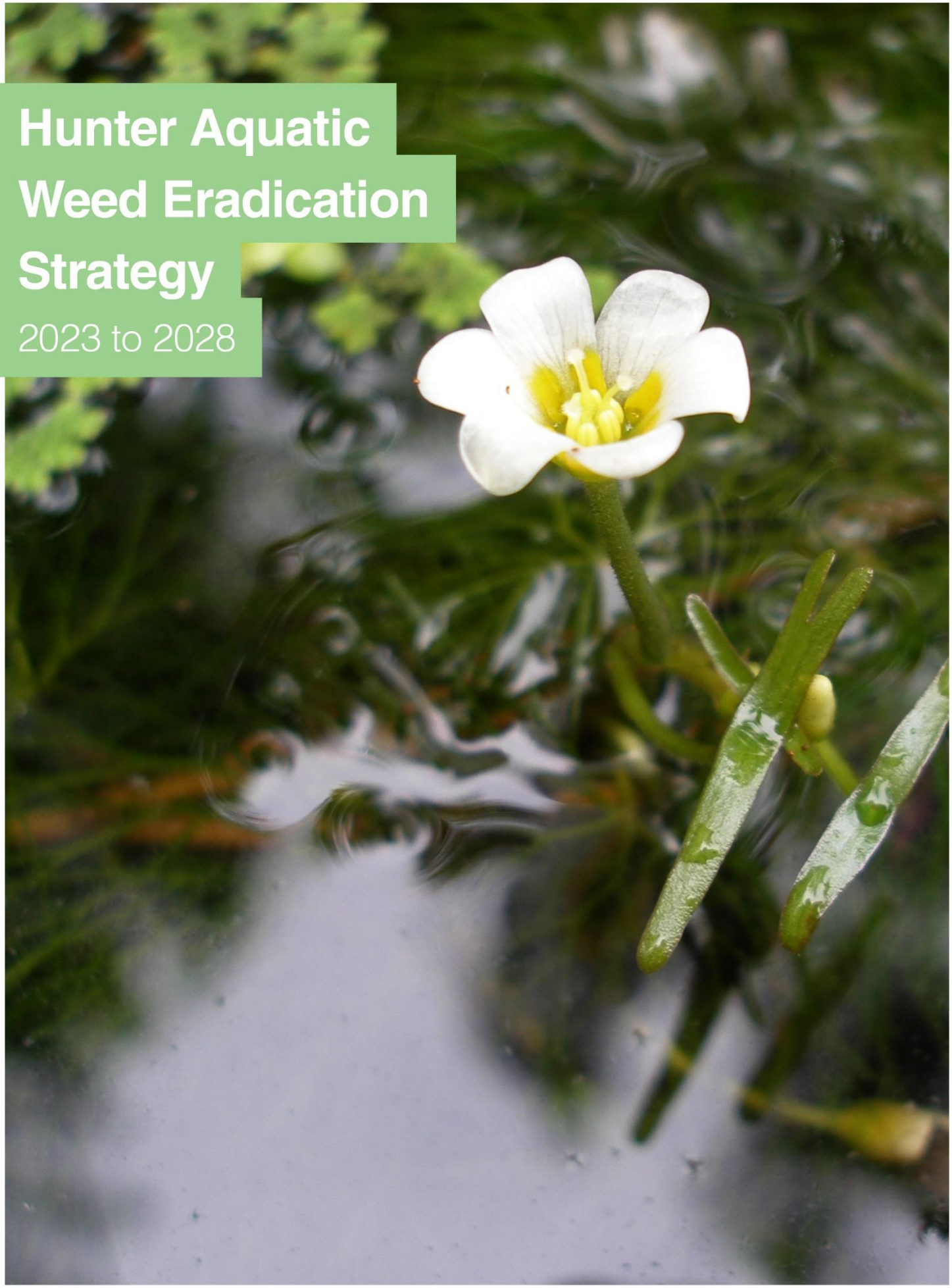
Hunter Aquatic Weed Eradication Strategy

2023 to 2028



Prepared by
Hunter Fauna and
Flora Controls

HUNTER REGIONAL weeds

HUNTER FAUNA & FLORA CONTROLS

PORT STEPHENS COUNCIL

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Introduction

The need for the plan, and the criteria for inclusion

Hunter Fauna & Flora Controls were engaged by Port Stephens Council through funding from the Hunter Regional Weeds Committee to develop a strategy for the eradication of priority aquatic weed species in the Hunter Region. The weed species included in The Hunter Regional Aquatic Weed Eradication Strategy (HAWES) were limited to aquatic weed species assessed through the NSW Weed Risk Management (WRM) system, during the development of the Hunter Regional Strategic Weed Management Plan (HRSWMP) as having a very high feasibility of control. Further, any aquatic weed covered by a State Biosecurity Zone has also been included. The Strategy takes a tenure neutral approach, and as such aims to engage all land owners and managers in the Hunter Local Land Services Region that have instances of these weeds on their property. The strategy aims to ensure and assist those responsible to adequately treat and rigorously inspect all known infestations of high priority aquatic weeds, moving each infestation towards eradication. Aquatic weeds are some the highest risk weed species due to the impact they can have on sensitive and important wetlands. Further, water and its uses are critical to social, and economic pursuits including but not limited to potable water supply, industrial and agricultural use, cultural significance, and recreational pursuits such as fishing, skiing, boating and swimming. Aquatic weeds are often the most invasive (Holm, *et al.*, 1977) with submerged aquatic weeds often potentially challenging to treat (Cuda, *et al*., 2008). It is with these potential and realised threats to society and the environment in mind, that the Hunter Regional Weeds Committee convened the development of this strategy supporting the implementation and the intent of the NSW Biosecurity Act 2015 through shared responsibility. The Hunter Regional Weeds Committee (through its Technical sub-committee) used the NSW Weed Risk Management (WRM) system to assess risk of all weeds included in the Hunter Regional Strategic Weed Management Plan. The aquatic weeds deemed eradicable through the process of risk assessment are those where the feasibility of control is considered high, generally because they exist in limited distribution, have critical vulnerabilities exploitable or, are considered easy enough to control. The aquatic weed species to be included in the Hunter Aquatic Weed Eradication Strategy are as follows: Alligator weed, Cabomba, Frogbit, Hygrophila costata, Kidney-leaf mud plantain, Ludwigia Peruviana, Senegal tea plant, Water hyacinth, and Water lettuce.

Aims and intention

The purpose of the Strategy is to:

1. Establish the current distribution of eradicable aquatic weeds in the Hunter region.
2. Establish and prioritise eradication goals, outlining species where;
    a. Eradication from the region is achievable **(Regional Eradication)**
    b. Localised eradication is achievable **(Local Eradication)**
    c. Destruction of infestations leading to containment where regional or localised eradication is unlikely **(Destruction)** achieving Regional containment and protection, pushing species into a position where eventually eradication may be achievable

3. Prioritise species for funding
4. Outline key actions and a timeline required to achieve these goals
5. Provide a stakeholder and community engagement plan and communication plan.
6. Provide a framework for monitoring, evaluation, reporting and improvement.

Legislation

The species included in this strategy are regulated at a State level through Prohibition, Biosecurity Zones, or General Biosecurity Duty. Due to limited distribution in the Hunter Region when compared to the wider State, some species have a higher level of control required inside the Hunter than at a State level. State and Regional regulations are outlined in Table 1 Below.

Table 1. State and Regional regulations for the eradicable water weeds found in the Hunter Region.

Species	State Legislation or Regulation	Hunter Regional Status
Alligator weed	An Alligator Weed Biosecurity Zone exists for all land within the Hunter Local Land Services region except land in the following local government areas: Lake Macquarie, Maitland, Newcastle, and Port Stephens.	Eradicate target inside the Biosecurity Zone (Cessnock, Mid Coast, and the Upper Hunter) Containment target for Lake Macquarie, Maitland, Newcastle, and Port Stephens.
Cabomba	General biosecurity duty to prevent, eliminate or minimise any biosecurity risk posed, and it must not be imported into the state, sold, bartered, exchanged or offered for sale.	Eradicate - the land must be kept free of the plant.
Frogbit	Prohibited Matter – It is an offence to deal with Frogbit in any way	Prohibited Matter – It is an offence to deal with Frogbit in any way
Hygrophila costata	General biosecurity duty to prevent, eliminate or minimise any biosecurity risk posed	Eradicate - the land must be kept free of the plant.
Kidney-leaf mud plantain	General biosecurity duty to prevent, eliminate or minimise any biosecurity risk posed	Eradicate - the land must be kept free of the plant.
Ludwigia Peruviana	General biosecurity duty to prevent, eliminate or minimise any biosecurity risk posed	Eradicate - the land must be kept free of the plant.
Senegal tea plant	General biosecurity duty to prevent, eliminate or minimise any biosecurity risk posed	Eradicate - the land must be kept free of the plant.
Water hyacinth	A Water hyacinth Biosecurity Zone exists for all land within the Hunter Local Land Services region except land in the following local government areas: Lake Macquarie, Maitland, Mid Coast, Newcastle, and Port Stephens.	Eradicate target inside the Biosecurity Zone (Cessnock, Dungog and the Upper Hunter) Containment target for Lake Macquarie, Maitland, Mid Coast Newcastle, and Port Stephens.
Water lettuce	General biosecurity duty to prevent, eliminate or minimise any biosecurity risk posed	Eradicate - the land must be kept free of the plant.

Approach

Stakeholder identification

The most up to date distribution information for each species has been provided by Local Control Authorities and other land management agencies. Stakeholder contact details have been collated as Appendix 1, and are sensitive in nature. These will only be shared to Local Control Authorities responsible for implementing actions out of the Communications Plan and will be removed from public publishing. All contact details are to be treated as sensitive, and not for distribution.

Weed delimitation

The Strategy is based on the best current information available. Information on weed distribution for the development of the Strategy has been provided by landholders and government agencies, especially Local Control Authorities (Councils). Shown below, eradicable aquatic weed distribution in the Hunter Region is scattered through much of the coastal zone and the Mid Hunter, missing largely the Upper Hunter.

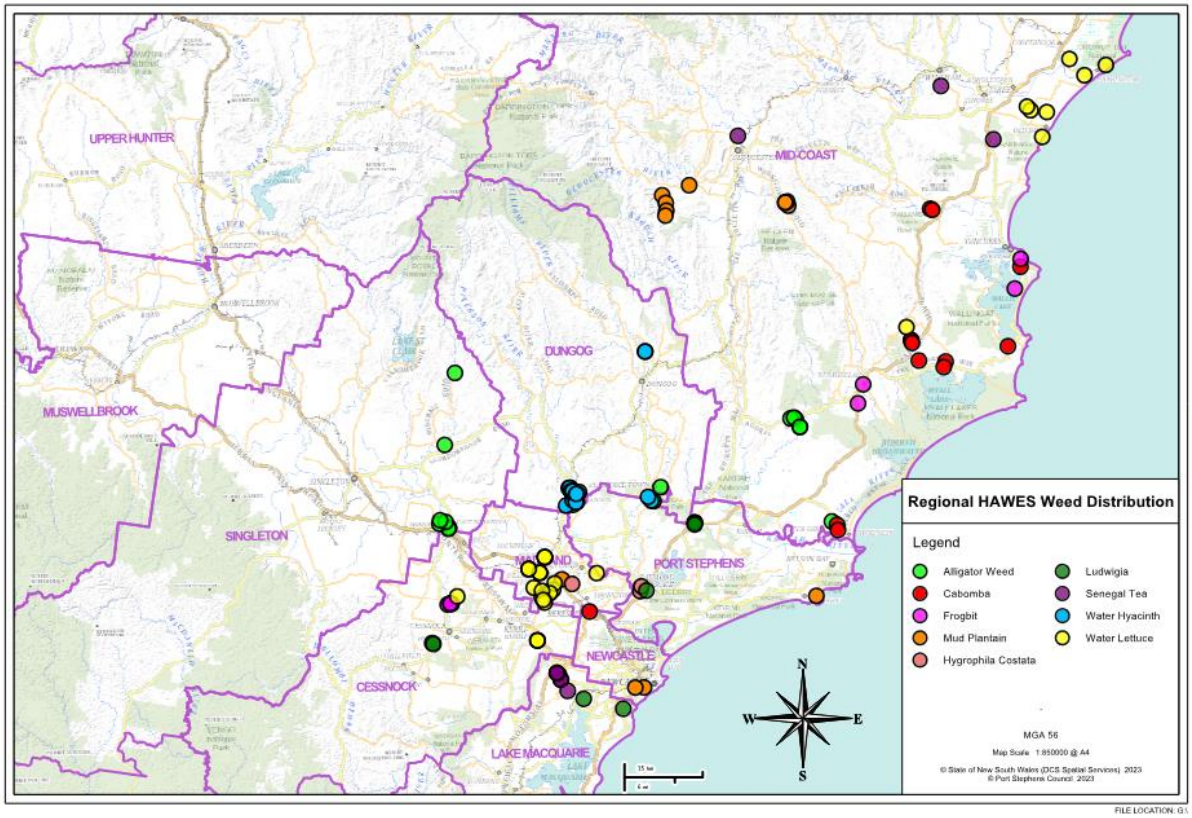

Figure 1. Hunter Regional overview of weeds included in the Aquatic Weed Eradication Strategy.

Cross tenure approach

A tenure neutral approach has been used when developing action plans for all species and all sites. This means, regardless of the landowner, be it public or private land, conservation land or industrial site, each site for any given weed, has been treated equally as far as treatment requirements and funding distribution is concerned. Excluding the large catchment scale infestations, there are 102 individual private property owners, 19 Local Government, 4 state government and 1 Crown Land site covered in this Strategy.

Responsibilities outlined

The HAWES will be managed by a Project Administration team as directed by the Hunter Regional Weeds Committee. The Project Administration team will meet quarterly to review and implement actions according to the strategy. Responsibility for actions assigned in each action table are linked to the priority level. Responsibility for High priority infestations will be that of the Project Administrator, Medium priority infestations will be the responsibility of the relevant LCA, and Low priority infestations will remain the responsibility of the land owner and may be subject to LCA's regular inspections. All responsibilities are in the Action Tables for each species.

Funding

Each Action Table in the following sections includes an indication of funding priority. The Hunter Weeds Action Program will provide funding for High priority sites, and may be supplemented by other funding sources. Priorities were assigned based on feasibility of eradication and the risk of spread. Funding or works for Medium priority infestations is to be undertaken by LCA's as funded, and required through WAP for High Priority Species inspections. Low priority infestations will remain the responsibility of the land owner. Where additional funds are required the Regional Weeds Committee will consider other funding sources to fund management works, particularly Hunter Catchment Contributions.

Weed Species

The following section of the strategy provides species specific information, an action plan for each species, and the best available distribution information available to author at the time of publishing, displayed as maps which should be viewed in conjunction with the Stakeholder table (Appendix 1). The Stakeholder table provides greater detail for each infestation. Fine scale maps of each infestations are available as Appendix 2. The maps are designed to show a full delimitation of the known area of the weed past or present and do not necessarily imply the area mapped is currently 100% infested. These maps are sensitive in nature and are only available to LCA's.

Alligator weed

Biology, ecology and critical vulnerabilities

Alligator weed (*Alternanthera philoxeroides* (Mart.) Griseb.) is considered one of the world's worst weeds (Gunasekera, *et al.*, 2001). A perennial, emergent semiaquatic species that has the ability to grow in tropical, subtropical and temperate areas in both aquatic and terrestrial habitats. It is inherently hard to eradicate due to a very deep root system and a tolerance to herbicides (Schooler, *et al*., 2008), and whilst it rarely sets viable seed (Julien & Stanley, 1999) it readily propagates via vegetative fragmentation, with water-borne dispersal of vegetative propagules, and allelopathic potential contributing to its success as an invasive weed (Tanveer, *et al*., 2018)

As an aquatic weed it can form large mats of stems and leaves, which can anchor by roots to the bank and extend across the water, often breaking off to form large free floating rafts, disrupting aquatic ecology by forming a blanket over the surface of water bodies. In doing so it can interfere with water ways, drainage, boat traffic, recreation activities, water quality, displace native species and affects flow and sedimentation rates. In terrestrial situations, it forms large amounts of leafy material aboveground, and dense mats of lignified root material under the soil (Julien & Stanley, 1999). Here it is generally highly competitive with other plants and displaces pasture and other desirable terrestrial plant species (Julien & Bourne, 1988).

Distribution & mapping

Introduced to Australia through the dumping of ships ballast at Stockton (Julien, 1995) it is now widespread in parts of the hunter, including Newcastle, Port Stephens, Maitland and Lake Macquarie. These Local Government Areas (LGA's) are outside of the State Alligator Weed Biosecurity Zone and Alligator weed is deemed not eradicable in these areas, with management here focused on containment of further spread.

The Strategy will therefore focus on the other LGA's of the Hunter that are inside the State Alligator Weed Biosecurity Zone, including; Cessnock, Mid Coast, Dungog, and the Upper Hunter. All four areas have Alligator weed infestations, and the distributed is summarised in the maps below.

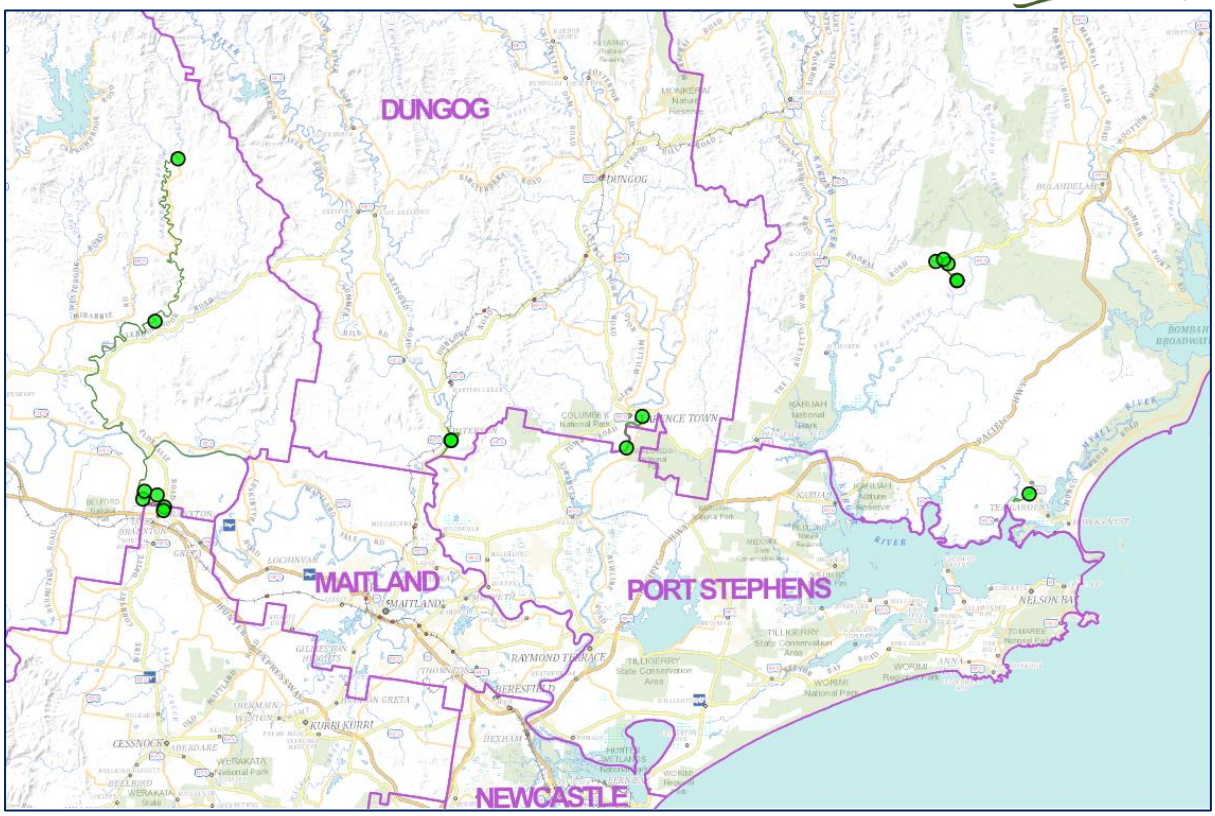

Figure 2. Regional overview of Alligator weed infestations inside the State Alligator weed Biosecurity Zone.

Upper Hunter

The Upper Hunter (Singleton) infestation of Alligator weed, begins in the North at Glendonbrook and occurring sporadically for 142km of Glendon Brook, Anvil Creek, Black Creek and the Hunter River, through mostly private properties and Crown land River easements. The Upper Hunter Weeds Authority conduct inspections on private properties and have annual funding provided by WAP and an internal source to complete works on the Hunter River. A one off DPI new incursion funding was received to treat the Glendon Brook infestations.

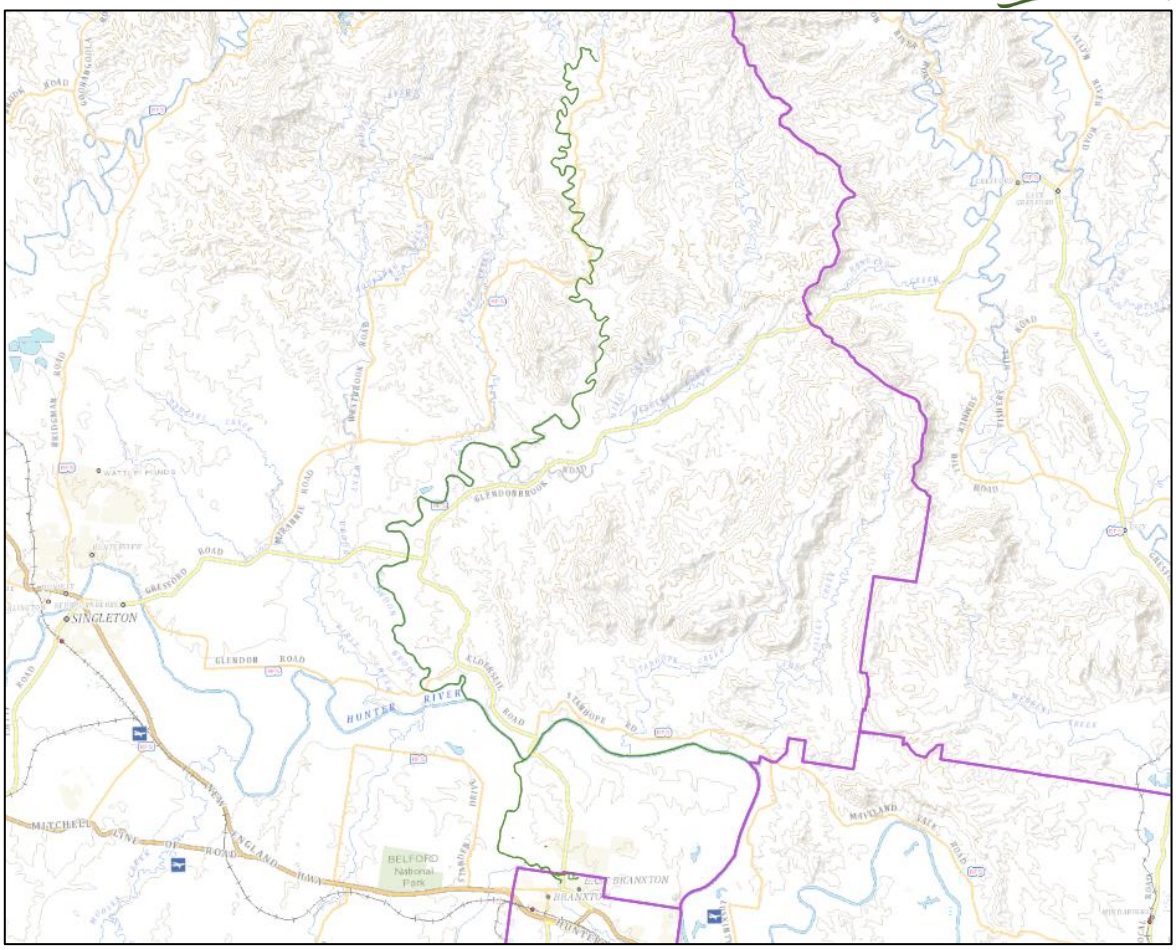

Figure 3. Upper Hunter (Singleton) infestation of Alligator weed, beginning in the North at Glendon Brook and occurring sporadically for 142km of Glendon Brook, Anvil Creek, Black Creek and the Hunter River, at Singleton. Occurring through mostly private properties.

Cessnock

In the Cessnock suburb of East Branxton areas of Anvil creek are effected as shown below. Here Anvil Creek makes its way towards the Hunter River via Black Creek. This infestation is on the edge of the Cessnock LGA and exists immediately upstream of already infested areas of Singleton, which perhaps renders investment in eradication efforts here futile.

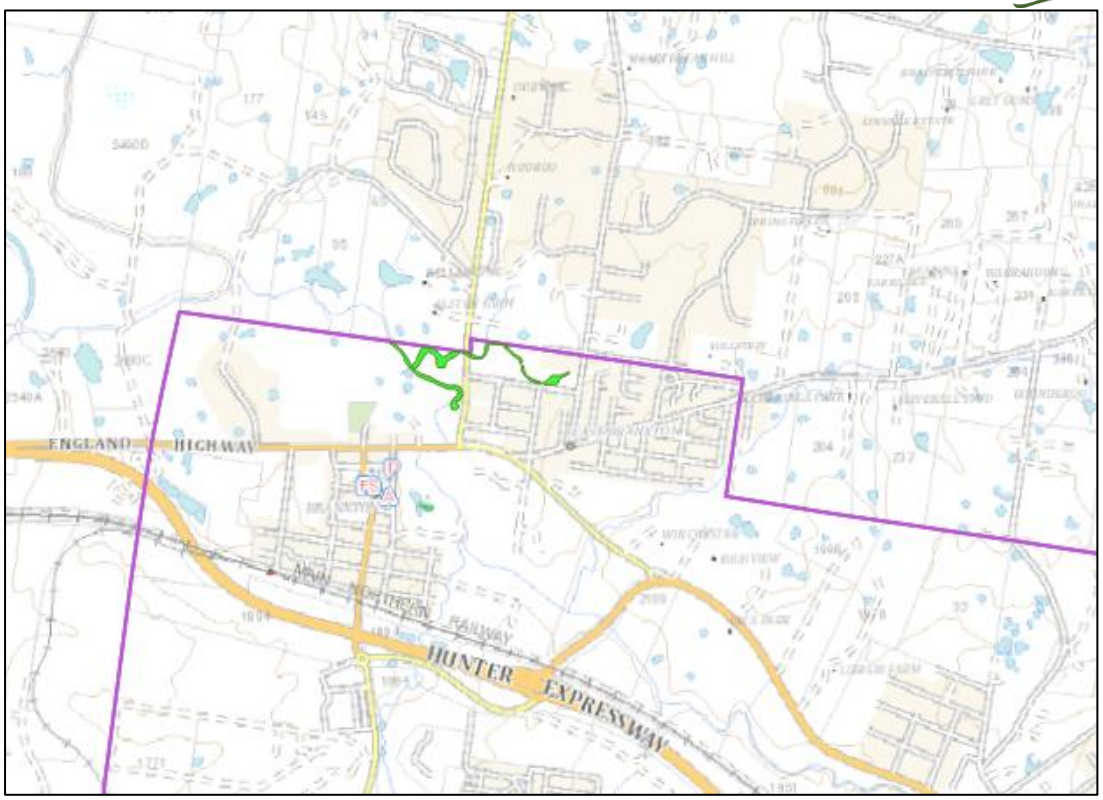

Figure 4. East Branxton Alligator weed infestation stretching for 2km through a mix of private and public land.

Dungog

Here Alligator weed exists immediately upstream of the non-biosecurity zone infestations of Port Stephens and are treated along with those areas 3 times annually. There would be little benefit in trying to eradicate these sites

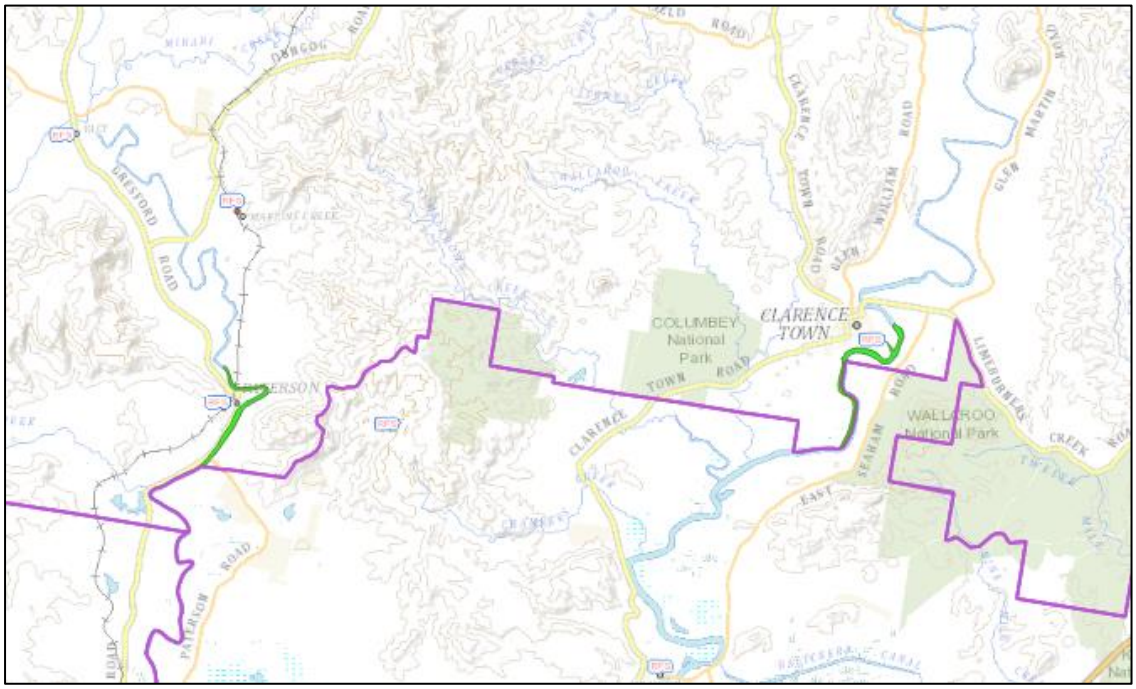

Figure 5. Alligator weed on the Williams and Patterson Rivers at Dungog. Immediately downstream is the Non Biosecurity Zone infestations of Port Stephens.

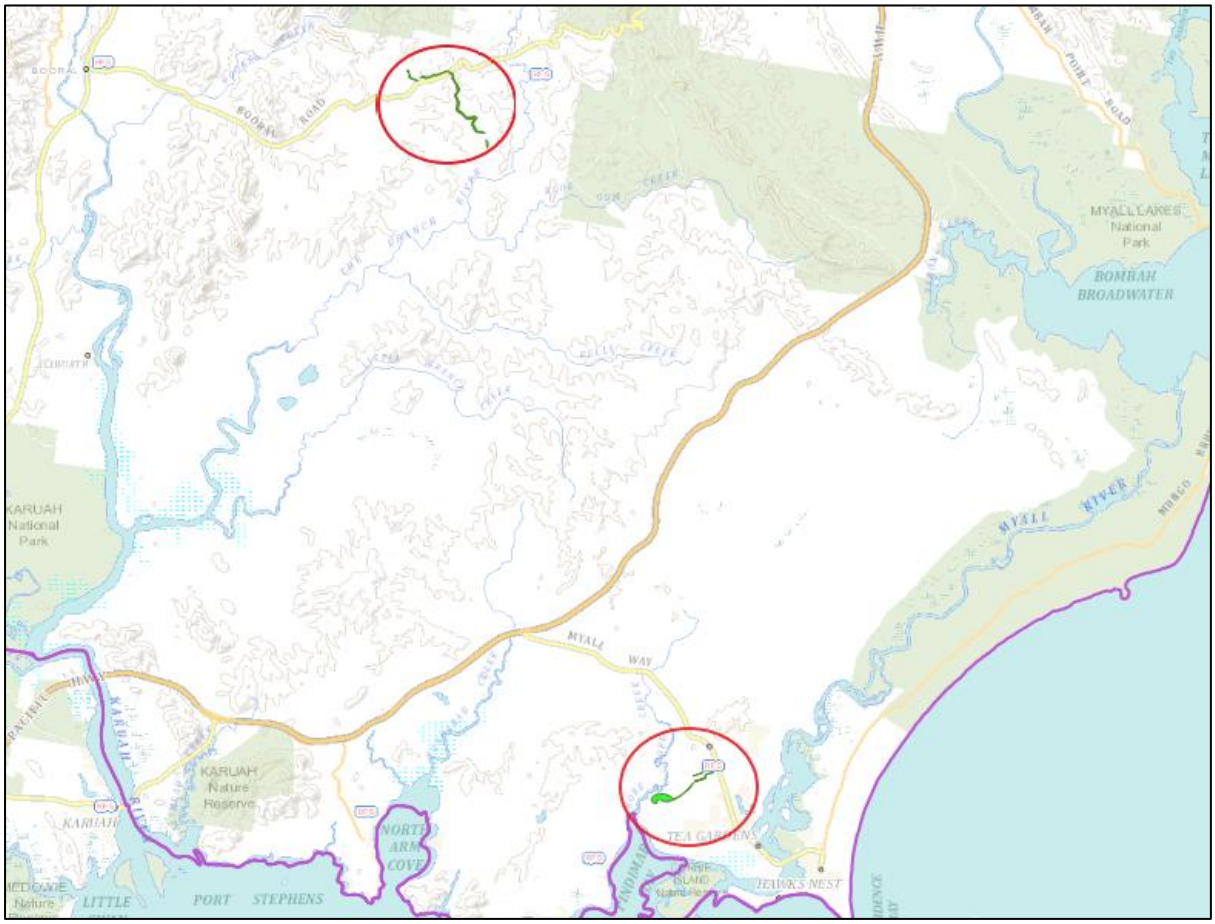

Figure 6. 12Ha of Alligator weed at Tea Gardens, and along 13km of Lewis Creek spanning 10 different private properties in the Mid Coast LGA

Treatment options and discussion

The control options currently considered appropriate and approved for Alligator weed are biological, herbicide, and physical removal. Biological control of Alligator weed may provide some relief for land holders where eradication of the plant is not achievable, but only in aquatic situations (Julien & Stanley, 1999). Herbicides can be effective at reducing biomass of the weed, and therefore reducing the risk of spread, but the weeds resistance or tolerance to herbicides, as discussed below, mean that any areas identified by this strategy as eradicable would require physical removal.

Alligator weed has a known resistance or tolerance to herbicides (Schooler, *et al*., 2008), which (Dugdale & Champion, 2012) attribute to the plants low rate of herbicide translocation from leaf to stem. Whilst the leaves absorb herbicides at similar rates to other plants, the chemicals translocation from leaf to stem in Alligator weed is as low as 5 -20% when compared to other plants. Further, Alligator weed has the ability to exude a portion of any herbicide that it does absorb (Dugdale & Champion, 2012) and the ability to auto-abscise or break at nodal tissue when high herbicide concentrations are absorbed. There is some evidence that soil-applied herbicide provides

better control than foliar-applied herbicide, because the issue of poor translocation is circumvented. However, additional research is required to confirm this. (Dugdale & Champion, 2012)

Herbicides can be effective in reducing biomass, but generally not in eradicating the weed. Although several herbicides achieved good to excellent control (80–89% and 90–100%, respectively) in the short- and medium-term, good to excellent long-term control was not as common and usually required repeated herbicide applications (Dugdale & Champion, 2012)

Action plan

Feasibility of localised Alligator weed eradication has been investigated through the development of this strategy, and deemed not achievable in any parts of the Hunter Region at a catchment or sub-catchment level. If deemed eradicable at that scale, excavation of material containing all propagules would be the only way this is achievable. This would require further investigations and environmental approvals may be needed, as would prioritisation of sites based on risk of spread (cost/benefit) and feasibility of eradication as cost will be prohibitive on at a catchment or even sub catchment level.

Action: Implement biannual inspection and treatment regime at sites inside the Alligator weed Biosecurity Zone to reduce the risk of spread, and move sites towards potential localised eradication. Funds are available to LCA's through LLS WAP and Hunter Catchment Contributions (HCC) for Hunter Alligator weed Biosecurity Zone eradication program for Cessnock, Dungog, MidCoast, and Upper Hunter.

Inspection & Treatment Action Table

Infestation ID	Site	Frequency	Responsibility	Funding priority	Indicative annual hours
Sites AW1 - AW6	Glendon Brook	Biannual	Upper Hunter Weeds Authority	Low	480
Sites AW7 - AW14 & AW31	Anvil Creek	Biannual	Landowner	Low	8.5
AW16 & AW17	Williams & Patterson Rivers Dungog	3 times annually	Dungog with PSC through Crown funding	Low	8
Sites AW18 - AW27 & AW30	Lewis Creek	Biannual	MidCoast Council	Medium	44
AW28 & AW29	Tea Gardens	Biannual	Landowner	Medium	8

Cabomba

Biology, ecology and critical vulnerabilities

Cabomba, or water fanwort (*Cabomba caroliniana* A.Gray) is a submerged freshwater herb native to the Americas (Dugdale TM, *et al.*, 2013). Introduced into Australia as an aquarium plant, it was first recognised as naturalised in 1986 (Mackey, 1996). Since then it has become established in areas of Queensland, New South Wales and Victoria (Sainty & Jacobs, 1981). Generally preferring still or slow moving water less than three meters deep where it easily roots to the substrate, though it can grow in water up to 10 meters deep (Dugdale TM, *et al.*, 2013).

Although Cabomba produces seed, the main mode of reproduction in its introduced range, including in Australia, is stem auto-fragmentation, where any stem fragment that includes a pair of open leaves can grow into a new plant (Mackey & Swarbrick, 1997). Reproduction by seed has been recorded in northern Australia but not from any southern Australian populations (Schooler, et al., 2006), and it does not have any other energy storage mechanisms like bulbs or tubers (Bickel, 2017)

In Queensland it grows and flowers continuously throughout the year and in summer buoyant stems up to 6 m long are produced with a growth rate of up to 5 cm per day (Mackey, 1996). This extreme growth may result in serious environmental harm through competition with and displacement of native species; social impact through degradation of recreational water ways and impact to fishing, swimming, skiing boating; and economic impacts through both direct cost of control and reduction of services available from affected waters (Sanders, 1979).

Distribution & mapping

The MidCoast LGA has scattered infestations of Cabomba, from Tea Gardens in the south, through suburbs bordering the RAMSAR listed Myall Lakes, to Nabiac in the North. Outside of the Mid Coast area, there is a lone infestation in the Newcastle suburb of Beresfield.

Newcastle

In the Newcastle suburb of Beresfield there is one infestation across 2 properties. Site 1 is a Council owned, privately run golf course, and site 2 is a nearby creek through private property downstream from the golf course site. These are shown below as figure 7 and are the top priority for eradication due to the isolated nature of the infestations.

MidCoast

Quite removed from the other MidCoast infestations, at Tea Gardens in the south of the LGA there are 2 infestations, both in constructed wetlands that are quite accessible. These are potential eradication targets, and present a high priority because of their isolated distribution. The remaining Cabomba infestations, as shown below are quite scattered across the LGA, and maybe less of a priority because of this. The risk presented to the Mayll lakes RAMSAR site however suggests works to contain the weed through intensive inspection and treatments regime here should be a priority. Many of the MidCoast Cabomba sites are well under control, and have been receiving attention since their discovery, while others may need some more attention.

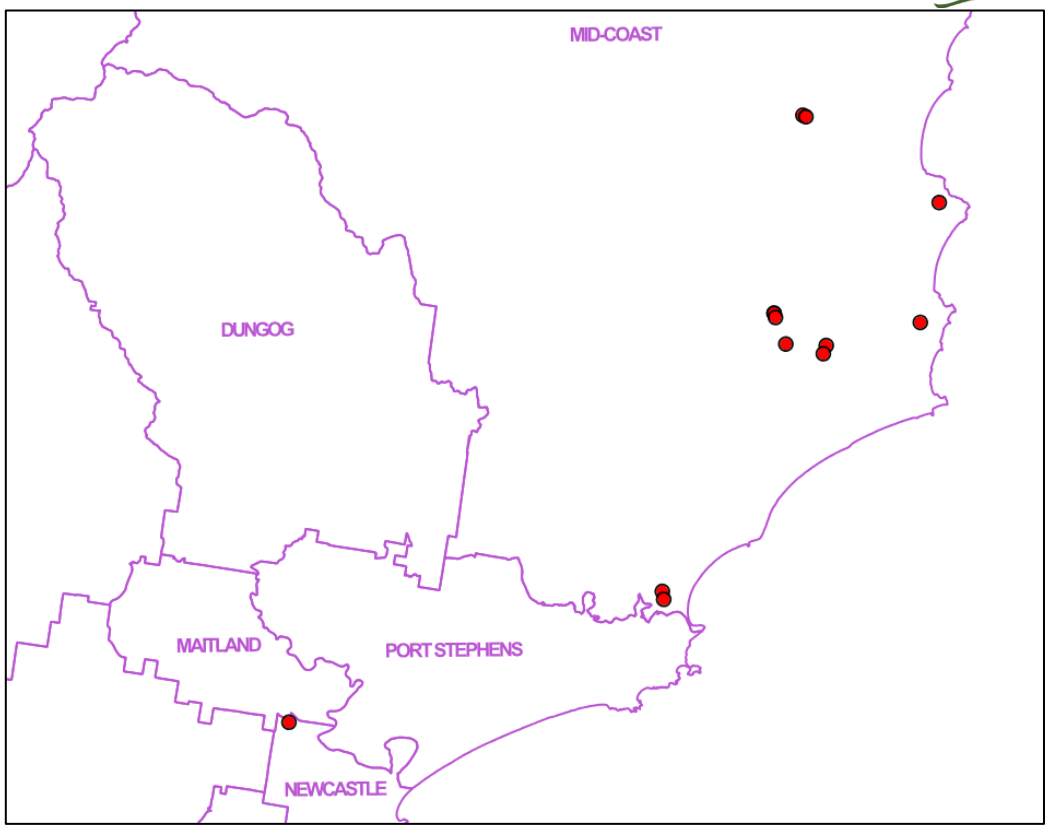

Figure 7. Regional Overview of Cabomba infestations in mostly MidCoast LGA, and an isolated infestation in Newcastle.

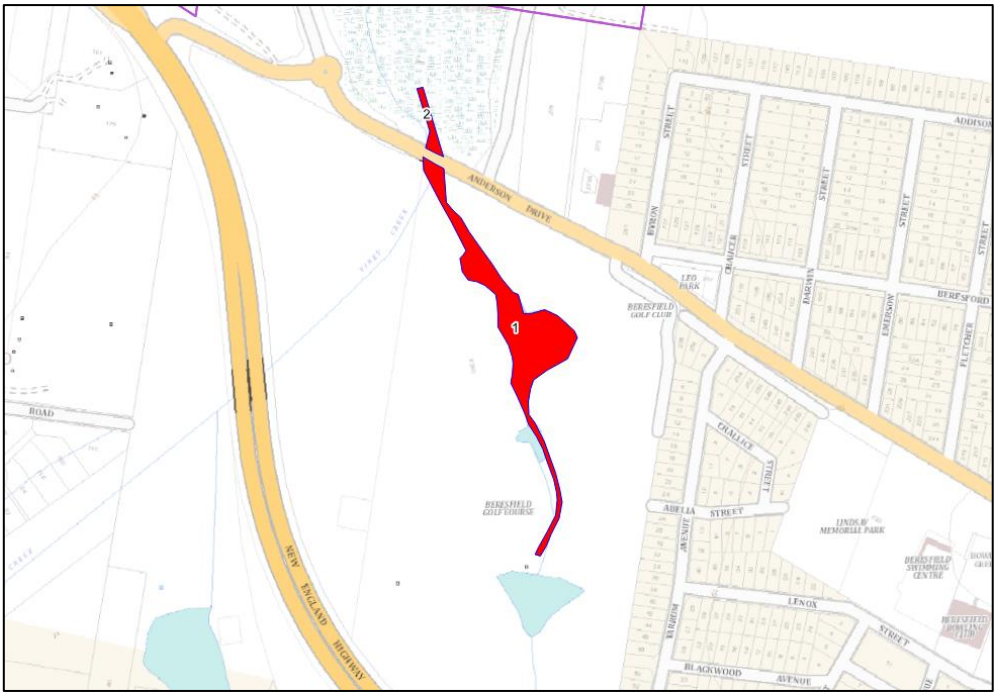

Figure 8. Cabomba on 2 properties over 1.3Ha at Beresfield in the Newcastle LGA.

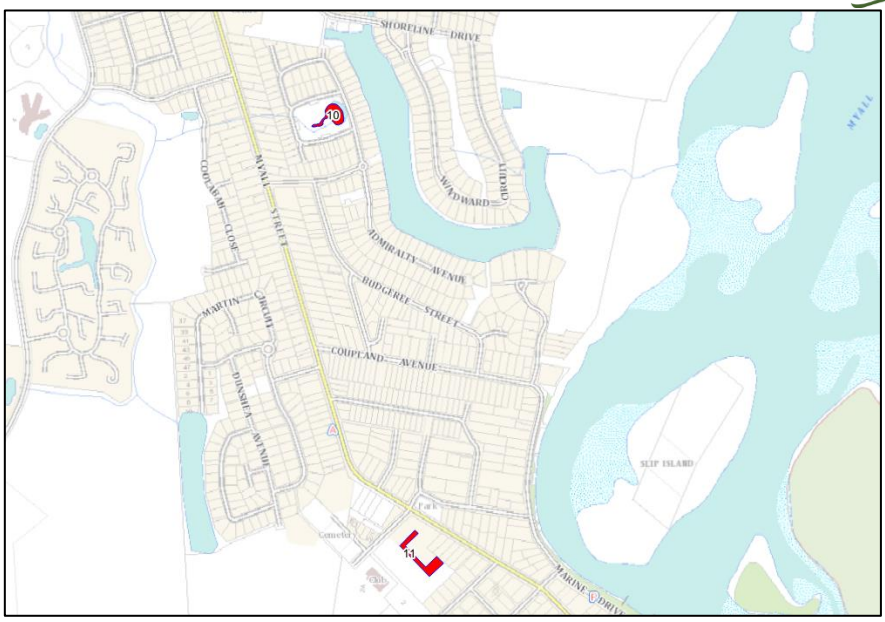

Figure 9. Cabomba in 2 constructed wetlands in the Tea Gardens area, totalling approximately 3000m^2.

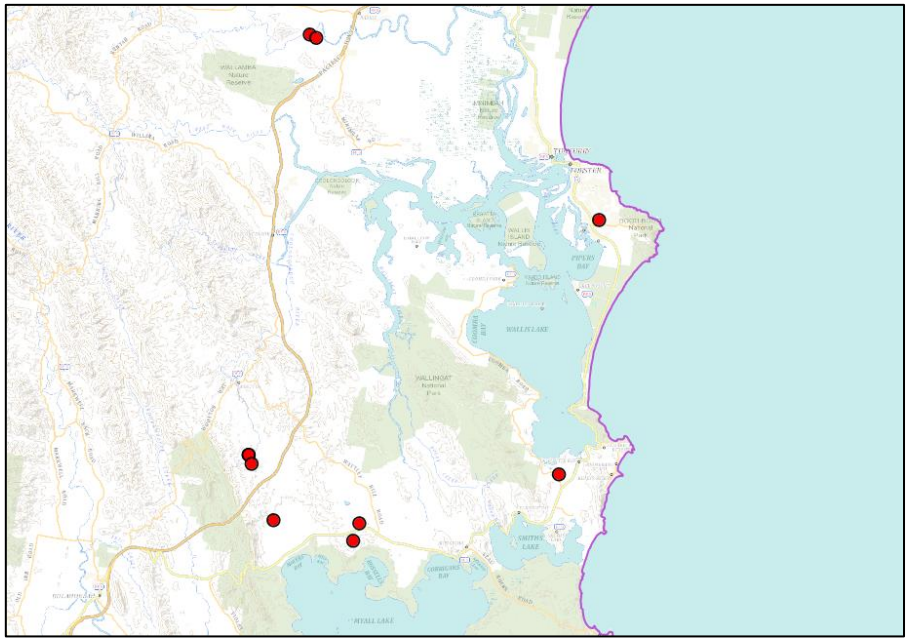

Figure 10. Mid Coast overview. Cabomba scattered from Myall Lakes in the South, to Coomba Park, Forster, and on the Wallamba River at Nabiac. Fine scale maps of all sites in Appendix 2.

Treatment options and discussion

Apart from some emerging herbicide options, shading, and water draw down (Schooler, *et al.*, 2006) suggests that there are currently no really effective methods of managing Cabomba, but insist that eradication in small enclosed waters is achievable.

Whilst there are now a couple of herbicide options registered for use on Cabomba in Australia, there are certainly many constraints to their use and potential limiting factors on their effectiveness (Bickel, *et al.*, 2018). There are no current biological controls options available in Australia and mechanical removal through harvesters are not considered sustainable or effective in open or running waters as the plant easily fragments and these fragments can float away and recolonise the

treated area or invade adjacent non-weedy areas (Mackey, 1996). Therefore herbicides will have a role to play in what will needs to be an integrated control method eradication plan based on site constraints.

Shade may be a useful method to clear areas in preparation for revegetation or possibly used for eradication of Cabomba from small outlying infestations. Schooler (2008) showed full shade over a 120 period resulted in complete destruction of all Cabomba in the treatment area, and whilst it is a non-selective control method, resulting in destruction of all vegetation, most native aquatic species produce seeds and/or have underground energy storage mechanisms (Stephens & Dowling 2002).

Shading, generally through the installation of manmade structures and materials may be an effective eradication method with low environmental impact when compared with the other common eradication methods. However, entirely covering a pond or lake may also have significant negative effects, such as reducing dissolved oxygen, and can be difficult practically for large areas (Janes, *et al.,* 1996) Removal of Cabomba through shading is expected to stimulate the growth of native species, but where natural recruitment is insufficient, assisted native revegetation can result in continued shading and competition (Mackey, 1996). Especially, emergent native species are expected to reduce light and inhibit Cabomba growth and biomass (Sanders, 1979)

Cabomba lacks specialised reproductive or storage features common in other aquatic plants, therefore, drawing water down where possible and drying the plants out can provide a means of killing all plant propagules (stems and crowns) (Dugdale TM, *et al*., 2013). For drawdown to be effective the substrate below them needs to completely dry out to avoid viable crowns remaining as a source of recolonization (Dugdale TM, *et al*., 2013).

Control outcomes for submerged aquatic weeds by drawdown can often be unsatisfactory where biomass of target weed and other vegetation is large (Dugdale TM, *et al.*, 2013), so prior to drawdown a reduction in biomass can be advantageous. Here we propose to reduce overall biomass of affected areas in the Hunter by shading or herbicide use before drawing down each water body. Shading and herbicide use are only applicable where water bodies are enclosed. Shading would be the preferred biomass reduction method, but where not practical, herbicides could be used. If not enclosed and herbicide is not an option, harvesting could be considered prior to enacting a drawdown to achieve improved control but spread from fragments will need to be very carefully managed.

Action plan

Local eradication could be achievable for the Newcastle infestations, and as it is quite removed and isolated from the other regional infestations. Regular herbicide treatments, rotating between herbicide types should be implemented in the golf course, and opportunistic treatment of the creek if and when dry weather disconnects it from flows. Tea Gardens should be next in priority due to its isolated distribution, followed by the remainder of the MidCoast sites.

Inspection & treatment Action table

Infestation ID	Site	Frequency	Responsibility	Funding Priority	Indicative annual hours
CC1 & CC2	Beresfield	Quarterly	Project Administrator	High	48
CC10 & CC11	Tea Gardens	Quarterly	Project Administrator	High	24
CC3 – CC9 & CC12 – CC14	MidCoast	Biannual	MidCoast Council	Medium	40

Frogbit

Biology, ecology and critical vulnerabilities

Frogbit or Spongeplant [Limnobium laevigatum (Humboldt and Bonpland ex Willdenow) Heine] is a free floating freshwater plant which is traded worldwide as a pond or aquarium ornamental (Perryman, 2013). As with many other invasive aquatic plants traded regularly as pond or aquarium ornamentals, Frogbit invasiveness is exacerbated by a low feasibility of control as the plants are regularly introduced or re-introduced into the environment through disposal of aquarium contents, deliberate spread by people, flooding of infested ponds and water features, and spread by animals (Padilla & Williams, 2004; Thum, *et al.*, 2012; Wilson, *et al*., 2007; Funnell, *et al*., 2009).

The California Department of Food and Agriculture assert the plant is a vigorous competitor that has the potential to have more impact than Water hyacinth (Perryman, 2013), though (Murphy, *et al*., 2003) suggests in its native range South America, Frogbit is found far less frequently than Water hyacinth; concluding that in its native habitat, Water hyacinth outcompetes Frogbit.

As with the other Aquatic weeds Frogbit has the ability to impact potable water supply, agricultural and industrial water supply, seriously impede recreation pursuits such as boating, skiing and fishing, and cause serious biodiversity decline through its competitiveness (Willis, *et al.*, 2018), Anderson & Akers (2011) attributing its competitiveness to its rapid clonal growth, and reproductive rate, coupled with small, floating seedlings leading to a very high dispersal potential.

Frogbit sets viable seed in its introduced range, and seeds remain viable for at least 3 years (anon, 2021) but its main source of spread can be attributed to its ability to rapidly clone its self through production of leafless stems that produce daughter plants and as such this species can rapidly form dense floating or rooted mats on the water surface (van de Witte, 2020). Records from its introduced range in California indicate up to 2500 plants can be present per square meter (Akers, 2010)

Distribution including mapping

Present and expanding at Cessnock, with 6 sites total, 4 original sites not yet under control and 2 new sites. Present but under control in 4 locations in the MidCoast. Other instances in the region can be attributed to aquarium trade, and we note that Frogbit has been seized or confiscated from premises in Port Stephens, Maitland, and Newcastle, but the plant is yet to be found naturalising in these areas.

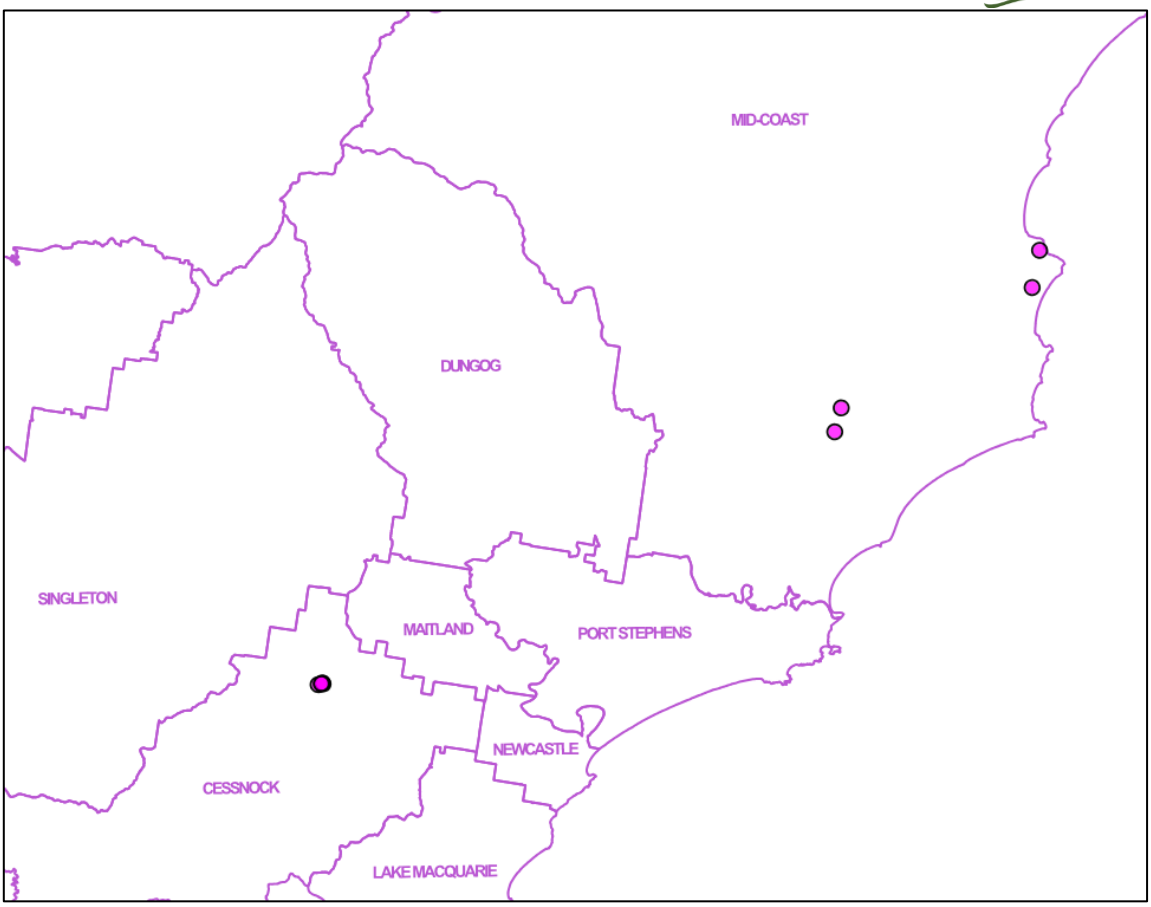

Figure 11. Regional overview of Frogbit locations, present in extremely low distribution, a definite eradicate target.

Treatment options and discussion

Small infestations of Frogbit can be hand removal but (van de Witte, 2020) suggests care should be taken if mechanical harvesters and the like are to be used, as this can easily lead to fragmentation and further spread. Infestations currently found in the Hunter do not need harvesting as weed biomasses are small and have all been targeted previously through herbicide treatments. Several herbicide options are approved for use in NSW and have been used successfully in the Hunter Region. Frogbit sites are to be targeted with intensive herbicide and inspection regimes as described in the action table below.

Action plan

A definite eradication target for the region with infestations limited to 10 sites in only two LGA's. An intensive action plan is outlined below and is a high regional priority.

Inspection & treatment Action Table

Infestation ID	Site	Frequency	Responsibility	Funding Priority	Indicative annual hours
FB1	Londons Rd Lovedale	Sept, Nov, Jan, April	Project Administrator	High	4
FB2	Londons Rd Lovedale	Sept, Nov, Jan, April	Project Administrator	High	2
FB3	Londons Rd Lovedale	Sept, Nov, Jan, April	Project Administrator	High	2
FB4	Lovedale Rd, Lovedale	Sept, Nov, Jan, April	Project Administrator	High	2
FB5	Wills Rd, Lovedale	Sept, Nov, Jan, April	Project Administrator	High	2
FB6	South Bulahdelah	Sept, Nov, Jan, April	Project Administrator	High	2
FB7	Kularoo Dr, Forster	Sept, Nov, Jan, April	Project Administrator	High	3
FB8	Café water feature, Bulahdelah	Sept, Nov, Jan, April	Project Administrator	High	2
FB9	Back yard pond, Green Point	Sept, Nov, Jan, April	Project Administrator	High	2
FB10	Wetland Reserve, Green Point	Sept, Nov, Jan, April	Project Administrator	High	4
FB11	Lovedale Rd	Sept, Nov, Jan, April	Project Administrator	High	2
FB12	Londons Rd	Sept, Nov, Jan, April	Project Administrator	High	2
FB13	Smiths Lake	Sept, Nov, Jan, April	Project Administrator	High	2

Hygrophila costata

Biology, ecology and critical vulnerabilities

Hygrophila (*Hygrophila costata*) is a highly invasive aquatic weed which can out-compete native plants found in wetlands, dams, rivers and other waterbodies (Setter & Styman, 2017). It can grow up to 1.5m in height and form dense infestations which dominate native vegetation and alter the natural habitats of fauna. Hygrophila can also restrict access to waterways for recreational activities such as boating, kayaking and fishing (Annon, 2018). Previously subject of the Hunter Regional Hygrophila Management Plan 2017-2022, Hygrophila is included here as it still persists in the Local Government Areas of Maitland and Port Stephens and remains an eradication target due to this limited distribution.

Hygrophila grows all year round, but most rapidly during summer. It is an erect emergent perennial herb which can reproduce vegetatively (by stem fragments) and also by seed. Plant fragments and seed are dispersed via water, wind, animals, machinery and watercraft/vehicles. When dispersed stems come into contact with soil, they will develop roots at the node and establish a new plant. Hygrophila seeds become sticky when wet which increases the risk of spread on vectors (Annon, 2018). Hygrophila is native to the Americas ranging from southern Mexico to Argentina, and has naturalised throughout the world in many other tropical and subtropical regions. It is thought that Hygrophila was imported and cultivated in Australia for use as an aquarium plant (Gettys, *et al*., 2014)

Distribution including mapping

In New South Wales Hygrophila has become invasive in the far north coast, central coast and greater Sydney regions. Infestations are also present in southeast Queensland. In the Hunter region, Hygrophila is present in extremely limited distribution, known to occur in only two Local Government Areas; Port Stephens and Maitland. In both cases these are single, isolated infestations. In Port Stephens the Hygrophila infestation is approximately 1ha in size and is situated in two reserves in Raymond Terrace. One site located in Boomerang Park has undergone intensive control and has been eradicated. The second site is located in Ross Walbridge Reserve. This reserve is a Port Stephens Council owned and managed property consisting of a waterbody and small islands surrounded by established terrestrial vegetation. The reserve is also a roosting site for a state significant population of the Grey-headed flying fox (*Pteropus poliocephalus*) which is listed as vulnerable in NSW under the Biodiversity Conservation Act 2016. As a result, Port Stephens Council has obtained a licence to undertake maintenance works including weed control activities at this site under stringent protocols. The Hygrophila infestation in the Maitland LGA originates in Two Mile Creek within a privately owned property on Raymond Terrace Road, East Maitland (see appendix 2). The Hygrophila spreads downstream in small isolated patches through Easts Leisure & Golf Club and into Tenambit Wetlands. The wetland forms part of a large Crown reserve, of which Maitland City Council is the trustee. The total infestation covers an area of approximately 5ha (Annon, 2018).

Figure 12. Regional overview of Hygrophila locations.

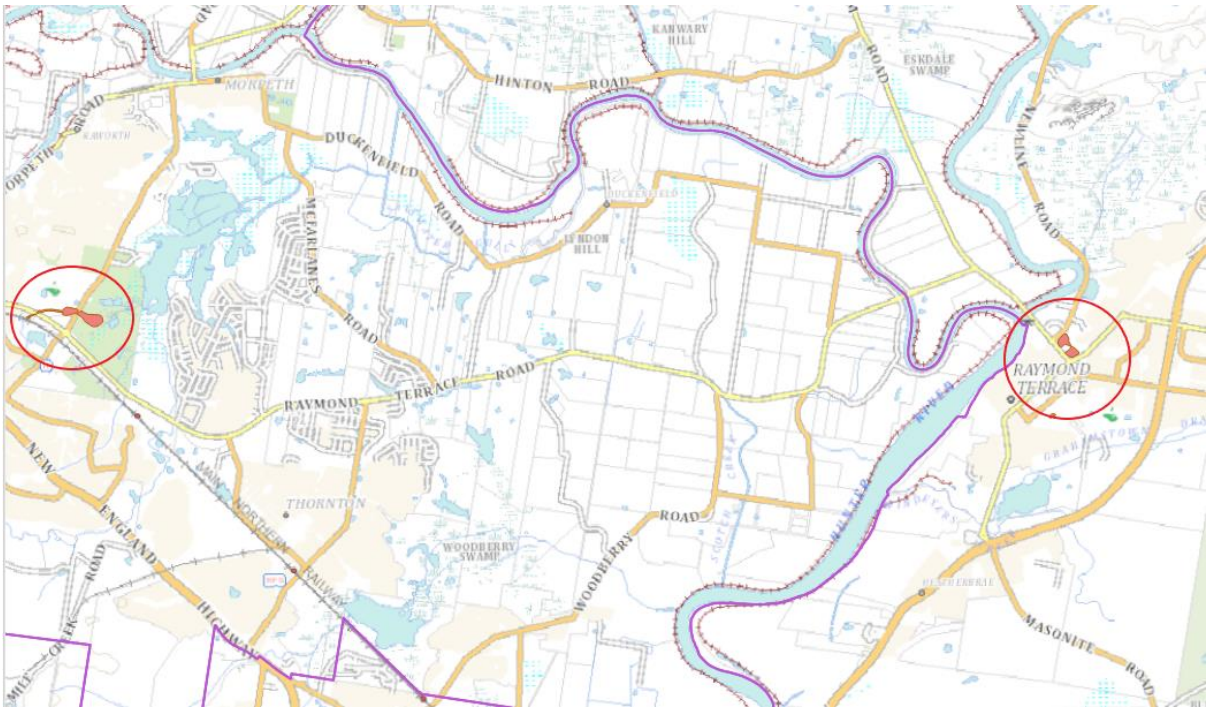

Figure 13. Hygrophila in 2 reserves at Raymond Terrace and over 3 properties in East Maitland at approximately 5 ha in size.

Treatment options and discussion

It is crucial that known Hygrophila infestations are contained and the potential for spread to other areas is minimised. Booms can be used to minimise the risk of downstream spread and contain the Hygrophila to the original infestation. Good weed hygiene practices are essential in preventing the spread of Hygrophila to other areas. (Gettys, *et al.*, 2014). Seasonal timing can affect the success of control methods used to manage weeds. The most appropriate timing for controlling Hygrophila in the Hunter region must be implemented in the management of the weed. APVMA permit number PER14729 allows for use of herbicides containing glyphosate (360 g/L) or metsulfuron-methyl (600g/kg) to treat Hygrophila. This can be undertaken in aquatic and semi-aquatic situations, providing it is in a non-potable water area. It is recommended that the herbicide used for treating the Hygrophila is alternated between glyphosate and metsulfuron-methyl. This will minimise the risk of herbicide resistance developing, and will also allow for four treatments to occur per year, rather than three (as stated in the permit for metsulfuron-methyl only) (Annon, 2018).

Action plan

A serious eradication target due to limited distribution. Inspection and herbicide treatments should occur four times per year commencing in September with further treatments in November, January and March. If physical removal is an option, this can be undertaken in the cooler months.

Inspection & Treatment Action Table

Infestation ID	Site	Frequency	Responsibility	Funding Priority	Indicative annual hours
HC1	Two Mile Creek	Quarterly	Project Administrator	High	16
HC2	Easts Leisure & Golf Club	Quarterly	Project Administrator	High	16
HC3	Tenambit Wetlands	Quarterly	Project Administrator	High	32
HC4	Ross Walbridge Reserve	Quarterly	Project Administrator	High	4
HC5	Boomerang Park	Quarterly	Project Administrator	High	4

Kidneyleaf mudplantain

Biology, ecology and critical vulnerabilities

A major weed of flooded rice fields in Europe (Gabela, 1974; Vescovi, *et al.*, 1998) Kidneyleaf mudplantain (*Heteranthera reniformis* Ruiz & Pavon) is an annual or perennial, floating or submereged weed regularly found creeping in mud or in shallow water throughout its native Central, North and South American regions (Csurhes, 2016). Mudplantain can grow rapidly to form dense mats when competition is low, but Csurhes (Csurhes, 2016) reports that it is actually a poor competitor when taller vegetation is present such as sedges and rushes.

The species has a narrow optimum temperature rane of between 23 and 30c, is quite salt tolerant, and despite not coping well with competition, does prefer partial shade, growing at its highest rate under 33% shade (Gabela, 1974)

Mudplantain can produce roots at each node allowing it to for dense mats and colonise areas through fragmentation. It produces viable seed that is potentially viable for greater than 10 years. Seeds can be dispersed by wind and water, and through fragmentation becomes a major mode of spread with single flood-events likely to disperse stem fragments over a considerable distance. Mudplantain is spread readily by water birds (Reynolds, *et al.*, 2015) and is an opportunistic coloniser of open, shallow wetlands, ditches and creek banks. (Csurhes, 2016) Suggests it is readily outcompeted and replaced by taller vegetation.

Research on the species is scarce but closely related species have decent seed longevity and allelopathic properties potentially present in H. reniformis (Baskin, *et al*., 2003; Dilday, *et al*., 1989). (Gabela, 1974) suggests repeatedly that competition is a serious threat to the species, and that the lack of research on biology and control of the species is due to this exploitable vulnerability, concluding that only poorly managed rice fields are impacted by the weed, and that the only control methods required are the introduction of competitive beneficial species or well managed crops.

Distribution & mapping

Isolated infestations in Newcastle, Maitland and Port Stephens are eradicable, as is the Waukivory infestation in the MidCoast LGA, however the weed persists along 30km of Berrico Creek in the MidCoast LGA where containment is a more achievable outcome.

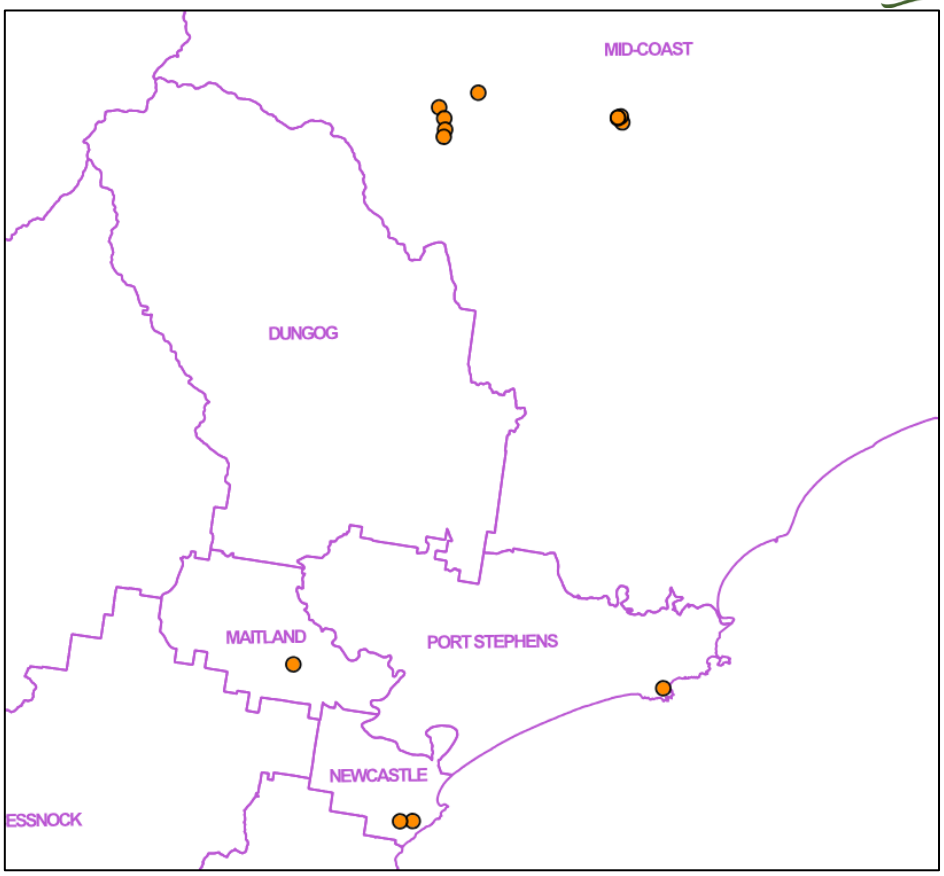

Figure 14. Regional overview of Kidneyleaf mudplantain locations across the Hunter.

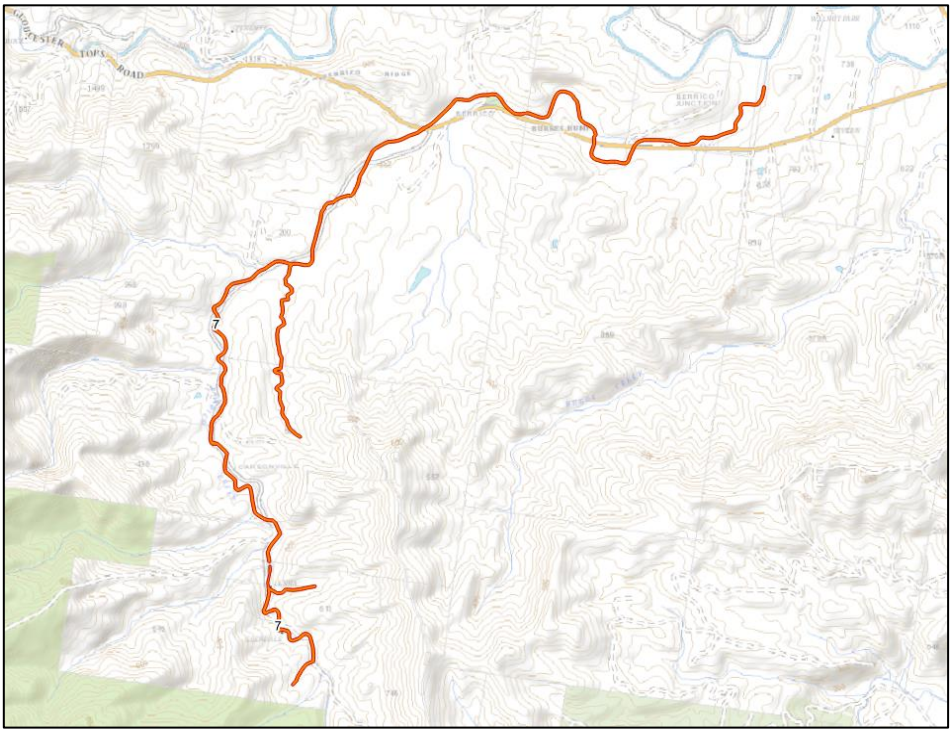

Figure 15. Kidneyleaf mudplantain in 30km of Berrico Creek in the MidCoast LGA. Eradication deemed unachievable in the short term here.

Treatment options and discussion

Small patches of mudplantain can be hand removed if care is taken not to leave fragments behind in the mud as the plant readily breaks apart on removal. Herbicide use is the preferred control method, and glyphosate and metsulfuron-methyl are both able to be used on Hunter infestations of this weed under PER9907.

Herbicide trials in Columbia found adequate control from glyphosate, though regrowth can occur quickly after only 4 to 8 weeks, but still conclude that amongst many other options, glyphosate remained the best option (Gabela, 1974). The Newcastle infestations are deemed low priority due to their location immediately upstream of a salt water catchment.

Action plan

Seed capsule development in mudplantain begins between 48 and 62 days after germination (Gabela, 1974), meaning quarterly inspections will be required to break the lifecycle of mudplantain in ideal conditions. Given the distribution at Berrico Creek, Regional eradication is potentially unachievable. The limited distribution in Port Stephens, Maitland, Newcastle and Waukivory and feasibility of control at these sites suggest local eradications are possible.

Inspection & treatment Action table

Infestation ID	Site	Frequency	Responsibility	Funding priority	Indicative annual hours
KL1	Jenner Parade	Quarterly	Land owner	Low	32
KL2	Velodrome	Quarterly	Land owner	Low	32
KL3	Boat Harbour	Quarterly	LCA	High	16
KL4	Melbourne St East Maitland	Quarterly	Project Administrator	High	16
KL5	Waukivory Rd 1	Quarterly	Project Administrator	High	16
KL6	Waukivory Rd 2	Quarterly	Project Administrator	High	16
KL7	Berrico Creek	Annual	LCA	Medium	160
KL8	Day St East Maitland	Quarterly	Project Administrator	High	16
KL9	Newcastle Athletics	Quarterly	Land owner	Low	16

Ludwigia peruviana

Biology, ecology and critical vulnerabilities

Ludwigia peruviana (Linnaeus) H. Hara is an aquatic shrub to 3m that has spread through the Sydney Basin and into the Hunter and South coast regions (Chandrasena, *et al*., 2002). Introduced from the Americas it became dominant in Sydney's Botany Wetlands, a series of shallow urban swamps and lakes in the early 90's.

Flowering peaks in early autumn, but can occur from spring (Chandrasena, *et al*., 2002), and the plant sets viable seed in its introduced range. Soil seed banks can be as high as 450000 seeds m^2 and the seeds are hydrophobic, usually germinate while afloat, and are easily dispersed by water, machinery and birds (Jacobs, *et al*., 1994). Viability of fresh seed can be as high as 99% and can germinate in as little as 4 days, with a 20% dormancy that appears to break down within two years (Jacobs, *et al*., 1993), meaning flushing germination could be a vulnerability that is exploitable.

Propagation and dispersal may also occur by means of stem pieces that produce new shoots. New plants from seed, seedlings or stem fragments may become established on strand lines or form floating islands that may eventually become stranded. Management focus should be on control of the seedlings and soil seed bank depletion (Jacobs, *et al.*, 1994; Jacobs, *et al.*, 1993).

Distribution including mapping

L. Peruviana has only a handful of sites outside of the Sydney basin, the hunter having 8 of those, and the Southcoast having the only 2 other sites in the State

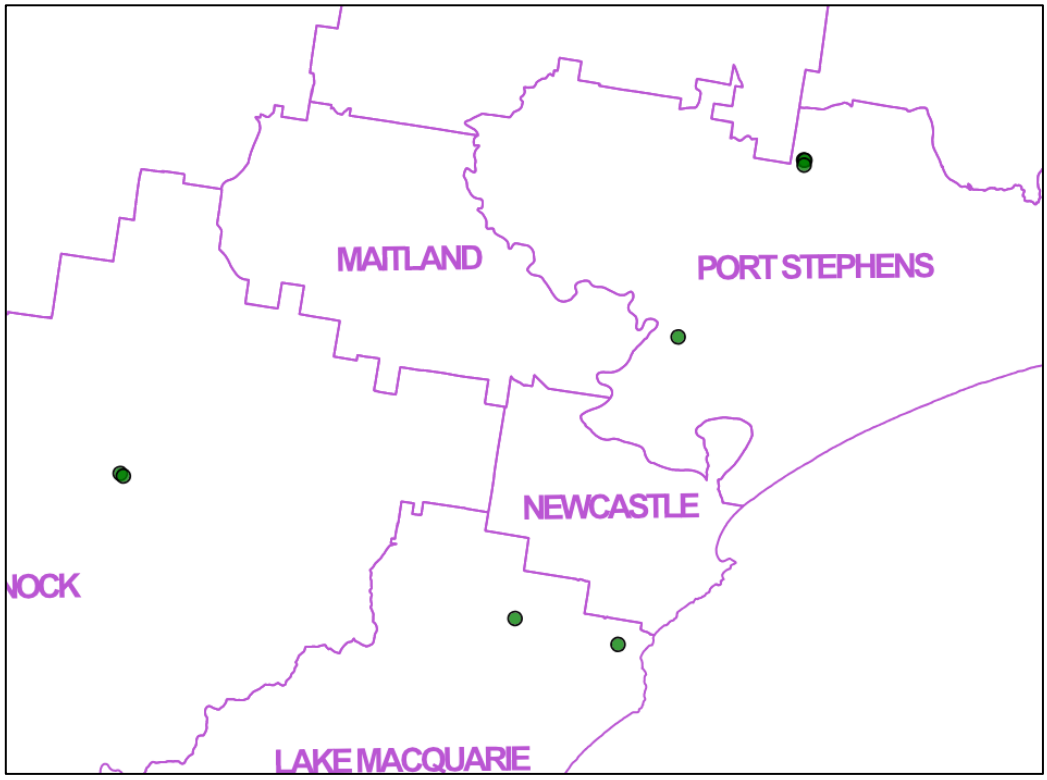

Figure 16. Regional overview of Ludwigia Peruviana locations across the Hunter.

Treatment options and discussion

Herbicides containing glyphosate are registered for use by persons generally and products containing 2,4-D are available for use by Government employees and licenced contractors. Both herbicides work best when applied to early growth stages of the plans, so may need to be used as a follow to slashing or burning as an initial knockdown. Absolute care must be taken if using a slasher on this species, and is not advised of the plant has already flowered. Strict hygiene protocols should be implemented if machinery is used to knock down this species. Cut stump and treatment with undiluted picloram/aminopyralid gel can be applied as a follow up or to infestations with low density, as can hand removal.

Action plan

A real possibility for eradication due to its limited distribution, the treatment and inspection targets are outlined below.

Inspection & treatment Action table

Infestation ID	Site	Frequency	Responsibility	Funding priority	Indicative annual hours
LP1	Flaggy Creek	Quarterly	Project Administrator	High	48
LP2	Boolaroo	Quarterly	Project Administrator	High	4
LP3	The Bucketts Way, Twelve Mile Creek	Quarterly	Project Administrator	High	16
LP4	Boat captain training dam	Quarterly	Project Administrator	High	16
LP5	Twelve Mile Creek Rd	Quarterly	Project Administrator	High	16
LP6	Abbortsford Street Bellbird	Quarterly	Project Administrator	High	4
LP7	Nargoon Reserve	Quarterly	Project Administrator	High	20
LP8	Muree Golf Course	Quarterly	Project Administrator	High	24
LP9	Glenrock Reserve	Quarterly	Project Administrator	High	48

Senegal tea plant

Biology, ecology and critical vulnerabilities

Yet another aquatic species spreading throughout the world as a traded ornamental, *Gymnocoronis spilanthoides* (D.Don) DC. (1838) or Senegal tea plant is an emergent aquatic weed to 1m forming dense stands in the shallows of slow moving or still fresh water (Ardenghi, *et al*., 2016). Native to South America, it now invades marshes, wetlands, creeks and dams throughout Asia and in parts of Europe where dense stands topple over forming large floating rafts and spreading via water blocking drains, degrading natural wetlands, displacing native plants and animals and impacting recreational potential (CABI, 2019).

Senegal tea reproduces by seeds and vegetatively, and both are spread by water and stem fragments and seeds can be spread in mud attached to machinery, people and animals, however the CRC (CRC, 2008) suggests seed production in Australia can be extremely low, less than 1% of its potential, which indicates that spread by seed is not very important and presents the potential for seed bank depletion by weed managers. Unfortunately seed persistence can be as long as 16 years (Panetta, 2009) and viability between 60–80% (Vivian-Smith, *et al*., 2005).

Senegal tea grows rapidly from September to November, and flowers from October to February, (extending to May in optimal conditions), it seeds form from November to March, or about one month after flowering (CABI, 2019).

Distribution & mapping

Whilst there are only three infestations known in the Hunter, one in the Manning Catchment in the Gloucester - Taree area, one in Western Lake Macquarie and a single isolates outbreak in the Kooraingha area, unfortunately Senegal tea may not be a viable eradication target at Regional scale, as the Manning infestation persist throughout a large 160km section of the River, and presents very difficult access and treatment. The Lake Macquarie infestation covers 15km of Slatey Creek through the suburbs of Holmesville and Barnsley to and is generally accessible, occasionally difficult, but should be eradicable as should the isolated outbreak at Kooraingha.

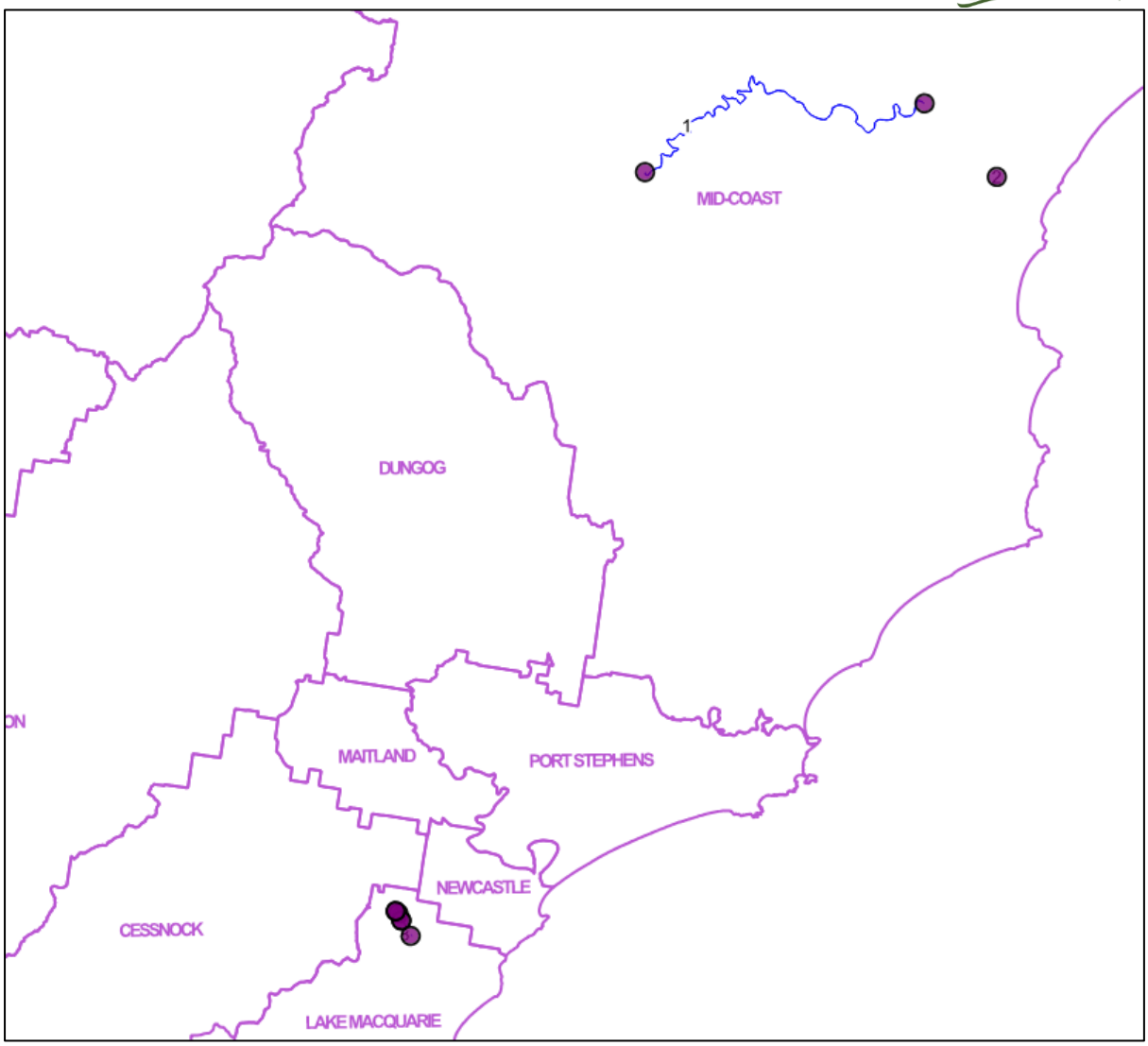

Figure 17. Regional overview of Senegal tea locations across the Hunter Region.

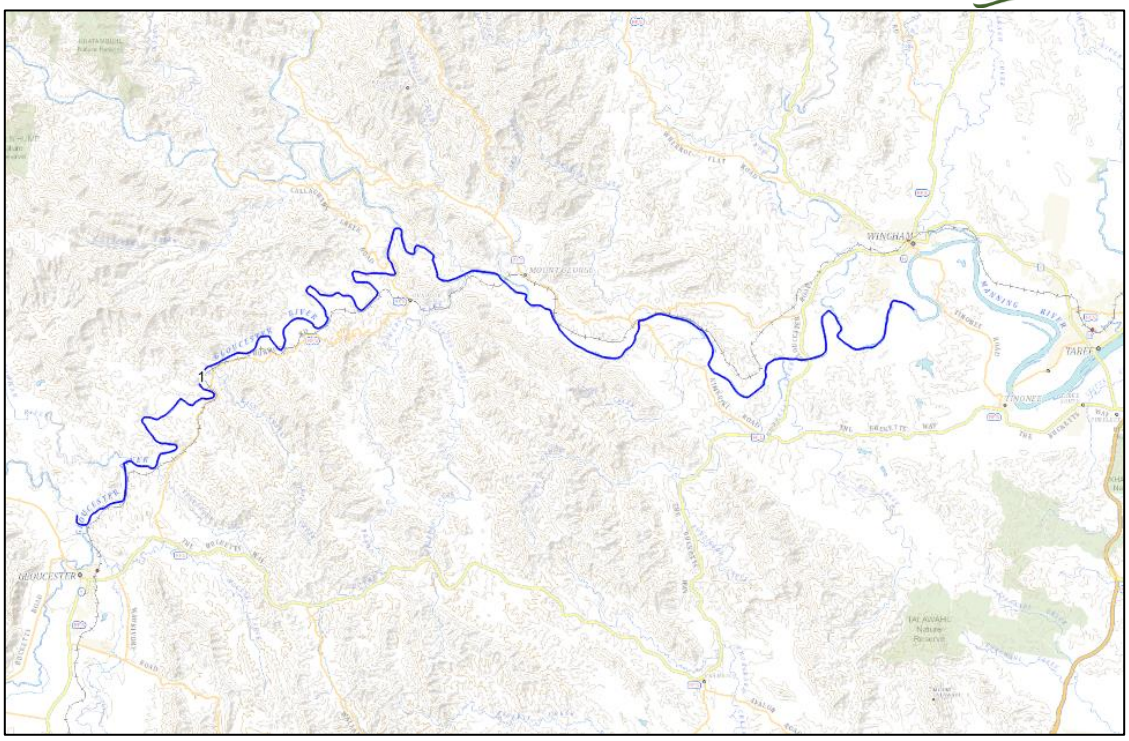

Figure 18. Senegal tea along 150km of the Manning River, from Barrington to Taree in the MidCoast LGA.

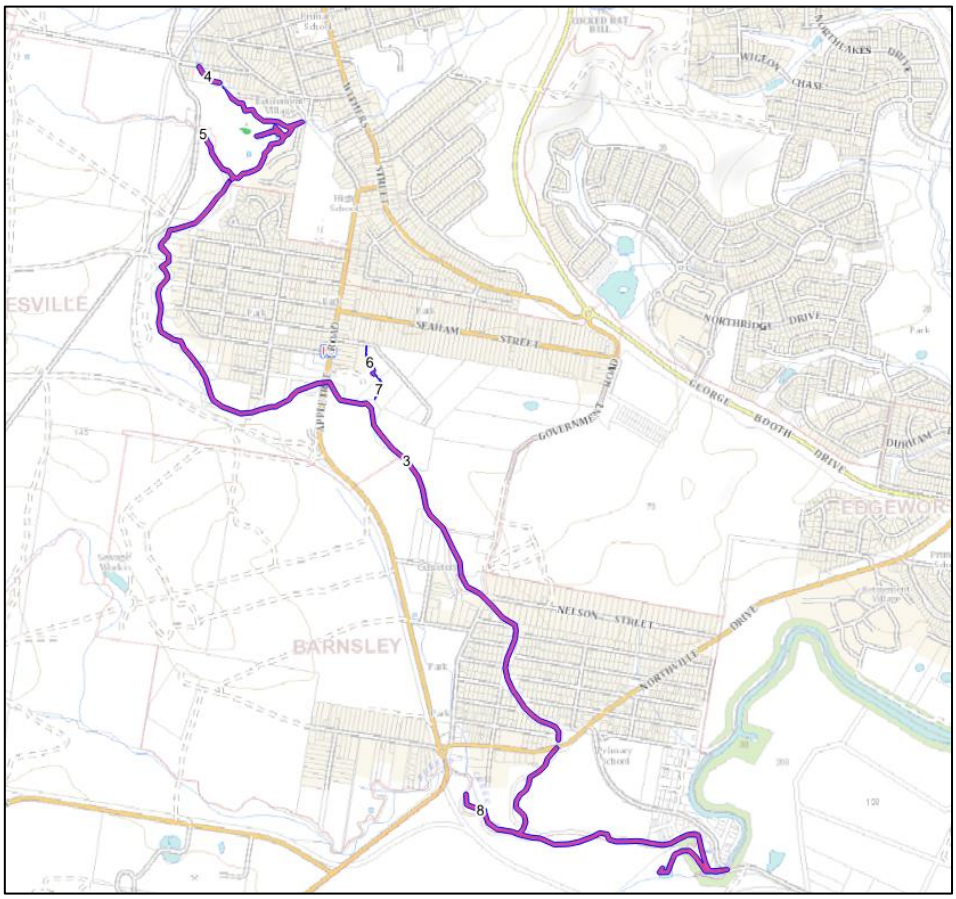

Figure 19. Senegal tea along 15km of Slatey Creek, at Barnsley in the Lake Macquarie LGA.

Treatment options and discussion

Manual control can quickly remove Senegal Tea biomass where it can be done efficiently, proving effective in reducing small infestations through hand removal, raking or drainage machinery (Parsons & Cuthbertson, 2001). Manual removal could be preferred to herbicide control, as under water plant parts are often unaffected by herbicide applications, and readily reshoot (Sainty & Jacobs, 1981).

Plants may be disposed of by drying and burning (CRC, 2008). Care is required not to leave plant fragments that can regenerate into new plants or be spread by water movements to new locations (Van Oosterhout, 2010). Re-establishment from seed germination is likely once the plant becomes established in a wetland or aquatic site, requiring follow-up control for many years (Panetta, 2010).

Glyphosate (PER 9907) and metsulfuron-methyl (PER 147290) can both be used under permit in Australia with metsulfuron-methyl proving successful (Champion & Clayton, 2003) and preferred as glyphosate has been found to give poor control (Sainty & Jacobs, 2003). Glyphosate ineffectiveness can be attributed in part to poor translocation into below-ground or underwater parts and can also be intercepted by the silt coating plants (Argentina, 2017).

Action plan

Essentially a Regional "Biosecurity Zone" could be established for all and in the Hunter Region except the Manning River from Barrington to Taree. The Lake Macquarie and Kooraingha infestations are eradicable and an intensive inspection and treatment regime should be implemented. Quarterly inspections, and treatments as necessary are recommended. Outside the Zone Senegal Tea should be contained in the Manning infestation via an annual treatment to be coordinated by Mid Coast.

Inspection & treatment Action Table

Infestation ID	Site	Frequency	Responsibility	Funding priority	Indicative annual hours
ST1	Barrington Manning	Biannual	LCA	Medium	320
ST2	Kooraingha 1	Quarterly	Project Administrator	High	4
ST3	Slatey Creek LMCC	Quarterly	Project Administrator	High	32
ST4	Bridge St West Wallsend	Quarterly	Project Administrator	High	16
ST5	Sugar Valley Lifestyle village	Quarterly	Project Administrator	High	16
ST6	Appletree Rd Holmesville	Quarterly	Project Administrator	High	12
ST7	Private lane Holmesville	Quarterly	Project Administrator	High	12
ST8	Colliery Teralba	Quarterly	Project Administrator	High	16

ST9	Kooranghat 2	Quarterly	Project Administrator	High	4

Water hyacinth

Biology, ecology and critical vulnerabilities

Widely considered the worst water weed in the world () *Eichhornia crassipes* (Mart.) Solms 1883 or Water hyacinth is yet another ornamental plant traded globally before conspicuously and repeatedly becoming and invasive nightmare. As well as being traded as an ornamental, Water hyacinth has been also been used widely for such things as water purification, where it proves useful in removing heavy metals, hydrocarbons, and excess nutrients form waste water (ShaoHua, *et al*., 2012); used as animal feed in many countries (Ding, *et al*., 2001), and proves useful as a bioenergy producer, with investigations pertaining to biogas, biofuel, and bioelectricity (Bergier, *et al*., 2012).

Water hyacinth propagates vegetatively and by seed, with able to germinate immediately but can also remain dormant for many years. Large numbers of seedlings generally establish on exposed banks when water levels fall, initially rooting in the mud, but becoming free-floating. The axillary buds of the older leaves of the seedlings are capable of developing into stolons, which grow horizontally and develop daughter plants. Such vegetative spread can occur indefinitely and very large populations are produced in this way without any sexual reproduction (Mailu, 2001).

Water hyacinth can have devastating effects on economies, and has been known to completely block ships from entering trading ports (Hill, 1999), completely decimate natural waterways and wetlands (Ding, *et al*., 2001), interfere with food supply (Gopal, 1987), destructive to built assets (Pitelli, 2000) and even impact socially by increased disease vectors (Mailu, 2001).

Distribution including mapping

Widespread outside of the NSW Biosecurity Zone in Lake Macquarie, Maitland, Mid Coast, Newcastle, and Port Stephens, Water hyacinth currently only known to exist in the Hunter Region inside the Biosecurity Zone in the Dungog Shire. As shown below infestations have spread here on the Williams and Paterson Rivers bordering Maitland and Port Stephens.

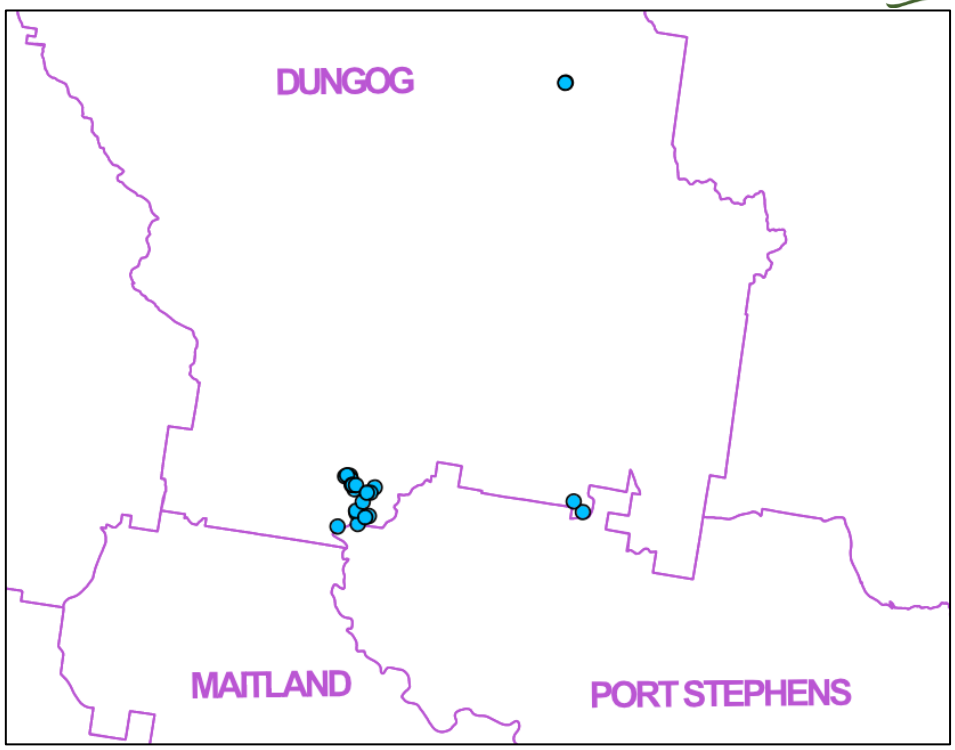

Figure 20. Regional overview of Water hyacinth locations across the Hunter Region.

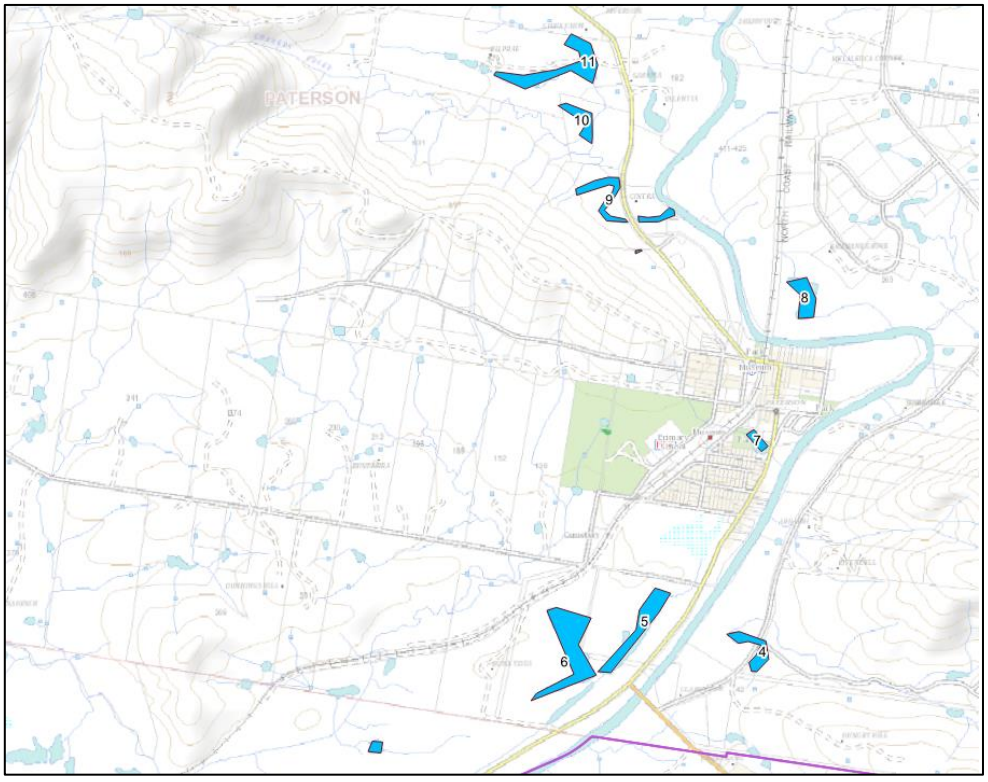

Figure 21. Water Hyacinth in 17Ha of dams in the vicinity of the Patterson River, in the Paterson area of Dungog LGA.

Treatment options and discussion

A variety of mechanical, chemical, and biological controls are available to control Water hyacinth. With the purpose of the strategy being to eradicate where possible, biological control comes of the list of options here, as control agents are inherently unable to completely destroy their hosts and therefore not considered a tool for eradication (Paterson, *et al.*, 2021). A mix of mechanical harvesting and chemical control could be implemented, especially where large amounts of biomass are present. Otherwise a simple inspection herbicide treatment regime should be all that is needed here. Products containing Amitrole, 2,4-D, Diquat, and glyphosate are all register for use on Water hyacinth in NSW.

Action plan

For upper hunter, Dungog and Cessnock intermittent invasions have and could continue to pop up, often through online sales and other forms of trade for ornamental or other purposes. These should be dealt with under the Regional Rapid Response Plan. The table below outlines Regional priorities.

Inspection & Treatment Action Table

Infestation ID	Site	Frequency	Responsibility	Funding priority	Indicative annual hours
WH1	Forsterton Rd	Biannual	Project Administrator	High	16
WH2	King St, Clarence Town	Biannual	LCA	Medium	16
WH3	Fotheringay Rd, Clarence Town	Biannual	LCA	Medium	16
WH4	Martins Creek Rd, Patterson	Biannual	LCA	Medium	16
WH5	Tocal Rd, Patterson	Biannual	LCA	Medium	16
WH6	Tocal	Biannual	LCA	Medium	16
WH7	Maitland Rd, Patterson	Biannual	LCA	Medium	16
WH8	Lomandra CCT, Patterson	Biannual	LCA	Medium	16
WH9	Gresford Rd Patterson	Biannual	LCA	Medium	16
WH10	Gresford Rd Patterson	Biannual	LCA	Medium	16
WH11	Gresford Rd, Patterson	Biannual	LCA	Medium	16

Water lettuce

Biology, ecology and critical vulnerabilities

Know commonly as Water lettuce, *Pistia stratiotes* L. is yet another ornamental plant traded globally and as suggested by (Rojas-Sandoval, *et al.*, 2013) is present either naturally or through human introduction, in nearly all tropical and subtropical fresh waterways globally. Water lettuce grows in a very wide variety of aquatic habitats, though it can favour relatively stagnant water. Usually a free-floating plant, it can survive for extended periods resting on moist soil. The plant is sensitive to frost. Its low temperature tolerance limit is 15°C, and its salinity tolerance is 1.66% (Rivers L, 2002). A perennial free floater that reproduces by seed and asexually via vegetative offshoots that are connected to the mother plant by stolons (Holm, *et al.*, 1977). A range of economic, environmental and social impacts arise after the introduction of the weed, and are in line with those presented for other weeds within this report.

Distribution & mapping

Water lettuce in the Hunter Region is present across only 3 LGS's, and whilst restricted and well under control at Cessnock, it is unfortunately quite scattered in Maitland and MidCoast. Cessnock has had two previous instances of the weed at Allandale and Buchanan with both sites currently free from the weed. Maitland has essentially two areas of infestation, Oakhampton and Telarah/Louth Park. All sites are under treatments and monitoring arrangements by Council and currently free from the weed. The MidCoast sites are scattered generally in the Taree area.

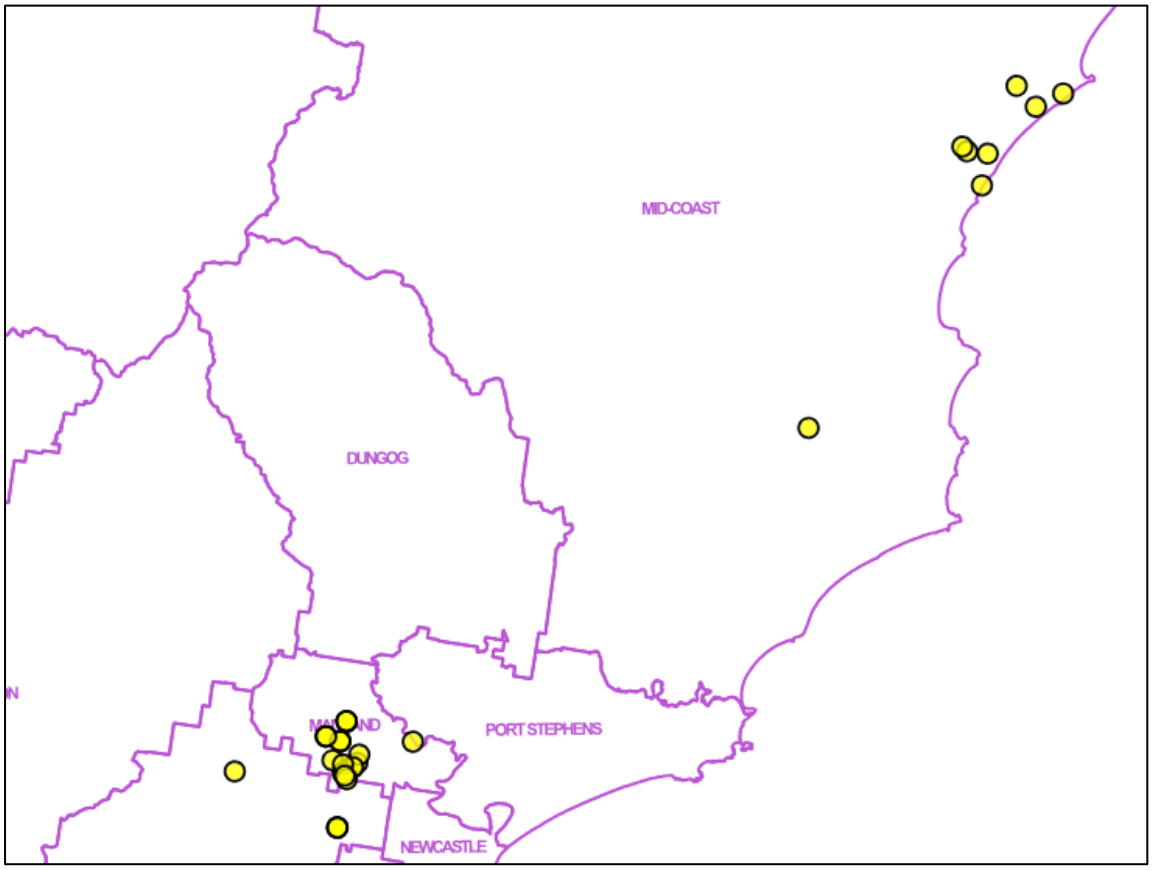

Figure 22. Regional overview of Water lettuce locations across the Hunter Region.

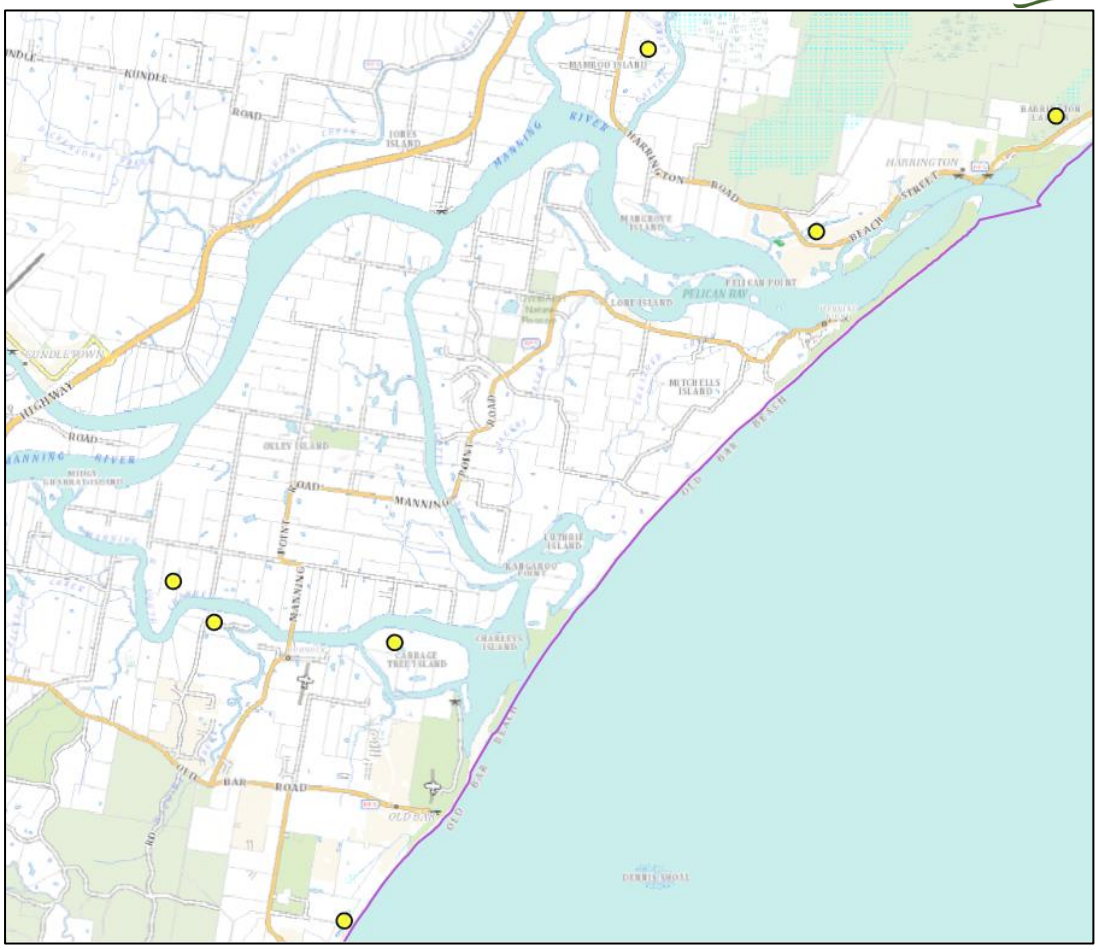

Figure 23. Water lettuce in 7 dams over 7 properties in the Taree area.

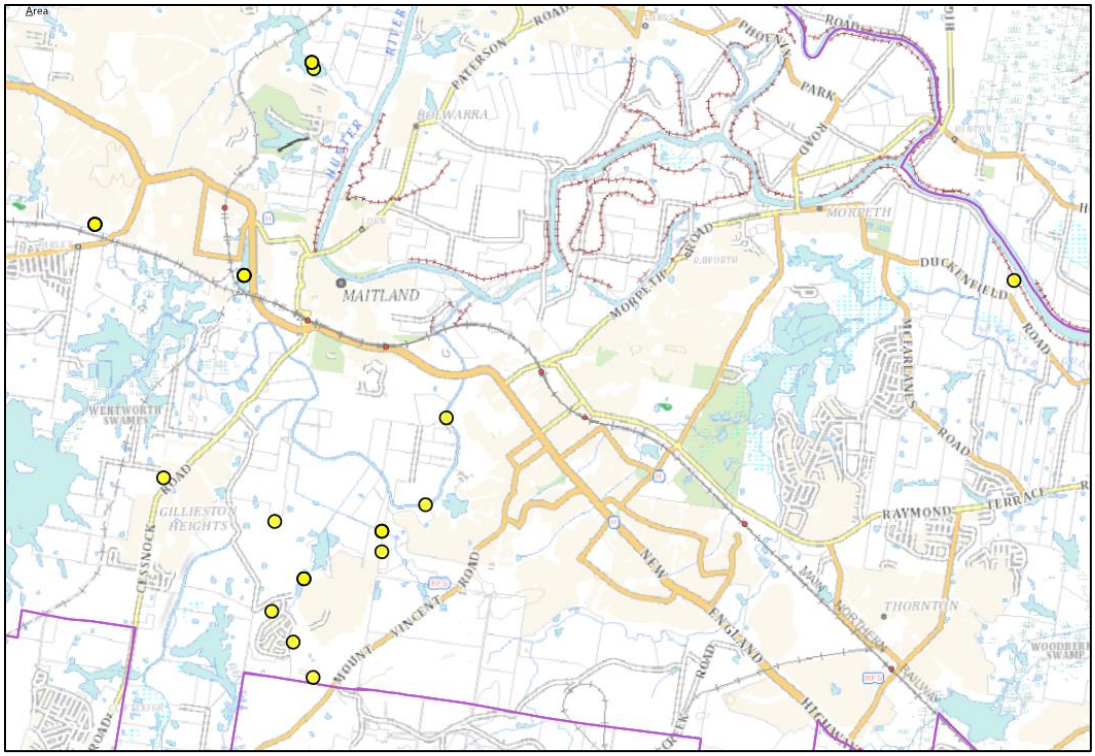

Figure 24. Water lettuce scattered over 28 properties in Maitland.

Treatment options and discussion

As with other aquatic weeds, a variety of mechanical, chemical, and biological controls are available to control Water lettuce. Again with the purpose of the strategy being to eradicate where possible, biological control comes off the list of possible options here and is generally considered most successful in tropical and sub-tropical situations anyway (Paterson, *et al*., 2021). A mix of mechanical harvesting and chemical control could be implemented, especially where large amounts of biomass are present. Otherwise a simple inspection and herbicide treatment regime should be all that is needed to obtain the desired level of control. Products containing Carfentrazone-ethyl, Flumioxazin, 2,4-D, Diquat, and glyphosate are all register for use on Water lettuce in NSW.

Action plan

A challenging component of the Water lettuce action plan will be the number of stakeholders. With 40 individual properties affected. Some sites are well under control, so for properties where the weed has been absent for more than 3 consecutive years, an annual inspection program is all that is required. For sites where the weed has been present more recently inspections by LCA's 4 times annually, and treatments as needed will be required to continue to push the weed towards Regional eradication.

Inspection & treatment Action table

Quarterly inspections to occur October, December, February, April. Annual inspections due February. All inspections to be logged in BIS. Sites 2 and 3 given high priority due to Regional Isolation, and site 4 high due to its public nature.

Infestation ID	Site	Frequency	Responsibility	Funding Priority	Indicative annual hours
WL 1	Wallabi Point Treatment ponds	Quarterly	Project Administrator	High	32
WL 2	Lovedale	Quarterly	Project Administrator	High	8
WL 3	Buchanan	Quarterly	Project Administrator	High	8
WL 4	Telarah Lagoon	Quarterly	Project Administrator	High	32
WL 5 – WL 32	Maitland sites other than WL4 & WL33	September, December, March	LCA	Medium	48
WL 33	Telarah Lagoon (car yard)	Quarterly	Project Administrator	High	8
WL 34 – WL 40	Midcoast sites other than WL1	September, December, March	LCA	Medium	48
WL36	Cabbage Tree	Quarterly	Project Administrator	High	32

Communication plan

Activity	Stakeholders involved	Tools/actions	Key messages/actions	Who is responsible	Timeframe
Stakeholder notifications/secondment	all	Mail out to all	• Initial notification of the plan • Finalise stakeholder contact details	LCA's	Prior to finalisation & post finalisation of the Strategy
Draft strategy delivered for comment	Councils All other primary project partners	Distribution of the draft plan	Ensure all parties understand intent and responsibilities	RWC	Prior to finalisation
Promotion of final plan	All members of the public	Include educational material and promote events on social media. Events can be advertised prior, or outcomes of events can be promoted.	• Encourage compliance • Encourage contribution of distribution data • Encourage involvement	Councils LLS and other authorities	On Finalisation of Strategy
Social media marketing	LCA's and LLS communication teams				throughout lifespan of project
Ongoing dialogue and collaboration	Councils All other primary project partners	Group emails or mail outs	Encourage ongoing involvement and engagement from all councils and other project partners	Project manager or RWC	Ongoing throughout lifespan of project
Species specific "taskforce" meeting(s)	All land owners of the weeds especially where contractors will not be funded	Landholders take ownership of weed control requirements	Build a team environment in the fight against the weed	Project manager	Early implementation
Contractor reports	Contractors and project manager	Reports to BIS to accompany invoices confirming works completed		Contractor	Quarterly

MERI Plan

Monitoring, evaluation, reporting and improvement (MERI) strategies are a key part of a successful management strategy (Figure 46; COA 2009). MERI allows the success and failures of management to be quantified and evaluated which can be reported and incorporated into adaptive management and program improvement to achieve positive environmental outcomes and return on investment.

Measurable goals provide a criterion which results of monitoring can be evaluated against. Satisfaction of the criteria will demonstrate the methods success or failure and provide a basis for improvement.

Inspection and treatment data will be entered into the Biosecurity Information System (BIS) by respective local government Biosecurity Officer.

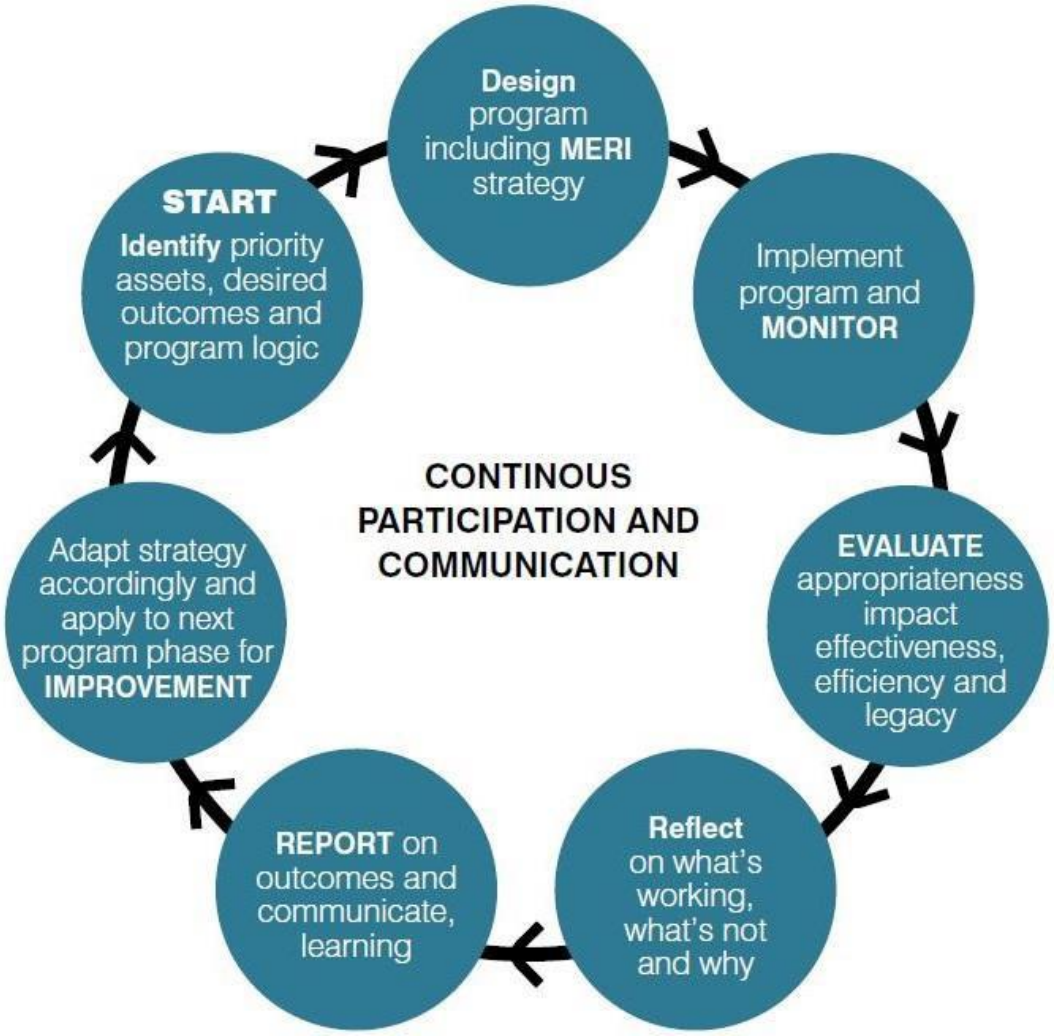

Figure 46. Program improvement and adaptive management approach to MERI (COA 2009).

Monitoring methods

The following methods have been developed for consistent monitoring:

- Data collected in the field will be based on input data consistent with the Biosecurity Information System (BIS), and entered into that system by LCA'a or by contractors engaged by LLS.
- Monitoring sites should be defined by maps included in this strategy. The Strategy can be a live document with new infestations able to be added if they are discovered through the life of the strategy
- Monitoring should be undertaken according to the action tables within the Strategy.

Evaluation

Quantitative evaluation can be undertaken using results from monitoring.

- Treatment & Inspections completed as per action tables (%)
- Change in presence absence of weeds at each site (e.g. increase or reduction).
- Stakeholder engagement levels (%)

An annual assessment by the Regional Weeds Coordinator of the appropriateness of the HAWES project that will include evaluation processes to help improve performance, fulfil accountability requirements and to collate learning to inform future programs will take place.

Quarterly Project Administration Team meetings will take place to review BIS records for all infestations in the strategy.

Key evaluation questions

Key evaluation question	Evidence
What % of actions have been completed?	**Record area of inspections and treatments in BIS database including GIS location.**
Is the treatment effective?	**Changes in weed cover, vegetation cover etc.** **Information recorded in reports from contractors and LCA's.**
Were there any other unanticipated, positive or negative change or other outcomes?	**Record information in reports.**
Consistency of Project Administration team meetings	**Record of meetings**

Evaluation questions for engagement plan

Key evaluation question	Evidence
To what extent has the engagement plan been achieved?	**Record the achievements of the engagement plan and document deviations through standard reporting formats and quarterly reporting.**
Have inspection & treatment targets been met?	**BIS records**
Number of attendee's at events or meetings	**Meeting minutes or workshop sign on sheets**
Were the key stakeholders engaged?	**Response to mail outs or call to action**
Evaluation of the activities	**What was the response? Were there any positive or negative outcomes?**

Reporting, Improvement and Adaptive Management

The Regional Weeds Coordinator to provide regular reflection on collated monitoring results, strategies, management processes and progress to inform an adaptive management approach for continuous quality improvement of the project. A brief report will be prepared for the Regional Weeds Committee annually by The Regional Weeds Coordinator with contributions from the project Admin team and LCA's. Reports will be used to guide any alterations to the plan or the management of any species within. The reports can be provided externally by the Regional Weed Coordinator or Regional Weed Committee.

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Appendix 1

Stakeholder information Table

(Available to LCA's only, removed from public document)

Appendix 2

Fine scale infestation mapping

(Available to LCA's only, removed from public document)

HUNTER REGIONAL weeds

PORT STEPHENS COUNCIL

HUNTER FAUNA & FLORA CONTROLS

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