Melbourne Water
Enhancing Life and Liveability

WWL GUI Pest Plant Guideline

Guideline

November 2018

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Executive Summary

Melbourne Water manages water supply catchments, treats and supplies drinking and recycled water, removes and treats most of Melbourne's sewage and manages waterways and major drainage systems in the Port Phillip and Westernport Region. As a significant landholder and waterways manager in the Port Phillip and Westernport Region, Melbourne Water plays a leading role in protecting, conserving and improving biodiversity.

Pest plants (commonly referred to as weeds) can significantly impact on assets, water quality, native biodiversity and economic and social values, and Melbourne Water is committed to minimising these impacts and adhere to legislative requirements.

This Pest Plant Guideline recognises the importance of prevention, early intervention, eradication of new and emerging pest plants and the reduction or containment of pest plants.

Glossary

Allelopathic

The inhibition of growth in one species of plants by chemicals produced by another species.

Aquatic Weeds

Pest plant species that occur in aquatic ecosystems, such as waterways and wetlands e.g. Water Hyacinth, Alligator Weed and Salvinia.

Asset

An asset can be a natural, physical or social value such as vegetation of high conservation significance or one or more threatened species at risk from pest plants.

Asset-Based Approach

An asset-based approach involves prioritising control actions for a number of threats based on the relative value of identified assets that will be protected by management actions. Prioritisation should be based on maintaining the viability of important environmental assets and optimising outcomes for asset protection and management.

Background Weed

A background weed is a species that has minimal capacity to alter the composition of indigenous vegetation by means of out competing a species, stratum or community at a specified site; and/or a species that may opportunistically occupy a niche for a short period of time or may persist at a specified site with minimal long term impact on indigenous structural diversity.

Bioregional Conservation Status

A state-wide classification of the degree of depletion in the extent and/or quality of an Ecological Conservation Class (EVC) within a bioregion in comparison to the State's estimation of its pre-1750 extent and condition.

Biosecurity

A process designed to mitigate the risks and impacts to the economy, the environment, social amenity or human health associated with pests and disease.

Containment

The application of measures in and around an infested area to prevent the spread of an invasive plant or animal species. This may include reduction of the density or area of the infestation where appropriate. A containment program may include eradication of satellite infestations.

Cover Score (CS)

Refers to the area of living material covered by an individual species if all the surface area is amalgamated into a single continuous mass.

Declared Noxious Weeds

Declared noxious weeds in Victoria are plants that have been proclaimed under the *Catchment and Land Protection Act 1994* (CaLP). The legislation requires that these species be controlled or eradicated by the land manager.

Declared noxious weeds fall into one of these categories: State Prohibited Weeds (S), Regionally Prohibited Weeds (P), Regionally Controlled Weeds (C) and Restricted Weeds (R).

Ecological Vegetation Classes

Native vegetation in Victoria is classified into units known as Ecological Vegetation Classes (EVCs). Ecological Vegetation Classes are described according to a combination of floristic, life form and ecological characteristics. Each EVC occurs under a common regime of ecological processes within a given biogeographic range and may contain multiple floristic communities (NRE 2002).

Environmental Weeds

An environmental weed is a non-indigenous plant species that has invaded (or has the potential to invade) natural ecosystems and threaten (or has the potential to threaten) environmental and/or conservation assets. It may include some Australian native plants not indigenous to a given area. Environmental weeds can be declared as noxious weeds (under schedules in the CaLP Act but many are not declared.

- Indigenous species that are ecologically-out-of-balance and are behaving as weeds within their natural distribution. Examples may include: *Kunzea leptospermoides* (Burgan) and *Leptospermum scoparium* (Manuka); and
- Australian and Victorian plant species naturalised outside their natural range/distribution. Examples may include: *Pittosporum undulatum*

(Sweet Pittosporum), *Acacia longifolia* subsp. *Longifolia* (Coastal Wattle) and *Melaleuca armillaris* (Giant Honey-myrtle).

Eradication

When a species has been removed or killed and no longer occurs at the site. In practice, this means that it can no longer be detected by recommended methods of survey for a defined period of time.

Established Weeds

Established weeds are weeds that have naturalised in a region and have increased their population size over a geographic area such that eradication would be, in practical terms, unlikely.

Habitat Hectares

A site-based measure of quality and quantity of native vegetation that is assessed in the context of the relevant native vegetation type (EVC).

Mycorrhizal

Mycorrhiza (class of Fungi) fungi symbiotically feed off of plants. This symbiosis provides a jointly beneficial relationship between the fungus colony and its host.

New and Emerging Weeds

Weeds that have recently been recorded or have been present for some time and are known or are suspected to have the potential for detrimental impact on environmental, social or economic values. The definition is determined by the extent of presence, and varies according to the scale of the environment of interest (Weed Alert Rapid Response Plan Victoria 2004/05). In these Guidelines new and emerging weeds refer to weeds that have a high probability of eradication from a significant area (catchment, bioregion, landscape).

Prevention

New infestations are kept out of a site by means of proactive land management methods.

Rare or Threatened Flora and Fauna

For the purpose of this Guideline, rare or threatened flora and fauna include flora and fauna species listed under any one or more of the following lists/Acts: *Environment Protection and Biodiversity Conservation Act 1999* (EPBC), *Flora and Fauna Guarantee Act 1988* (FFG), The Department of Environment, Land,

Water & Planning (DELWP) Advisory List of Rare or Threatened Flora (DELWP 2014) and DELWP Advisory List of Threatened Fauna (DELWP 2014).

Regionally Controlled Weeds (C)

Regionally controlled weeds are invasive plants; usually widespread and considered important in a particular region. To prevent their spread, continuing control measures are required. Landowners have the responsibility to take all reasonable steps to prevent the growth and spread of regionally controlled weeds on their land.

Regionally Prohibited Weeds (P)

Regionally prohibited weeds are not widely distributed in a region but are capable of spreading further. It is reasonable to expect that they can be eradicated from a region and must hence be managed. Landowners, including public authorities responsible for Crown land management, must take all reasonable steps to eradicate regionally prohibited weeds on their land.

Restricted Weeds (R)

Restricted weeds are plants that pose an unacceptable risk of spreading in Victoria or to other parts of Australia if they were to be sold or traded in Victoria, and are a serious threat to another State or Territory of Australia. Trade in these weeds and their propagules, either as plants, seeds or contaminants in other materials is prohibited.

Sleeper Weeds

Sleeper weeds are exotic plants that have naturalised in a region but have not yet increased their population size rapidly.

S.M.A.R.T.

The acronym for the criteria by which objectives should be set and performance indicators written: Specific—what will be achieved is clearly defined, Measurable—there is some way of measuring what will be achieved, Achievable—the objective is realistic given the resources available, Relevant—the objective is relevant to the project vision and goals, Time-framed—there is a time by which the objective will be achieved.

State Prohibited Weeds (S)

State prohibited weeds are invasive plants that either do not occur in Victoria but pose a significant threat if they were to invade Victoria, or if present in Victoria, pose a serious threat and can reasonably be expected to be eradicated. If present, infestations of a State prohibited weed are relatively small. They are to be eradicated if possible from Victoria or excluded from the

State. The Victorian Government is responsible for their eradication, but under Section 70(1) of the CaLP Act, it may direct landowners to prevent their growth and spread.

Transforming Weed

Transforming weeds are species that have the capacity to significantly alter the composition of indigenous vegetation by means of outcompeting a particular species, stratum or community at a specified site at the time of survey or in the future in response to disturbance. Transforming species have the capacity to occupy habitat and/or proliferate in disturbed and relatively undisturbed vegetation. These species can out compete, exclude, restrict or eliminate ground-storey and/or mid-storey and/or over-storey life forms.

Victorian Alert Weeds

Victorian alert weeds are potential weeds of the future. They may pose a serious threat to Victoria's agricultural and natural assets or could affect human health. Some of these weeds are thought to occur in small numbers in Victoria and are still eradicable. Other species are yet to reach Victoria, but present a serious threat if they were to arrive. These weeds are not yet proclaimed under the CaLP Act, but will undergo a detailed Weed Risk assessment by the Department of Primary Industries (DPI) and DSE to better understand their potential impact and invasiveness. Responses may include the emergency declaration as State Prohibited weeds for very high priority weed species, through to provision of information to land managers for lower priority weeds (DPI website, 2009). In the meantime, land managers are encouraged to be on alert and report any outbreaks of species listed on the Victorian alert weed list (which can be found on the DPI website).

Weeds of National Significance

Weeds of National Significance (WONS) are weeds considered a threat within Australia, within an agricultural, forestry and environmental context. Twenty WONS were identified by the Federal government as a priority for control within Australia (see Appendix A for a complete list). The list is intended to provide a framework to prioritise weed management at the state, regional and local levels. Individual landowners and managers are ultimately responsible for managing WONS. Each WONS has a strategic plan that outlines strategies and actions that are required to control the weed and identifies responsibilities for each action.

Abbreviations

C	Regionally Controlled Weeds
CaLP Act	Catchment and Land Protection Act 1994
CMA	Catchment Management Authority
CS	Cover score
DPI	*Old* Department of Primary Industry
DSE	*Old* Department of Sustainability and Environment
DELWP	*New* Department of Environment, Land, Water and Planning
EPBC	Environment Protection and Biodiversity Conservation Act 1999
FFG	Flora and Fauna Guarantee Act 1988
LGA	Local Government Authority
P	Regionally Prohibited Weeds
PPA	Pest plants and animals
PPW	Port Phillip and Westernport
PPWP CMA	Port Phillip and Westernport Catchment Management Authority
R	Restricted Weeds
S	State Prohibited Weeds

sp.	Species
spp.	More than one species
WONS	Weeds of National Significance

Introduction

Pest plants include weeds that threaten biodiversity values (often called environmental weeds) and declared noxious weeds that threaten agricultural and amenity values as well as human and animal health. Pest plants may also modify ecosystem function (e.g. pest plants may use more water than native species) and pose environmental risk (e.g. pest plants can increase fuel loads by increasing biomass).

Pest plants may be introduced from overseas (most species), elsewhere in Australia (e.g. New South Wales or Western Australia) or naturally occur in Victoria but are weedy where introduced outside their natural range (e.g. Sweet Pittosporum; *Pittosporum undulatum)*. To ensure projects do not remove or destroy indigenous vegetation requiring a permit, it is recommended to confirm the proposed native vegetation removal with the local Planning Authority.

Pest Plant Management Responsibilities

Pest plant management in Victoria is principally the responsibility of each land and waterway manager. As such, Melbourne Water has obligations for pest plant management under the *Water Act (1975)* and the *Catchment and Land Protection Act 1994* (CaLP Act), as described in Appendix A.

Table 1 illustrates the link between Melbourne Water's Guideline to relevant national, state, regional and local pest plant legislation and policies (including management plans). The overarching objectives and guiding principles of this Guideline are aligned with those of the *National Weed Strategy* (National policy; Natural Resource Management Ministerial Council; 2007), the *Victorian Invasive Pest Plant and Animal Policy* (State policy; DSE and DPI 2010), the *Draft Port Philip and Westernport Invasive Plants and Animals Strategy* (regional level, 2011; in progress) and the *Port Philip Westernport Regional River Health Strategy* (PWP CMA and Melbourne Water 2010).

For example, the Guidelines recognise the importance of prevention, early intervention and eradication of new and emerging pest plants, as well as the reduction and containment of pest plants that threaten assets. The Guidelines incorporate both a species-led and asset-based protection approach to pest plant management.

Further information on the identified national, state, regional and local legislation, policies and strategies is provided in Appendix A.

Table 1 Melbourne Water Pest Plant Guidelines and other relevant documents

Level	Responsible Agency	Legislation Policy or Strategy
National	Federal Government	• National Weed Strategy
State	DELWP	• Victorian Invasive Pest Plant and Animal Policy • CaLP Act • Water Act
Regional	Catchment Management Authorities	• Port Phillip and Westernport Regional Catchment Strategy • Port Phillip and Westernport Invasive Pest Plant and Animal Strategy • Port Phillip and Westernport Native Vegetation Plans
	Melbourne Water	• **Melbourne Water Pest Plant Guidelines** • **Healthy Waterways Strategy** • **Pest Animal Strategy/Guidelines**
Local	Local Government Authorities	• Various Weed Strategies, Pest Animal Strategies, Biodiversity Strategies/Plans and Native Vegetation Plans

Objectives

- Prevent the introduction of new and emerging pest plants. For example, identification and management of new and emerging pest plants, while populations are small and readily manageable;
- Eradicate, contain or prevent further spread of established infestations of high risk invasive plants;
- Address the risks of impacts of invasive plants on assets (environmental, social and economic assets/values);
- Improve management of invasive plants through effective monitoring, evaluation and reporting;
- Inform Melbourne Water people and externals of pest plant management principles/guidelines and techniques;
- Establish standards and benchmarks for best-practice pest plant management e.g. machinery/vehicle hygiene protocols;
- Implement coordinated, cooperative and effective management of invasive plants across Melbourne's Port Philip and Westernport region.

It should be noted that pest plant management is a long term process and the complete eradication of pest plants within an area may not be practical, realistic or financially justifiable in many situations.

Guiding Principles for Pest Plant Management

Once sites have been identified for pest plant management, the next step is to prioritise the targeted pest plant species. The guiding principles below can be used to assist prioritisation of pest plant management at a site and assist in developing a pest plant management program for a given site. These principles are in line with National, State and regional legislation and policies related to pest plant management.

The Seven Guiding Principles

Principle 1: Prevention and early intervention: prevention is better than cure

Principle 2: Education and best practice

Principle 3: Containment: where eradication is not possible, containment may be the goal (i.e. preventing further spread of a pest plant species)

Principle 4: Asset-based protection: programs should adopt an asset-based risk management approach. In a biodiversity context, this means protecting the highest quality, most intact, extensive and significant assets

Principle 5: Development of partnerships with key stakeholders: a holistic and consistent approach to natural resource management should be applied

Principle 6: Integration of pest plant programs

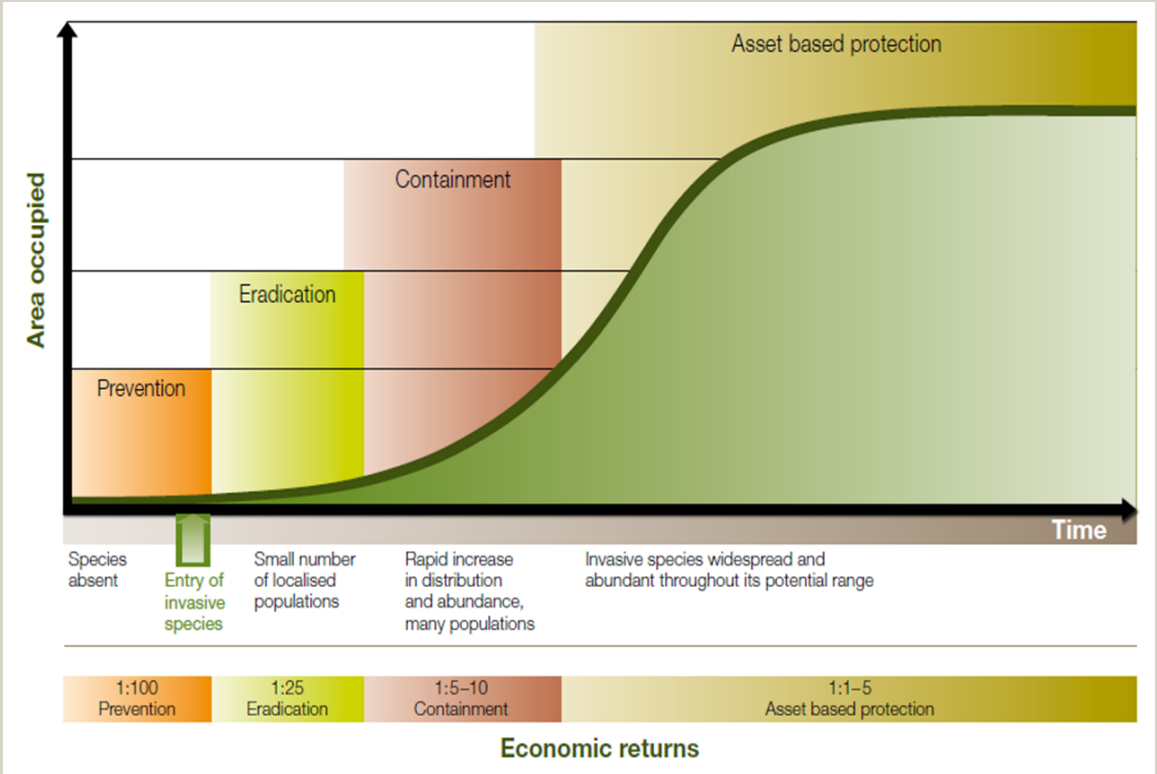
Principle 7: Monitoring and evaluation: control programs should be based on an adaptive management approach that fosters a continuous improvement framework incorporating monitoring, evaluation, feedback and change.

Note: Each of these guiding principles is described on the following pages.

All goals for the management for pest plants should align with the Department of Primary Industries (DPI) 'Invasive Plants and Animals Policy Framework' (2011) refer to Figure 1.

Figure 1 General Invasion Curve
The curve below illustrates the relationship between the area occupied by a pest plant species and the effectiveness of different management strategies. Where a species is not currently found within a region, preventing its introduction to the region is of upmost importance. Where a pest plant species is present as small localised populations, eradication may be possible. However, as a pest plant species becomes widespread and established within a region, eradicating the pest plant becomes impossible and too costly. For well-established pest plants, resources are best focussed on protecting high priority assets first and containing or suppressing the pest plant species.

Weed invasion curve and benefit-cost ratio from investment goals (adapted from DPI, 2009)



Prevention (excluding a pest species from a site) is the most cost-effective pest animal management outcome. The development of an LPAAP will require the consideration of pest species which may potentially spread to the site, and potential measures to reduce this threat.

Eradication is generally only possible in the early stages of establishment when distribution and abundance of the invasive species are low. This approach can be almost as cost-effective as prevention, however, for many species or areas this may not be a realistic goal. Where a pest animal is widespread and recolonisation cannot be prevented, the goals of containment and asset-based protection are likely to be more feasible.

Containment refers to limiting the spread of established pest species beyond their core area(s), by targeting satellite populations and/or dispersal into new areas. Containment can provide environmental and financial benefits by delaying the spread of the species and by providing time for the development of more effective control techniques. However, it requires an understanding of the distribution of the pest species and may be difficult to implement effectively in linear and fragmented areas, especially where collaboration with adjacent landowners is lacking.

Asset-based protection aims to protect high value assets (environmental, financial or social) from the specific threats posed by one or more pest species which are widespread within the area. This approach may be the most realistic and cost-effective goal for pest plants which are widespread and abundant throughout the region or in the core areas of pest plants targeted for containment.

Principle 1: Prevention and Early Intervention

Preventing the establishment of high risk pest plants from establishing is the most cost-effective approach to managing the threat they pose (DPI and DSE 2010; refer to Figure 1 above). The prevention framework applies to species that are not present in Australia, species that are present in Australia but not Victoria, and species that are in Victoria but only in controlled conditions (e.g. retail outlets). For the purpose of these Guidelines, all of these species are relevant, as well as species that are not yet present.

Prevention requires the coordination of a number of activities, such as a risk assessment to determine which species need to be addressed, an analysis of

pathways that may introduce these species (DPI and DSE 2010), and development and implementation of sound pest plant hygiene protocols.

Once a species is able to reproduce and spread unassisted, an attempt to remove them is termed eradication (DPI and DSE 2010). Eradication is generally only possible in the early stages of establishment when distribution and abundance of the invasive species are low (DPI and DSE 2010). This approach can be almost as cost-effective as prevention.

Priority pest plant species for prevention and eradication may include State Prohibited Weeds, Regionally Prohibited Weeds and Victorian alert weeds. Definitions of weed categories are provided in Section 0.

A Melbourne Water example of a program focusing on prevention and early intervention is the management of the early introduction of *Nassella charruana* (Lobed Needle Grass) in the Yarra Valley, for instance.

Principle 2: Best Practice and Education

Implementing strict vehicle and machinery hygiene protocols is of utmost importance in successfully preventing the introduction or further spread of pest plants between sites. This requires ensuring Melbourne Water people and service providers are trained in appropriate hygiene protocols, have the facilities, time and resources to implement these hygiene protocols and the means for reporting or capturing such activities by means of data collection.

It is important that Melbourne Water people and service providers have skills to identify pest plant species, appropriate pest plant management protocols/techniques and knowledge of who is responsible for pest plant management. Education of Melbourne Water people and service providers is seen as an important tool in helping the organisation manage their land sustainably.

Principle 3: Containment

Containment is an appropriate strategy where a pest plant is no longer localised in distribution (e.g. greater then a few populations) and eradication is no longer possible but the species is not yet widespread or abundant (refer Figure 1). At this stage of weed invasion, containing current known populations and preventing further spread of the pest plant and establishment of new populations may be an achievable management goal.

Principle 4: Asset-Based Protection

An asset-based approach to managing pest plants is appropriate once a species has become so widespread that eradication is no longer possible and

containment would provide low return on investment relative to other potential investments (DPI and DSE, in progress). This approach ensures that instead of selecting a pest plant species for targeted action, the focus is on achieving protection and restoration outcomes for highly valued assets. For each asset, all threats are identified and assessed for their relative risk, considering likelihood and consequence (i.e. not just pest plants as a threat). Management effort is allocated to where it will provide the greatest net benefit. In a biodiversity-related context, this means protecting the highest quality, most intact, extensive and significant patches of native vegetation. This approach can be taken in the context of a single site, a reach of a waterway or an entire catchment.

An asset is a biophysical item of environmental, social, cultural or economic value to the community for the ecosystem services it provides. For Melbourne Water, this not only includes natural assets (e.g. native vegetation or threatened species), but also includes the maintenance of water quality for human health and infrastructure at managed sites.

Principle 5: Partnerships with Key Stakeholders

Collaborative planning with key stakeholders (in particular those relevant to priority assets) should be considered when developing a pest plant management program, where relevant. A coordinated approach that particularly includes neighbouring landholders, is more likely to be effective in the long-term as a coordinated approach can assist control broader areas and prevent pest plant reestablishment

Principle 6: Integration of Pest Plant Programs

Pest plant control may not be effective in the long-term, if applied in isolation. To be effective, pest plant management must be part of an integrated land management approach (pest plant and animal management programs), which is based upon information on the life cycles of various pests and their interaction with the environment. This information, in combination with available pest control techniques, is used to minimise pest impacts through cost-effective means and with minimal hazard to people, property and the environment.

Integrated pest plant and animal management considers the interactions between animal and plant species, whether they are exotic pests or indigenous. When a pest species is controlled, this may alter the abundance of other species and ecosystem function. For example, pest plants may provide habitat for native fauna and their removal may need to incorporate alternative provision of habitat for those species. A holistic approach to pest plant

management, through integrated pest management, is essential to minimise the negative impacts and ensure effective pest plant control.

There may be a need (and substantial benefit) to follow up with revegetation using locally indigenous plants, to minimise the risk of reinfestation of a site. In addition, changes in land management practices may be required to increase the likelihood of long-term success of pest plant control. These Guidelines acknowledge that pest plant management is likely to be more effective if integrated with other land management activities such as revegetation, fencing and pest animal control.

Principle 7: Monitoring and Evaluation

Management of pest plants also requires development and implementation of a monitoring program that measures whether management actions have been effective post implementation. This Guideline provides recommendations on baseline data collection (i.e. collating data before management intervention), record keeping of management activities, monitoring post management and evaluating and providing feedback on management actions and any pest plant management program.

Pest Plants: Definitions, Categories, Biology and Potential Impacts

This chapter provides a summary of common types/categories of pest plants and a discussion of the potential impacts of pest plants on environmental, economic and social assets/values relevant to Melbourne Water. It also includes an overview of the biology of pest plants and potential dispersal mechanisms. Understanding the means by which pest plants reproduce and spread is critical in effectively managing pest plants.

Pest Plant Definition

The Australian Weeds Strategy (Commonwealth of Australia, 2007) defines a weed/pest plant as: "**a plant that requires some form of action to reduce its effects on the economy, the environment, human health or amenity**"

This Guideline adopts this definition as a useful working definition of pest plants. It allows a distinction to be made between plants that pose a serious threat to specific values and plants that are not threatening. It also acknowledges the impacts, or potential impacts, of pest plants in a variety of situations.

Pest Plant Categories

Numerous classes/categories of pest plants are recognised in the literature. Pest plants are largely grouped into categories based on the types of assets/values that they may impact, or the scale at which they are significant (e.g. some pest plants are considered a threat throughout Australia; Weeds of National Significance). Three main categories of pest plants are relevant to these Guidelines: Weeds of National Significance (WONS), Environmental Weeds and Declared Noxious Weeds. Definitions are provided later in this section.

There are numerous other categories of pest plants that are commonly used and are relevant to these Guidelines, such as:

- New and Emerging Weeds
- Victorian Alert Weeds
- Sleeper Weeds
- Aquatic Weeds

- Noxious Aquatic Species.

Definitions of each of these categories are provided in the

Glossary.

Weeds of National Significance

The Australian Weeds Strategy establishes a weeds of national significance (WONS) list. Four major criteria were used in determining WONS: the invasiveness of a weed species, a weed's impacts, the potential for spread of a weed and socio-economic and environmental values.

WONS identified through this process (see **Error! Reference source not found.** for a complete list) have a strategic plan to outline strategies and actions that are required to control the weed, and identifies responsibilities for each action. The list is intended to provide a framework to prioritise weed management at the state, regional and local levels. Individual landowners and managers are ultimately responsible for managing WONS.

Many of the listed WONS are of significance to Melbourne Water, as they are known to occur or potentially occur on Melbourne Water managed land e.g. *Ulex europaeus* (Gorse), *Nassella trichotoma* (Serrated Tussock), *Nasella neesiana* (Chilean Needle Grass) and *Rubus fruticosus* spp. Agg (Blackberry). Many of these species are also listed as Declared Noxious Weeds in Victoria (definitions provided below).

Declared Noxious Weeds

Declared Noxious or Agricultural Weeds are pest plants that primarily impact on agricultural production (however, they can also be Environmental Weeds or WONS). Declared Noxious Weeds in Victoria are plants that have been proclaimed under the CaLP Act. The legislation requires that these species be controlled or eradicated by the land manager.

Declared Noxious Weeds fall into one of these categories: State Prohibited Weeds (S), Regionally Prohibited Weeds (P), Regionally Controlled Weeds and Restricted Weeds. A list of declared Noxious Weeds relevant to the Port Philip and Westernport Region of Victoria is provided in **Error! Reference source not found.**.

State Prohibited Weeds (S)

These invasive plants either do not occur in Victoria, but pose a significant threat if they were to invade Victoria, or if they are present in Victoria, pose a

serious threat and can reasonably be expected to be eradicated. If present, infestations of a State prohibited weed are relatively small. They are to be eradicated, if possible, from Victoria or excluded from the State. The Victorian Government is responsible for their eradication, but under Section 70(1) of the CaLP Act, it may direct landowners to prevent their growth and spread.

Regionally Prohibited Weeds (P)

Regionally Prohibited Weeds are not widely distributed in a region but are capable of spreading further. It is reasonable to expect that they can be eradicated from a region and they must be managed with that goal. Landowners, including public authorities responsible for Crown land management, must take all reasonable steps to eradicate regionally prohibited weeds on their land.

Regionally Controlled Weeds (C)

These invasive plants are usually widespread and are considered important in a particular region. To prevent their spread, continuing control measures are required. Landowners have the responsibility to take all reasonable steps to prevent the growth and spread of Regionally Controlled Weeds on their land.

Restricted Weeds (R)

This category includes plants that pose an unacceptable risk of spreading in this State or to other parts of Australia if they were to be sold or traded in Victoria, and are a serious threat to another State or Territory of Australia. Trade of these weeds and their propagules, either as plants, seeds or contaminants in other materials is prohibited.

Environmental Weeds

Environmental Weeds are pest plants that primarily impact on biodiversity values and ecological or ecosystem function. This includes:

- Indigenous species that are ecologically out-of-balance and are taking on pest plant characteristics within their natural distribution. Examples may include: *Kunzea leptospermoides* (Burgan) and *Leptospermum scoparium* (Manuka); and
- Australian and Victorian plant species naturalised outside their natural range/distribution. Examples may include: *Pittosporum undulatum* (Sweet Pittosporum), *Acacia longifolia* subsp. *Longifolia* (Coastal Wattle) and *Melaleuca armillaris* (Giant Honey-myrtle).

Environmental Weeds can also be declared Noxious Weeds (e.g. *Nassella trichotoma*; Serrated Tussock) or WONS.

DELWP have a Victorian Environmental Weeds Advisory List – including: aquatic habitats of Victoria, coastal plains and healthy forests bioregions and the inland plains bioregions (DSE 2009a, b, and c). These lists provide a ranking of environmental pest plants based on their potential for invasion, impact on natural systems, area of potential distribution, range of susceptible habitat types and rate of dispersal (DSE 2009a).

Life Forms of Pest Plants

There is a variety of types (or life-forms) of pest plants. It is important to recognise different life-forms of pest plants, life history strategies, ecological attributes and dispersal mechanisms, as this will assist in determining appropriate control techniques and their potential impacts as invaders. Typical life-forms of pest plants include: herbaceous (annual and perennial herbs and some vines) or woody species (trees, shrubs) and scrambler/climbers. Definitions and examples of life-forms of pest plants are provided in Table 2.

Table 2 Types of life forms of pest plants and example pest plant species

Life-form	Definition	Example pest plant
Herbaceous life forms (terrestrial and aquatic)		
Herbaceous	Not woody; usually green and soft in texture	Includes grasses such as *Nassella neesiana* (Chilean Needle-grass) and forbs such as *Echium plantagineum* (Patterson's Curse)
Annuals	Plant that completes its life cycle in one year	*Ehrharta longiflora* (Annual Veldtgrass)
Biennials	Plant that completes its life-cycle in two years	*Echium plantagineum* (Patterson's Curse) occasionally
Perennials	Plants that can live for more than two years	*Foeniculum vulgare* (Fennel)
Aquatics	Living in or on water, usually associated with freshwater species	*Alternanthera philoxeroides* (Alligator Weed)
Emergent aquatics	Species rooted in the substrate and whose stems, flowers and most	*Alternanthera philoxeroides* (Alligator Weed)

Life-form		Definition	Example pest plant
		mature leaves project above the water	
Submergent aquatics		Species rooted in the substrate and whose leaves are normally fully submerged	*Elodea anadensis* (American or Canadian Waterweed or Pondweed)
Floating aquatics (attached to substrate or unattached)		Species that are rooted in the substrate but normally have at least the mature leaves floating on the water surface. Stems and flowers may not float on the water surface	*Eichhornia crassipes* (Water Hyacinth) and *Salvinia molesta* (Salvinia)
Geophytes (seasonally dormant perennial herbs with storage organs)	Bulbous geophytes	Produce underground storage organ comprising short underground stem and fleshy leaf bases	*Allium triquetrum* (Angled Onion)
	Cormous geophytes	Produce underground storage organ comprising a short, swollen, fleshy stem base (corm)	*Moraea spp.* (Cape Tulip) *Watsonia meriana var. bulbillifera* (Bulbil Watsonia)
	Rhizomatous geophytes	Produce underground stem, usually growing horizontally, that produces roots and foliage	
	Tuberous geophytes	Produces underground storage organ formed from the swelling of a root or stem (tuber)	*Anredera cordifolia* (Madeira Vine)
Rhizomatous/ stoloniferous perennial herbs		Produces underground stems, usually growing horizontally	*Pennisetum clandestinum* (Kikuyu)
Tufted/ tussock-forming	Dicots	A flowering plant whose embryo has two cotyledons	

Life-form		Definition	Example pest plant
perennial herbs	Monocots – including grasses and graminoids (grass-like plants)	A flowering plant whose embryo has one cotyledon	*Nassella trichotoma* (Serrated Tussock) *Nassella neesiana* (Chilean Needle-grass)
Scramblers and climbers (annual or perennial)		A plant that climbs and or attaches to other plants such as trees or shrubs	*Anredera cordifolia* (Madeira Vine)
Succulent (water-storing) annual or perennial herbs		Juicy, a herb with thick fleshy habit	*Mesembryanthemum nodiflora* (Small Iceplant)
Woody life forms (terrestrial or wetland inhabiting)			
Shrubs (small, medium and large)		Multi-stemmed, woody perennial plant usually smaller than a tree	*Erica lustanica* (Spanish Heath) and *Genista* spp. (Brooms)
Trees		A woody plant usually with a single trunk, generally recognised as being over 8 metres tall	*Crataegus monogyna* (Hawthorn)
Root climbers		A climbing plant that climbs by adventitious roots	Notably Ivy *Hedera helix* climbing by adventitious stem roots
Scramblers/ Climbers		A woody plant that climbs and or attaches to other plants such as trees or shrubs	*Hedera helix* (English Ivy) and *Vinca major* (Blue Periwinkle)
Succulent (water-storing) shrubs		Juicy, a shrub with thick fleshy habit	*Opuntia* spp. (Prickly Pear)

Reproduction and Dispersal Mechanisms

Pest Plants spread by a wide range of mechanisms. Mechanisms plants use to spread can generally be divided into vegetative (asexual) methods and reproductive (sexual) methods, while dispersal mechanisms can be delineated into natural (wind, water, plants, etc.) or human assisted dispersal (Shire of Yarra Ranges, 2005). Table 3 lists some examples of common mechanisms of reproduction and dispersal in pest plants and definitions.

Table 3 Reproduction and dispersal mechanisms of pest plants

Mechanism of reproduction/dispersal	Definition and examples
Vegetative methods	Include the growth of propagules such as bulbs, tubers, corms and bulbils or through vegetative growth either above the ground (such as creepers, vines, formation of stem tip plantlets) or below ground (rhizomes or roots).
Sexual reproduction	Generally through the production of seeds. Natural dispersal of seed involves a wide range of vectors, and sometimes multiple vectors, including airborne, waterborne seeds and dispersal via plants – both internally (e.g. through digestive tract) and externally (e.g. attached to fur/feathers). Seed may be spread far more widely than vegetation material because of the diversity of vectors seed bearing plants use.
Airborne and gravity dispersal	Includes winged seeds that fall from a height and 'helicopter' away from the parent plant (e.g. maples, many conifers), seeds with light air catching fluff or filaments (e.g. thistle, dandelion), exploding seed pods that eject seed at speed (e.g. wisteria) or seeds that blow across open land or roll down hills.
Waterborne seeds	Are naturally most common in plants that are found along water courses, however, given most seeds float, heavy rain and floods have the potential to become a secondary vector for great variety of seeds. A wide range of pest plants grow in drains or washout areas along roadsides.
Plants	Carry seed externally (e.g. attached to fur/feathers) either deliberately (usually if the seed is a food source e.g. ants) or inadvertently when the seed sticks to the animal (e.g. burrs, or sticky seeds like *Paspalum*). Plants that carry seed internally (through digestive tract, e.g. Birds, Bats, Foxes, Horses) are responsible for the spread of many of the most invasive and most widely dispersing of the weed species. These seeds are usually berries or fruits which

Mechanism of reproduction/dispersal	Definition and examples
	entice the vector to eat it and then is still viable once digested (e.g. Boneseed, Blackberry, Ivy, Holly, Cotoneaster).
Dispersal by humans	Has resulted in the greatest movement of plant propagules across the world, with thousands of (mostly) deliberate introductions into and out of Australia. With quick travel, reduced trade barriers and access to an international market, weed spread has never been more global. Artificial dispersal from human activity also varies greatly in method and distance dispersed. On a more local scale, human activities can directly transfer propagules as soil and machinery is being moved and boots/socks catch burrs that might be transferred across sites. Cars can carry plant parts of hundreds of different species, for instance. Indirectly, humans alter water flows, create disturbances, openings and barriers and can create wind by driving vehicles – all of which can move seeds or plant pieces to different sites.

Pest Plant Impacts

Weeds of National Significance, Declared Noxious Weeds and Environmental Weeds have major environmental, economic and social impacts in Australia. Some examples of their impacts are provided below.

Environmental Impacts of Pest Plants

Pest plants are a major cause of decline biodiversity across Australia and destroy natural ecosystems by displacing indigenous flora and depriving native plants of their natural habitat. Pest plants can offer safe harbour to pest species such as Rabbits and Foxes. Few, if any, natural ecosystems in Australia appear to be immune from invasion by pest plants.

Pest plants can cause a huge loss of biodiversity, leading to 'downsized' and simplified and often depleted ecosystems. Simplified ecosystems can have decreased resilience compared to the original ecosystem and can be susceptible to continued degradation (e.g. further weed invasion, salinity, erosion and loss of productivity). Once an ecosystem begins to degrade, large amounts of effort and expense are required to halt the decline and it is rarely

possible to restore the ecosystem to the same level of biodiversity, resilience and productivity.

It is important to put into context that some regions are highly urbanised, public land that is both fragmented and highly utilised and feature large tracts of ecologically intact land. Garden plants, seeds or cuttings can be improperly disposed of and introduced into area supporting valuable remnant vegetation, parks, waterways and other areas. This impacts the quality of these areas.

General impacts on the environment that can be attributed to pest plant invasion include:

- Destruction of indigenous vegetation and fauna habitats by competition for resources (water, light, nutrients) and allelopathic effects;
- Prevention of recruitment of indigenous species, thus eliminating populations in the longer term;
- Facilitation of invasion of other undesirable species (e.g. legumes increase soil nitrogen, allowing invasion of exotic grasses; pine trees support exotic fungal mycorrhizal populations);
- Genetic pollution and hybridisation whereby foreign genes 'pollute' the gene pool of indigenous species (where the same species is involved), and hybridisation where different species (one introduced) hybridise; notable examples are found in Acacia, Grevillea, Correa and Eucalyptus;
- Increased water use (e.g. willows along streams);
- Production of increased fuel loads, increasing the risk of fires and producing more intense fires, which may sterilise soils, destroying standing indigenous vegetation and soil-stored seedbanks (e.g. Chilean Needle-grass (*Nassella neesiana*) invasion in Grassy Woodland environments);
- Modification of nutrient cycling (e.g. exotic, nitrogen-fixing legumes) can and cause anoxia in water (e.g. pulsed willow leaf-fall);
- Destabilisation of stream banks.

Economic Impacts of Pest Plants

Pest plants have the potential to adversely alter ecosystem function, reduce primary industry productivity and profitability and seriously limit the long-term sustainability of the State's agricultural and natural resources. Negative economic impacts of pest plants can include increased costs on water

quality/irrigation and management costs arising from the use of physical, mechanical and chemical control methods.

Some of the social impacts identified earlier in the guideline are relevant to economic impacts also, e.g. reduced recreational and visual amenity can negatively impact on local economies by downgrading recreational assets. Increased fuel loads (e.g. exotic shrubs and trees invading heathlands, woodlands or forests), could have major economic impacts in ongoing management of fuel loads and potentially causing loss of life and property in the event of a wildfire. Increased water use by pest plants (as opposed to lower water use by indigenous vegetation) may lead to major economic implications overall.

Social Impacts

Pest plants can have serious social impacts in the community, including reduced landscape and recreational benefits, contributions to disputes between neighbors, increased stress and workloads for land managers and reduced land values.

Pest plants can affect recreational and tourism activities through restricting access to sites, or attracting potentially harmful plants such as feral bees. Pest plants on public land can affect the provision of other ecosystem services such as the availability and quality of water. They may also impact on cultural values such as significant sites to indigenous people.

Human activity contributes to the dispersal of about 90% of Noxious Weeds (Panetta and Scanlan, 1995). Many species will invade without environmental disturbance, but for many species the degree of spread and potential to establish depends on the degree of soil disturbance; the greater the disturbance, the greater the degree of weed spread and establishment (Davies, 1992).

General social and economic impacts of pest plants include:

- Decreased productivity of agricultural and horticultural lands
- Destruction of cultural heritage values
- Compromised landscape amenity (e.g. obscured views, altered character of landscape to an 'exotic' feel)
- Destroyed or compromised assets, such as infrastructure
- Downgraded or destroyed recreational amenity (e.g. willows choke streams rendering canoeing difficult; aquatic pest plants may destroy boating and swimming amenity; blackberries prevent access to streams)

- Health problems caused by toxicity (contact dermatitis) and allergenic responses (hay fever) in humans, domestic plants etc.
- Toxicity to stock
- Supply of food for undesirable exotic pest animals
- Harbour for pest animals.

Common Targeted Pest Plant Species

Melbourne Water controls a vast diversity of pest plants on land and waterways it manages. This managed area has been divided into three regions; West, North East and South East. Each region has developed a list of their top ten commonly controlled pest plants.

It should be noted that this is not an exhaustive list of all pest plants. This list is indicative of high priority species in terms of current effort and expenditure and can be supplemented with new species as they emerge and priorities change. It is not intended to list pest plants of the most significant long term threat. Many of the pest plants on this list are WONS or Declared Noxious Weeds.

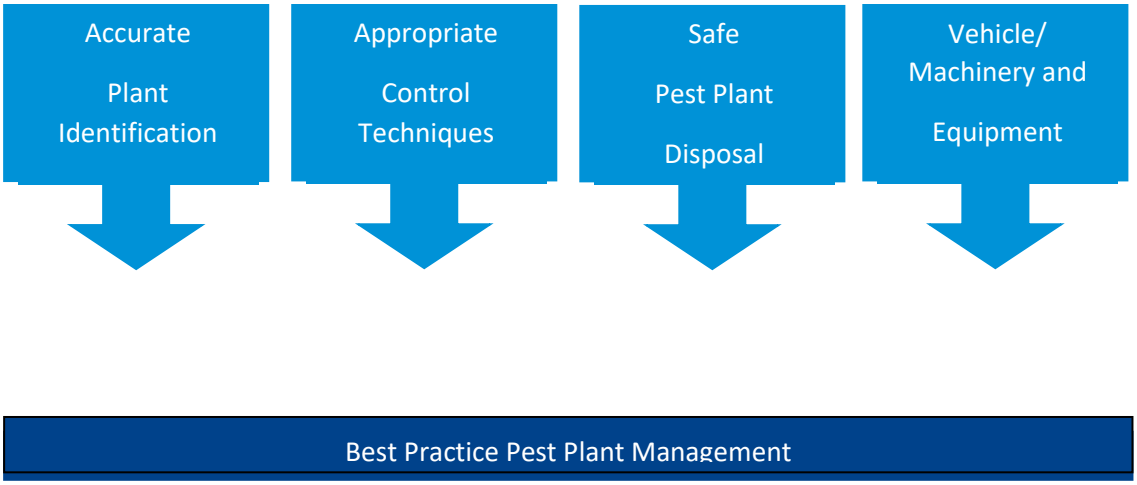
Table 4 Example list of Melbourne Water priority pest plants species

Melbourne Water region	Target species Scientific name	Target species Common name
West	*Asparagus asparagoides*	Bridal Creeper
	Fraxinus angustifolia	Desert Ash
	Galenia pubescens var. *pubescens*	Galenia
	Juncus acutus subsp. *Acutus*	Spiny Rush
	Lycium ferocissimum	African Boxthorn
	Nassella spp.	Needle-grasses, Serrated Tussock
	Opuntia spp.	Prickly Pear
	Salix spp.	Willow
	Ulex europaeus	Gorse
North East	*Cestrum elegans*	Elegant Poison-berry
	Crataegus monogyna	Hawthorn
	Delairea odorata	Cape Ivy
	Fraxinus angustifolia	Desert Ash
	Hedera helix	English Ivy

Melbourne Water region	Target species Scientific name	Target species Common name
	Hypericum spp.	St John's Wort, Tutsan, St Peter's Wort
	Lonicera japonica	Honeysuckle
	Rubus anglocandicans	Blackberry
	Salix spp.	Willow
	Solanum spp.	Wild Tree Tobacco, Madeira Winter Cherry
South East	*Asparagus asparagoides*	Bridal Creeper
	Crataegus monogyna	Hawthorn
	Fraxinus angustifolia	Desert Ash
	Glyceria maxima	Reed Sweet Grass
	Lonicera japonica	Honeysuckle
	Pittosporum undulatum	Sweet Pittosporum
	Rubus fruticosus spp. Agg.	Blackberry
	Salix spp.	Willow
	Spartina spp.	Cord Grass
	Ulex europaeus	Gorse

Best Practice in Pest Plant Management

This chapter focuses on 'best practice' protocols for pest plant management, in particular:



In order to ensure these 'best practice' protocols are applied, effective internal communication and training is required.

Accurate Pest Plant Identification

The importance of accurate identification of pest plants can not be underestimated. This is a fundamental step in prioritising pest plants for management, as well as identifying and refining appropriate techniques for control. Plant identification skills are also essential to identifying native species present at a site, requiring protection during pest plant control programs. Melbourne Water has extensive internal expertise ranging from plant identification to the control of pest plants that can be leveraged.

Broad ecological knowledge and identification of common species within a defined geographical area, is considered an essential skill for anyone engaged in the management of pest plants for either infrastructure/assets management or natural resource management.

New pest plant species continue to be recorded for Victoria (and Australia) and several have been found for the first time on land managed by Melbourne

Water. In cases where Melbourne Water people are unfamiliar with a pest plant species, specimens can be forwarded to the National Herbarium of Victoria, or an appropriately qualified consultant, for identification. It is essential to collect adequate flowering/fruiting material of the plant as well as other data (e.g. collector, location) to enable identification and form a voucher specimen to lodge at the Herbarium. Photographs are also useful. Refer to the national herbarium website for further details on collecting and lodging plant specimens for identification (RBG Identification Services).

Some useful field guides to assist with pest plant identification and control techniques in Victoria include:

- Richardson *et al.* (2011): Weeds of the South-east: An identification Guide for Australia, second edition
- Muyt (2001): Bush Invaders of South-east Australia
- Lamp and Collett (2004): Field Guide to Weeds in Australia

For plant identification also consult:

- Walsh and Entwisle (1989, 1996, 1999): Flora of Victoria, volumes 2, 3 and 4
- Blood, K. (2003). Environmental Weeds: A Field Guide to South East Australia.

Selecting Pest Plant Control Techniques

Selecting control methods to manage a specific pest plant should be done on a case-by-case basis. Before choosing techniques, the following factors need to be considered:

- Target pest plant species(s)
- Suitability and effectiveness of the technique for the target pest plant species
- Catchment or waterway characteristics, including water-quality issues and proximity to waterway or water body
- Context of the site (surrounding land title, land-use, and current pest control)
- Presence of native vegetation and fauna habitat

- Access considerations
- Potential impacts to non-target species and other environmental attributes
- Funding considerations
- Contractor skills and availability
- Cultural heritage
- Health and safety requirements.

A range of options (techniques) may be available for pest plant control at a given site or for particular pest plant species. Careful evaluation and planning is required for all pest plant management exercises to select the most appropriate technique to achieve effective and timely management (an optimum 'kill'), minimise off-target impacts and obtain cost-effectiveness. For many pest plant species, the only realistic control option is the use of herbicide, but for others, several complimentary techniques may be appropriate, depending on context, scale of the control operation, time of year, size of the pest plant population and other factors.

Appropriate techniques may vary in time and space. Techniques discussed below include:

- Chemical control
- Physical control (varying options)
- Biological control
- Cultural control
- Burning
- Solarisation.

Table 5 provides some examples of different control methods that may be effective for some commonly encountered pest plants. It also identifies the strengths and weaknesses of each of the potential methods for that species and the site conditions and life-forms for which each method may be suitable. For a thorough review of the advantages and disadvantages of weed control methods refer to Muyt (2001, pages 20-21).

Pest Species	Description (Plant Form)	Reproduction & Dispersal	Management Technique	Strengths	Weaknesses	Suitability
Acacia longifolia subsp. *Longifolia* (Coastal Wattle)	Upright spreading shrub or small tree 2-8m high	Seed. Seed is dispersed by birds, ants, slashing, in soil and garden refuse	Hand pull seedlings and young plants		Need to remove/dig out roots	Most effective on seedlings and young plants
			Cut and paint or drill and fill			
			Ringbark		Not suitable for immature plants that may resprout	Old very mature plants do not usually re shoot so they can be ring barked
			Fire	Destroys mature plants and stimulates seed germination for herbicide treatment of seedlings	Seedlings will need to be controlled Follow-up work is essential	
			Herbicide spray		Large plants are difficult to treat High risk of non-target damage Follow-up treatment required	Most effective on seedlings and plants under 2m tall

Pest Species	Description (Plant Form)	Reproduction & Dispersal	Management Technique	Strengths	Weaknesses	Suitability
Asparagus asparagoides (Bridal Creeper)	Rhizomatous, cool-season perennial climber reaching to 4 m	Seed and rhizomes. Seed is dispersed mainly by birds, water, machinery and in garden refuse. Rhizomes are dispersed by animal diggings, machinery, in garden refuse and during removal.	Digging out plants and sever stems at base and leave to dry	Stems can be severed at base and left to dry out in the canopy. Carefully excavate around and under the rhizome-tuber mass then lever it out using hand tools. Ensure entire mass is removed to prevent regrowth.	During manual removal small pieces of rhizomes with growing points may remain attached to tubers, thus it is important to remove all tubers to ensure no regrowth occurs.	Seedlings and small infestations. Remove plants in autumn-winter while soils are moist and before fruit forms.
			Scalping	Infestations in areas with little or no indigenous flora can be scalped to depths that remove the rhizome-tuber mass. Earth moving equipment can be used for large infestations or hand tools such as shovels and rake-hoes can be used for smaller infestations.	Only suitable for large infestations and/or where there is little or no indigenous flora present. Can impact adjacent trees (i.e. roots).	Undertake before stems twine amongst the overstorey canopy. Dispose of material by burning or safely dispose offsite. Rehabilitate scalped areas as soon as possible to minimise risk of erosion or further weed invasion.
			Herbicide spray	Spray with non-selective or selective herbicide spray.	For established plants, repeat applications over 2-6 years may be required.	Spray during winter-early spring flowering period.
Rubus fruticosus spp. Agg	Dense thicket forming shrub reaching heights of 2-6	Reproduces from seed, stem-tip rooting and root suckering. Seed is dispersed by Birds,	Dig out seedlings and young plants		Time consuming	Only effective on small infestations

Pest Species	Description (Plant Form)	Reproduction & Dispersal	Management Technique	Strengths	Weaknesses	Suitability
Blackberry	m	Foxes and water. Vegetative reproduction may occur when dislodged crowns, roots or stems fragments come into contact with moist soil	Cut and paint small infestations or drill and fill		Follow-up treatment may be required as plants can reshoot	Only effective on small infestations Apply during growing season Avoid extended dry seasons
			Biological control – Blackberry rust		Only effective on some taxa	
			Herbicide spray		Follow-up treatment is critical as spray rarely kills all plants	Apply during growing season Selective herbicides usually provide better results

Chemical Control

Herbicides are generally an essential component of pest plant control programs (although not always required). In some situations, herbicides offer the only practical, cost effective and selective method of managing certain pest plants.

In some cases, a pest plant is only susceptible to a specific herbicide and it is important to use the correct product and application rate for control of that particular pest plant. In most cases, pest plants must be actively growing to be vulnerable to herbicide treatments.

Common mistakes of herbicide use include: incorrect weed identification and incorrect herbicide selection, timing of application and inappropriate concentration of the product. Conditions such as wind speed and direction, the possibility of rain and proximity to drinking water supply and waterways must be taken into account when preparing to use herbicides. Herbicide resistance can also be an issue with some pest plant species.

By law, herbicides can only be used in accordance with the corresponding label. However there are cases where the off-label use of a chemical is legal with a permit from the responsible agency. As part of most permit application processes, a risk assessment of the proposed off-label use is carried out to ensure negative impacts arising from the off-label use are avoided.

Note: Not all off-label chemical use is illegal however, and this Agricultural Note provides information on when off-label use is illegal, when it is not, and what permit may be required to legalise the off-label use.

Chemical Use

In Victoria, there are a number of agricultural chemicals that are restricted to on-label use by authorised persons. These are referred to as 'restricted use' chemicals and are agricultural chemical products that:

- Schedule 7 Poisons (Dangerous Poisons)
- Contain atrazine, metham sodium, ester formulations of 2,4-D, 2,4-DB, MCPA and triclopyr.

To be authorised to use these chemicals on your own property, you must hold a valid Agricultural Chemical User Permit (ACUP), with the appropriate chemical endorsement, or be working under the direct supervision (i.e. within sight and sound) of an ACUP holder.

'Restricted use' chemicals may also be used by DELWP licensed spray contractors and chemical users operating within a recognised Quality Assurance program that requires chemicals to be used in accordance with label directions and is independently audited at regular intervals of less than two years.

Certain areas in Victoria have been declared Chemical Control Area's (CCA's). These areas have restrictions on the types and methods of application of certain herbicides. Details can be accessed from herbicide label and further information from the DPI website Agricultural Chemical Control Areas.

The Australian Pesticides and Veterinary Medicines Authority (APVMA) is the Australian Government authority responsible for the independent assessment and registration of pesticides and veterinary medicines. The APVMA keeps a record of all registered pesticides in Australia and their approved uses and also reviews older chemicals to make sure that they continue to meet contemporary high standards.

Physical Control

Physical control is the removal of pest plants by physical or mechanical means, such as mowing, grazing, mulching, tilling, burning or by hand. The method employed often depends on the area of pest plants to be managed, land use/value and physical characteristics of the land.

Controlled Grazing/Browsing

In some cases stock can be used to reduce biomass or inflorescences/infructescences of certain palatable weed species to minimise the targets for herbicide application to prevent flowering or seeding, or eliminate plants entirely (in the latter case for example, using goats to kill blackberries). Use of grazing/browsing will be highly specific to the site and conditions and has attendant risks, e.g. causing unacceptable disturbance, or stock acting as vectors (dispersal agents) of weed propagules.

Cut Down

Woody species without basal buds may be killed when cut (felled) close to the ground.

This category includes those fire sensitive species that can be killed by ringbarking, but also includes species such as most palms (e.g. *Phoenix*).

Drowning (cutting stems/leaves below water surface)

This technique effectively drowns some pest plants by starving the roots or rhizomes of oxygen. Stems are usually cut below the water line, stopping oxygen that

is captured by the leaves traveling down to the root or rhizome. Lack of oxygen in the root or rhizomes disrupts the respiration process, eventually killing the plant.

Hand Removal

Removal by hand (pulling, digging, hoeing) is the selective removal of pest plants without disturbing the surrounding desirable vegetation. It is labor-intensive and is often only used in small areas, such as gardens or in larger areas during bush regeneration, or where populations of the target pest plant are small.

Hay Making, Mowing and Grazing

Hay making, mowing and grazing before pest plants produce seeds may effectively restrict the amount of weed seed in an area and reduce the spread of pest plants.

Mowing and Slashing

Mow weed-free areas first and:

- Avoid mowing if pest plants are in seed (if unavoidable, mowing should be carried out from least to most infested areas and machinery thoroughly cleaned before proceeding to an un-infested area)
- Machinery cleaning, where required, must be carried out within the infested site before moving to an un-infested area.

Mulching

Mulching, by covering the ground with a layer of organic material, suppresses or kills pest plants by providing a barrier between the pest plants and sunlight. Mulching has an added advantage in that it improves the condition and moisture level in the soil. Planting competitive and desirable plants that provide a dense cover over the pest plants suppresses growth in a similar way to mulching.

Ringbarking

Woody species without basal buds that may re-sprout (on lower trunks or lignotubers) can be killed by ringbarking without the need for herbicide application. This generally applies to fire-sensitive species and includes most conifers (*Pinus, Cupressus*), *Hakea, Eucalyptus, Melaleuca*, and most *Acacia*.

Biological Control

Biological control is the control of pest plants by natural predators, pathogens and parasites. This technique has the potential for effective long-term control of some weed species. However, suitable organisms and/or vectors must be discovered and stringent tests and controls are required when implementing biological controls to investigate potential target and non-target impacts. The required research intensity for this method can result in high costs, however even small successes may more than pay for the outlay (Henzell *et al.* 2008).

It is critical that the introduced biological control agents do not become pests themselves. Considerable testing is done prior to the release of biological control agents to ensure they will not pose a threat to non-target species such as native and agricultural plants.

Although in the long term, biological control can be cost effective and can reduce the need for less desirable management practices, a limited number of weed species are susceptible to biological control.

There have been several successful biological control programs in Australia, the most spectacularly successful being the control of Prickly Pear (*Opuntia* spp.) by the Cactoblastis Moth. Insects that attack leaves, fruits or stems have been released, following stringent screening, to control pest plants such as Skeleton Weed (*Chondrilla juncea*), Bridal Creeper (*Asparagus asparagoides*), and Salvinia (*Salvinia molesta*). Research is underway relating to biological control for a number of weed species.

Fire

Fire is a potentially important pest plant control technique, as fire may be used to:

- Kill fire-sensitive pest plant species, particularly woody pest plants, which do not re-sprout post-fire because of the absence of basal buds (a moderate to hot fire may be needed to achieve this);
- Stimulate fresh growth (resprouts), particularly in perennial grasses to more effectively control with herbicide (as physiological activity is

enhanced following fire) and/or reduce off-target damage in mixed native and weed invaded vegetation when spot-spraying;

- Stimulate the recovery of indigenous vegetation from soil-stored seed banks and resprouting species;
- Deplete soil-stored seed banks of pest plant species, particularly those hard-seeded species persisting long-term (notably Wattles; Acacia spp. And Brooms; Genista spp.);
- In the event of fire used purposefully for pest plant control (or unplanned fire) rapid post-fire follow-up pest plant control is essential because of a narrow window of opportunity to take advantage to easily remove emerging seedlings or new growth. In addition, target or non-target pest plants may seriously impede the recovery of the indigenous vegetation following fire (by competition with seedlings or resprouters). Another potentially adverse consequence of burning is the creation of 'fresh pick' for rabbits or macropods after the fire. Such grazing may be intense and harm recruiting/regenerating indigenous species and promote competition from unpalatable (e.g. toxic or spiny) weed species. Some management intervention may be required to protect recovering vegetation.

Solarisation

At a relatively small scale, solarisation – using the heat of the sun to 'cook' pest plants under a clear plastic cover – can be very effective. Lethal temperatures can kill an in-situ pest plant population or on bare soil can be used to kill weed seed in the upper few centimetres of the soil profile. Solarisation may also be used to kill pest plant material that has been removed, eliminating the need for off-site disposal (e.g. aquatic plants removed from a wetland). Solarisation is only effective in the warmer parts of the year.

Working Along Drinking Water Storages and Waterways

Aquatic systems are particularly sensitive to environmental impacts making control of invasive plants problematic. Inappropriate herbicide treatments may have unforeseen consequences e.g. effecting aquatic flora and fauna, contaminating drinking water supply or manual removal and mechanical harvesting may exacerbate an infestation by spreading plant material over wider areas (Muyt, 2001).

A range of strategies and practices should be applied when working in or near drinking water storages and waterways:

- Certain aquatic pest plants must be reported to DELWP e.g. State Prohibited Weeds such as Alligator Weed, Hyacinth and Salvinia. People from these organisations are equipped to design appropriate eradication programs and should be consulted for advice (Muyt, 2001);
- If using chemical sprays, select the appropriate chemicals so that the pest plants are controlled without killing native plants, such as frogs and fish, and eliminate the risk of contaminating drinking water supply;
- Waterways are particularly susceptible to erosion when soil is exposed. Follow-up revegetation should be undertaken to prevent erosion and assist in stabilising banks following the removal of pest plants and to prevent their reinvasion.
- See Appendix C for approved herbicides at these sites

Minimising Native Flora and Fauna Impacts

A range of strategies and practices should be applied when working in areas supporting or adjacent to native vegetation and/or fauna habitat for example:

- Hand weed around susceptible indigenous vegetation;
- Protect rare or threatened species;
- Burn, mow or slash weed infestations amongst indigenous vegetation prior to spraying to minimise non-target damage;
- Select herbicide and method of application that has minimum impact on surrounding vegetation e.g. selective herbicide or cut-paint rather than spray;
- Where possible cut down larger woody pest plants;
- Sever aerial vines;
- Avoid herbicides known to be soil-mobile in certain soil types;
- Limit the use of residual or soil-active herbicides to degraded environments.

General Best Practice

Considerations

- Target minor or scattered infestations before they increase;
- Time treatments to maximise results e.g. during active growth season and prior to propagules forming;
- Minimise the volume of herbicide usage (where applicable);
- Never exceed herbicide recommended rates or application frequency;
- Reduce herbicide rates when known to be effective;
- Use only experienced, skilled operators;
- Plan how on-ground operators move through areas to minimise non-target damage;
- Use fitted hoods, shields and appropriate nozzles to minimise non-target damage;
- Avoid spraying in windy conditions to minimise non-target damage;
- Select low volatile chemical formulations (where applicable);
- Maintain equipment thereby reducing likelihood of spillage/leaks.

Safe Pest Plant Disposal

Disposal of pest plants (after control efforts are complete) must be undertaken as the pest plant material may:

- Carry propagules (seed or vegetative material) that may germinate/sprout or is capable of rooting to form new plants;
- Smother other site vegetation;
- Impede indigenous plant recruitment/regeneration;
- Create a fire risk;
- Cause physical obstruction (reduced amenity) (e.g. felled trees, woody debris);
- Harbour vermin.

All of the above effects must be considered when choosing a pest plant material disposal option. Pest plant material disposal options include:

- Burning on-site (in a cleared area away from native vegetation);
- Transport to a council landfill;
- Buried on-site Chipped;
- Stockpiled;
- Removal of fuel load (retain logs for site habitat).

Careful consideration must be taken when disposing pf pest plant material. It is important the pest plant material disposal option will not impact on hygiene, allow pest plant propagation, negatively impact the environment or create a fire, safety or pest animal harbour risk.

Note: there may be a seasonal consideration dictating whether plant material needs to be removed or not (e.g. leafless willow branches may take root in winter/spring, or alternatively rapidly die in summer, without the need for removal). Ensure pest plant material is covered when in transit to prevent material falling or blowing from the vehicle.

Depending on the type of pest plant disposal, the health and safety of Melbourne Water people and service providers is a priority; Task Risk Assessments should be completed where relevant.

Cleaning of Vehicles, Machinery and Equipment

Contamination of vehicles, machinery and equipment (notably slashers) is a major factor in the dispersal of seed and vegetative propagules of pest plants (e.g. bulbils in *Watsonia meriana* var. *bulbillifera;* Watsonia). These contaminants may adhere to or lodge on the surface of vehicles, machinery and equipment, or may be present in adhering soil, especially under vehicles. If not cleaned, vehicles, machinery and equipment may introduce new pest plants to a site or further spread pest plants within or between sites.

The need for measures to decontaminate vehicles, machinery and equipment needs to be clearly established and implemented according to the risks posed in the particular situation. However, the risks of contamination and inadvertent dispersal are high when working in weed infested areas. Factors that will influence the decision to decontaminate or clean vehicles, machinery and equipment include:

- The pest plant species present on a site and aspects of their biology and ecology (e.g. means by which the species may propagate and disperse (vegetative versus by seed);
- Growth stage of pest plant species;
- Site conditions, especially in relation to availability of exposed soil and soil-moisture conditions;
- Time of year and weather conditions.

All vehicles, machinery and equipment working in an infested area should be cleaned of soil and plant material before moving to an un-infested area. Vehicles should be equipped with the appropriate materials to clean the vehicles, machinery and equipment within the infested area, preferably on a grassy area away from watercourses or drains.

Vehicles, machinery and equipment can be cleaned by scraping, brushing, using compressed air to remove plant material and soil or washing with high-pressure water equipment. If water is used, apply minimal amounts to reduce run-off on site.

Where vehicles, machinery and equipment need to be transported for cleaning, e.g. to works depot, ensure that soil and/or plant material does not fall or blow off in transit. Cleaning should subsequently be carried out in a quarantined area with waste disposed of at a council landfill site.

A checklist for cleaning a vehicle is provided in **Error! Reference source not found.** as a guide. Refer to DPI website for further information: Machinery Hygiene Guidance.

Education and Training Standards

It is essential that service providers undertaking on-ground pest plant activities to be appropriate education/training. Service providers should have a sound knowledge of plant identification, vehicle/machinery hygiene protocols and keep abreast of new and emerging weeds within Victoria and the Port Phillip and Westernport region.

Training Requirements for On-Ground Works

At a minimum, people undertaking pest plant control on-ground should have appropriate training and skills to undertake pest plant control activities, for example:

- Agricultural Chemical Users Certificate;

- Plant identification skills (indigenous and exotic);
- Diploma in land management or equivalent (desirable); and
- Relevant health and safety training/certificates.

It is also desirable that:

- Ongoing plant identification and control techniques skills training to be provided for people working on-ground;
- Direct supervision to be given to people with limited experience/skills undertaking control techniques;
- Field supervisors have more than two year's field experience in ecological pest plant management.

Developing a Pest Plant Program

This chapter outlines the main steps involved in developing a pest plant management program.

The assumption is made from the outset that priority sites and/or zones for pest plant management have already been identified. Therefore, this Guideline does not include steps required to identify priority sites and/or zones for pest plant management; instead, the focus is on prioritising the pest plant control within the site or zone.

Three main sources of information were used to identify the steps required to develop a pest plant management program:

- *Bush Invaders of South-east Australia* (Muyt, 2001);
- *Guidelines and Procedures for Managing the Environmental Impacts of Weeds on Public Land in Victoria 2007* (Environmental Weeds Working Group 2007);
- Discussions/consultation with Melbourne Water people who are involved in preparing pest plant management programs.

The proposed steps for developing a pest plant management program are illustrated in Figure 2 and outlined below.

Figure 2 Developing a Pest Plant Management Program

	Step	Process
Planning and Development	1	Develop a Project Plan
	2	Determine a Budget
	3	Conduct Field Survey and Identify Primary Site Values
	4	Collect Data on Threats
	5	Determine Pest Plant Priorities
	6	Determine Management Goals
	7	Determine Control Techniques
Implementation	8	Undertake the Management Actions
	9	Monitor During and After Control Treatment
	10	Evaluate Management Actions

Step 1: Project Planning

Before developing a pest plant management program, the following actions are recommended:

- Establish project objectives;
- Define the type of pest plant program;
- Define the site boundaries and appropriate landscape scale for the project.

Establish objectives

Establishing objectives or purpose should be the starting point in planning. They help to orient everyone involved toward one, common goal and assist prioritising pest plant species and selecting appropriate control techniques. Such objectives may include protection of water quality, protection of a waterway, protection of an environmentally significant area and/or adhere with state legislation.

Identify the type of pest plant program

There are likely to be two main types of pest plant management programs relevant to Melbourne Water: 'site specific' programs that aim to tackle dominant pest plants at a given site (or perhaps all pest plants within a site) and protect a particular asset or 'species specific' programs that aim to tackle a specific pest plant species across one or a number of Melbourne Water managed sites (e.g. new and emerging pest plants).

Define site boundaries and appropriate landscape scale for the project

It is important to set site boundaries to allow pest plant species to be identified within the site boundary and appropriate control techniques and budget decisions to be made.

Appendix G provides a template that can be used to plan a pest plant management program.

Step 2: Determine Budget

- Identify project budget and discuss with major stakeholders.

It is important to identify a realistic budget for the project during the planning phase, so that there are adequate resources available to implement the management program. This may involve consulting major stakeholders to determine if additional resources are available and/or development of partnerships with such stakeholders.

Step 3: Conduct Field Survey and Identify Primary Site Values

- Baseline data collection;
- Identify primary site values.

Baseline data collection

It is essential to gather appropriate data before pest plant management commences for a number of reasons, mostly to obtain a baseline to measure effectiveness of management efforts against, and to identify management priorities, e.g. site selection(s) and highest priority pest plant at a given site.

Data will generally need to be captured in two ways:

- Desktop assessment of available information, such as government ecological databases (relevant DELWP databases), and existing in-house information (e.g. Flora and Fauna reports and Management Plans for Melbourne Water sites) and any previous vegetation assessments undertaken;
- A field assessment of the site(s) of interest.

A desktop assessment alone is unlikely to produce meaningful results, due to current limitations of the databases for EVCs, rare or threatened flora and fauna species[1]. Ideally, an initial site visit is strongly recommended in order to justify management effort and measure progress over time.

The level of appropriate data collection at a site will depend on the site operations, complexity of pest plants present, vegetation condition, number of target pest plant species and other factors, such as budget, risk to 'primary site values' and resources.

Note: see Table 12 for an example a Baseline Pest Plants Template

The following vegetation condition methods are discussed in this Guideline including:

- Broad overview;

[1] Limitations including areas may have been surveyed more extensively than others, records may be decades old and have altered placing limitations on data accuracy and the conclusions that can be drawn.

- Rapid Vegetation Assessment Method;
- Transects or flora quadrats;
- Detailed mapping of pest plant distributions and indigenous vegetation;
- Index of Stream Condition;
- Habitat Hectare Assessments.

A combination of each of these methods may be appropriate for some programs, refer to **Error! Reference source not found.** for further information on each methodology.

Table 6 Summary of methods for vegetation condition assessments

Assessment Method	Scale/Suitability	Skills Required	Frequency of Use
Broad overview	Catchment/sub-catchment	General knowledge of pest plant species	Common
Rapid Vegetation Assessment Tool	Land parcel, river/creekline or sections of river/creekline	Experience/ knowledge of pest plant species	Preferred
Transect or flora quadrats	Land parcel, sections of river or creekline	Experienced botanist	Not common
Detailed mapping of pest plant distributions and indigenous vegetation	Sections of river or creekline	Experienced botanist	Preferred
Index of Stream Condition	Long term catchment scale	Trained environmental practitioner	Not common (undertaken every five years)
Habitat Hectare assessments	Site scale	Habitat Hectare assessment competent ecologist/botanist	Not common

Primary Site Values

A key component of determining the pest plant priorities for a site is to determine what the 'primary site values' are. These values can include operational, ecological or financial assets at a site, and they constitute values which are considered to be at measurable risk from pest plants. These values should be identified whilst collecting baseline information.

Step 4: Collate Data on Threats

- Collate pest plant records and map invasion extent.

Collate pest plant records and where appropriate map the extent of invasion of pest plants or a particular pest plant species using GPS tools.

Step 5: Determine Site Pest Plant Priorities

- Check information sources
- Prioritising pest plant species
- Other considerations.

Check Information Sources

The following is a list of potential information sources to assist pest plant prioritisation:

- Internal people and stakeholders (e.g. relevant government agencies and service providers);
- Government Documents; refer to Appendix A and **Error! Reference source not found.**;
- Common Targeted Pest Plant Species; refer to Table 4;
- Pest Plant Categories;
- Relevant scientific literature;
- Local government and community-based information.

Prioritising Pest Plant Species

There is no one quick process to prioritise pest plant control, whilst meeting a project's objectives and ensuring the project values operational, financial and ecological considerations equally.

Despite these challenges, a pest plant prioritisation approach is listed below and is divided into operational, financial and ecological values.

Prioritising Pest Plant Species Process

Prioritising Pest Plants affecting Ecological Values (two approaches)

1. Utilise the Advisory lists of Environmental Weeds for Victoria (DSE and DPI, 2009a, b, and c). This List will assist identify a priority ranking of Environmental Weeds for management, based on their potential for invasion, impact on natural systems, area of potential distribution, range of susceptible habitat types and rate of dispersal (DSE 2009a). In the Advisory Lists, Environmental Weeds are scored based on each of these parameters and then ranked as *very high risk, high risk, moderate risk, medium risk or lower risk* (based on their final total score). These rankings may be used to determine priority pest plants: e.g. manage very high risk before high risk pest plants etc.
2. Utilise the Risk Analysis Framework provided in Appendix D which may assist in prioritising pest plants for management, where suitable/reliable data on pest plants is available. In the Risk Analysis Framework, pest plants for control are selected primarily due to their invasive attributes, ease of removal and infestation size. The risk matrix can be modified on a case by case basis.

After these three sections have been completed a number of pest plants will have been identified for management. These identified pest plants can then be further prioritised to align with the projects objectives.

Other Considerations

It is important when prioritising pest plant species to identify potential sources of introduction of pest plants and pathways of spread.

It is frequently necessary to document/evaluate pest plants off-site (e.g. outside of the Melbourne Water managed site), to identify sources of infestation, if possible, it is useful to gather the following information:

- Potential sources of introduction and high risk areas for establishment of new and emerging weeds;
- Dispersal modes;
- Quarantine, surveillance and rapid response processes;
- Sites of known occurrences of new and emerging, and sleeper weeds and determine if they be managed to eliminate/reduce risk;
- Legislative or regulatory drivers (if any) relating to dealing with off-site pest plant populations;
- Potential for adjacent landholders to removing pest plant sources on their properties.

Step 6: Determine Management Goals

- Determine pest plant management goals

The most suitable goal for pest plant management will depend on the distribution and impact of pest species, the extent and the type of values in the area and the efficacy of available control techniques. These factors vary between pest species and between areas, and therefore, within a particular site there may be different management goals for each pest plant species present.

The four options generally work in order of least to most cost and pest plant population size, refer to Figure 1 for further information.

Pest plants are can be grouped according to their degree of establishment in Victoria. A framework, Table 7 developed by the Environmental Weeds Working Group (2007) can be used in assigning goals and management responses. For example, for new and emerging weeds, the goal is to eradicate the weed at a site, whilst for weeds that are established and expanding in range/density, containment may be the goal (e.g. prevent further spread beyond the boundary of the current infested area).

Table 7 Weed categories, goals of management and suggested response

Group	Goal	Response

Prevent introduction	**Prevention:** Prevent the spread into a defined boundary	Identify, prioritise and control
New and emerging (including sleeper weeds)	**Eradication:** A weed has been removed or killed over time and no longer occurs at that site including its propagules	Identify, prioritise and Eradicate (including 'sleeper' weeds) Contact Weed Alert Rapid Response (WARR) program for advice
Established and expanding range/density	**Containment:** Prevent spread beyond the defined boundary of the current infested area	Identify, prioritise and control
Established across potential range to maximum density	**Asset protection:** To reduce the density or health of weeds at a location below thresholds at which they have an ecological impact	Identify, prioritise and control

Step 7: Determine Control Techniques

- Determine appropriate control techniques;
- Consult with government/research organisations;
- Develop targets to measure progress;
- Reassess project budget.

Consult with government/research organisations

There are a number of government/research organisations that may be interested to collaborate in order to assist and ensure most effective pest plant control outcomes. Partnerships have thus far demonstrated the efficiency and economies of scale that collaboration can bring to integrated pest plant control efforts and these linkages should be explored, if feasible.

Develop targets to measure progress

It is important to identify suitable targets to gauge progress of the pest plant programs. These targets are likely to be specific to a particular component of the project and will need to specify both the measure of progress and the time by which it is to be completed. For example, a progress milestone for a monitoring program may be that pre-control (baseline) monitoring is

completed prior to the beginning of the optimal period of control for a pest plant (see Guidelines). Alternatively, a progress milestone for complimentary activities might be that pest animal control activities are carried out prior to the period of seed-set for a key pest plant species.

Melbourne Water expects that most pest plant types may have three different susceptibility ratings or 'kill levels' for treatment of a population (high, medium and low) depending on the vigour/susceptibility of the target species to treatment.

Species-specific objectives may be appropriate and are encouraged, as outlined below.

High Kill Level: e.g. for Tree Tobacco, the expectation would be that 100% of the plants treated within a targeted population are killed in the first year of treatment. This is the 'high' category (i.e. highly susceptible to treatment).
Medium Kill Level: e.g. for Willow species, the expectation would be that 95% of the plants treated within a targeted population are killed in the first year of treatment. This is the 'moderate' category (i.e. moderately susceptible to treatment.)
Low Kill Level: e.g. for Desert Ash, the expectation would be that 75% of the plants treated within a targeted population are killed in the first year of treatment. This is the 'low' category (i.e. less susceptible than the previous categories).

The above categories could be used to set targets in a pest plant management program and to measure whether targets are being met. They may need to be varied based on the targeted pest plant species and extent of invasion. For example, serious infestations are likely to take many years to eliminate/reduce.

Reassess project budget

A reassessment of the budget to undertake desired control techniques should be undertaken prior to implementation, ensuring all identified control activities can be undertaken.

Step 8: Undertake the Management Actions

This phase of the pest plant management program involves:

- Develop a works plan for the project refer to **Error! Reference source not found.** (a useful tool to communicate the program and its objective);
- Initiate a work order and assign responsibilities (if applicable);
- Brief people/service providers/volunteers of the management program (if required);
- Undertake the work plan ensuring employment of best ecological and weed management practices to:
    - Identify the species to be removed;
    - Minimise disturbance to the surrounding area;
    - Time treatments to maximise results;
    - Minimise the spread of pest plant during and after removal;
    - Encourage local flora;
    - Integrate different control methods;
    - Modify treatments through adaptive management;
    - Practice pest plant hygiene protocols;
    - Stagger the removal of pest plant species providing critical habitat;
    - Reduce impacts of treatments on the broader environment;
    - Undertaken removal of waste pest plant material (if required).

Record Keeping

Legal Requirements for Agricultural and Veterinary Chemical Use in Victoria control the use of agricultural and veterinary chemicals in Victoria. All chemical users (i.e. primary producers and commercial spray contractors) who use agricultural chemical products are required to make and keep the prescribed records for agricultural chemicals including Schedule 7 agricultural chemicals, certain ester herbicide formulations and Atrazine soil residual herbicide.

The following records must be made within 48 hours of using an agricultural chemical product and kept for a period of two years from the date of use:

1. Product trade name;
2. Date the product was used;

3. Application rate of the product;
4. Crop/commodity that was treated or the situation in which the product was applied;
5. Extent of use (the area of land treated, or the volume of water treated, or the volume of stored commodity treated, or the weight of the commodity treated)*
6. Location where the product was used;
7. Name and address of the applicator/supervisor;
8. Name and address of the person for whom the application was carried out.

Where a product is being sprayed outdoors (excludes hand-held devices that are operated manually), the following record must also be made:

9. Wind speed and direction at the time of application.

Melbourne Water requires all service providers to keep relevant herbicide recording sheets with the Area Coordinator or sub-contractors for a minimum period of two years. A recording sheet is located Appendix H.

Step 9: Monitor Before and After Treatment

The monitoring program for a site will need to be designed to allow the collection of data which can be analysed to evaluate the success of control activities. Monitoring must be based on scientifically robust and objective principles, and will need to be incorporated as a comprehensively planned and costed component of every pest plant program.

Monitoring of the effectiveness of pest plant control can occur at a number of different scales. Monitoring can occur at:

- Project level and effectiveness of works in a defined area and specified project;
- Landscape scale, e.g. over a specified waterway length or land parcel.

Selecting an appropriate monitoring method (or vegetation condition method) will be dependent on the landscape scale of the pest plant management and resources available.

The 'before' and 'after' pest plant control monitoring data needs to be collected to allow determination of the program meeting its goals and objects. It can be

useful to employ similar techniques of those used to gather the baseline information post management activities.

In some instances monitoring should take place at 1, 3, 5 and 10 years post-initiation of the pest plant management program. More frequent monitoring may be required for some pest plant species (e.g. seasonal species and pest plants that require repeated control efforts within short time-frames).

Step 10: Evaluate Management Actions

After implemental of the pest plant management program is complete it is time to evaluate the success of the program.

Following the collection of monitoring data, an evaluation of the overall effectiveness of the pest plant management program should be undertaken. This involves reporting if the program met its objectives, targets and goals and identifying any required revisions.

The evaluation may identify that pest plant management program may need to be revised (e.g. in order to achieve targets within the specified timeframe or additional new and emerging pest plants/management issues have arisen that require addressing).

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DSE (2009d). *Advisory list of environmental weeds of the Ranges bioregions of Victoria.* Department of Sustainability and Environment, Melbourne.

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Appendix A – Pest Plant Legislation and Policy

Australian Weeds Strategy 2006

Australian Weeds Strategy: A National Strategy for Weed Management in Australia (2006) provides the framework to establish consistent guidance for all parties, and identifies priorities for weed management across the nation with the aim of minimising the impact of pest plants on Australia's environmental, economic and social assets.

The goals of the Australian Weeds Strategy are threefold.

- Prevent new weed problems
- Reduce the impact of existing priority weed problems
- Enhance Australia's capacity and commitment to solve weed problems.

Water Act 1989

A purpose of the *Water Act (1989)* is to provide formal means for the protection and enhancement of the environmental qualities of waterways and their in-stream uses; and provide for the protection of catchment conditions. In addition an Authority that has management control may make by-laws applying to any or all of those areas for the following purposes – The control of the introduction if any new flora or fauna to the area; The control of the numbers of any flora or fauna in the area.

Under the Water Act, an Authority must perform its functions in an environmentally sound way, having regard to the need to preserve aspects which have landscape and fauna and flora values. Its functions include: to identify and plan for State and local community needs relating to the use and economic, social and environmental values of land and waterways and to develop and implement effectively schemes for the use, protection and enhancement of land and waterways.

The Catchment and Land Protection Act 1994

The *Catchment and Land Protection Act 1994* (CaLP) provides the legislative framework for the management of land and in particular the control of Declared Noxious Weeds in Victoria. The Act sets out the roles and responsibilities for land managers (private and public) for weed management within Victoria. Sections 70, 70A and 71 of the CaLP Act for all Declared Noxious Weeds, irrespective of category or Region, prohibits the:

- Movement from land on to a road (and vice versa) of:

- Vehicles and trailers used for carrying, moving or transporting
    a. hay, grain, stone, gravel, soil, plant material, fodder or livestock;
    b. machinery or equipment for road and utility building or maintenance, primary production or earth works;
    c. machinery, implements or other equipment;
- without first taking precautions to ensure the vehicle and equipment is free from noxious weed seeds and any other part of a noxious weed that is capable of growing (weed propagules).

Port Philip and Westernport Regional River Health Strategy (2005)

The Port Philip and Westernport Regional River Health Strategy was developed by Melbourne Water and the PWP Catchment Management Authority, in consultation with other stakeholders. The Strategy provides a region-wide framework for agencies to work together to improve the health of rivers and waterways. The Strategy identifies high priority catchments, sub-catchments and rivers and creeks within the Port Philip and Westernport region based on an assessment of environmental, social and economic values of the waterways (see Appendix 3 of the Strategy for further information on criteria used to prioritise rivers and creeks).

The Strategy also includes targets for revegetation and weed control within the PPWP region: e.g. revegetation and weed control is proposed along 1026 km and 1021 km, respectively, of rivers and creeks. The objective is to improve the streamside zone Index of Stream Condition (ISC) sub index of approximately 3,000 km of rivers and creeks within the region.

Port Philip and Westernport Invasive Plants and Plants Strategy 2011

The PWP Invasive Plants and Plants Strategy (IPPS; PWP 2011 in progress) addresses Invasive Plant and Animal (IPA) management in the Port Phillip and Westernport region. It lays out the principles and logic that government agencies, industry and the community can use to take a strategic and coordinated approach. The Strategy is not intended as an operational document to describe annual IPA works programmes. Instead, it sets objectives and broad actions for region-wide IPA management and proposes a system to monitor, evaluate and report on the progress of major programs. These Guidelines follow the principles and objectives outlined in the PWP IPA Strategy.

The five objectives of the Strategy are:

Objective 1: Implement coordinated, cooperative and effective management of invasive plants and plants across the region

Objective 2: Prevent the introduction and establishment of new high risk invasive plants and plants

Objective 3: Eradicate, contain or prevent further spread of established infestations of high risk invasive plants and plants

Objective 4: Address the risks of impacts of invasive plants and plants on the priority environmental and agricultural assets

Objective 5: Improve management of invasive plants and plants through effective monitoring, evaluation and reporting

Guidelines and Procedures for Managing Environmental Impacts of Weeds on Public Land (DSE 2007)

The Guidelines and Procedures for Managing Environmental Impacts of Weeds on Public Land (DSE 2007; Platt et al. 2005) outlines the objectives, legislation, principles, priorities, standards and planning procedures for managing the environmental impacts of pest plants on public land throughout Victoria. This includes the interface with private land and covers all terrestrial and aquatic environments (excluding marine environments).

These DSE guidelines aim to:

- Provide a practical and adaptive framework to guide weed management decisions
- Develop a high level of consistency in the planning, implementation and evaluation of weed management efforts on public land.

The priorities for managing the environmental impact of pest plants on public land in Victoria are:

Priority 1: New and emerging weeds (wherever they occur, state-wide or regional, includes 'sleeper' weeds) based on the level of potential risk the weed species poses to assets.

Preventing the impacts of new and emerging weeds through early intervention avoids future management costs. Eradication is the goal for new and emerging species. Whether this is a realistic option given the biology of the species and resources available, must be assessed by the land manager. Sleeper weeds are included in this category because of the potential over time for significant

impacts. This may occur due to selection of natural variation within the species or due to extrinsic factors, such as the introduction of an exotic pollinator. Sleeper weeds that occur within largely natural bushland should be a high priority for eradication. They may occur, for example, at former townships, rubbish dumps, mining sites, tracks and plantations.

Priority 2: Established pest plants based on the relative value of the asset area, the level of risk and the practicality of control. In this case the goal is to protect the most valuable asset areas from the impacts of pest plants. Having selected the most valuable asset area then pest plants can be ranked according to the level of risk they pose to the assets in question and the practicality of control.

Appendix B – Pest Plant Species Lists

List of Weeds of National Significance (WONS)

This list is the current list of Weeds of National Significance at August 2011. Refer to the following website for a full list of species http://www.weeds.org.au/WoNS/.

List of declared Noxious Weeds in the Port Philip and Westernport region

This list is the current list of Declared Noxious Weeds for the Port Philip and Westernport Region at August 2011. Refer to the following website for the Port Phillip and Westernport region species list: http://www.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/invasive_plants_common_a

Environmental Weeds – very high and high risk aquatic plants in Victoria

Table 8, below features a list of aquatic pest plants considered very high and high risk within Victoria (obtained from the DSE Advisory List of Aquatic Weeds in Victoria). For other Advisory lists of environmental weeds in Victoria, see:

DSE (2009b). *Advisory list of environmental weeds of coastal plains and healthy forests bioregions of Victoria*. Department of Sustainability and Environment, Melbourne.

DSE (2009c). *Advisory list of environmental weeds of the Inland Plains bioregions of Victoria.* Department of Sustainability and Environment, Melbourne.

DSE (2009d). *Advisory list of environmental weeds of the Ranges bioregions of Victoria.* Department of Sustainability and Environment, Melbourne.

Table 8 Very high/high risk aquatic plants in Victoria

Botanical name	Common name	Ranking (score)	CaLP Act	Vic Alert Weed	National alert weed	WONS
Very high risk environmental weeds						
Sagittaria platyphylla	Arrowhead	1				
Alternanthera philoxeroides	Alligator Weed	2	yes	yes		yes
Cabomba caroliniana var. *caroliniana*	Cabomba	2	yes			yes
Egeria densa	Dense Waterweed	2				
Gymnocoronis spilanthoides	Senegal Tea	4			yes	
Eichhornia crassipes	Water Hyacinth	5	yes	yes		
Myriophyllum aquaticum	Parrot's Feather	5				
Salvinia molesta	Salvinia	7	yes	yes		yes
Spartina anglica	Common Cord-grass	9				
Spartina X *townsendii*	Townsend's Cord-grass	9				
Typha latifolia	Lesser Reed-mace	13				
Elodea canadensis	Canadian Pondweed	14				
Lilaea scilloides	Lilaea	28				
High risk environmental weeds						
Ludwigia palustris	Marsh Ludwigia	31				
Aponogeton	Cape Pond-	34				

distachyos	lily					
Leersia oryzoides	Rice Cut-grass	36				
Crassula natans var. *minus*	Water Crassula	4				

Key to table:

CaLP Catchment and Land Protection Act

WONS Weed of National Significance

Appendix C – Preferred Herbicide Application List

All herbicide use poses risks to users, other people and the environment and consequently their use is regulated in Victoria. Land managers in Victoria have a legal obligation to use herbicides safely and keep records of all use of agricultural chemicals, including herbicides.

The Department of Environment, Land, Water & Planning (DELWP) has a system of restricting the use of certain high risk chemicals. An Agricultural Chemical User Permit (ACUP) is required for most uses of agricultural chemicals, and an additional endorsement required to obtain agricultural chemical products classified as 'restricted supply' chemicals by the Australian Pesticides and Veterinary Medicines Authority (APVMA), including Schedule 7 poisons and compounds containing atrazine, metham sodium, ester formulations of 2,4-D, 2,4-DB, MCPA or triclopyr.[2]

Herbicide Labels

A herbicides label provides the general directions and instructions on how and where a chemical can be applied.

'On label' directions must always be followed (e.g. using the correct application rate and observing the withholding period as well as any label restraints, i.e. the 'DO NOT' statements) by all Melbourne Water employees and service providers undertaking works on behalf of Melbourne Water. Refer to the approved herbicide lists Tables A, B and C to select the most appropriate herbicide.

'Off label' herbicide use is unacceptable by Melbourne Water (unless a permit has been applied and approved from the responsible agency). Off label use can lead to issues with water quality and endanger threatened flora and fauna.

Caution must be taken when using more than one chemical on-site. Combinations of herbicides can amplify a herbicide's

[2] Australian Chemical User Permit System

effects.

Chemical Control Areas

Certain areas in Victoria have been declared Chemical Control Area's (CCA's). These areas have restrictions on the types and methods of application of certain herbicides. Details can be accessed from herbicide label and further information from the DPI website Chemical Control Areas

Non Chemical Alternatives

Non-chemical alternative options must be considered first for pest plant management (see section 0). Non chemical controls can include but not limited to: hand removal, fire, excavation (with roots/rhizomes to frosts), cultivation (expose roots/rhizomes), controlled grazing (limit regrowth and density), ringbarking, drowning (cutting stems/leaves below water surface), slashing and suppression using native vegetation.

The ChemAlert database should be used to check chemical status, obtain Material Safety Data Sheets and to manage stock inventory at all Melbourne Water sites. The status of these herbicides can change and therefore should be checked every six months to ensure its currency. Additions can be made to ChemAlert by following the following procedure CORP H&S 040 Chemical Management. ChemAlert provides information on OH&S aspects of chemical use and does not provide information about environmental exposure.

Melbourne Water has had an external risk assessment conducted on herbicides and potential human and environmental exposure to herbicides. The following Tables A, B and C identify the Melbourne Water approved herbicides for use following this risk assessment.

Approved = use on all Melbourne Water sites, **Restricted** = approved for use at the site that solicited the pre-purchase assessment using a system of work that has been agreed with the Melbourne Water's Occupational Hygienist. If the site of use or the system of work changes then the substance must be reassessed in consultation with Melbourne Water's Occupational Hygienist.

Table A: Preferred Herbicide Application List – Riparian and Wetland Sites

Area	Active Ingredient	Common Trade Name (info, from ChemAlert)	CAS no.	ChemAlert Status	Note:
Riparian and Wetland Sites - any land that adjoins, directly influences, or is influenced by a body of water	Amitrole - ammonium thiocyanate	Amitrole T	1762-95-4	Restricted	Polyether modified polysiloxane (Pulse Penetrant) and
	Methyl-chlorophenoxyacetic acid	L.V.E. MCPA Selective MCPA 500 Selective	94-74-6	Restricted Restricted	

Area	Active Ingredient	Common Trade Name (info, from ChemAlert)	CAS no.	ChemAlert Status	Note:
including those that are occasionally or rarely inundated (excl. drinking water supply areas)		Genfarm LVE MCPA 500		Restricted	Nonyl phenol ethylene oxide condensate (Agral emulsifier/ surfactant) must not be used near aquatic sites Use Roundup Bioactive as the first Glyphosate herbicide choice
	Clopyralid	Lontrel	1702-17- 6	Restricted	
	Dicamba	Broadside	62610-39-3	Approved	
		Campbell Methar Tri-Kombi		Approved	
		Cyndan Selectacide		Approved	
		Genfarm Dicamba 500		Approved	
		Kamba 500 Selective		Approved	
		Kamba M Selective		Approved	
	Diquat	Reglone Non Residual	85-00-7	Approved	
		Spay Seed 250		Restricted	
	Fluazifop	Fusilade Forte 128 Selective	69335-91-7	Approved	
	Flupropanate	Taskforce Water Soluble	22898-01-7	Approved	
	Fluroxyhyr	Starane Advanced	69377-81-7 3	Restricted	
		Starane 200		Approved	
	Glyphosate	Arsenal Xpress	9008-02-0	Restricted	
		Eraze 360		Approved	
		Glyphosate 360		Approved	
		Glyphosate CT Broadhectare		Approved	
		Gullfag Clearup Bio 360		Approved	
		Kenso Agcare Nugget		Approved	
		Roundup		Approved	

Area	Active Ingredient	Common Trade Name (info, from ChemAlert)	CAS no.	ChemAlert Status	Note:
		Roundup Biactive		Approved	
		Roundup CT Broadacre		Approved	
		Roundup Powermax		Restricted	Sempra - last choice, use with caution
		Rygel Clearup Glyphosate 450		Approved	
		Touchdown Broadacre		Approved	
		Touchdown Hitech		Approved	
		Trounce Brush-Pack		Approved	
		Weedmaster 360		Approved	Garlon - last choice, use with caution
	Halosulfuron-methyl	Sempra	100784-20-1	Approved	
	Clopyralid	Lontrel	1702-17- 6	Restricted	
	Metsulfuron-methyl	Brush-off Brush Controller	74223-64-6	Restricted	
		Metsulfuron-Methyl		Approved	
		Genfarm Metsulfuron 600 WG		Approved	
	Metsulfuron and Glyphosate	Weedmaster 360	79510-48-8/9008-02-0	Approved	
	Triclopyr	Garlon 600	55335-06-3	Approved	

Table B: Preferred Herbicide Application List – Terrestrial Sites

Area	Active Ingredient	Common Trade Name (info, from ChemAlert)	CAS no.	ChemAlert Status	Note:
Terrestrial Sites – paddocks, pipe tracks, beyond waterway setback, etc)	Methyl-chlorophenoxyacetic acid	L.V.E. MCPA Selective	94-74-6	Restricted	
		MCPA 500 Selective		Restricted	
		Genfarm LVE MCPA 500		Restricted	

Area	Active Ingredient	Common Trade Name (info, from ChemAlert)	CAS no.	ChemAlert Status	Note:
	Clopyralid	Lontrel	1702-17- 6	Restricted	
	Dicamba	Broadside	62610-39-3	Approved	
		Campbell Sportsground		Approved	
		Cyndan Selectacide		Approved	
		Genfarm Dicamba 500		Approved	
		Kamba 500		Approved	
		Kamba M Selective		Approved	
	Diquat	Reglone Non Residual	85-00-7	Approved	
		Spay Seed 250		Restricted	
	Fluazifop	Fusilade Forte 128 Selective	69335-91-7	Approved	
	Fluroxyhyr	Starane Advanced	69377-81-7 3	Restricted	
		Starane 200		Approved	
	Glyphosate	Arsenal Xpress	9008-02-0	Restricted	
		Eraze 360		Approved	
		Glyphosate 360		Approved	
		Glyphosate CT Broadhectare		Approved	
		Gullfag Clearup Bio 360		Approved	
		Kenso Agcare Nugget		Approved	
		Roundup		Approved	
		Roundup Biactive		Approved	
		Roundup CT Broadacre		Approved	
		Roundup Powermax		Multiple	

Area	Active Ingredient	Common Trade Name (info, from ChemAlert)	CAS no.	ChemAlert Status	Note:
		Rygel Clearup Glyphosate 450 Touchdown Broadacre Touchdown Hitech Trounce Brush-Pack Weedmaster 360		Approved Approved Approved Approved Approved	
	Metsulfuron-methyl	Brush-off Brush Controller Metsulfuron-Methyl Genfarm Metsulfuron 600 WG	74223-64-6	Restricted Approved Approved	
	Metsulfuron and Glyphosate	Weedmaster 360	79510-48-8/9008-02-0	Approved	
	Picloram and 2,4-D Amine	Tordon 22K Tordon 75D Tordon Double Strengh	8067-55-8	Approved Approved Approved	
	Picloram and Triclopyr	Grazon Extra	64700-56-7/1918-18-1	Approved	
	Simazine	Farmoz Simazine Flowable Gesatop 500 SC Liquid Flowable Gesatop 600 SC Liquid Genfarm Simagen 900WG Gesatop a Liquid Gasatop Granules 900 WG	122-34-9	Approved Approved Approved Approved Approved Approved	Use with caution for long term vegetation removal (paths etc). Review use following two applications.

Area	Active Ingredient	Common Trade Name (info, from ChemAlert)	CAS no.	ChemAlert Status	Note:
		Simagranz Simazine Simazine Flowable Liquid		Approved Approved Approved	
	Triclopyr	Garlon 600	55335-06-3	Approved	

Table C: Preferred Herbicide Application List – Drinking Water Supply Sites

Area	Active Ingredient	Common Trade Name (info, from ChemAlert)	CAS no.	ChemAlert Status	Note:
Drinking Water Supply Sites - any site upstream of a drinking water supply point (such as a treatment plant, a reservoir, or harvest point), irrespective of whether the site is within a so-called 'closed' or 'open' catchment (the Yarra and its tributaries upstream of Yering Gorge, and Tarago catchment waterways upstream of the Tarago treatment plant, are examples of waterways within open catchments)."	Glyphosate	Roundup Biactive	9008-02-0	Approved	Surfactants must not be used with herbicides at drinking water supply sites. All herbicide use must be at least 500 m from the exposed water supply or if closer must complete a SEPHA to demonstrate minimised risk.
	Metsulfuron-methyl	Brush-off Brush Controller		Approved	
	Triclopyr	Garlon 600		Approved	

Commonly Used Herbicide Notes (based on Rivercare: Guideline for Safe and effective herbicide use near water)

Triclopyr (Garlon 600®)	Is a commonly used selective herbicide. Triclopyr is considered slightly toxic to birds and low in toxicity to fish and invertebrates. It is moderately toxic to mammals. Triclopyr breaks down fairly readily in soil and water. This herbicide not recommended in aquatic areas. It could be used on woody weeds in commonly inundated areas when inundation within 6 months is of low likelihood – prior to summer for example.
Metsulfuron (Brush-Off®)	Is a commonly used selective herbicide. It has very low toxicity to birds, mammals, aquatic organisms and bees. Metsulfuron-methyl has been known to persist in certain soils and impact on re-copping. This herbicide not recommended in aquatic areas. It can be used in commonly inundation within 6 months is of low likelihood – prior to summer for example.
Glyphosate (Roundup Biactive®)	Glyphosate in its various forms and trade names is the herbicide most commonly used by Melbourne Water and its contractors particularly in the management of weeds along waterways. This herbicide may have a surfactant added that contributes to its ability to spread across a leaf surface. This herbicide is used in three main ways. • Diluted foliar spray and applied with a herbicide backpack or high volume rig apparatus • Undiluted form to stem inject woody weeds using the 'drill and fill' technique or • Applied to cut stumps via the 'cut and paint' technique. Glyphosate inhibits an essential plant enzyme called EPSPS (5-enolpyruvyl shikimate-3–phosphate synthase). Inhibition of this enzyme prevents production of aromatic amino acids required for protein synthesis.[3]
Methyl-chlorophenoxyacetic acid - MCPA®	Is a commonly used herbicide. MCPA is moderately toxic to birds; slightly toxic to mammals and freshwater fish; practically non-toxic to freshwater invertebrates or estuarine and marine organisms; and non-toxic to bees. MCPA isrepidly broken down by soil and water based micro-organisms. It takes longer if micro-organism presence is low. MCPA is not recommended for use in aquatic areas or (due its toxicity to birds) in areas subject annual inundation (waterfowl habitat).

Further Information

The Australian Pesticides and Veterinary Medicines Authority (APVMA) manages the registration of pesticides and veterinary medicines in Australia. The APVMA maintains the Public Chemical Registration Information System (PUBCRIS) database. The

[3] Monsanto.2012. Roundup Products. Available URL: http://www.monsanto.com.au/products/roundup/default.asp

PUBCRIS database may be searched to identify herbicides suitable for controlling particular weed species, or chemical labels can be sourced to help determine suitable uses for specific herbicides.

Appendix D – Ecological Pest Plant Prioritisation

There is no one quick process to prioritise pest plant control, whilst meeting a project's objectives and ensuring the project values operational, financial and ecological considerations equally.

Table 9 is a risk analysis framework that may be used to identify priority species for management based on ecological values. The table primarily selects priority species due to their invasive attributes i.e. ease of removal and infestation size. The risk matrix is an adaptation of the risk matrix provided in Weed Strategies for the Yarra Ranges and Cardinia Shire Councils (Yarra Ranges (2006) and Cardinia Shire (2007)).

The pest plants with the highest scores (after ranking in Table 9) assist identification of the priority ecological value based pest species for control. Note this framework should be used in conjunction with section 0 Prioritising Pest Plant Species.

Table 9 Risk Analysis Framework – weed risk matrix

Criterion	Category	Score
Weed of national significance (WONS)	Weed of national significance	8
Declared Noxious Weed	State prohibited Regionally prohibited Regionally controlled Restricted	50 30 5 5
Melbourne Water listed priority weed	See Table 4	8
Population size	< 20 plants or < 0.01 Ha 20-500 plants or 0.01-0.1 Ha 500+ plants or >0.1 Ha	5 2 1
Ease of removal number of treatments required damage/disturbance to indigenous flora due to control methods efficiency of removal/treatments	Single treatment, rarely damage surrounding vegetation, rapid removal 1-3 treatments, minor damage, moderately time consuming Multiple treatments, moderate damage, highly time consuming	3 2 1

This risk matrix is an adaptation of the risk matrix provided in Weed Strategies for the Yarra Ranges and Cardinia Shire Councils (Yarra Ranges (2006) and Cardinia Shire (2007)

(i.e. number of plants removed per unit of time)	Continuous treatment, major disturbance, highly time consuming	0
Seed dispersal and time to maturity	Can readily spread > 50 m, plants take > 1 year to seed Can readily spread > 50 m, plants take < 1 year to seed Rarely spreads > 50 m	8 3 0
Threat to native vegetation Ability to invade native vegetation Suppression of native vegetation once established	Able to invade and strong suppression Needs disturbance, competes once established or can invade, moderately suppresses Establishes only in disturbed areas, out competed by robust native vegetation	5 2 0
Total possible score:		95

Appendix E – Vehicle/machine inspection checklist

Wherever possible, vehicles/machinery and equipment (tools and footwear) should be clean of pest plant seeds before moving offsite, to prevent the transfer of new pest plants. Table 10 is a checklist that can be used to assist vehicles/machinery and equipment to be thoroughly cleaned before moving offsite.

Table 10 Vehicle/machine inspection checklist

Area	Contamination point	Inspected	Cleaned	Method
Front of Vehicle	Bull bar			
	Winch			
	Inside of bull bar/bumper bar			
	Light covers			
	Bonnet protector			
Engine bay	Front grill			
	Radiator and other cooling cores/fins			
	Grill or recess under wipers			
	Engine mounts			
	Top of gearbox			
	Battery recess/tray			
	Any recesses on engine or manifold			
	Air cleaner (including element)			
Cabin	Footwells			
	Carpets and matts			
	Under seats			
	Seats			
	Tool boxes			
	Air vents			

Area	Contamination point	Inspected	Cleaned	Method
Wheels & arches	Tyre treads			
	Rims and wheel caps			
	Wheel arches			
	Mud flaps and brackets			
	Brakes			
	Springs and mounts			
Tray	Body of tray (especially any recesses)			
	Mats and toolboxes			
	Around fuel tank caps (esp. if diesel)			
	Support rails under tray			
Under carriage	Chassis rails (esp. recesses and holes)			
	Struts and stabilisers			
	Steering components			
	Axels and differentials			
	Spare tyre and mounts			
	Guards			
	Fuel tank			
Attachments	Tow bar			
	Slip on unit			
	Jerry can storage			
	Tool boxes			
Personal Protection Equipment	Clothing			
	Footwear			

Appendix F – Methods for Vegetation Assessment

Rapid Vegetation Assessment Method

Melbourne Water has developed a *Rapid Vegetation Assessment Tool* for assessing vegetation condition along waterways. This is one type of monitoring that could be used to capture data before and after pest plant management actions. The objective is to monitor change in vegetation condition in the short to medium term (0 to 10 years).

This technique involves assessing:

- Overall weed cover and weed cover of the main high threat pest plants
- Indigenous species cover
- Ecological Vegetation Class
- Natural recruitment
- Aquatic pest plants
- Bare ground created by disturbance
- Streamside zone length
- Longitudinal continuity
- Other impacts/threats present
- Documenting condition change through photo points.

Transects or Flora Quadrats

Flora quadrats/transects are another survey technique that can be used to monitor weed abundance/invasion. The size, shape, number and spacing of quadrats will be project dependent, and also largely dependent on the scale of the pest plant management program. The following information is therefore intended as a guide only; survey techniques need to be tailored to suit specific pest plant management programs.

Size and Shape of quadrats

Typical size of flora quadrats is 30 m X 30 m when measuring species richness (recommended by DSE in order to capture species diversity). This may vary for linear projects e.g. riparian vegetation, where quadrats may be narrower but longer than 30 m (e.g. 45 m X 20 m).

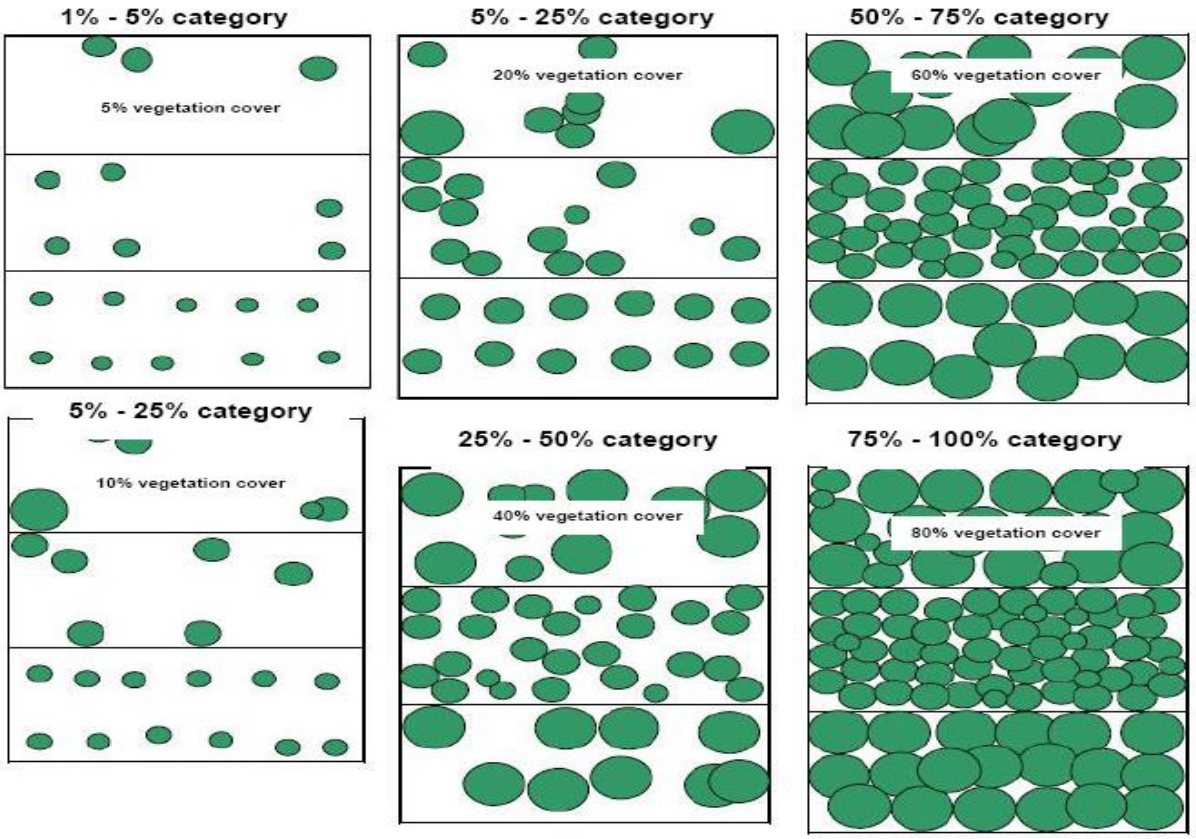
Cover Abundance

A fundamental part of all of the methods listed above is a consistent approach for measuring the extent and cover of a pest plant species (cover score). Cover score (CS) refers to the area of living material covered by an individual species if all the surface area is amalgamated into a single continuous mass.

The standard method for quadrat sampling in Victoria is to identify all species within the quadrat and assign a cover abundance score based on a modified Braun Blanquet method of scoring.

Table 11 Modified Braun Blanquet cover abundance scale

Cover Score	Cover Abundance	Cover class
+	Few individuals with small cover	Insignificant cover
1	Numerous individuals, but cover < 1/5 of the sample sites, or scattered with cover up to 1/5 of the sample site	< 5 %
2	Any number of plants covering between 1/5 and ¼ of the sample site	5-25% cover
3	Any number of plants covering ¼ to ½ of the sample site	25-50% cover
4	Any number of plants covering between ½ and ¾ of the sample site	50-75% cover
5	Any number of plants covering more than ¾ of the sample site	75-100% cover



Detailed Mapping of Pest Plant Distributions and Indigenous Vegetation

Mapping of pest plant extent or distribution can be undertaken in a number of ways and will largely be dependent on available resources and project objectives. Site maps can be based on aerial imagery, topographic and cadastral maps and data collated on pest plant distributions and indigenous vegetation quality.

Pest Plant Invasion Maps

Major pest plant populations are mapped within the area of interest (e.g. compile maps indicating location of populations of specific species within the area of interest). This can be done with a GPS on the ground or sometimes from aerial imagery (e.g. willows along a waterway). For more detailed mapping of target species, the area of interest can be divided into blocks and the cover abundance of target species can be measured in each of those blocks and then used to plot/map extent of invasion. For example, for a linear corridor of riparian vegetation of 1-10 km, the area may be divided into 20 m X 100 m

blocks. Within each 20 m X 100 m block, the cover abundance of target pest plant species is measured. This data is then used to create a map showing areas of greatest cover to areas of least cover, which may assist in determining where to focus pest plant control efforts.

Indigenous Vegetation Maps

For pest plant management programs aimed at protecting site-specific biodiversity, consider mapping the quality and extent of indigenous vegetation throughout the area of interest and location as well as rare and/or threatened species. For example, as previously detailed, the area of interest can be divided into blocks and the cover abundance of indigenous flora can be measured in each of those blocks and then used to plot/map quality of indigenous vegetation. This data is then used to create a map showing areas of highest quality to areas of lowest quality, which may assist in determining where to focus pest plant control efforts (e.g. higher quality patches first, if appropriate). Within this map, spot locations of significant species should be detailed. An example of scale: < 25% indigenous cover, 25-50% cover, 50-75% cover and >75% cover.

Index of Stream Condition

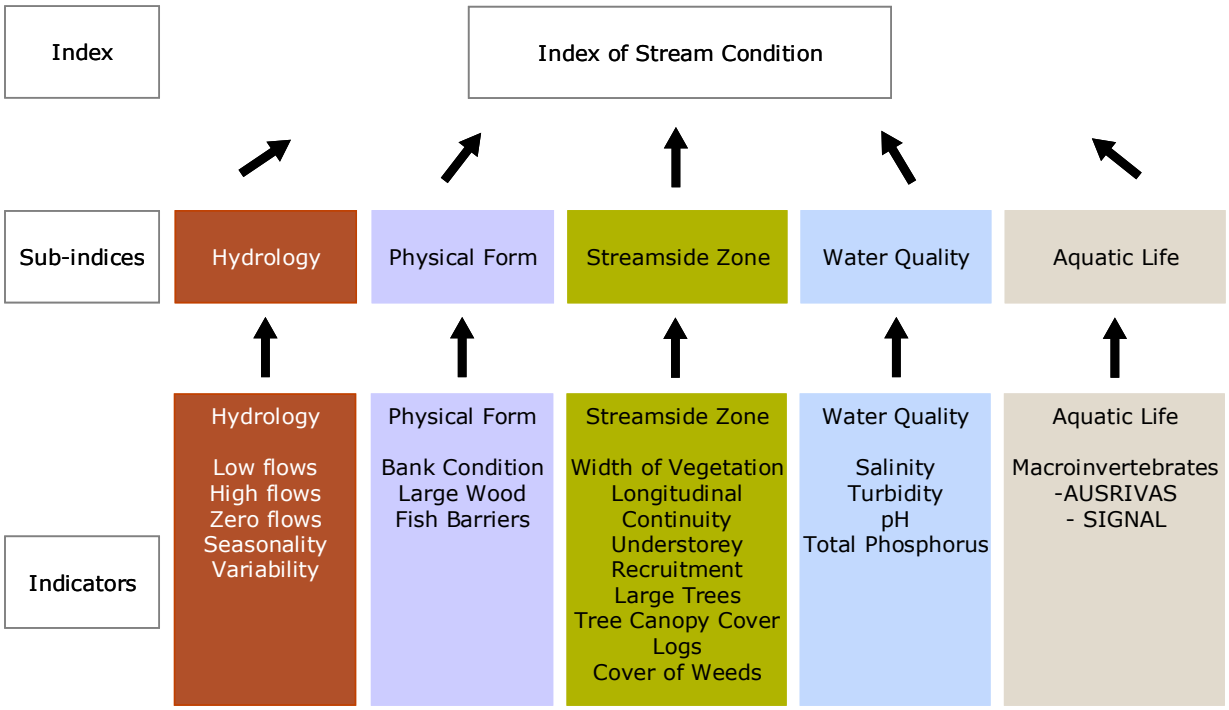
The Index of Stream Condition (ISC) is the first consistent State wide study of the environmental condition of rivers anywhere in Australia and was also the first integrated measure of river condition in Australia. It integrates the condition of river hydrology, water quality, streamside zone (vegetation), physical form (bed and bank condition and instream habitat) and aquatic life.

Five key components of river health are assessed. These components, or sub-indices, measure changes in hydrology, water quality, streamside zone (vegetation), physical form (bed and bank condition and instream habitat) and aquatic life. A list of the indicators assessed is provided in the table below.

Example field recording sheets are provided in this appendix. Further information can be found at: www.water.vic.gov.au/monitoring/river-health/isc

Figure 3 Components of the Index of Stream Condition

Habitat Hectare Assessment



Habitat Hectare assessment methods are used by ecologists to assess the condition of native vegetation against a benchmark for the particular Ecological Vegetation Class.

The Vegetation Quality Field Assessment Sheet can be used to identify the quality of vegetation on site. The method involves the assessment of a number of site-based habitat and landscape components against a pre-determined 'benchmark' relevant to the vegetation type being assessed.

The Vegetation Quality Assessment Manual describes the application of the habitat hectares method for assessing native vegetation quality. It provides a step-by-step approach to conducting assessments in the field and useful tips for ensuring consistency of application.

The method involves the assessment of a number of site-based habitat and landscape components against a pre-determined EVC benchmark. The detailed method can be found on the DSE website: http://www.dse.vic.gov.au/conservation-and-environment/vegetation-quality-assessment-manual.

Table 12 Baseline Pest Plants Template

Date of assessment:	Assessor(s):
Site identifier:	GPS Easting: Northing:
Photograph numbers: Photo bearings: Permanently marked Y/N:	Overall weed cover: Dominant weed species:
Possible reasons for outbreak:	Size of outbreak:
Other management issues: e.g. rabbits	Quadrat size: Ecological Vegetation Class:

Weed species Scientific name (common name)	Weed status e.g. WONS, DNW	Cover abundance (refer over)	Control required	Flowering/ seeding	Recommended control method	Recommended timing of weed control	Weed control undertaken Date etc.

Appendix G – Pest plant management program (example template)

Site and/or name of the pest plant management program:

Details	
Document/version no:	
Development date:	
Pest plant management program authors:	

Establish project objectives and type of pest plant program (see Section 6.1)	**Define the site boundaries and landscape scale (see Section 6.1)**

Identify the project budget		
Planning (Indicative budget requirement – up to 15%)	(Estimated % of total budget required) ___%	(Estimated total price required) $_____
Collaboration (Indicative budget requirement – up to 10%)	(Estimated % of total budget required) ___%	(Estimated total price required) $_____
Control activities (Indicative budget requirement – over 50%)	(Estimated % of total budget required) ___%	(Estimated total price required) $_____
Complementary activities (Indicative budget requirement – up to 10%)	(Estimated % of total budget required) ___%	(Estimated total price required) $_____
Monitoring (Indicative budget requirement – 10 to 20%)	(Estimated % of total budget required) ___%	(Estimated total price required) $_____
Review (Indicative budget requirement – 5 to 10%)	(Estimated % of total budget required) ___%	(Estimated total price required) $_____
(Other budget expenses)	(Estimated % of total budget required) ___%	(Estimated total price required) $_____

Pest plant species known to exist on-site (see section 6.3) **(Delete non-applicable rows)**	
Pest species	**Information source** (e.g. monitoring, 2011; Joe Bloggs, DSE pers. comm. 2010; ABC Pest Animal Contractors, ETP works summary 2009, Joe Bloggs Observation)

List of primary site values (e.g. water quality, threatened species, sewerage treatment pond, cultural heritage, endangered EVC, etc) (see Section 6.3)

Map extent of pest plant invasion (see Section 6.4)

Yes/No

List priority pest species (see Section 6.5) and determine management goals for each species (see Section 6.6) (Insert/delete rows where applicable)

Pest species	**Specific details of management goals** (e.g. 'species X will be eradicated in area A' or 'impacts to asset Y from species X will be reduced (by Z amount)' etc.)	**Bio-Security Goal** (Prevention, Eradication, Containment or Asset-based Protection)

Control techniques (see Section 6.7) and complementary activities (Insert/delete rows where applicable)

Pest species	**Location**	**Technique**	**Timing (season/months)**	**Repetition (per year)**	**Estimated total area (Ha) for control**	**Cost estimate per Ha**
Complementary Activities	**Location**	**Goal(s)/details of activities**	**Timing (season/months)**	**Repetitions (per year)**	**Estimated total area (Ha) for complementary works**	**Cost estimate per Ha/year**

Total pest plant control cost estimate per year (i.e. for total area, including repetition)	$
Total complementary activities cost estimate per year	$
Total cost for control/complementary activities for Site (year)	$

Identify targets to measure progress (see Section 6.7) (Insert/delete rows where applicable)

Target 1:	**Measure:**	**Completion:**
Target 2:	**Measure:**	**Completion:**

Collaboration (see Section 6.7) (Insert/delete rows where applicable)

Participants	**Communication process**	**Level of involvement**
(Participant 1)	(Details of communication process)	(Details of the level of involvement by participant)

Monitoring (see Section 6.9) (Insert/delete rows where applicable)

Species 1: (species name)

Objective of monitoring:

Monitoring technique(s): (Details of monitoring technique to be used for this pest species - relating to the values being impacted)
(include personnel, timeframes and data management)

Evaluation (see Section 6.10) (Insert/delete rows where applicable)

Comments:

Endorsement

By:	**Effective Dates:**

Review

Date of review:

(Outcome of review process)

Attachments:
1) Map of management boundary
2) Map of total area of control (following determination of extent of collaboration)

Appendix H – Chemical Records Sheet

Completed sheets must be returned to supervisor within 48 hours after chemical use.

Job Details

Location	
Date	
Work Order Number	
Works Permit Number	
Description of Works	

Contact Details

Name and address of person whom application was carried out for (Melbourne Water Representative)

Contact Name	
Contact Telephone No.	
Postal Address	

Name and address of applicator and supervisor

	Applicator	Supervisor
Contact Name		
Contact Telephone No.		
Postal Address		

Prior to chemical usage read the MSDS and Label and wear appropriate safety equipment

Product/Trade Name	
Active Constituent	
Batch No.	
Application Method and Rate	

Quantity Used	
Marking Agent & Surfactant Used	
Target Species	
Temperature	
Wind Direction (Direction coming from)	
Wind Speed (average)	

The application of chemicals as indicated on this sheet has been done in accordance with all legislative and job specific requirements.

Document History

Date	Reviewed/ Actioned By	Version	Action
November 2018	Capital Delivery & Improvement Lead	1	1