



NSW DEPARTMENT OF  
PRIMARY INDUSTRIES

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# Part 5:

## Case studies

### Pinpoint mapping: keeping track of a moving target on the Hunter River

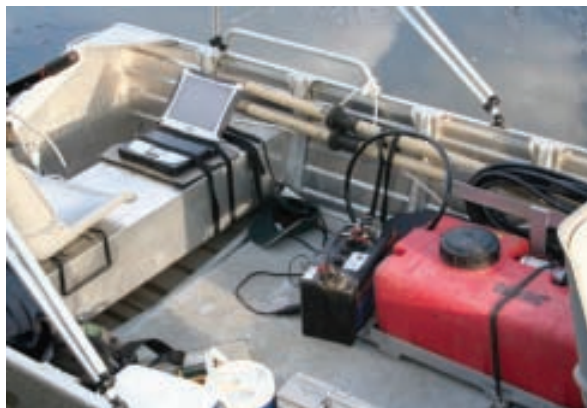
Written by Brian Worboys

Edited by Elissa van Oosterhout

#### Introduction

This case study presents a method of mapping alligator weed developed by Brian Worboys and Maitland City Council. The method was developed to allow better use of time and resources when controlling extensive alligator weed infestations in core areas, but it would also help in managing scattered infestations or plants in non-core areas.

Maitland City Council local government area is within the Lower Hunter core area for alligator weed distribution in Australia. The weed is widespread and long established in the area, occurring in both terrestrial and aquatic situations. This situation has called for extensive, ongoing, high-cost control efforts. The infestation-mapping method described here has reduced the time spent looking for and treating infestations and has provided a record of the control treatments carried out at any given site. It also enables assessment of the effectiveness of an ongoing control effort over time and allows for monitoring and recording of the spread of alligator weed, particularly in aquatic situations (along lengthy stretches of riverbank).



Pinpoint mapping set-up. Photo: Brian Worboys

#### What is pinpoint mapping?

Pinpoint mapping uses a global positioning system (GPS), a field laptop, a geographic information system (GIS) and a mapping program to record and track alligator weed infestations or plants. This technique can successfully pinpoint an infestation the size of a single stem.

The GPS is connected to the field laptop or is incorporated in the field laptop as one unit. (Maitland City Council's field laptop has the GPS incorporated as one unit.) The GIS MapInfo® and a mapping and inspection program called WeedMap® are installed on the laptop. Both programs are used in conjunction with the GPS to map, record and track weed infestations.

MapInfo® provides the geographic information required to map and record an infestation after the GPS has located exact coordinates. The WeedMap® program is then used to record the inspection and the control treatments that are carried out.

In Maitland City Council's local government area, pinpoint mapping is used to record alligator weed infestations along extensive stretches of riverbank. Inspections and mapping are done by boat, so the equipment and the method must be robust and easy to use in the field. Control treatments are carried out simultaneously and recorded as part of the inspection and mapping effort.

#### The alligator weed problem

In the Maitland City Council local government area (LGA), alligator weed infestations occur along the Hunter and Paterson River systems. The Hunter River is a major watercourse that runs through Maitland. The Paterson River forms a boundary between the Port Stephens and Maitland City Council LGAs. Both rivers supply irrigation water to the vegetable and turf farms



Pinpoint mapping locates alligator weed regrowth in amongst other vegetation. Photo: Brian Worboys



*Panasonic Toughbook® laptop with built in GPS and GIS software.*  
Photo: Brian Worboys



*A 4.2-m aluminium boat is used.* Photo: Brian Worboys



*Spray rig.* Photo: Brian Worboys

on the floodplain and the grazing lands in the foothills. Alligator weed infestations range in size from one or two plants to 2 or 3 m<sup>2</sup>.

Infestations occur along a 40-km stretch of riverbank on the Hunter River and a 17-km stretch of riverbank on the Paterson River. Maitland is subject to seasonal flooding and there is a high possibility for alligator weed from upstream areas to be washed out onto the highly productive floodplain, as well as downstream and into adjacent river systems.

Currently there are approximately 180 infestations scattered along the 57 km of riverbank on the Hunter and Paterson Rivers. (Before pinpoint mapping there were over 400 scattered infestations.) A number of years ago it became obvious that an effective and efficient control program was needed to manage, suppress and contain these infestations.

### Why is pinpoint mapping necessary?

In accordance with the gradual depletion strategy, it is important that each and every plant or infestation is treated with herbicide three times during the growing season each year. However, the problem of finding alligator weed amongst taller vegetation or similar-looking vegetation makes this difficult, particularly from a boat.

With the pinpoint mapping system every infestation that is found is recorded, treated and easily located for its follow-up treatments. With such accurate and effective control treatments there has been a reduction in the size and number of infestations along the riverbanks.

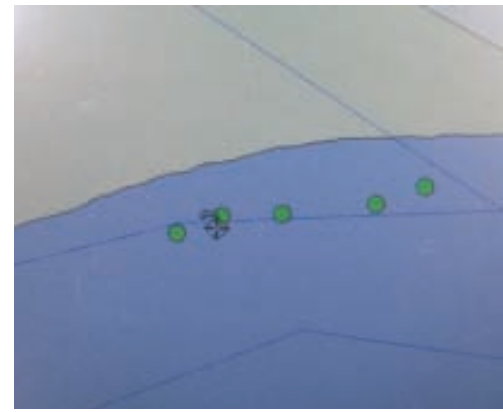
### Methods and equipment

Maitland City Council has used various methods to record infestations along the Hunter and Paterson Rivers over the last 10 years, and a number of improvements have been made over this time. The equipment currently used is as follows:

- GPS – incorporated in laptop by manufacturer
- laptop – Panasonic Toughbook CF 19®
- software
  - MapInfo® GIS
  - WeedMap® mapping and recording program.
- spray rig – 50-L tank with pump, with hose and hand gun
- boat – 4.2 m aluminium V-bottom boat with 25-hp motor



*Alligator weed infestations along the Hunter River.* Photo: Brian Worboys



Recorded infestations show as green dots on a map of the river that adjusts according to the boat's movement, shown as a black cross.  
Photos: Brian Worboys

## 1996 – 2000

In the early stages a Garmin II Plus® GPS unit was used to pinpoint infestations and the coordinates and size of infestations were recorded on pen and paper. The points would then be entered onto an Excel spreadsheet and incorporated onto Council's GIS system (MapInfo®) in a specific layer.

The process worked well at the time but had limitations and problems. Time and accuracy problems occurred with hand-recording of the coordinates and entering them into the GIS system. Inaccurate recordings could result in time lost looking for absent infestations. (All it takes is one wrong number and the record could end up way off target and be lost.)

## 2000 – 2003

The Garmin II Plus® GPS unit continued to be used but was connected to a laptop running MapInfo. The laptop was strapped to the boat seat and connected via a cable to the GPS. Council's GIS staff created a program in MapInfo® to run with the GPS. The rivers, property boundaries and previously recorded alligator weed infestations could then be displayed on screen. Records show as dots along a map of the river and the boat's location is also shown, allowing the GPS to guide the inspection to each previously recorded infestation. As the boat moves along the river the GPS adjusts the position on the map on screen.

To allow fast recording into MapInfo® a code system was developed for the weed species (this system is also used to record other weeds simultaneously), the area and density of the infestation, and the land use.

## 2003 – present

With the rugged locations the laptop was used in, Council decided to purchase a Panasonic Toughbook® Laptop Computer. The unit is able to handle dusty, wet, hot or cold conditions without failing. The laptop was purchased with a GPS incorporated in the unit.

In late 2003 Council purchased the WeedMap® software program from Rapid Map Global. This program assists with all aspects of noxious weed control at a local government level. The program has the capacity to operate with the GPS and MapInfo® in recording and displaying the control treatments that have been carried out at each recorded infestation.

## Inspecting, recording and treating

Two operators are able to carry out inspections and recording and control treatments, with one operator driving the boat and observing and the other operator observing from the bow. A 50-L spray unit is carried in the boat and used to treat the infestations. All infestations are spot-sprayed with metsulfuron-methyl herbicide under the Council's off-label permit.

With all systems working on the laptop the boat travels along the river as close as possible to the river bank, moving in and around trees and any obstructions as slowly as possible, with the motor just idling. At each green dot on the map (as shown in the photo above) the boat is driven in to the bank to find the recorded infestation or plant. If alligator weed can't be found the record is retained to enable follow-up inspections later in the growth season. When new infestations are seen the size and extent are checked on foot, and the infestation is immediately recorded and treated.

If the riparian vegetation is too dense, the observer walks along the bank while the boat operator continues to look from the riverside. New infestations are often found this way and are recorded and treated before they become established.

If the hose cannot reach an infestation from the boat, a small 4-L atomizer spray bottle is filled from the tank on the boat and used to treat the infestation.

## Key points

The combination of a GPS, GIS, mapping program and laptop has enabled Council to effectively and efficiently manage alligator weed infestations along the Hunter and Paterson Rivers. With the ability to reinspect and treat every known infestation three times over the growing season, Council has reduced the number of infestations along the riverbanks.

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*Two operators are needed for inspection, recording and treatment.*  
Photo: Brian Worboys



*New and regrowth infestations are treated immediately.*  
Photo: Brian Worboys



*The observer looks from the bank when the vegetation is dense.*  
Photo: Brian Worboys

# Coolabah Reserve: immediate eradication by using shallow mechanical excavation

*Written by Graham Prichard  
Edited by Elissa van Oosterhout*

## Introduction

This case study shows how an isolated infestation at Coolabah Reserve in the Port Stephens Council local government area was carefully and successfully eradicated by using an integrated approach involving herbicides, mechanical removal and manual removal.

## Coolabah Reserve stormwater basin

Port Stephens Council local government area contains approximately 3500 ha of land affected by alligator weed, with over 300 individual infestations on record. These infestations make up part of the core area infestations of alligator weed in Australia (see *Current distribution* in Introduction). Within this core area approximately 30 new infestations are recorded each year, most resulting from spread by floodwaters and machinery. When new infestations are isolated from the main areas of infestation they are treated intensively with the aim of eradication. This was the case with the Coolabah Reserve infestation.

The Coolabah Reserve stormwater basin is an 800-m<sup>2</sup> stormwater retention basin with a piped inlet and outlet points. The basin is in a suburban area and is surrounded by a mown grass buffer area.

## The infestation

In January 2004 following an alligator weed identification workshop conducted by the Port Stephens Council Weeds Unit for council field staff, horticultural staff reported alligator weed in the Coolabah Reserve stormwater basin, an area with no previous history of alligator weed infestation.

The site was inspected the following day and the new outbreak was confirmed. The infestation was surrounding the inlet pipe entering the basin and covered an area of approximately 60 m<sup>2</sup>. Dense growth of cumbungi rushes (*Typha orientalis*) had slowed the spread of the alligator weed through the basin, and it had not reached the outlet pipe. The infestation was considered small enough and had been detected early enough for immediate eradication to be feasible.

There were no possible upstream sources of introduction, and the cause of the outbreak was suspected to have been the use of reach mowers to slash the surrounding grassy embankments. (This method of spread has since been addressed, and hygiene protocols are now part of Council's slashing operations.)



An isolated infestation was found growing in the Coolabah Reserve stormwater basin. Photo: Graham Prichard



The alligator weed was close to the inlet, growing amongst dense cumbungi rushes. Photo: Graham Prichard



A 10 m × 10 m area was excavated to a depth of 150 mm.  
Photo: Graham Prichard



The result was a smooth bare surface. Photo: Graham Prichard



Machinery required careful on-site washdown. Photo: Graham Prichard

## The control strategy

Immediate eradication was the objective for this isolated outbreak in a previously alligator-weed-free area. The control strategy involved herbicide applications, mechanical removal of plant material and soil, and manual removal of regrowth with ongoing monitoring.

### Initial herbicide treatments

The infestation was immediately sprayed with herbicides before any mechanical removal, to improve visibility, reduce the amount of above-ground plant material, and lower the risk of viable fragments being spread further.

Initial treatments with glyphosate and metsulfuron-methyl herbicides were used to treat the alligator weed and effectively clear the drainage area of vegetation in preparation for mechanical removal. The initial treatments were followed 4 weeks later by another application, which helped with further knockdown of the alligator weed and the other vegetation.

### Shallow mechanical excavation

In August an excavator was brought in to remove the wet plant material and soil over an area of 100 m<sup>2</sup> (10 m × 10 m). It was apparent that the alligator weed had not sent down deep roots, so the excavation was kept to a depth of 150 mm. After one day's work, the final result was a bare smooth surface in one corner of the basin.

Council weeds officers went in on foot to guide the excavator operator to the exact extent of the infestation and to ensure that no alligator weed was missed.

The excavation required diligence and skill to prevent the spread of the alligator weed and to carefully remove as much plant and root material as possible. A secure disposal site was required to dispose of the 12 t of contaminated soil (Port Stephens Council has a nominated disposal site for alligator-weed-contaminated soil: see *Disposal* in Part 4). A water cart was brought in for on-site washdown of all the machinery and vehicles. After the work had been completed the machinery and vehicles were washed down and inspected.

Some alligator weed plants growing around the inlet pipe could not be dug by the excavator and had to be dug by hand. These were deeper rooted, with some roots going into the dry soil to a depth of 250 mm.

### **Manual removal and follow-up**

After the excavation the site was frequently checked for regrowth. It wasn't until 4 months later in January that regrowth was found, coinciding with warmer temperatures stimulating the remaining fragments. The fragments were removed manually.

### **Current alligator weed levels**

Since the last piece of alligator weed was removed 12 months after the infestation was discovered, (January 2005) there has been no regrowth and the program has been deemed successful to date. The site is monitored on an ongoing basis, and eradication will be declared a success when monitoring show no signs of regrowth for at least 5 years.

### **Key points**

The outbreak was detected early through field staff training. Council staff in other sections of the council (engineering, horticulture, machinery operators) are now aware of alligator weed control protocols (e.g. prevention of spread, hygiene).

Mechanical removal was successful because of the prior applications of herbicide; the slower plant growth in August; and the careful execution and follow-up to ensure that all plant material and regrowth was removed. This method has been used since at other sites to achieve successful eradication.

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*Small amounts of regrowth were found 4 months later and manually removed.* Photo: Graham Prichard



*The eradication program has been deemed successful to date.* Photo: Elissa van Oosterhout



*The site is monitored on an ongoing basis.* Photo: Elissa van Oosterhout



*'Crystal Brook' grows irrigated wheat, canola and rice in the Murrumbidgee Irrigation Area. Photo: Birgitte Verbeek*



*Alligator weed was found on an irrigation bank. Photo: Birgitte Verbeek*



*On further inspection alligator weed was found growing in the irrigation bay. Photo: Birgitte Verbeek*

## Living and farming near alligator weed infested areas: Barren Box Swamp

*Written by Birgitte Verbeek with Julian Zanatta  
Edited by Elissa van Oosterhout*

### Introduction

This case study presents the importance of being able to identify alligator weed. It also demonstrates the vigilance and persistence that are critical for preventing the spread of alligator weed from known infestations onto private property in flood-irrigation systems.

The 283-ha property 'Crystal Brook' is owned and operated by Julian and Josephine Zanatta and is located on the edge of the Barren Box Swamp near Griffith in NSW. The property is adjacent to the by-wash area of the Swamp near the entry point of Mirrol Creek. The property grows irrigated wheat, canola and rice. The family bought this property in 2001, but having lived in the Griffith region for many years they were aware of the nearby alligator weed problem. Julian attended a field day on alligator weed at the Swamp in 2001 to update his knowledge about the weed.

Irrigation staff found alligator weed in the Swamp in 1993. Local authorities and Murrumbidgee Irrigation immediately began containing, suppressing and eradicating the alligator weed in the swamp.



*Alligator weed fragments were found amongst the newly planted wheat crop. Photo: Birgitte Verbeek*



*The plants on the bank were immediately sprayed with herbicide.* Photos: Birgitte Verbeek



*Regrowth was found in the follow-up inspections.* Photo: Birgitte Verbeek

The Mirrol Creek by-wash area was one of the originally heavily infested sites in the swamp, and constant herbicide treatments have suppressed the infestation to scattered plants. Murrumbidgee Irrigation staff undertake regular inspections of the swamp and its associated channel systems and treat any outbreaks with metsulfuron, glyphosate or dichlobenil as appropriate.

### Finding the infestation

In May 2003 Murrumbidgee Irrigation staff members were conducting routine ground inspections for alligator weed within the Swamp at the by-wash area adjacent to 'Crystal Brook'. At this location a levy bank (10 to 12 m high) separates the swamp from the property. Staff members were checking over the bank and observed many terrestrial infestations in a drainage area about 20 m wide between the irrigation bays and the Swamp levy bank. On further investigation they found more plants growing on an irrigation bank that separated the drainage area from an irrigation bay that had recently been cultivated. One particular plant on the bank had obviously been cultivated over, and sections of the plant had spread throughout the irrigation bay. On further inspection within the irrigation bay area (2 ha) many segments of alligator weed were growing. Unfortunately the irrigation bay had been cultivated and sown to wheat several weeks before.

Murrumbidgee Irrigation staff immediately sprayed the plants they found on the bank with a tank mix of glyphosate and metsulfuron-methyl and then contacted Julian, officers from NSW Agriculture, and the Griffith City Council Weeds Inspector to advise them of the problem.

An onsite meeting was arranged on 12 May and a management plan was devised. Fortunately the infested irrigation bay had been the last bay to be sown, and after the property owners found out about the alligator weed infestation they ensured that all the cultivation equipment was thoroughly cleaned before it was used on other parts of the property.

### Current alligator weed levels

In October 2006 there were two remaining alligator weed plants in the irrigation bay. Further herbicide treatments were undertaken and no further regrowth has been observed to date. However, because the remaining underground plant material has not been physically removed there is a risk that regrowth will occur. The infestation is currently at a point where physical removal could be the key to successful eradication.

### The management strategy

The aim of the management plan was to eradicate alligator weed from the irrigation bay. To do this, the bay was taken out of production and managed so that treatment of alligator weed was the priority. The bay is still not in use, as further herbicide treatments, physical removal and follow-up work are still required before Julian can be confident that the infestation has been eradicated.

### Herbicide treatments

On 1 July the infested irrigation bay was treated with 1.5 L/ha of glyphosate herbicide and 10 g of metsulfuron-methyl herbicide with a water rate of 70 L/ha. The spray rig used was washed down with a pressure sprayer before being moved off the area to remove any soil and plant material.

After this initial treatment the area was inspected for regrowth and all areas of regrowth were pegged for future reference, with 16 areas identified for future monitoring and treatment. These plants were then spot-sprayed with the glyphosate and metsulfuron-methyl tank mix.

To begin with, regrowth plants were re-treated soon after they emerged, but after a number of months of treatment Julian was convinced that a better result occurred when the plants were allowed some time to regrow before being re-treated. (This is in line with current best practice advice to wait till there is at least 10 cm of vertical growth before treating with herbicides).



*Regrowth was re-treated once it reached the required height.*

Photos: Birgitte Verbeek



*By October 2006 there were only two remaining areas of regrowth.*

Photo: Birgitte Verbeek

On advice from local weed managers who had been suppressing alligator weed in the area for many years, Julian commenced using dichlobenil (Casuron G®) from March 2004. This chemical was applied to the 16 pegged regrowth areas. After two applications regrowth occurred in only three areas. These areas were treated a third time.

By October 2006 there were only two remaining areas of regrowth in the irrigation bay. Julian attributes this result to the sustained use of dichlobenil; although this is a typical result from this chemical there is always a risk that viable plant material remains underground.

### ***Physical removal opportunity***

Having suppressed the infestation to only two plants, there is now a chance for Julian to undertake physical removal of the remaining regrowth by using deep manual digging. Julian intends to irrigate the affected bay to stimulate growth and to determine whether he has won the battle of eradicating the weed in this area. Production in the irrigation bay will commence after monitoring shows that no regrowth has occurred over at least two seasons after physical removal has taken place, but careful monitoring will continue for at least 5 years after the last observed occurrence of the weed before eradication can be deemed successful.

### **Key points**

Early detection and persistence have prevented a major ongoing problem with alligator weed on 'Crystal Brook'. However, because the property is close to the known infestations within Barren Box Swamp, vigilant monitoring and rapid response to new outbreaks of alligator weed will remain important. The main lesson for irrigators is 'look before you cultivate'.

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# Containment and suppression of a non-core infestation: Currumbin District Horse Club

*Written by Lyn Willsher, Greg Mifsud and Paul Mason  
Edited by Elissa van Oosterhout*

## Introduction

The Currumbin District Horse Club is in the Southern Gold Coast area of south-east Queensland. The horse club is located on low-lying land close to Currumbin Creek and contains several drainage lines that feed the creek. Because of the low-lying, flat nature of the land water moves slowly in the drainage lines and the area experiences flooding in high rainfall events.

## The alligator weed problem

A weed control officer from Gold Coast City Council first identified alligator weed at the site during a routine inspection in May 2006. Patches of both terrestrial and aquatic alligator weed were present over 5 of the 12 ha of the horse club site. Aquatic alligator weed was abundant in the drainage lines, and the terrestrial form occurred in the pasture at various locations in the paddocks. One of the drainage lines containing alligator weed was surrounded by marine couch and the other is lined with mangroves and contains brackish water.

*Alligator weed was abundant in the drainage lines.* Photos: Greg Mifsud

## Current alligator weed levels

All known alligator weed plants at the site have been treated with herbicide. Although the site currently looks relatively clean it is expected that alligator weed will regrow following periods of rain and warmer weather. Follow-up inspections and further suppression and control work will be necessary for many years.

## The management strategy

The primary and most immediate aim of the management strategy is to prevent the further spread of alligator weed to other sites. Possible means of spread were identified as movement of stem fragments on slashers and vehicles, and movement offsite in horses' hooves, tack and horse manure. Actions are currently being put into place to prevent movement by these vectors.

The long-term aim is eradication of alligator weed from the site, as in Queensland it has been declared a Class One species (see table on page 15). It will take many years of suppression before it is feasible to consider eradication on the site. For eradication to be a likely





*One infestation was occurring in brackish water amongst mangroves.* Photo: Greg Mifsud



*The potential for spread of alligator weed in manure, hooves, tack and vehicles, and by slashing, was high.* Photo: Greg Mifsud

long-term objective, constant vigilance will be required from the Gold Coast City Council, the Queensland Department of Primary Industries and Fisheries and the Currumbin District Horse Club and its members.

## Management issues

A number of issues had to be incorporated into the management of alligator weed. First, the site is used to agist horses and also by club members to exercise and train horses, resulting in constant movement of horses on and off the property on training days. Fortunately the club is not actively involved in holding large competitions that involve the movement of horses to and from other regions or States.

Containment issues arising out of site usage include the potential spread of alligator weed through removal of horse manure from the site; potential spread of alligator weed through transportation in horses' hooves, tack and vehicles; and potential spread of alligator weed through slashing and maintenance works.

Another issue associated with weed management at a public recreation site is the need to communicate management practices to all site users to ensure that they are informed and supportive of management practices. The use of herbicides in waterways supporting mangrove communities also had to be considered, as well as the use of herbicides in paddocks being actively grazed by stock.

## Planning

After identifying the alligator weed, Gold Coast City Council pest management staff and Queensland Department of Primary Industries and Fisheries land protection staff carried out a joint site inspection. They needed to establish the scope of the infestation, the key stakeholders who need to be consulted,

possible sources of the infestation, management issues associated with the site, and management priorities and resource requirements. The key stakeholders were identified as representatives from the horse club, fisheries officers from Department of Primary Industries and Fisheries, slashing contractors, pest management staff from Gold Coast City Council and land protection staff from the Department of Primary Industries and Fisheries.

A central contact for the horse club was established, and that person was kept informed of management decisions. Two-way communications of issues relating to site management was encouraged.

## Assessing the infestation

Weed management officers from Gold Coast City Council surveyed the surrounding area over 2 days to determine the extent of the infestation. A number of terrestrial infestations were found on a small number of surrounding private properties. To date, staff have been unable to locate the source of the infestation. From information provided by a horse club member, it is thought that the alligator weed has been localised at the site for some time but only recently become more widespread when some earth was moved from one paddock to another. It is thought that slashers were responsible for spreading the alligator weed locally on the site.

It was decided at the initial on-site planning meeting that the first priority for management of the site was to prevent the further spread of alligator weed off site. Several actions were taken to prevent further spread, including changes to the slashing practice, consultation with horse club representatives, and control of alligator weed in drainage lines.



Signs were erected at the site. Gold Coast City Council

Shallow mechanical excavation was considered but not pursued further because of a number of issues, including the cost; the need to transport and dispose of contaminated soil; and drainage and water logging issues associated with the excavation of low-lying land.

### Quarantine and hygiene

Council designed, constructed and erected signs for the site to explain how alligator weed is spread and give details of the hygiene practices that need to be adopted by site-users to prevent the spread of alligator weed. Signs cover topics such as vehicle washdown, picking out horses hooves before leaving the site, and not removing manure from the site.

It was possible that alligator weed had been spread over the site through routine maintenance work carried out by a contract slasher operator. To minimise the risk of further spread by slashing, the council opted to use their own slasher at the site so they could be certain that adequate machinery hygiene practices were followed. To track down any other possible infestations that may have been spread by the contract slasher, council staff inspected other sites that the slasher had gone to after working at the horse club site. No further infestations of alligator weed were found.

Council also took the opportunity to use the site to educate its staff about the alligator weed threat. They held a site-inspection tour with staff from Engineering Services, Catchment Management, Natural Areas,

Beaches and Water Cycles to educate them in the identification of alligator weed and the correct response if new infestations are found.

Gold Coast City Council recently requested that horse club members refrain from using affected paddocks to allow council pest management staff unlimited access to the paddocks to apply herbicide.

It was established that the horse club members were removing horse manure from the site to keep the sheer volume of manure down in the heavily used paddocks. Removal from the site is undesirable because of the potential for weed spread, so Council is currently investigating locating a skip on site where manure can be deposited.

Disposal of the contaminated manure is still a concern, as most waste facilities will not accept the manure, and management practices at the only facility that will accept the manure will potentially facilitate the spread of the plant material. At this point in time Gold Coast City Council is investigating the possibility of placing the manure into a soil sterilisation unit. These units are designed to heat soil up to approximately 200°C to destroy harmful bacteria and microbes. Alligator weed can be killed at temperatures of around 60 to 70°C, and it is hoped that the soil steriliser will kill any plant material found in the manure. It is likely that the treated manure will then be deposited at the appropriate landfill site.

## Herbicide control in the vicinity of mangroves

Fisheries officers from the Department of Primary Industries and Fisheries were consulted about the possibility that using herbicides on the aquatic infestations in the drainage lines could have some effect on the mangrove trees. Following a site inspection with Fisheries officers, it was decided that licensed operators would apply glyphosate herbicide to the aquatic infestations, as containment of the alligator weed was the highest priority. To date there appear to be no ill effects on the mangrove trees.

The aquatic form has been treated twice to date with glyphosate herbicide at a rate of 1:100 by volume, applied with a vehicle-mounted Quickspray® unit. The initial treatments were done in July and August and required 400 L and 20 L of herbicide mixture, respectively. The first treatment took two staff 3.5 hours – a total of 7 hours. The August treatment was a spot-spraying application and took a further 2.5 hours to ensure no material was overlooked. A subsequent treatment was applied in October and required 400 L of herbicide mixture and took a total of 4.5 hours for two staff to complete. The timing and amount of herbicide used for this subsequent treatment are indicative of the rate at which alligator weed can grow, even after an initial knockdown application of herbicide.

## Herbicide control of terrestrial infestations

The terrestrial alligator weed in the paddocks was initially treated with a mixture of glyphosate herbicide (rate 1:100) and metsulfuron-methyl herbicide (1 g/10 L). The tank mix was used to knock down all vegetation growth so that any alligator weed growing amongst the pasture grasses could be seen and treated. These treatments were conducted once in July (100 L) and twice in August (total 70 L). The time taken to treat these sites varied, with two staff applying herbicide over 3 hours in July and one staff member taking approximately 4 hours to treat the infestation on the second occasion.

Spot-sprays of metsulfuron-methyl herbicide at a rate of 1 g/10 L were applied in July with 15-L hand-powered knapsacks. This treatment followed the initial knockdown and treated those plants that were found growing under the pasture grasses. This type of application is time-consuming and took two staff members approximately 5 hours to ensure complete coverage of the area.

The terrestrial infestations on the surrounding private properties were treated with a mixture of metsulfuron-methyl herbicide (1 g/10 L) and glyphosate herbicide at a rate of 1:100, using a hand-powered knapsack. The properties were treated in October with a total of 17.5 L of prepared herbicide, in November with 2 L of herbicide, and in February with 1.5 L of herbicide. The first application took the operator approximately 3 hours, whereas the subsequent applications take approximately 1 hour each.

## Key points

Because of the nature of both the location of this infestation and the usage of the site, both internal and external consultation has been essential. Good communication with key stakeholders has helped to change slashing practices, educate horse club members about weed hygiene, involve the owners of affected private properties, keep all stakeholders informed, and share management ideas among different agencies.

## Future management

An off-label permit will be applied to allow the use of metsulfuron-methyl on the aquatic infestations. From now on, an annual treatment program of three applications of metsulfuron-methyl will be used on both the aquatic and the terrestrial plants for ongoing suppression, until such time that the number of plants is reduced to the point that eradication through physical removal can be considered.

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