
Whangamarino weed surveillance



Alligator weed (*Alternanthera philoxeroides*) on the Waikato River Delta

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Whangamarino weed surveillance

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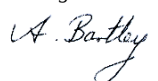


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Executive Summary

The Whangamarino Wetland is a large (7,290 ha) wetland on the floodplain of the Waikato River and is one of six Ramsar sites within New Zealand. This wetland is highly impacted by a range of introduced weeds such as the grey and crack willow (*Salix cinerea* and *S. fragilis*), reed sweet grass (*Glyceria maxima*), reed canary grass (*Phalaris arundinacea*) and royal fern (*Osmunda regalis*), with a range of scrub weeds supported on the margins and dry sites surrounding the wetland. However, there are a range of weed species that either have yet to become established in, or are only locally present within the Whangamarino Wetland.

DOC contracted NIWA to identify these weeds (both wetland and terrestrial) and to develop a weed surveillance plan based on the DOC Weed Surveillance Standard Operating Procedure (West 2008).

A list of 17 potential high-impact weed species was compiled from literature, the DOC Weeds Database, previous botanical investigations by the authors and field investigations undertaken in May and June 2009. Key identification features were detailed for each pest plant along with habitats threatened and likelihood and pathway of invasion.

Species that could affect wetland vegetation were alder (*Alnus glutinosa*), alligator weed (*Alternanthera philoxeroides*), water celery (*Apium nodiflorum*), moth plant (*Araujia sericifera*), Spanish heath (*Erica lusitanica*), Senegal tea (*Gymnocoronis spilanthoides*), Yellow flag (*Iris pseudacorus*), Japanese honeysuckle (*Lonicera japonica*), Purple loosestrife (*Lythrum salicaria*), Wandering Jew (*Tradescantia fluminensis*), bladderwort (*Utricularia gibba*) and Manchurian wild rice (*Zizania latifolia*). Additional potential weeds of marginal terrestrial vegetation were mignonette vine (*Anredera cordifolia*), cathedral bells (*Cobaea scandens*), blue morning glory (*Ipomoea indica*), African feather grass (*Pennisetum macrourum*) and evergreen buckthorn (*Rhamnus alaternus*).

This report provides the key identification features for those species, identifies habitats threatened, assesses the risk of invasion, identifies management responsibility for control (e.g., National or Regional Pest Management Programmes) and proposes an active surveillance and incursion response (weed-led control) programme for Whangamarino Wetland, should any of these species be detected. It is important that DOC be vigilant for potential new weeds. Any plant starting to invade vegetation in the vicinity of the wetland should be identified and assessed for invasive risk with appropriate action taken.

1. Introduction

The Whangamarino Wetland is a large (7,290 ha) wetland on the floodplain of the Waikato River. It is one of six Ramsar sites, which includes 4,460 hectares of peat bog, swampland, mesotrophic fens, open water and river systems that are managed as both wetland and wildlife management reserves by the Department of Conservation (DOC).

This wetland is highly impacted by a range of introduced weeds such as the grey and crack willow (*Salix cinerea* and *S. fragilis*), reed sweet grass (*Glyceria maxima*), reed canary grass (*Phalaris arundinacea*), royal fern (*Osmunda regalis*), primrose willow (*Ludwigia peploides* subsp. *montevidensis*) and parrot's feather (*Myriophyllum aquaticum*). The margins and dry sites within the wetland support a range of scrub weeds including gorse (*Ulex europaeus*), blackberry (*Rubus fruticosus* agg.) and pampas (*Cortaderia selloana*). However, there are a range of weed species that either have yet to become established in, or are only locally present within the Whangamarino Wetland.

DOC contracted NIWA to identify these weeds (both wetland and terrestrial) and to develop a weed surveillance plan based on the DOC Weed Surveillance Standard Operating Procedure (West 2008). An integral part of the DoC operating procedure is active surveillance, that is, a systematic examination of a site or area for invasive weed species.

This report presents a weed species surveillance list, provides the key identification features for those species, identifies habitats threatened, assesses the risk of invasion, identifies management responsibility for control (e.g., national or Regional Pest Management Programmes) and proposes an active surveillance and incursion response (weed-led control) programme for Whangamarino Wetland.

2. Methods

A list of potential high-impact weed species present in low numbers or densities in the Whangamarino Wetland or present in the Waikato Conservancy and perceived as a threat to the Whangamarino Wetland was compiled from Reeves (2001) and the DOC Weeds Database (both for Whangamarino and the entire Waikato Region).

Field investigations undertaken in May and June 2009 involved surveillance along:

- perimeter roads (Island Block, Coalfields and Falls Roads);
- properties adjacent to and accessed from Swan, Paddy, Wattle and Black Roads;
- perimeter roads surrounding Lake Waikare (Te Kauwhata, Waerenga, Waikare, State Highway 1);
- railway track from Black Road to Paddy Road;
- boat survey of the Whangamarino River from Falls Road to the confluence with Reao Stream and up the Reao Stream to the causeway;
- helicopter overview of the wetland.

These observations were combined with previous botanical investigations by the authors in the vicinity of the wetland.

3. Weed surveillance list for Whangamarino Wetland

Table 1 contains a list of the high ranked weed species (divided into wetland and terrestrial species), and their location in, or nearest occurrences to, the Whangamarino Wetland. This list is not exhaustive and only species currently known to be present in Waikato Region have been included. Other wetland weeds outside the Waikato, such as phragmites (*Phragmites australis*) and Christmas berry (*Schinus terebinthifolius*), would be very damaging but are unlikely to find their way to the wetland.

Table 1: Surveillance weed species and their location in or near the Whangamarino Wetland.

Common name	Botanical name	Location
Wetland plants		
Alder	<i>Alnus glutinosa</i>	Dominant on the lower Waikato River. Common around Lake Waikare. Confluence of Maramarua and Whangamarino Rivers.
Alligator weed	<i>Alternanthera philoxeroides</i>	Not known from the wetland. Scattered on Waikato River from Ohinewai to Port Waikato. Te Onetea Stream (since 2008) with a few fragments washed up on the shoreline of Lake Waikare, Wattle Road (W. Mead, Environment Waikato pers. comm.).
Water celery	<i>Apium nodiflorum</i>	Common to abundant on the lower Waikato River. Lake Waikare (noted 1993). Drain edges on the Meremere-Maramarua causeway (noted 1989). Dense patch of ~1 ha in Raeo Arm Wetland near wattle stand by railway (noted 2009). Eradicated from Whangamarino River near Falls Road (K. Hutchinson pers. comm.).
Moth plant	<i>Araujia sericifera</i>	Not known from the wetland. Scattered in populated areas of the Waikato Basin, starting to establish along Waikato River (Champion, 2002).
Spanish heath	<i>Erica lusitanica</i>	Raeo Arm Wetland (since 1981) and Meremere-Maramarua causeway (1989). On wetland margins only. Extensive roadside populations on banks of Falls Road (noted 2009).
Senegal tea	<i>Gymnocoronis spilanthoides</i>	Not known from the wetland. Few naturalised sites in Waikato; Te Kowhai in a wetland linking to the Waikato River.
Yellow flag	<i>Iris pseudacorus</i>	Not known from the wetland. Dense patches to almost entire covers along the banks of the Waikato River from Ngaruawahia to Mercer. Present in Te Onetea Stream and locally established in Lake Waikare (C. Purvis pers. comm.).

Common name	Botanical name	Location
Wetland plants		
Japanese honeysuckle	<i>Lonicera japonica</i>	Not known from the wetland or Lake Waikare (1993). Widespread in willows along Waikato River. In trees near the Whangamarino control gates off Oram Road (C. Purvis pers. comm.).
Purple loosestrife	<i>Lythrum salicaria</i>	Not known from the wetland. One naturalised site in Waikato; Melville-Koromatua (2007).
Wandering Jew	<i>Tradescantia fluminensis</i>	Known from a few garden dump sites on the edge of the wetland (K. Hutchinson pers. comm.). Widespread understorey species along Waikato River and many forested wetlands in lower Waikato.
Bladderwort	<i>Utricularia gibba</i>	Pukeko Pond, Raeo Arm wetland and Raeo Stream (first record 2008).
Manchurian wild rice	<i>Zizania latifolia</i>	Not known from the wetland. Rare in Waikato; Horahora, Cambridge and Hauraki Plains.
Terrestrial plants		
Mignonette vine	<i>Anredera cordifolia</i>	Not known from the wetland. Scattered in populated areas of the Waikato Basin, starting to establish along Waikato River (Champion, 2002).
Cathedral bells	<i>Cobaea scandens</i>	Not known from the wetland. Scattered in Hamilton on marginal cliff of the Waikato River (Champion, 2002).
Blue morning glory	<i>Ipomoea indica</i>	Not known from the wetland. Scattered in populated areas of the Waikato Basin including Te Kauwhata and Meremere, established along Waikato River (Champion, 2002).
African feather grass	<i>Pennisetum macrourum</i>	Rare in Waikato: Taupiri Mountain and old sites from Lake Waikare, Waikiwi and Taniwha Roads (P. Mabin, Environment Waikato pers. comm.).
Evergreen buckthorn	<i>Rhamnus alaternus</i>	Rare in Waikato: Hamilton East. Found 2009 on Lloyd property near Raeo Arm Wetland, occupies most dry land on the property (D. Embling, Environment Waikato pers. comm.).

4. Key identification features of surveillance species

4.1 Alder (*Alnus glutinosa*)



Alder is a tall, deciduous tree with a grey trunk, up to 15 m tall, but can also grow as a leafy shrub. Leaves are oblong to ovate with prominent raised veins beneath. When mature, female fruit (like a small pine cone) remain on the plants throughout the year. Male flowers are a long thin catkin, produced on the same plant. No similar plants.

4.2 Alligator weed (*Alternanthera philoxeroides*)



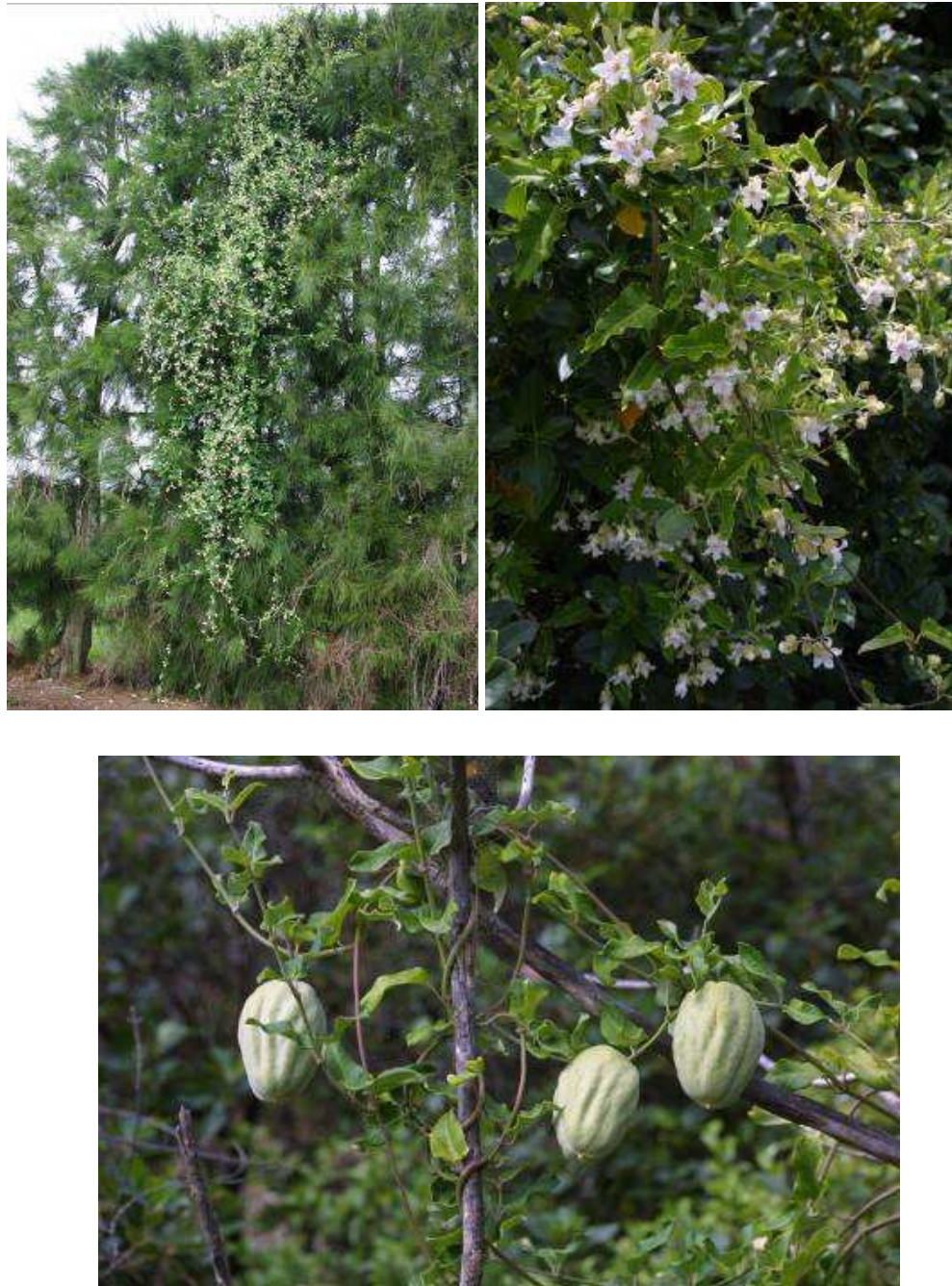
Alligator weed is a sprawling emergent plant, often forming mats floating on the edge of water bodies. Stems smooth, round and hollow. Leaves are bright green, waxy, with untoothed margins, in opposite pairs. Flowers are like white clover heads, but are papery to the touch, borne on stalks. Similar species are primrose willow which has alternate leaves and yellow flowers. Nahui and lesser joyweed (both are also *Alternanthera* species) have stalkless flower heads borne in leaf bases. Senegal tea is more upright with angular stems and toothed leaves.

4.3 Water celery (*Apium nodiflorum*)



Water celery is a sprawling emergent plant, often forming mats floating on the edge of water bodies. Plants have a carrot smell when crushed. Stems are ridged and hollow. Leaves are glossy, bright green with several pairs of lance-shaped, toothed leaflets. Flowers are tiny, white and in umbels borne at the leaf base. Water cresses (*Nasturtium* species) have less toothed leaflets, flowers in open spikes and peppery smell when crushed.

4.4 Moth plant (*Araujia sericifera*)



Moth plant is a vigorous perennial climber, scrambling through woody vegetation. Stems produce sticky, white latex when broken. Leaves are lance-shaped with a square base, undersides grey and downy, in opposite pairs. Flowers white, bell shaped, fragrant. Fruit are large (10 x 7 cm) pear-shaped, green with down-covered (like kapok) black seeds inside. Fruit are held on the plants for much of the year. No similar plants.

4.5 Spanish heath (*Erica lusitanica*)



An upright, woody shrub, usually up to 1 m tall. Leaves light green, needle-like around 5 mm long densely clothing branchlets. Flowers white, bell shaped, covering plants during winter. The native manuka (*Leptospermum scoparium*) and *Epacris pauciflora*, both grow in similar habitat, but have broader larger leaves, and five-petalled open (not bell-shaped) flowers.

4.6 Senegal tea (*Gymnocoronis spilanthoides*)



Senegal tea is a sprawling emergent plant, often forming mats floating on the edge of water bodies. Plants become upright when flowering. Stems 6 or 8-angled and hollow. Leaves are dark green, lance-shaped with toothed and wavy margins, in opposite pairs. Flowers are in fragrant white heads subtended by many green bracts, these flower heads being grouped at the ends of each stalk. No similar plants apart from alligator weed (see 3.2).

4.7 Yellow flag (*Iris pseudacorus*)



Yellow flag is a clump-forming iris, with fan-shaped arrangement of leaves up to 2 m tall, dying off over winter. Plants are odourless when crushed. Leaves are sword-shaped, purple near the base, and shred to fibres on senescence. Flowers are pale to golden yellow, up to 12 cm across, typical iris-shaped, produced in spring to early summer. Plants with thick corky rhizomes allowing the plant to raft over sheltered water bodies. Stinking iris (*Iris foetidissima*) is shorter and has foul-smelling leaves when crushed. Raupo (*Typha orientalis*) is taller, has twisted leaves and doesn't form dense clumps. Inkberry (*Dianella* species) and flax (*Phormium tenax*) have tough, fibrous leaves and leaves persist over winter.

4.8 Japanese honeysuckle (*Lonicera japonica*)



Japanese honeysuckle is a vigorous perennial climber, scrambling through woody vegetation or forming a dense sprawling ground cover in open areas. Stems often purple-red, tough and wiry. Leaves oval, stalkless or with very short stalks, margins untoothed up to 12 cm long, in opposite pairs. In early spring, wavy edged, lobed leaves are produced. Flowers white to pale yellow, tubular with two lobes, very sweet fragrance. Fruit clusters of black berries 5-7 mm across. No similar plants.

4.9 Purple loosestrife (*Lythrum salicaria*)



Purple loosestrife is tall emergent perennial plant, growing to 2 m tall and capable of forming monocultures in fen and swamp wetlands. Stems 4 or 6-angled, becoming woody, dying back to basal shoots during winter. Leaves are hairy when young, stalkless, lance-shaped with entire margins, in opposite pairs, or in threes near the base. Flowers are showy purple spikes heads. Willow herbs (*Epilobium* species) are similar, but much smaller, without woody stems and smaller, paler flowers.

4.10 Wandering Jew (*Tradescantia fluminensis*)



Wandering Jew is a vigorous, dense sprawling ground cover usually growing in shaded areas. Stems are succulent, trailing, easily broken and able to root at each node. Leaves are dark green, shiny, smooth, and elliptic, arranged alternately on the stem. Flowers are white, 3-petaled, 2 cm diameter. No similar plants.

4.11 Bladderwort (*Utricularia gibba*)



Bladderwort is a free-floating aquatic plant often forming dense mats, looking like filamentous algae. Leaves are filamentous simply branched or unbranched, each with a small round bladder (trap for small aquatic animals). Prolific flowerer in summer, the distinctive yellow flowers are held above the water surface. The endangered native species *Utricularia australis* has leaves that are divided many times and rarely flowers.

4.12 Manchurian wild rice (*Zizania latifolia*)



Manchurian wild rice is a giant, erect grass growing up to 4 m tall from stout long-spreading rhizomes. Leaves are coarse, with cutting edges, often over 1 m long, with a long membranous flap (ligule) between the leaf blade and sheath. Flower spikes are large and red or purplish in colour, produced in late spring. Nothing is similar to this grass, although raupo (*Typha orientalis*) is superficially similar but has soft leaves with a characteristic twist.

4.13 Mignonette vine (*Anredera cordifolia*)



Mignonette, or Madiera vine is a vigorous perennial climber, scrambling through woody vegetation. Stems characteristically bear aerial tubers, which can form new plants when detached from the parent vine. Leaves are slightly succulent, shiny, heart-shaped, stalkless or with very short stalks, margins untoothed up to 11 cm long, alternately arranged on the stem. Flowers are white, fragrant, in long narrow spikes, often smothering the plant. No similar plants.

4.14 Cathedral bells (*Cobaea scandens*)



Cathedral bells is a vigorous perennial climber, scrambling through woody vegetation or forming a dense sprawling ground cover in open areas. Leaves arranged alternately with three oval leaflets, dark green above, whitish beneath, also with a twining tendril. Flowers are large (6-7 cm long) bell-shaped, green at first turning purple or occasionally white. Fruit are an egg-shaped green capsule producing flattened winged seeds. No similar plants.

4.15 Blue morning glory (*Ipomoea indica*)



Blue morning glory is a vigorous perennial climber, scrambling through woody vegetation or forming a dense sprawling ground cover in open areas. Leaves three lobed, silky hairy beneath, up to 12 cm long, alternately on the stem. Flowers bright blue, trumpet-shaped, 10 cm across. No similar plants.

4.16 African feather grass (*Pennisetum macrourum*)



African feather grass is a tussock-forming grass growing up to 1 m or more tall, with long-spreading rhizomes. Leaves are coarse, with cutting edges. Flower spikes are long and thin. Similar to pampas, which is larger and has a characteristic plume-like flower head. Pampas lacks a spreading rhizome.

4.17 Evergreen buckthorn (*Rhamnus alaternus*)



Evergreen buckthorn is a small evergreen shrub or small tree to 5 m tall. Male and female flowers on separate plants. Leaves are glossy green above, pale green below, ovate, with usually sharp-toothed margins, can be in opposite pairs or alternate. Two pits (domatia) either side of the main leaf vein are a key diagnostic feature (refer red circle). Flowers in winter, these are green and inconspicuous. Bunches of 5-7 mm across berries ripen in summer from dark glossy red to black.

5. Habitats threatened by surveillance weeds

Vegetation classes recognised in the vegetation map of Whangamarino Wetland (Reeves 2009) included:

Bog

Sedges and wirerush

Short manuka with sedges

Fen (semi-mineralised)

Tall manuka scrub

Grey willow forest

Swamp

Crack willow forest

Carex sedgeland

Seasonal adventives and grasses

Eleocharis - *Baumea* reedland

Eleocharis reedland

Bolboschoenus reedland

Open willow over seasonal adventives and grasses

Raupo reedland

Kahikatea forest

Harakeke flaxland

Terrestrial

Exotic treeland and scrubland (marginal vegetation)

Pasture

Ponds or open water

Table 2 presents the habitats threatened by surveillance weeds and an estimation of impact (high, moderate and low):

Table 2: Surveillance weeds, their predicted impact and vegetation types susceptible to invasion in the wetland.

Common name	Impact	Vegetation type
Alder	High - capable of forming dense shady forest with few other species	Terrestrial and drier crack willow forest (e.g., riparian zones of the rivers)
Alligator weed	High - capable of smothering and forming monocultures over most short-stature (< 1 m tall) vegetation	Open water, terrestrial and especially swamp vegetation types: <i>Carex</i> sedgeland, seasonal adventives and grasses, <i>Eleocharis</i> - <i>Baumea</i> reedland, <i>Eleocharis</i> reedland, open willow over seasonal adventives and grasses
Manchurian wild rice	High - capable of forming monocultures over most non-woody vegetation	Riparian margins of rivers and most swamp vegetation types
Purple loosestrife	High - capable of smothering and forming monocultures over most short-stature (< 1 m tall) vegetation	Most open swamp and fen vegetation types
Senegal tea	High - capable of smothering and forming monocultures over most short-stature (< 1 m tall) vegetation	Open water, and especially swamp vegetation types: <i>Carex</i> sedgeland, seasonal adventives and grasses, open willow over seasonal adventives and grasses and crack willow forest
Yellow flag	High - capable of smothering and forming monocultures over most short-stature (< 1 m tall) vegetation	Open water, terrestrial and especially swamp vegetation types: <i>Carex</i> sedgeland, seasonal adventives and grasses, <i>Eleocharis</i> - <i>Baumea</i> reedland, <i>Eleocharis</i> reedland, open willow over seasonal adventives and grasses and crack willow forest
Wandering Jew	High - capable of smothering other ground covers and forming monocultures under trees	Terrestrial and crack willow vegetation
Japanese honeysuckle	Moderate - capable of forming dense ground covers over disturbed peat soils, also climbing through all willow types	Terrestrial, willow forests in swamp and fen vegetation and open disturbed peatland
Spanish heath	Moderate - capable of establishing in disturbed terrestrial areas and marginal peat-influenced area	Terrestrial (disturbed gravels and bare soil banks) and margins of bogs. A weed of peat habitats in other wetlands (e.g., Moana and Awarua Wetlands)
Water celery	Moderate - capable of forming monocultures in flowing water systems	Open water, and swamp vegetation types adjacent to flowing water
African feather grass	Low - capable of dominating grazed pasture margins of the wetland	Pasture and other open disturbed terrestrial areas

Common name	Impact	Vegetation type
Moth plant	Low - capable of scrambling through and potentially smothering trees	Open terrestrial and drier crack willow forest (e.g., riparian zones of the rivers)
Mignonette vine	Low - capable of scrambling through and potentially smothering trees	Open terrestrial woody vegetation
Cathedral bells	Low - capable of scrambling through and potentially smothering trees	Open terrestrial woody vegetation
Blue morning glory	Low - capable of scrambling through and potentially smothering trees	Open terrestrial woody vegetation
Evergreen buckthorn	Low - capable of invading and dominating marginal vegetation	Hedgerows and other terrestrial scrub vegetation

6. Risk of invasion and management responsibility

Several of the surveillance species are already subject to management action, either by DOC, the Environment Waikato (EW) Regional Pest Management Strategy (RPMS) (<http://www.ew.govt.nz/policy-and-plans/Regional-Pest-Management-Strategy/Regional-Pest-Management-Strategy-2008-2013/> accessed July 2009) or, in the case of Manchurian wild rice, a National Incursion Pest Response (NIPR) led by Ministry of Agriculture and Forestry Biosecurity New Zealand (MAFBNZ) (<http://www.biosecurity.govt.nz/pests/surv-mgmt/mgmt/prog/nipr> accessed July 2009). The risk of those species affecting Whangamarino Wetland is therefore likely to be much more reduced than species where no concerted control effort is in place. Table 3 lists the surveillance species, their likelihood of invading the wetland and current management status. Several species are included in the Waikato RPMS solely as National Pest Plant Accord (NPPA) plants, which prohibits the sale and deliberate spread of those species, but there is no requirement for control of those plants.

Table 3: Surveillance weeds, their likelihood and pathway of invading the wetland and their management status.

Common name	Likelihood of invasion	Management status
Alder	High - wind- and water-dispersed, present in catchment	None
Bladderwort	High - bird- and water-dispersed, already locally established in the wetland	NPPA. No statutory management
Evergreen buckthorn	High - bird-dispersed, already well established adjacent to the wetland	EW Eradication pest plant. EW have initiated an eradication programme for the site
Japanese honeysuckle	High - bird-dispersed, common on the Waikato River close to the wetland	NPPA. No statutory management
Spanish heath	High - wind-dispersed, common in the vicinity of the wetland	None
Wandering Jew	High - water-dispersed and garden waste, common on the Waikato River close to the wetland and in garden dump sites adjacent to it	NPPA. No statutory management
Water celery	High - water-dispersed, present in catchment and Raeo Arm	None, but DOC eradicated an incursion on the Whangamarino River
Yellow flag	High - water-dispersed, was present in Te Onetea Stream and Lake Waikare	EW Containment (occupier control) pest plant. Occupier shall destroy all yellow flag, unless it is less than 20 m from a waterway, then control will be undertaken pursuant to an approved EW programme.
Alligator weed	Moderate - water-dispersed, was present in Te Onetea Stream, but actively controlled	EW Eradication pest plant. Active surveillance on Waikato River and eradication for all known populations (both EW and DOC)
Blue morning glory	Moderate - garden waste, presently in Te Kauwhata and Meremere	None
Moth plant	Moderate - wind-dispersed, but not known from the vicinity of the wetland	EW Containment (occupier control) pest plant.
African feather grass	Low - wind- and water-dispersed, eradicated from known sites in the catchment	EW Eradication pest plant. EW have eradication programmes for all known sites in the region
Cathedral bells	Low - garden waste, short distance wind-dispersed	EW Eradication pest plant. EW have eradication programmes for all known sites in the region

Common name	Likelihood of invasion	Management status
Manchurian wild rice	Low - water-dispersed, nearest known site ~ 60 km away, targeted for eradication	NIPR. EW carrying out eradication of all known sites under MAFBNZ programme
Mignonette vine	Low - garden waste, short distance water dispersal	EW Containment (occupier control) pest plant.
Purple loosestrife	Low - water-dispersed, nearest known site ~ 50 km away, thought to be eradicated	EW Potential pest plant. EW have eradicated the one known population in the region
Senegal tea	Low - water-dispersed, nearest known site ~ 40 km away, nearly eradicated	EW Eradication pest plant. EW eradication programme for all known populations

7. Active surveillance and incursion response

Active surveillance should be concentrated at the most likely sites for plant incursions and include:

- road- and track-sides, particularly road ends, and likely rubbish dumping areas;
- developed areas such as along railways, near quarries and other disturbed habitats, old homesteads, near settlements;
- areas affected by introduced animals;
- in and near rivers and streams (boat surveillance along all navigable waterways);
- high value sites such as threatened plant locations;
- places subject to disturbance (fire events, extreme floods and large scale weed control);
- along boundaries, particularly reserve boundaries, and especially near habitation.

Six-monthly checks (November and April) of these areas are advocated, especially close to known weed sources (e.g., Pungarehu Canal, railway, road ends and areas adjacent to settlements where garden rubbish is habitually found). As the shoreline of Lake Waikare and the Te Onetea Stream are routinely surveyed for alligator weed by DOC and EW staff. Other surveillance species could also be monitored on these occasions.

Should an incursion be found the response recommended is:

- Confirm weed identification (DOC Weed Technical Officer, EW biosecurity staff, NIWA, Landcare, AgResearch).
- Contact the appropriate management agency (e.g., EW if the plant is an eradication target).
- Delimit the extent of the incursion (GPS, photo points etc.).

- Attempt to contain the incursion (e.g., net-off the area), especially if in flowing water.
- Evaluate management options (contain, control, eradicate, do nothing):
 - o if continued invasions are predicted and no control tools are available, e.g., bladderwort, management would be restricted to physical removal of plants from high value sites;
 - o hand-weeding or digging; ensure all plant material is collected, securely bagged and disposed by deep burial/incineration;
 - o herbicide application; ensure applicators are appropriately qualified, that herbicides are selective for that species (http://www.arc.govt.nz/environment/biosecurity/search-for-plants/regional-plants_home.cfm or Table 4) and that damage to non-target vegetation, contamination of waterbodies etc. is prevented (seek advice from DOC Weed Technical Officer, EW biosecurity staff, NIWA, or AgResearch);
 - o where application over water is required, ensure a resource consent is obtained (or a waiver from EW is issued);
 - o where eradication is pursued, continue to monitor the site for an appropriate length of time after weed removal to ensure eradication is achieved (usually a minimum of 5 years).

Surveillance and response actions following weed detection are fully described in the DOC Weed Surveillance Standard Operating Procedure (West 2008).

Table 4 outlines control options currently available based on Auckland Regional Council (2009) and Champion et al. (2008). Where a range of products are available, the active ingredient is listed.

Table 4: Surveillance weeds and appropriate herbicides for their control in Whangamarino Wetland.

Common name	Herbicide	Application technique
Alder	*Garlon 360	Drill and inject
Alligator weed	metsulfuron	Foliar spray (consent required over water or where contamination of water may occur)
Water celery	*Garlon 360	Foliar spray
Moth plant	Tordon Brushkiller	Foliar spray
	Vigilant	Cut and paint
Spanish heath	2,4-D ester	Foliar spray or weed wipe
Senegal tea	*Garlon 360	Foliar spray
Yellow flag	*glyphosate	Foliar spray
Japanese honeysuckle	metsulfuron	Foliar spray or cut and paint
Purple loosestrife	*Garlon 360	Foliar spray
Wandering Jew	triclopyr ester	Foliar spray or weed wipe
Bladderwort	none trialed	
Manchurian wild rice	haloxyfop	Foliar spray
Mignonette vine	metsulfuron + glyphosate	Foliar spray or cut and paint
Cathedral bells	Tordon Brushkiller	Foliar spray or cut and paint
Blue morning glory	*glyphosate	Foliar spray or cut and paint
African feather grass	*glyphosate	Foliar spray or weed wipe
Evergreen buckthorn	Tordon Brushkiller	Foliar spray
	Vigilant	Cut and paint

* indicates products available and registered for use where contamination of water may occur. Application rates and additives are detailed in Auckland Regional Council (2009).

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