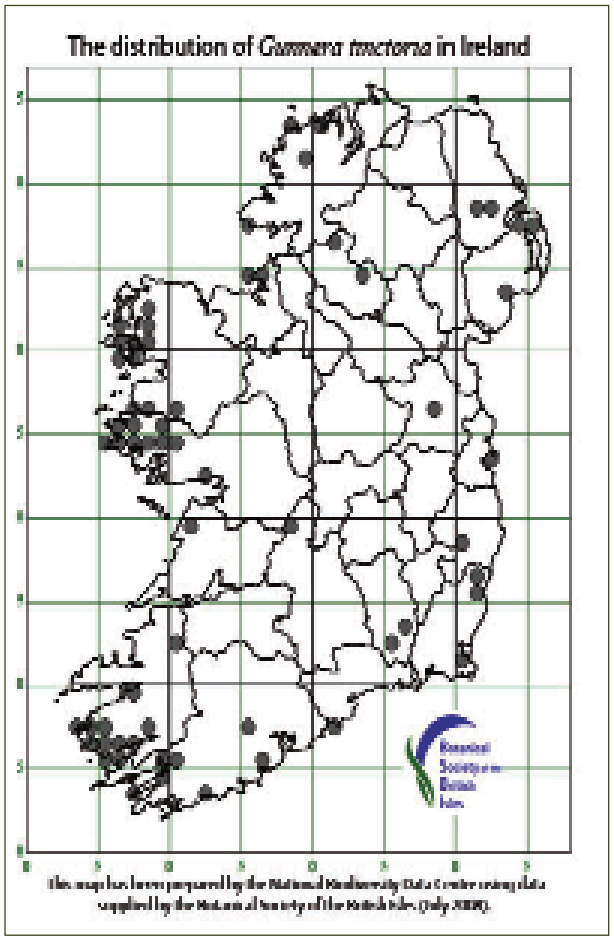

Figure 31: Distribution of Giant Rhubarb (National Biodiversity Data Centre, July 2008)

7.4.2. Identification

- Giant rhubarb has unmistakable massive rhubarb-like leaves (up to 100cm in diameter and 200cm in height) which emerge from a perennial rhizomatous rootstock on stout stalks.
- The entire plant is covered with coarse prickles.
- Tiny green flowers are borne in large spikes during the summer which produce abundant tiny seeds.
- The leaves wither back in winter and expose the large dormant buds that are covered in pinkish scales.
- Giant rhubarb is able to thrive in low nutrient and immature soils such as on sedimentary cliffs, exposed moraines, and disturbed soil sites.
- It has huge tolerance to salt spray and is found growing right to the shore on Achill Island and in parts of Connemara, and appears to thrive in water-logged situations growing in stream beds and wet meadows. It does not appear to do well in well-drained or drought-prone soils.
- 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.

7.4.3. Control

Physical Control

Control of established stands of giant rhubarb is only really feasible using chemical means. Small or recently

7 Non-Native Invasive Species Identification, Ecology and Control

established infestations may be dealt with by grubbing out plants physically. Regular follow-ups will however be required to deal with seedlings or re-growth from rhizomes. As the plant is capable of regeneration from bits of rhizome, all material must be handled and disposed of in a way which does not result in the potential for further spread. Disposal of material can be by deep burial (more than 2m deep), incineration or to licensed landfill. Removal of flower spikes will aid in limiting dispersal by seed.

Chemical Control

Experimental control of giant rhubarb on Achill Island is being carried out using glyphosate and triclopyr (Irish Strategy for Plant Conservation 2007). Trials suggest that application of herbicide is most effective late in the growing season (late August to early September) by direct application to cuts made on the stems or on leaf stalks following cutting back of leaves (C. Armstrong, National Botanic Gardens 2008). Glyphosate has been used extensively in New Zealand for its control and has been found to be effective using 1.5–2% foliar spray. On steep ground where access with knapsack sprayers was not possible, abseilers cut off the leaves and treat the exposed cut surface with a 25% glyphosate (Law 2003). After spraying, some rhizomes can take up to 18 months to decay. Sub-lethal doses of herbicide have resulted in multi-headed re-growth. Follow-up control will be required to deal with re-growth and subsequent seedling germination.

Figure 32: Giant Rhubarb

Figure 33: Giant Rhubarb – Young Growth

7 Non-Native Invasive Species Identification, Ecology and Control

Table 8: Summary of Physical and Chemical Control Measures for **Giant Rhubarb**

Physical Control

Method	Season	Follow-up
Grubbing	Pre-flowering following recent rain. Only suitable for recently established infestations.	Regular follow-up to deal with seedlings or re-sprouting.
Removal of flower heads	**Before flowering in June.**	Only effective in preventing seed dispersal.

Chemical Control

Chemical	Season	Follow-up
Glyphosate	During active growth late in the growing season – **late August / early September.**	Foliar spray, wiper applicator or spot treatment.
2,4-D amine	During active growth late in the growing season – **late August / early September.**	Foliar spray, wiper applicator or spot treatment.
Triclopyr	Late in the growing season – **late August / early September.** Not when hot or during drought.	Foliar spray or spot treatment.

All Plant Protection Products should be used in accordance with the product label and with Good Plant Protection Practice as prescribed in the European Communities (Authorization, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003 (S.I. No. 83 of 2003). It is an offence to use Plant Protection Products in a manner other than that specified on the label.

7 Non-Native Invasive Species Identification, Ecology and Control

7.5. Montbretia *(Crocosmia X crocosmiflora)*

7.5.1. Ecology and Distribution

Crocosmia's are members of the iris family *(Iridaceae)* native to the grasslands of the Cape Region in South Africa. Montbretia *(Crocosmia X crocosmiflora)* is an artificially produced hybrid that has become invasive in parts of Europe and New Zealand.

7.5.2. Identification

- Montbretia is a perennial herb that grows from underground corms. The corms form linear chains with the youngest at the top and the oldest buried deepest in the soil. The chains are fragile and corms readily break off giving the plant a ready means of spread.
- The linear leaves are up to about 500mm in length and may not dieback completely in winter in milder areas.
- The bright reddish-orange flowers are produced in a loose terminal panicle on slender stems up to 600–1000m in height.
- The flowers are capable of producing viable seed which further aids the spread of the plant.
- Montbretia has naturalised itself in many parts of Ireland, especially in the south-west where it is very common along road banks and hedgerows. It is also frequent along watercourses and lakeshores. Its current distribution within Ireland is shown in **Figure 35.**

7.5.3. Control

Physical Control

Physical control of montbretia is difficult as the corms break up from their chains very readily and can result in ready re-infestation or further spread. Where infestations are limited in extent, the entire stand can be excavated and buried at a depth of at least 2m, incinerated or disposed of to licensed landfill. The corms are very hardy and are not suitable for composting. Due to the potential for re-infestation from corms, regular follow-up will be required over a period of at least 2 years to deal with any re-growth.

Chemical Control

Control can be achieved using glyphosate. **All Plant Protection Products should be used in accordance with the product label and with Good Plant Protection Practice as prescribed in the European Communities (Authorization, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003 (S.I. No. 83 of 2003). It is an offence to use Plant Protection Products in a manner other than that specified on the label.**

Figure 34: Monbretia – Flowers and Foliage

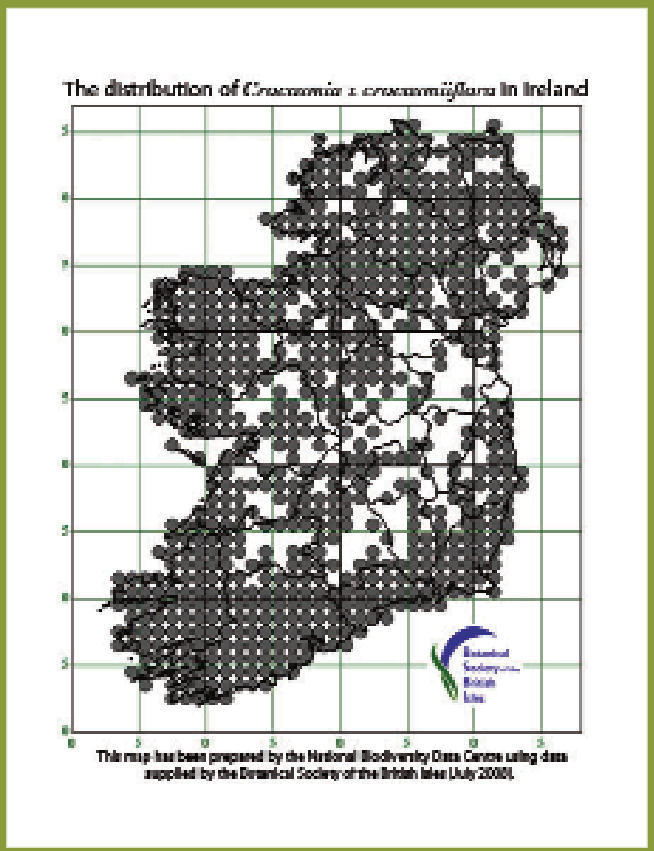

Figure 35: Distribution of Monbretia
(National Biodiversity Data Centre, July 2008)

Figure 36: Monbretia – Foliage

7 Non-Native Invasive Species Identification, Ecology and Control

Table 9: Summary of Physical and Chemical Control Measures for **Montbretia**

Physical Control

Method	Season	Follow-up
Excavation	**Any time of year** when the soil is suitably dry.	Regular follow-up to deal with missed corms re-sprouting.

Chemical Control

Chemical	Season	Follow-up
Glyphosate	During active growth in **late spring** or **summer.**	Foliar spray, wiper applicator or spot treatment.
Metsulfuron	During active growth in **late spring** or **summer.**	Foliar spray, wiper applicator or spot treatment.

All Plant Protection Products should be used in accordance with the product label and with Good Plant Protection Practice as prescribed in the European Communities (Authorization, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003 (S.I. No. 83 of 2003). It is an offence to use Plant Protection Products in a manner other than that specified on the label.

7 Non-Native Invasive Species Identification, Ecology and Control

7.6. Winter Heliotrope *(Petasites fragrans)*

7.6.1. Ecology and Distribution

Winter heliotrope *(Petasites fragrans)*, a member of the Asteraceae family, is a low-growing herbaceous plant originating in North Africa. It is established widely in Ireland being frequent along roadsides, hedgerows, woodland edges and waste ground. As apparently only the male plant that is present in Ireland, its spread is confined to vegetative means.

7.6.2. Identification

- Winter heliotrope produces large roundish leaves up to 30cm in diameter, which are downy underneath.
- Its pale pink flowers, which are amongst the earliest flowers of the year appearing in December and January, have a distinctive sweet smell.
- The foliage appears later in spring (though last years foliage may not dieback completely) and forms a dense carpet at about 30cm in height.
- Winter heliotrope has a rhizomatous root system which enables it to spread vegetatively.

Figure 37: Winter Heliotrope – Foliage and Flowers (Photo: Mike Dodd)

Figure 38: Winter Heliotrope – Foliage

7.6.3. Control

Physical Control

Due to the extensive rhizome network, physical removal of winter heliotrope is really only practical on a limited scale. Where mechanical means can be employed, it should be possible to deal with larger infestations but due to the potential for regeneration from fragments of roots, it may be best to tackle its control using a combination of excavation with follow-up treatment by herbicides. As with other plants with the potential to spread from small root fragments, disposal of material should be undertaken with due caution to prevent accidental spread of the plant. Other means of disposal include burial of material at a depth of at least 2m, incineration or disposal to licensed landfill. There is no evidence that the material would withstand composting though this approach would probably only be suitable for limited infestations.

7 Non-Native Invasive Species Identification, Ecology and Control

Chemical Control

An application of a glyphosate-based herbicide after flowering in February to March is recommended by Cornwall Nature Reserves (2008), though the Royal Horticultural Society (2008b) recommends spraying in mid-summer or later but before the foliage begins to die back.

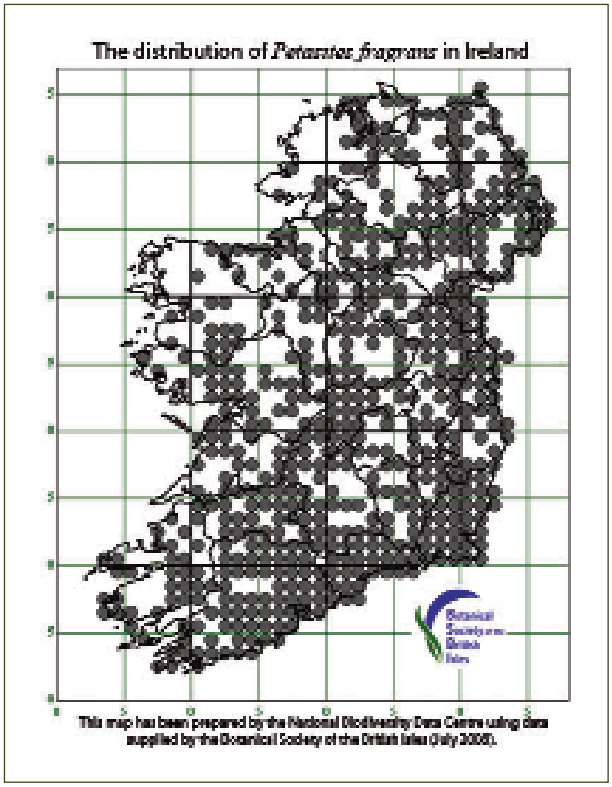

Figure 39: Distribution of Winter Heliotrope (National Biodiversity Data Centre, July 2008)

Table 10: Summary of Physical and Chemical Control Measures for **Winter Heliotrope**

Physical Control

Method	Season	Follow-up
Excavation	Any time of year when the soil is suitably dry.	Regular follow-up to deal with re-sprouting.

Chemical Control

Chemical	Season	Follow-up
Glyphosate	After flowering in February to March, or in mid to late summer.	Foliar spray, wiper applicator or spot treatment

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7 Non-Native Invasive Species Identification, Ecology and Control

7.7. Old Man's Beard *(Clematis vitalba)*

7.7.1. Ecology and Distribution

Old man's beard *(Clematis vitalba)*, also known as travellers joy, is a member of the Ranunculaceae family. It is a vigorous, deciduous climber with characteristic feathery seed heads in the late summer from which it derives its common name. It is a native of central and southern Europe, but has established itself throughout much of Europe, North America and New Zealand where it has become a major weed of woodland. In Ireland, its distribution is mainly in the southern half of the country (see **Figure 41**) where it is found in hedgerows, roadsides, riverbanks and along forest edges. The vine can form dense thickets blanketing trees and shrubs, ultimately depriving them of light. It can break limbs or cause their collapse from its sheer weight and mass. It also prevents regeneration of native vegetation by blocking light and physically oppressing young plants. Outside of its native central and southern Europe, the ecological behaviour of old man's beard changes and it exhibits invasive characteristics that include: rapid growth rate; early reproductive maturity; easy vegetative spread from fragmentation; quick recovery from physical damage with the ability to re-sprout; and prolific seed production with wind dispersal (Cronk and Fuller 1995, p. 69–72).

Figure 40: Old Man's Beard – Flowers and Foliage

7.7.2. Identification

- Old man's beard has pinnate leaves with three to five leaflets on mature plants.
- The vines have strong longitudinal ribs and furrows and are pale brown and stringy on old stems.
- The flowers are produced in late summer to early autumn and are green-white and lightly fragrant.
- The wispy seed heads, which are produced in large amounts, remain on the plant through the winter dispersing primarily by wind.
- The trailing stem can also root at nodes to produce new plants.

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7.7.3 Control

Old man's beard can be controlled by both mechanical control and herbicides, though typically its control relies on a combination of both i.e. cut-stump application. In New Zealand, biological control has also been used with good effect. An agromyzid fly (*Phytomyza vitalbae)* and a sawfly *(Monophadnus spinolae*) were shown to be highly specific to the target weed and released in New Zealand between 1994 and 1998 (Gourlay et al 1999). **Table 11** presents a summary of control measures for old man's beard.

Physical Control

Small seedlings can be readily pulled by hand. Larger stems have to be cut, the roots grubbed out and the material placed off the ground so it cannot take root again.

Chemical Control

A number of chemicals have been used effectively against old man's beard in New Zealand, including glyphosate, though control invariably takes more than one year (New Zealand Department of Conservation 2005). Control should be undertaken during active growth. For mature plants, the vines should be cut back to ground level or waist height in winter or spring and the subsequent re-growth can be then foliar sprayed. This method will avoid impacting on the host plant the vine may be covering. For larger specimens, the plant can be cut at the base with a straight horizontal cut. Herbicide is then applied immediately to the wound with a paint brush, eye dropper or small squeeze bottle. On larger stems it is only necessary to wipe herbicide around the outer rim of the cut. The plants should be left in situ until they are dead. Where plants are not killed in a single application, wait until re growth before re spraying.

At this point it must be restressed that all Plant Protection Products must be used in accordance with the product label and with Good Plant Protection Practice as prescribed in the European Communities (Authorization, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003 (S.I. No. 83 of 2003). Again, it should be noted that it is an offence to use Plant Protection Products in a manner other than that specified on the label. The methods just outlined are not in accordance with the product label and so it will be necessary to discuss the use of such methods with the Pesticides Control Service with a view to seeking approval under the derogation procedures provided under the Plant Protection Regulations.

Triclopyr can also be used as a foliar spray or as a spot treatment. This should be applied in summer during active growth before senescence, when it is not very hot or during drought. Following control, regular monitoring will be required with appropriate follow-up to deal with re-growth or new seedling germination over a period of 2–3 years.

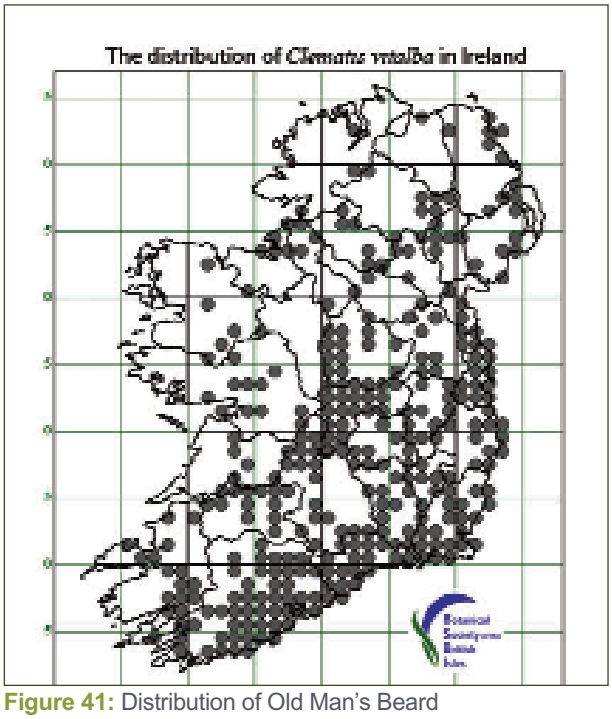

Figure 41: Distribution of Old Man's Beard (National Biodiversity Data Centre, July 2008)

7 Non-Native Invasive Species Identification, Ecology and Control

Table 11: Summary of Physical and Chemical Control Measures for **Old Man's Beard**

Physical Control

Method	Season	Follow-up
Cutting	**Any time of year when the soil is suitably dry.** Small plants can be pulled by hand. Large stems cut and roots grubbed out.	Regular follow-up to deal with re-growth or seedlings.

Chemical Control

Chemical	Season	Follow-up
Glyphosate	During active growth in **late spring or summer.** May require follow-up for 2–3 years.	Foliar spray, wiper applicator or spot treatment. For large vines cut at base and apply to cut surface.
Triclopyr	During active growth in **summer**.	Foliar spray or spot treatment. Do not apply if very hot or during drought.

All Plant Protection Products should be used in accordance with the product label and with Good Plant Protection Practice as prescribed in the European Communities (Authorization, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003 (S.I. No. 83 of 2003). It is an offence to use Plant Protection Products in a manner other than that specified on the label.

Figure 42: Old Man's Beard – Winter

Figure 43: Old Man's Beard – Seed

7 Non-Native Invasive Species Identification, Ecology and Control

7.8. Rhododendron *(Rhododendron ponticum)*

7.8.1. Ecology and Distribution

Rhododendron *(Rhododendron ponticum)* is an evergreen, acid loving shrub introduced to Ireland in the 18th Century. There are more than 900 species of Rhododendron, but only one, Rhododendron ponticum is invasive in Ireland. Since then, it has established itself as a major weed of acid woodlands in Wicklow, Kerry and Cork (see **Figure 44**) where its control has been an ongoing battle for many decades. It is only likely to be a problematic species on road schemes in areas of acid or peaty soils.

It produces masses of showy lilac flowers in May which help endear it to ill-informed members of the public. Ironically, rhododendron occurred as a native in Ireland during the (geologically) recent interglacial period. It is considered native to east and southern Europe and the current stock found in Ireland has been linked genetically with that found in the Iberian peninsula (Tyrie 2008).

It can withstand considerable shade and thrives as an understorey species in woodland, though it also tolerates open conditions in suitable acid soils. Its dense tangle of stems can block pathways, smother watercourses and encroach on roadways thereby impinging on sight-lines and reducing the capacity of the road to drying out. The foliage of rhododendron contains various compounds that appear to have an allelopathic action on other species (inhibiting their growth) which may further inhibit plants from growing within close proximity.

Rhododendron hosts a serious pathogen Phytophthora ramorum which is a fungus that attacks a variety of woody plants and tree species and is the causative agent of 'sudden oak death'. If suspicious symptoms are observed on Rhododendron such as wilting of shoots, brown/black colour on twigs that can spread onto leaves where the leaf bases and tips blacken this must be reported to the Forest Service for testing. Under the EU Plant Health Directive, emergency legislation was introduced in 2002 to prevent further spread of Phytophthora ramorum within the EU. If present, Forest Service will offer advice on control measures in accordance with EU technical guidelines.

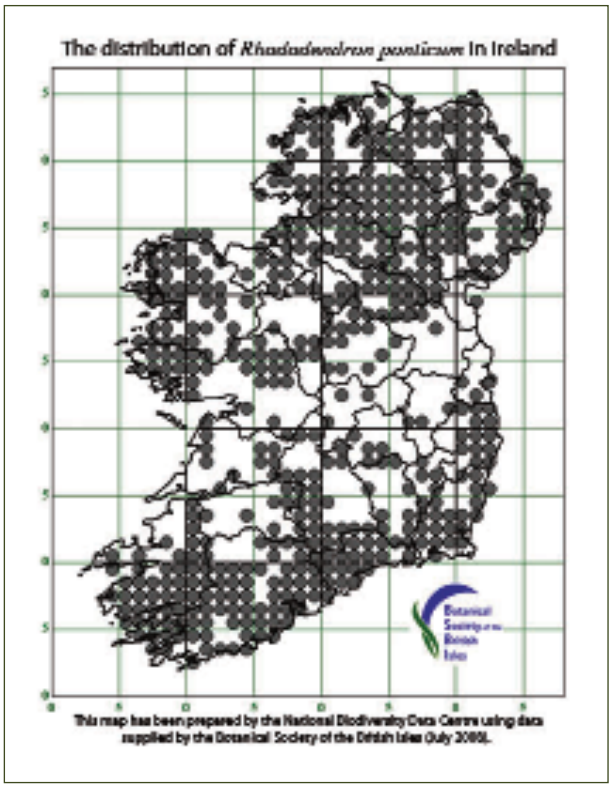

Figure 44: Distribution of Rhododendron (National Biodiversity Data Centre, July 2008)

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7.8.2. Identification

- Rhododendron is a shrub or small tree growing up to 8m in height.
- As a member of the Ericaceae (heather family), it is confined to soils with a low pH.
- It has oval, waxy leaves up to 20cm in length, which are darker above than below.
- The bell-shaped flowers are produced in a cluster at the tips of branches.
- The small seeds are produced in capsules and have a high germination rate.
- Spread can also occur by vegetative means where plants sucker or throw up new sprouts from roots as well as from branches (layering).
- Rhododendron forms dense thickets that excluded all light from the understorey thereby eliminating herbaceous plants and preventing the natural regeneration of trees and shrubs.

7.8.3. Control

Considerable effort has been put into the control of rhododendron, particularly in woodland habitats, in Ireland and elsewhere in the northern hemisphere. The choice of control method can influence the recovery of the site and should be considered prior to undertaking any control operation. Control options that include the partial or complete removal of rhododendron prior to the application of herbicides will allow re-invasion of plants, especially if coupled with ground disturbance (Tyrie 2008).

Figure 45: Rhododendron – Flower Head (Photo: Mike Dodd)

Table 12 provides a summary of control measures for rhododendron.

Physical Control

A range of physical control measures have been developed for rhododendron in response to the general sensitivity of acid woodland sites where it frequently becomes established. Collateral damage by spray drift on non-target species is a prime concern in such sites. Physical control options include uprooting by hand, uprooting by winching (hand-operated or tractor mounted), chainsaw cutting of root-ball, mulch-matting and bud rubbing.

Cutting of stems by manual means has been used as a control in Ireland, the UK and Turkey, but on its own it has been proven not to be particularly effective (Esen et al 2005). The plants capacity for regeneration by suckers from remaining bits of root or stem render the cutting ineffective on its own unless applied in areas of limited infection where adequate follow-up can be made. The approach is labour-intensive and expensive.

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Figure 46: Rhododendron – Foliage

Uprooting of plants provides a better result than simply cutting and is more cost effective in the long term. The roots of rhododendron are relatively shallow, being confined to the upper horizons (seldom deeper than 45cm) and typically extend uphill from the plant. This allows plants to be easily toppled using a hand operated turfer or mechanical winch. Younger plants in newly-established infestations can be readily hand-pulled. Winching is labour intensive and requires suitable anchor points or tractor access to the site. Leaving stumps sufficiently high to provide anchor points can impede access during initial clearance operations. Resultant soil disturbance may be unacceptable on sensitive sites.

Chainsaw cutting of the root-ball is effective on larger plants but is generally restricted to soft soil areas. This approach can be used in conjunction with winching methods to reduce the level of soil disturbance. It requires skilled operators to implement and results in considerable wear and tear on equipment.

The use of mechanical means (machinery to uproot or excavate plants) is generally only appropriate for sites of low ecological interest where damage to existing vegetation is not a concern. Heavy trafficking of woodland soils can result in puddling of soils; give rise to sediment run-off and nutrient leaching which can impact on watercourses.

In all the above instances, the accumulated material is typically windrowed or mounded and let break down naturally, or in some instances burnt. As vast amounts of material can be generated from quite small areas of infestation, the former option is preferable.

Follow-up is required to deal with re-growth and seedling germination irrespective of the control method employed. Mulch matting has been devised as an experimental means to prevent re-growth following initial clearance. Heavy-duty geotextile is laid either directly over the cleared ground or over removed stumps and other material to prevent re-sprouting and germination. While this system reduces soil disturbance it is labour intensive and material costs can be high.

Another experimental method currently being investigated is bud-rubbing on cut stumps (ibid). Following cutting back of the pant to a low stump, re-growth on the plant is removed by hand or using a thin metal rod (more practical for crevices) on a periodic basis. The timing of repeat visits is important in order to prevent the re-growth from establishing itself.

Chemical Control

Rhododendron is hard to kill even with herbicides and repeated application at low rates may be required to control it (Esen et al 2005). Due to the scale of infestation typical of rhododendron, foliar spraying with herbicides is not recommended, as considerable quantities of spray will be required which can have effects beyond the target species. However, foliar spray may be an option in areas where there are either young

7 Non-Native Invasive Species Identification, Ecology and Control

populations or in tall dense, monotypic stands. A variety of herbicides have proven effective for control including 2,4-D, glyphosate, dicamba and triclopyr.

The cut-stump method involves cutting back of the aerial growth and application of herbicide directly to the cut stem or stump ideally within minutes but not later than 48 hours of cutting. A vegetable dye should be added to the herbicide to enable treated stumps to be clearly identified. Re-growth may occur following treatment which should be dealt with by a follow-up foliar spray (using glyphosate, triclopyr, etc.) when the growth reaches about 1m in height.

Stem injection control involves herbicide application directly into the stems of large plants. This method enables precise application of the herbicide and uses less product thereby proving more cost effective than foliar spraying. Holes of 11–16mm diameter are drilled every 7.5cm around the trunk just above ground level as vertically as possible in order to hold the herbicide. 2ml of herbicide should be applied per stem immediately after drilling with a spot-gun. A 25% solution of glyphosate (ie. 1:3 mixture with water) has been used successfully for complete control of target bushes (ibid). Triclopyr has also been used as a stem injection in an undiluted or 1:1 mixture. Application during March, April or October been found to be most effective.

At this point it must be restressed that all Plant Protection Products must be used in accordance with the product label and with Good Plant Protection Practice as prescribed in the European Communities (Authorization, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003 (S.I. No. 83 of 2003). Again, it should be noted that it is an offence to use Plant Protection Products in a manner other than that specified on the label. The methods just outlined are not in accordance with the product label and so it will be necessary to discuss the use of such methods with the Pesticides Control Service with a view to seeking approval under the derogation procedures provided under the Plant Protection Regulations.

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Table 12: Summary of Physical and Chemical Control Measures for **Rhododendron**

Physical Control

Method	Season	Follow-up
Cutting	**Anytime of the year.**	Very labour intensive and does not kill plant. Regular follow-up to deal with re-growth required.
Uprooting	**Anytime of the year.**	Small plants can be pulled by hand. Large stems cut and roots grubbed out by winch or machine.
Mulch matting	**Anytime of the year.**	Labour intensive. Requires maintenance and follow up treatment.
Bud-rubbing	**Spring to autumn.**	Labour intensive. Requires regular follow-up.

Chemical Control

Chemical	Season	Follow-up
Glyphosate	During active growth in **late spring or summer (June to September).** May require follow-up for 2–3 years.	Foliar spray, wiper applicator or spot treatment. Also as stem injection or cut-stump.
Triclopyr	During active growth in **late spring or summer (June to September).** May require follow-up for 2–3 years.	As for glyphosate. Do not apply if very hot or during drought.

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7 Non-Native Invasive Species Identification, Ecology and Control

7.9. Buddleia *(Buddleja davidii)*

7.9.1. Ecology and Distribution

Buddleia (also known as the butterfly bush) is a member of the *Buddlejaceae* family. It is very fast growing and can reach 2m in its first year, producing flowers and setting seed.

Buddleia is a native of China but is common as a garden plant owing to its profusion of flowers which tend to attract a considerable diversity of butterflies (hence its other common name). It is frequently found in waste ground in urban environments (common in Dublin and Cork), though has a widespread distribution throughout the country (See **Figure 49**). It colonises bare ground very rapidly and can quickly form mono-typic stands.

As buddleia tolerates very poor soils, it is capable of growing on walls, rock outcrops or sub-soils, conditions which are frequent on new road schemes. In particular it poses a threat where such features are being left to re-colonize naturally as in rock cuttings, eskers, etc. In other countries it has established itself as a problem plant along watercourses where due to its shallow root system, it is frequently washed away resulting in erosion of the river banks and downstream blockages.

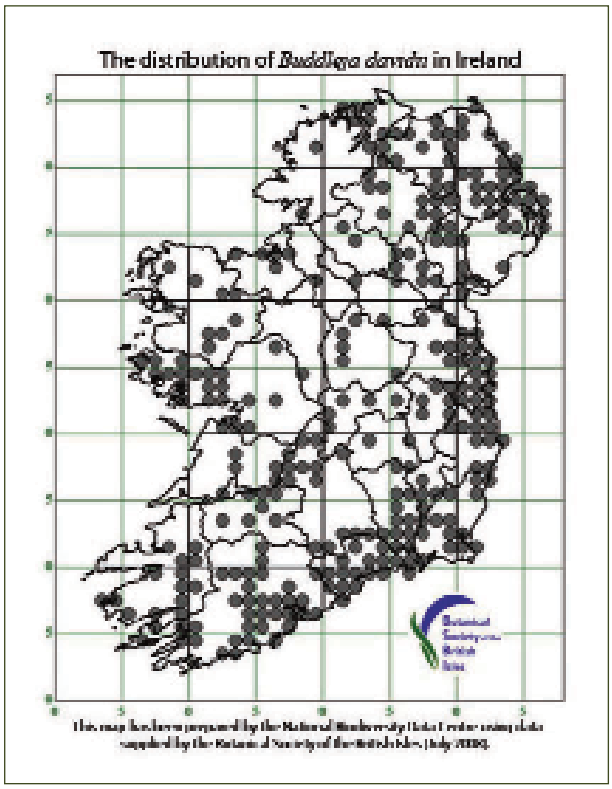

Figure 49: Distribution of Buddleia (National Biodiversity Data Centre, July 2008)

7.9.2. Identification

- A multi-stemmed shrub reaching up to 4m in height with arching branches, topped with showy, conical panicles of lilac flowers during the period June to September. Flowers may also be pink, red, purple or white.
- The leaves are 10–20cm in length, lanceolate with a slightly serrated edge and a felted whitish under surface.
- The plant is deciduous though in winter the desiccated flower heads and seed capsules remain on the bush.
- The seeds produced are very small and numerous with up to 3 million produced per plant. They can remain viable in the soil for many years.

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7.9.3. Control

As buddleia is a plant that favours disturbed sites, physical grubbing of plants can provide ideal conditions for the germination of seeds. Care needs to be taken to ensure re-vegetation of controlled areas is undertaken swiftly. The branches of buddleia are capable of rooting as cuttings, so care should also be taken to ensure material is disposed of in a manner to avoid this risk.

Physical Control

Management methods such as digging it out are applicable only to minor infestations at the initial stage of invasion. Hand-picking of young plants is feasible but should be undertaken with care to avoid soil disturbance which can give rise to a flush of new seedling. Grubbing of mature stands as a sole attempt at control is not recommended for the same reason. After uprooting, it is essential to plant the ground in order to prevent a flush of new seedling growth.

When it is cut, Buddleia grows back from the stump very vigorously. Mowing of young plants does not provide control as they re-sprout with vigour. Where removal of mature plants is not feasible in the short term, the flower heads should be cut off in June before seed set.

Chemical Control

Recommended practice for the application of herbicides requires cutting back of plants to a basal stump during active growth (late spring to early summer) which is then treated (brushed on) immediately with a systemic weed killer mix (Starr et al, 2003). Foliar application of triclopyr or glyphosate may be adequate for limited infestations of younger plants, but should be followed up at 6 monthly intervals. At this point it must be restressed that all Plant Protection Products must be used in accordance with the product label and with Good Plant Protection Practice as prescribed in the European Communities (Authorization, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003 (S.I. No. 83 of 2003). Again, it should be noted that it is an offence to use Plant Protection Products in a manner other than that specified on the label. The methods just outlined are not in accordance with the product label and so it will be necessary to discuss the use of such methods with the Pesticides Control Service with a view to seeking approval under the derogation procedures provided under the Plant Protection Regulations.

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Table 13: Summary of Physical and Chemical Control Measures for **Buddleia**

Physical Control

Method	Season	Follow-up
Grubbing	**Any time of year when the soil is suitably dry.** Small plants can be pulled by hand. Large stems cut and roots grubbed out.	Regular follow-up to deal with re-growth or seedlings which can result from exposure of soil.

Chemical Control

Chemical	Season	Follow-up
Systemic weed-killer mix (Starr et al 2003)	During active growth in **late spring or summer.**	Brushed on to cut back stumps.
Triclopyr or Glyphosate	During active growth in **summer** of limited infestations of young plants	Foliar spray. Requires follow-up at 6 monthly intervals.

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Figure 47: Buddleia – Flower & Foliage

Figure 48: Buddleia – Flower

8 References

ACOT, 1997. Noxious Weeds and their control.
Dublin: An Chomhairle Oiliúna Talmhaíochta.

Armstrong C., National Botanic Gardens, 2008. [Discussion on the treatment of Giant rhubarb]
(Personal communication, 2008)

Australian Department of Primary Industries and Water, 2008.
Weeds Index. [Online].

- Available at:

http://www.dpiw.tas.gov.au/inter.nsf/WebPages/SSKA-73U3QA
[accessed 30 October 2008]

Booy, O. and Wade, M., 2007. Giant Hogweed Management in the United Kingdom.
UK: RPS Group Plc.

Centre for Ecology and Hydrology, 2004.
Information sheet 3: Himalayan Balsam.

Cornwall Nature Reserves, 2008.
Invasive Species. [Online].

- Available at:

http://www.cornwallnr.org.uk/inspec.htm
[accessed 30 October 2008]

Cronk, Q.C.B. & Fuller, J.L., 1995. Plant Invaders. The threat to natural ecosystems.
London: Chapman and Hall.

Database of Alien Plants in Ireland.

- Available at:

www.biochange.ie/alienplants/

DEFRA, 2005. Helping to prevent the spread of invasive non-native species: Horticultural code of practice.
UK: Department of Environment, Food and Rural Affairs.

DEFRA, 2008. Ragwort and Injurious Weed Control.

- Available at:

http://www.defra.gov.uk/farm/wildlife/weeds/index.htm
[accessed 30 October 2008]

8 References

Department of Agriculture and Rural Development Northern Ireland, n.d. Giant Hogweed.
Online.

- Available at:

http://www.ruralni.gov.uk/giant_hogweed_cmb.pdf

Dolan, L.M.J., 2003. Roads as Ecosystems: a more sustainable approach to the design of Irish rural roadside verges. ***In Proceedings of the National Committee for Biology Annual Seminar 1 (of 2) "Boats and Planes, Cars and Trains: The Effects of Human Transport on Ecosystems" 2nd April 2003.***
Dublin, Royal Irish Academy.

Dolan, L.M.J., 2004. (In Prep.) ***An "Ecological Landscape Design" approach to Landscape Treatments on National Road Schemes: a pilot project on the N21 Ballycarthy to Tralee, Road Improvement Scheme, Co. Kerry.***

Dolan, L.M.J. et al, 2006. Chapter 13: Towards the Sustainable Development of Modern Road Ecosystems. In John and Julia Davenport, eds.*Transport and the Environmen*t.
The Netherlands: Environmental Series, Springer.

DoT, 2008. Chapter 8 – Temporary Traffic Measures and Signs for Roadworks. In DoT, 1996. Traffic Signs Manual.
Dublin: Department of Transport.

- Available at:

http://www.transport.ie/viewitem.asp?id=9095&lang=ENG&loc=1225

English Nature, 2003. The Herbicide Handbook: Guidance on the use of herbicides in Nature Conservation sites.
Wetherby, West Yorkshire: English Nature/FACT.

Environmental Agency, n.d. Managing Japanese knotweed on development sites – the knotweed code of practice.
Online.

- Available at:

http://www.environment-agency.gov.uk/business/sectors/31364.aspx

Environment Agency, 2003. Guidance for the control of invasive weeds in or near freshwater.
UK: Environment Agency.

Esen, D. & Zedaer, S., 2004. Control of rhododendron (Rhododendron ponticum and R. flvum) in the eastern beech (Fagus orientalis) forests of Turkey. New Forests, 2004 (Vol. 27) (No. 1) 69–79.
Kluwer Academic Publishers.

8 References

Esen, D., Nilsen, E.T., and Yildiz, O., 2006. Ecology, competitive advantages and integrated control of Rhododendron: An old ornamental yet emerging invasive weed around the globe. P407–421 in Floriculture, Ornamental and Plant Biotechnology Vol. III.
Global Science Books.

Fleming, J., 2008. [Discussion on the definition of noxious species]
(Personal communication, 2008)

Gourlay et al, 1999. The Biological Control Programme against Clematis vitalba in New Zealand. In N.R. Spencer, ed. *Proceedings of the X International Symposium on Biological Control of Weeds.*
Bozeman, Montana, USA: Montana State University, 2000, p. 709–718.

- Available at:

http://www.invasive.org/publications/xsymposium/proceed/09pg709.pdf

Invasive Species Ireland, n.d. Best Practice Management Guidelines – Giant Hogweed Heracleum mantegassianum
Online

- Available at:

http://www.invasivespeciesireland.com/files/public/BPM%20Guidance/Giant%20Hogweed%20BPM.pdf

Invasive Species Ireland, n.d. Giant Rhubarb (Gunnera tinctoria) Invasive Species Action Plan.
Online

- Available at:

http://www.invasivespeciesireland.com/files/public/Management%20contingency/Gunnera%20tinctoria%20Invasive%20Species%20Action%20Plan.pdf

Invasive Species Ireland, n.d. Best Practice Management Guidelines – Himalayan balsam (Impatiens glandulifera).
Online

- Available at:

http://www.invasivespeciesireland.com/files/public/BPM%20Guidance/Himalayan%20Balsam%20BPM.pdf

Invasive Species Ireland, n.d. Best Practice Management Guidelines Rhododendron (Rhododendron ponticum) and Cherry Laurel (Prunus laurocerasus).
Online

- Available at:

http://www.invasivespeciesireland.com/files/public/BPM%20Guidance/Rhododendron%20BPM.pdf

8 References

Invasive Species Ireland, 2008. Best Practice Management Guidelines for Japanese knotweed.
Online

- Available at:

http://www.invasivespeciesireland.com/files/public/BPM%20Guidance/Japanese%20knotweed%20BPM.pdf
[accessed 30 October 2008

Invasive Species Ireland, 2008. *Horticulture Code of Practice.*
Online

- Available at:

http://www.invasivespeciesireland.com/files/public/Codes/Horticulture%20COP.pdf
[accessed 30 October 2008]

Irish Strategy for Plant Conservation, 2007. Target 10 – Managing Invasive Alien Species. Gunnera tinctoria (Giant rhubarb).
Online

- Available at:

http://www.botanicgardens.ie/gspc/targets/news/gunnera.htm
[accessed 30 October 2008]

Kabat, T.J., Stewart, G.B. & Pullin, A.S., 2006. A systematic review of the effectiveness of Japanese knotweed (Fallopia japonica) control and eradication methods.
University of Oxford, Oxford, UK: BES annual meeting.

King County Noxious Weed Control Program 2007.
Online

- Available at:

http://www.kingcounty.gov/weeds

Law, C., 2003. Giant problems for Taranaki.
New Zealand: Taranaki Regional Council.

LGMSB, 2007. Guidance for the Control and Management of Traffic at Road Works.
Dublin: Local Government Management Services Board.

- Available at:

http://www.nra.ie/Publications/DownloadableDocumentation/LGMSBDocument-GuidancefortheControlandManagementofTrafficatRoadWorks/file,10784,en.pdf

8 References

Miller, J. Organic methods of Rhododendron control.
UK: Kehoe Countryside Ltd.

- Available at:

http://www.forestry.gov.uk/pdf/rhod_jm_techniques.pdf/$FILE/rhod_jm_techniques.pdf
[accessed 30 October 2008]

Montgomery, M., n.d. Invasive alien plants: A review of Japanese Knotweed (Fallopia japonica).
UK: LK Pollution Response Ltd.

NetRegs, 2008. Environmental Guidance for small businesses in the UK.
Online

- Available at:

http://www.netregs.gov.uk/
[accessed 30 October 2008]

New Zealand Department of Conservation, 2005. Old Man's Beard Factsheet.
Online

- Available at:

http://www.doc.govt.nz/templates/MultiPageDocumentTOC.aspx?id=40082
[accessed 30 October 2008]

Northern Ireland Environment Agency, n.d. Japanese Knotweed – Fallopia japonica – Commonly Asked Questions.
Online

- Available at:

http://www.ni-environment.gov.uk/japanese_knotweed-commonly_asked_questions__2_.pdf

Noxious Weeds (Common Barberry) Order, 1958 (S.I. No. 120 of 1958).

Noxious Weeds (Male Wild Hop Plant) Order, 1965 (S.I. No. 189 of 1965).

Noxious Weeds (Thistle, Ragwort, and Dock) Order, 1937 (S.I. No. 103 of 1937).

Noxious Weeds (Wild Oat) Order, 1973 (S.I. No. 194 of 1973).

Noxious Weeds Act, 1936.

8 References

NRA, 2004. ***Guidelines for the Treatment of Noise and Vibration in National Road Schemes.*** **1st ed.**
Dublin: National Roads Authority.

- Available at:

http://www.nra.ie/Environment/

NRA, 2005a. ***Guidelines for the Treatment of Bats During the Construction of National Road Schemes.***
Dublin: National Roads Authority.

- Available at:

http://www.nra.ie/Environment/

NRA, 2005b. ***Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes.***
Dublin: National Roads Authority.

- Available at:

http://www.nra.ie/Environment/

NRA, 2005c. ***Guidelines for the Treatment of Watercourses During the Construction of National Road Schemes.***
Dublin: National Roads Authority.

- Available at:

http://www.nra.ie/Environment/

NRA, 2005d. ***Guidelines for the Assessment of Archaeological Heritage Impacts of National Road Schemes.***
Dublin: National Roads Authority.

- Available at:

http://www.nra.ie/Environment/

NRA, 2005e. ***Guidelines for the Assessment of Architectural Heritage Impacts of National Road Schemes.***
Dublin: National Roads Authority.

- Available at:

http://www.nra.ie/Environment/

NRA, 2005f. ***Guidelines for the Testing and Mitigation of the Wetland Archaeological Heritage for National Road Schemes.***
Dublin: National Roads Authority.

- Available at:

http://www.nra.ie/Environment/

8 References

NRA, 2005g. ***Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes.***
Dublin: National Roads Authority.

- Available at:

http://www.nra.ie/Environment/

NRA, 2005h. ***Environmental Impact Assessment of National Road Schemes – A Practical Guide.***
Dublin: National Roads Authority.

- Available at:

http://www.nra.ie/Environment/

NRA, 2006a. ***A Guide to Landscape Treatments for National Road Schemes in Ireland.***
Dublin: National Roads Authority.

- Available at:

http://www.nra.ie/Environment/

NRA, 2006b. ***Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub, Post, Prior and During the Construction of National Road Schemes.***
Dublin: National Roads Authority.

- Available at:

http://www.nra.ie/Environment/

NRA, 2006c. ***Guidelines for the Treatment of Otters prior to the Construction of Nationals Road Schemes.***
Dublin: National Roads Authority.

- Available at:

http://www.nra.ie/Environment/

NRA, 2006d. ***Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes.***
Dublin: National Roads Authority.

- Available at:

http://www.nra.ie/Environment/

8 References

NRA, 2007a. *Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan.*
Dublin: National Roads Authority.

- Available at:

http://www.nra.ie/Environment/

NRA, 2008a. *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.*
Dublin: National Roads Authority.

- Available at:

http://www.nra.ie/Environment/

NRA, 2008b. *Guidelines for the Assessment of Ecological Impacts of National Road Schemes.* 2nd ed.
Dublin: National Roads Authority.

- Available at:

http://www.nra.ie/Environment/

NRA, 2008c. *Environmental Impact Assessment of National Road Schemes – A Practical Guide.* 1st ed.
Dublin: National Roads Authority.

- Available at:

http://www.nra.ie/Environment/

NRA, 2008d. *Guidelines for the Management of Waste from National Road Construction Projects.*
Dublin: National Roads Authority.

- Available at:

http://www.nra.ie/Environment/

Reynolds, S., 1999. Recent higher plant introductions into Ireland. In D. Murray, ed. Royal Irish Academy in the Proceedings of a seminar on Biological invaders: the impact of exotic species.
Dublin: RIA.

Reynolds, S., 2002. Catalogue of Alien Plants in Ireland.
Dublin: National Botanic Gardens.

Royal Horticultural Society, 2008a. Himalayan balsam control.
Online

- Available at:

http://www.rhs.org.uk/advice/profiles0705/himalayanbalsam.asp
[accessed 30 October 2008]

8 References

Royal Horticultural Society, 2008b. Winter Heliotrope.
Online
- Available at:

http://www.rhs.org.uk/advice/profiles0904/winter_heliotrope.asp
[accessed 30 October 2008]

Scott R. & Mars R.H., 1984. Impact of Japanese knotweed and methods of control.
In Aspects of Applied Biology 5: Weed Control and Vegetation Management in Forestry and Amenity Areas. p.291–296.

Scottish Agricultural College weed control methods.
- Available at:

http://www.sac.ac.uk
[accessed 30 October 2008]

Starr, F., Starr, K. & Loope, L., 2003. Buddleia davidii.
Maui, Hawaii: US Geological Survey – Biological Resources Division.
- Available at:

http://www.hear.org/Pier/pdf/pohreports/buddleia_davidii.pdf
[accessed 30 October 2008]

Stokes, O'Neill & McDonald, 2004. (Unpublished) Invasive species in Ireland.
Belfast: Quercus, Queens University Belfast.

Teagasc, 2008. Fact Sheet Ragwort.
Wexford: Teagasc.
- Available at:

http://www.teagasc.ie/advisory/factsheets/ragwort.asp
[accessed 30 October 2008]

The Applied Vegetation Dynamics Laboratory, 2008.
Online
- Available at:

http://www.appliedvegetationdynamics.co.uk/
[accessed 30 October 2008]

8 References

The Centre for Aquatic Plant Management.
Online
- Available at:

http://www.ceh.ac.uk/sections/wq/CAPM1.htm
[accessed 30 October 2008]

The Cornwall Knotweed Forum (for Japanese Knotweed).
Online
- Available at:

http://www.cornwall.gov.uk/index.cfm?articleid=6568
[accessed 30 October 2008]

The Global Invasive Species Programme.
Online
- Available at:

http://www.issg.org/IUCNISGuidelines.html#GISP
[accessed 30 October 2008]

The Royal Botanic Gardens – Kew.
Online
- Available at:

http://www.kew.org/
[accessed 30 October 2008]

Tu, M, Hurd, C. & Randall, J.M. (2001). Weed Control Methods Handbook.
UK: The Nature Conservancy Council.

Tyrie, C., 2008. Invasive Aliens in Northern Ireland – Rhododendron.
Online
- Available at:

Available at: http://www.habitas.org.uk/invasive/species.asp?item=3888
[accessed 30 October 2008]

University of Exeter, 2007. Control of Japanese knotweed by application of herbicide into cut cane stumps.
Online
- Available at:

http://www.projects.ex.ac.uk/knotweed/standardmethodology.pdf

8 References

Weeds of Blue Mountains Bushland, 2008.
Online
- Available at:

www.weedsbluemountains.org.au
[accessed 30 October 2008]

Wildlife (Amendment) Act, 2000.

Wildlife Act, 1976.

Appendix 1

Noxious Weed and Non Native Invasive Site Assessment and Outline Management Plan

<table>
<tr><th colspan="4">NOXIOUS WEEDS / NON-NATIVE INVASIVE SPECIES SITE ASSESSMENT
AND OUTLINE MANAGEMENT PLAN</th></tr>
<tr><td colspan="3">Site Name</td><td>Chainage</td><td>Recorder</td></tr>
<tr><td colspan="3"></td><td></td><td></td></tr>
<tr><td colspan="3">Noxious Weed or Invasive Species present</td><td colspan="2">Land Owner / Occupier</td></tr>
<tr><td colspan="3"></td><td colspan="2"></td></tr>
<tr><td>Grid Ref</td><td>Area (ha)</td><td>Date</td><td colspan="2">Current Activity on Site</td></tr>
<tr><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td colspan="3">Sketch map of site showing location of species, scale of infestation & access points (indicate north & scale)</td><td colspan="2">Description of site,
substrate & vegetation</td></tr>
<tr><td colspan="3"></td><td colspan="2"></td></tr>
<tr><td colspan="3">Size of population (flowering / fruiting / vegetative)</td><td colspan="2">Current management</td></tr>
<tr><td colspan="3"></td><td colspan="2"></td></tr>
<tr><td colspan="3">Associated Species</td><td colspan="2">Proposed works on site</td></tr>
<tr><td colspan="3"></td><td colspan="2"></td></tr>
<tr><td colspan="3">Proposed control measures</td><td colspan="2">Other data / information</td></tr>
<tr><td colspan="3"></td><td colspan="2"></td></tr>
</table>

Where possible, attach a locality map (1:5,000 or less) showing location, photographs to show the general site area and plant population.

Appendix 2

Submitting Invasive Species Records to the National Invasive Species Database

The national invasive species database is held by the National Biodiversity Data Centre and is intended to provide centralised up-to-date information on the distribution of invasive species in Ireland.

Maps of the distribution of invasive species in Ireland will be publicly available through the Data Centre's web GIS system. As a tool for the recording of new and spread of established species in Ireland, it is important that the database accurately reflects the current distribution of invasive species in Ireland. For that reason, it is important that **all** observations of invasive species within Ireland be submitted to the database, regardless of how widespread the species may be.

To submit a record of an invasive species to the national database you need to record the name of the species, the date on which you observed it, the location of the species and a grid reference. This should be submitted along with your name and the name of the person who identified the species (if different) to either the Invasive Species Ireland project (www.invasivespeciesireland.com/sighting) or directly to the National Biodiversity Data Centre (info@biodiversityireland.ie). An excel template explaining in further detail how to submit records to the national database is available at:

www.invasivespeciesireland.com/sighting/dataset.asp.

GUIDELINES ON THE MANAGEMENT OF NOXIOUS WEEDS AND NON-NATIVE INVASIVE PLANT SPECIES ON NATIONAL ROADS

Appendix 3

Recommendations for Using Herbicides

(After Weeds of Blue Mountain Bushland www.weedsbluemountains.org.au)

A3.1. Using Herbicides

- Many of the weed control techniques suggested in these guidelines involve the use of herbicides.
- Herbicides are poisons, and should be handled with the greatest respect. They can be absorbed very easily through the skin, by breathing the vapours, and by ingestion.
- By law, herbicides must be used strictly in accordance with the manufacturer's label. They should be kept well out of the reach of children, preferably secured in a locked cabinet.
- They should always be stored in the original labelled container.

A3.2. Safety Precautions

- Read the label before opening the container and follow the instructions exactly.
- Wear protective clothing: long sleeves, long pants, sturdy shoes, gloves, eye protection.
- Always wear waterproof gloves.
- A respirator is advised when mixing or pouring the liquid.
- Do not eat, drink or smoke while using herbicide.
- Keep children and pets away.
- Wash skin and equipment afterwards. Wash contaminated clothing separately.
- Clean up any spills, including on your skin, with large amounts of water, or by shovelling up contaminated soil and disposing of it at the tip.

A3.3. Types of Herbicide

The two most widely used herbicides for use in the control of noxious weeds and invasive species are:

- Glyphosate
- Triclopyr

A3.4. How Herbicides Work

- Glyphosate is a systemic, non-selective herbicide. It inhibits the action of an enzyme, preventing the production of an amino acid essential to plant life and growth. It must be applied to green leaves, or directly to the plant's sapwood, which lies just under the bark.
- Triclopyr is a selective systemic herbicide for woody and broadleaf plants. It is a growth inhibitor which moves to the plant's roots, stops growth, and eventually leads to the death of the plant. Triclopyr can be applied to green leaves and to bark.

Appendix 3

Recommendations for Using Herbicides

A3.5. Herbicides, Waterways and Steep Land

- Some chemicals and herbicides are not safe to use near waterways and have the potential to seriously affect the quality of aquatic ecosystems.
- If you need to remove weeds within 20 metres of any kind of watercourse, you should consult with the relevant Regional Fisheries Board.
- Try to stage weed removal to avoid exposing large areas of bare soil which will lead to weed invasion or erosion. Mulch bare soil, and stabilise it by planting appropriate plants as soon as possible.

A3.6. When to Treat with Herbicide

- Apply herbicide when the plant is actively growing.
- Do not apply herbicide when the plant is under stress: extreme heat or cold, drought, waterlogged, or diseased.
- Choose early morning or late afternoon in summer; midday in winter.
- Do not apply when wet or windy weather is anticipated.
- For many plants, especially bulbous plants and those which sucker, the best time is between flowering and fruit set.
- Treat deciduous plants in late spring or in summer, when in full leaf.

A3.7. Herbicide Application Techniques

A3.7.1. The Cut and Paint Technique (Woody Weeds)

- Suitable for small to medium sized woody weeds up to 10cm in diameter (or larger shrubs if using a chain saw).
- Clear the ground around the base of the stem.
- Cut the stem horizontally as close to the ground as possible, using secateurs, loppers or a bush saw.
- Make cuts horizontal to prevent the herbicide running off the stump. Sharp angled cuts are also very hazardous.
- Apply undiluted herbicide to the cut stem immediately. Squeeze, not squirt, if using an applicator. Apply herbicide immediately after cutting – within 20–30 seconds – before the plant cells close and the translocation of the herbicide ceases. Ensure there is no runoff of poison. Use as little herbicide as possible.
- If cutting at the base is impractical, cut higher to get rid of the bulk of the plant, then cut again at the base and apply herbicide.
- If plants re-sprout, cut and paint the shoots after sufficient re-growth has occurred.

Appendix 3

Recommendations for Using Herbicides

A3.7.2. Stem and Leaf Swiping

This method is suitable for herbaceous plants with bulbs, tubers or corms, e.g. Montbretia.

- First read about using herbicides, safety precautions, the conditions of use, when to treat with herbicide, and the cut and paint technique.
- Remove and bag any seed or fruit.
- Using a herbicide applicator, swipe the stems and/or the leaves with undiluted herbicide.

A3.7.3. Tree Injection

Tree injection and Frilling or Chipping are methods for treating shrubs or trees greater than 10cm in diameter at the base.

Method 1: Injection

- Using a cordless drill or brace and bit, drill a hole into the base of the plant. Drill at an angle of 45º, through the bark, and into the sapwood.
- Within 20–30 seconds fill this hole with undiluted herbicide.
- Repeat this process at 5cm intervals around the trunk.

Method 2: Frilling or Chipping

- If a drill is not available, use a sharp chisel or axe and make a deep cut at 45º into the sapwood.
- Fill with undiluted herbicide immediately.
- Repeat these cuts around the base of the tree.
- Do not ring-bark the plant.

A3.7.4. Spraying

These guidelines do not set out to give a thorough treatment of the subject of spraying. Consider all other options for weed control first.

Spray at the correct stage of the plant's growth, at the right time of day, and when there is no wind. Spray at low volume, using the minimum amount of herbicide.

- Spray low: often it is best to cut a weed down to near ground level, then spray the re-growth.
- Avoid off-target damage, i.e. spray drift on to desirable plants.
- Do not spray near watercourses.

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