

Cleavers Action Plan

Actions for the Management of Cleavers in the areas covered by
Blackwood Biosecurity Inc.



Jon Dodd Consulting

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ABBREVIATIONS USED IN THIS REPORT

BAM Act	<i>Biosecurity and Agriculture Management Act (2007)</i> – the State’s principal biosecurity legislation
BBI	Blackwood Biosecurity Incorporated – the Recognised Biosecurity Group for the Blackwood River region centred on Bridgetown
DAFWA	Department of Agriculture and Food, Western Australia
LGA	Local Government Authority/ies
NHT	Natural Heritage Trust
WA	Western Australia

Cover photo: Blackwood Valley upstream from Bridgetown, December 2016 (Photo - Jon Dodd)

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SUMMARY

The weed Cleavers was already relatively widespread and well established when it was first recorded in the Bridgetown area in late 2004. The timing and cause of its initial introduction are unknown, but it was possibly first introduced ~20 years earlier.

The Cleavers Action Plan presented here is structured on the principles of weed management planning described in the *Introductory Weed Management Manual* (NHT 2004)¹, which is a national document prepared by the CRC for Australian Weed Management.

This plan proposes that several actions should be undertaken in 2017 before any actual control operations are carried out. The proposed actions should provide more comprehensive knowledge about this weed than currently exists; for example, knowledge of the weed's distribution throughout the BBI area is incomplete, and the weed's actual environmental and agricultural impacts in the area have not been documented formally.

This improved knowledge will, in turn, allow an objective, evidence-based assessment to be made of the impact and significance of Cleavers. The resulting assessment should then enable Cleavers to be ranked relative to the other declared weeds currently targeted by BBI.

Conducting an objective assessment of Cleavers is a critical step, because the resulting priority levels will allow BBI to decide where to target its weed management resources and effort and, therefore, how much effort to invest in Cleavers management.

The actions proposed are grouped into three categories

Group 1 – actions to be undertaken in 2017 that will provide essential background information on Cleavers in the BBI area.

Group 2 – objective assessment of the impacts and significance of Cleavers and BBI's other priority declared weeds. The results of these assessments will determine whether to proceed with subsequent actions, which largely deal with control.

Group 3 – subsequent actions to pursue if the comparative assessment shows that Cleavers has sufficiently high priority status to justify further management/control actions.

The various actions required for each category are detailed in the following report.

¹ *Introductory weed management manual. Module 1: Developing and implementing a weed management plan.* CRC for Australian Weed Management and the Department of Environment and Heritage, Canberra. 26 pages.

INTRODUCTION

Scope

In Spring 2016 Blackwood Biosecurity Inc. (BBI) contacted the Invasive Species Program of the Department of Agriculture and Food, Western Australia (DAFWA) for assistance in developing an Action Plan for Cleavers (*Galium aparine*)² in Bridgetown and, more generally, in the areas represented by BBI. This led to the involvement of *Jon Dodd Consulting* to develop the plan.

BACKGROUND

Blackwood Biosecurity Inc. (BBI)

Blackwood Biosecurity Inc. (BBI) is a recently-established Recognised Biosecurity Group whose vision is 'to prevent, eradicate, contain and minimise the economic, environmental and social impacts of declared pests in the Shire of Bridgetown/Greenbushes' and 'to foster an informed community equipped for early identification and management of declared pests' (Anon/Posavec, undated).

Initially centred on Bridgetown/Greenbushes Shire, BBI's area now includes the Shires of Boyup Brook and Nannup, and the southern part of Donnybrook Shire.

Priority pest species for BBI

Cleavers (*Galium aparine*) is one of several weeds that are priority declared pests currently targeted by BBI, the others being Narrow-leaved Cotton bush (*Gomphocarpus fruticosus*), Blackberry (*Rubus* species), Paterson's curse (*Echium plantagineum*) and Bridal creeper (*Asparagus asparagoides*) (Howat, 2016).

Three declared vertebrate pests (foxes, feral pigs and wild rabbits) and feral cats are also priority species for the BBI.

Cleavers weed status

Cleavers is native to Europe and Central Asia. It was a relatively early introduction to Australia and had established as a crop weed by 1866. It is a competitive climbing plant found in crops, along fences and on waste land, and is recognised as both an agricultural and environmental weed. It is widely distributed and often common in eastern Australia from south-east Queensland through to South Australia and Tasmania (Weeds in Australia, undated).

Richardson *et al.* (2011) describe Cleavers as a widespread weed of gardens and disturbed sites, in all States.

² Two very similar-looking *Galium* species are reported from the Bridgetown area, Cleavers (*G. aparine*) and False cleavers (*G. spurium*) (FloraBase 2016). Both are declared pests and on a few occasions have been collected from the same locations, e.g. Carbanup Brook Road. This report will generally not differentiate between the two and will refer to them both as Cleavers.

Cleavers is understood to be a recent introduction to WA. It caused concern to grain growers and DAFWA when it was listed as a seed contaminant of Canola seed imported into this State in the mid-1990s. Fortunately, no Cleavers populations established as a result of the contaminated Canola seed being sown. At that time, Cleavers was not known to be naturalised in this State, although the WA Herbarium holds a specimen of *G. aparine* that had been collected in 1985 from Whitlock Island Nature Reserve, off Jurien Bay.

The detection of several populations of Cleavers in the Carbanup Brook Road area south-east of Bridgetown in late 2004 was the first time that large populations of this weed had been reported in the State.

Cleavers was already relatively widespread and well established when first recognised as a weed in the Bridgetown area. The timing and cause of its initial introduction are unknown, but it was possibly first introduced ~20 years earlier. Its discovery in several mature timber plantations suggests that its introduction might have been associated somehow with plantation establishment or maintenance.

Cleavers specimens have been collected from a few WA locations in the following Local Government Areas (LGAs): Armadale, Bridgetown-Greenbushes, Busselton, Dandaragan, Harvey, Koorda, Perenjori, with most specimens coming from around Bridgetown, Busselton and Bunbury (FloraBase 2016).

Declaration Status

Both Cleavers (*G. aparine*) and False cleavers (*G. spurium*) are declared pests under section 22(2) of the *Biosecurity and Agriculture Management Act 2007 (BAM Act)*. Although they are declared pests, neither species is assigned to a control category³, and they are termed 'unassigned'. Their unassigned status recognises that they have harmful impacts under certain circumstances where their subsequent control requirements are delivered by a plan or other legislative arrangements under the BAM Act.

CURRENT SITUATION

Known distribution in the BBI area

Following the detection of Cleavers populations in the Bridgetown/Greenbushes Shire in late 2004 a considerable amount of surveillance and mapping activity was undertaken to document the weed's extent in the Shire. Since then there has been some intermittent searching and mapping; however, there is currently no comprehensive documentation of the distribution of Cleavers in the areas covered by the BBI because many areas have not yet been checked for this weed.

The greatest number of known infestations are in those areas 10-15 km south-east of Bridgetown, especially along Tweed Road, Carbanup Brook Road, and along the Blackwood River between the Carbanup Brook and Ti Tree Gully junctions. This corresponds largely with the areas where it was first reported in 2004/05.

³ Control categories are: C1 Exclusion, C2 Eradication, C3 Management.

Some State NRM funding is currently being used to update information on the distribution of Cleavers in the areas represented by the BBI, and to map the weed's current distribution. This activity includes a component of 'Citizen Science' reporting that involves members of the public reporting populations of the weed.

During a meeting on 20 December 2016 between BBI members, DAFWA Biosecurity officer Julie Webber, and *Jon Dodd Consulting*, some other Cleavers infestations beyond Bridgetown/Greenbushes Shire were mentioned, specifically ~10 properties in Donnybrook Shire, an area adjoining the Greater Kingston National Park, and one small patch at Donnelly.

Impacts

In the BBI area Cleavers is currently behaving largely as an environmental and amenity weed, and is not causing obvious, direct impacts on agriculture or other primary industries, including plantation-based forestry.

BBI is concerned that - if left uncontrolled - Cleavers could contaminate harvested grain when growing alongside crops, and that its vigorous growth in timber plantations could smother newly planted tree seedlings. BBI is also aware that some landholders are already committing considerable resources and effort to Cleavers control.

Stakeholders

A large number of stakeholders were identified during the 20 December meeting, specifically:

- Private landholders.
This includes ~2,000 absentee landholders, to whom BBI recently sent a letter providing information on Cleavers and other priority pests.
- Plantation owners and managers, of which there are many in the BBI area.
Although Cleavers appears to have no direct impact on plantation forestry, it is known to occur in plantations and might have been introduced during the establishment of the plantations decades ago. Plantations are viewed as Cleavers seed sources and timber trucks as primary vectors.
- The Shires/Local Government Authorities in the BBI area.
Shire workers have a key role in reporting the presence of Cleavers infestation on roadsides, in reserves, etc.
- Government agencies.
This includes agencies responsible for managing Cleavers-affected and Cleavers-prone land, such as Main Roads WA, Water Authority and DPaW.
- Outdoor recreation groups,
This includes specialist groups such as bushwalkers, canoeists, cyclists, and Blackwood Marathon organisers and participants who might visit Cleavers-infested sites.
- Members of the general public.
- Blackwood Biosecurity Inc.

Current concerns regarding Cleavers in Bridgetown

The following comments, concerns and observations about Cleavers were expressed by BBI and DAFWA participants during the 20 December meeting in Bridgetown. They reflect the extensive amount of local knowledge and depth of concern about Cleavers.

- Cleavers is spreading fast.
- It seeds prolifically. Seeds survive 2-3 years.
- Germinates several times during the season.
- Does not need frost to stimulate germination.
- Seedlings/immature plants have been found in a creek line in February.
- It can progress from flowering to seeding very quickly.
- It occurs in bushland and on edges of bushland.
- Can be found under the densest native bush and in dense stands of bracken.
- Not a problem in the open, such as in pastures and paddocks.
- Abundant along the Blackwood River, which is the responsibility of Water Commission (not DPaW).
- Spreading from beside the Blackwood River into adjacent bushland.
- Especially prevalent in bushland on cool, damp south-facing slopes.
- Is difficult to control and requires many years of treatment to control.
- Can be controlled, but requires diligence and repeated applications of herbicides such as glyphosate 3 times per year, with SpraySeed® at the end of the growing season.
- Many people do not recognise it.
- BBI has reasonably good information on its distribution on roadsides.
- Kangaroos, rabbits and birds spread Cleavers seeds.
- Has not been seen in State Forest.
- Cleavers is a potential threat to rare flora, especially if growing on south-facing slopes; however, DPaW seems not to recognise the threat.
- Main concerns are to:
 - Prevent further spread, i.e. limit its distribution to that at present
 - Stop Cleavers at “The Ford”, i.e. the summer crossing of the Blackwood River from Tweed Road to Blackwood Terrace
 - During control, work in from the boundaries, i.e. undertake control in from the current distribution boundaries
 - Seek smarter control techniques such as more selective control methods
 - Important to protect natural assets such as good quality woodland/forest
 - Keep Cleavers out of conservation reserves
 - Prevent Cleavers invading cropping areas, eg the canola and hay-growing areas around Winnejup, due east of Bridgetown.
- Tree plantations are a major source of spread/infestation.
- There are multiple plantation owners/managers – they need to be brought on-side for effective Cleavers management, but this is hard to achieve.

- Plantation managers do not want to have to clean down vehicles leaving Cleavers-infested plantations. There is no supervision of plantation contractors.
- Can fire be used as an effective control tool? Eric Wheatley used fire for bracken control, which also destroyed Cleavers seeds on the ground surface.
- Need to repeat chemical or other control every 6-8 weeks.
- Has largely been controlled at the roadside site at the junction of the Elphick-Fleeton Road and Carbanup Brook Road.
- Has regrown after treatment in damp roadside opposite the old 1-teacher Sunnyside School building. Plants showed bunched regrowth typical of regrowth after glyphosate treatment.
- At Eric Wheatley's property (Snottygobble Hill) on Savage Creek Road, Cleavers has spread in recent years up the slopes from the valley floor to the crest.
- There are multiple seed sources along Carbanup Brook Road.

WEED MANAGEMENT PLANNING – PRINCIPLES

The principles of Weed Management Planning and developing a Weed Action Plan are described in Module 1⁴ of the *Introductory Weed Management Manual* (NHT 2004). Although the manual focusses mainly on developing a management plan for situations where there are several weeds present on a single reserve, property or site, the planning principles are applicable to larger areas, such as the portion of the Blackwood Valley that is covered by the BBI.

The manual describes the following four steps in developing a weed management plan.

Step 1: Site assessment - carry out a site assessment

Step 2: Develop a weed management strategy - set objectives based on priorities and available resources.

Step 3: Implement the strategy - develop and implement an action plan to achieve objectives

Step 4: Monitor and review - monitor performance and change actions as necessary.

As with most management processes, these steps are part of an ongoing process and need to be repeated in sequence over time.

Developing and implementing a Weed Action Plan is one step (Step 3) in the larger process of weed management planning (Table 1).

The activities required for each step are outlined in the following table (Table 1) and are discussed in more detail in the *Introductory Weed Management Manual* (NHT 2004).

⁴ **Module 1:** Developing and implementing a weed management plan. 26 pages.

Table 1: activities associated with each step of weed management planning (from NHT 2004).

Step 1: Site assessment

- Identify the presence of target weeds in the infested area.
- Map the location of weeds and landscape features in the infested area. The latter include features such as water courses, roadsides, bushland and reserves, plantations and farmland.
- Understand why the weeds are present. This includes how the weeds were introduced, where they have spread from, how they spread (i.e. vectors, both natural and human-mediated), and any differences in how readily sites are invaded.
- Identify risks associated with future management actions on infested sites/areas, such as closeness to watercourses and water bodies, presence of significant flora and fauna, site (in)accessibility, susceptibility to fire or flooding, and conflicting land uses.
- Identify and record other significant plants and animals present in infested areas.

Step 2: Develop a weed management strategy

- When dealing with several weeds of significance, determine which are to be the highest priority to manage by assessing the impact of each weed⁵
- Agree on the objectives for managing each weed.
- Set measurable objectives to achieve the agreed priorities, using the resources available.
- Keep a long-term view, recognising that weed management may take several years to make a difference.

Step 3: Implement the strategy

- Agree on the actions required to achieve the objectives, keeping in mind the resources available.
- Allocate responsibility for the actions.
- Make actions time-lined and measurable.
- Start delivering the actions.

Step 4: Monitor and review

- Periodically (such as annually) map weed distribution, abundance and density.
- Assess the impact of management actions on the target weed.
- Investigate and record which actions worked, and which have not.
- Revise the plan if objectives are not being met, techniques are not working, and so on. This will improve future outcomes from weed management.

⁵ See Appendix 1 for further discussion of impact assessment, and determining priorities.

CLEAVERS MANAGEMENT

The following section is presented as a table that lists weed management activities (from NHT 2004) and identifies the actions relevant to managing Cleavers in the BBI area.

Table 2: activities associated with weed management planning steps (from NHT 2004) in relation to managing Cleavers in the BBI area. **Actions in Bold** are recommended to be undertaken during 2017.

Weed management activity	Comment – in relation to Cleavers	Actions recommended for Cleavers in the BBI area (Bold = recommended actions for 2017)
Step 1: Site assessment		
Identify the presence of target weeds in the infested area.	Comprehensive mapping of Cleavers in the BBI area is required to delimit the weed infestation, and to form the basis for assessing control effectiveness. This is known as the <i>Delimitation Survey</i> .	Complete the mapping of Cleavers-infested locations in the BBI area, and record the extent and density of Cleavers within infestations.
Map the location of weeds and landscape features in the infested area. The latter include features such as water courses, roadsides, bushland and reserves, plantations and farmland.	The distribution of Cleavers in the BBI area is broadly understood, especially around Bridgetown, but is incomplete because not all areas have been surveyed for Cleavers. Much of the detail on landscape features can be derived from GIS-based mapping systems.	Include information on weed location and site landscape features when mapping Cleavers distribution.
Understand why the weeds are present. This includes how the weeds were introduced, where they have spread from, how they spread (i.e. vectors, both natural and human-	Cleavers dispersal methods are generally well understood. A range of natural seed vectors are involved in the spread of Cleavers (especially native, domestic and feral	For each infested site or area, analyse and document the main vectors likely to spread Cleavers seeds into and out of the site/area.

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<p>mediated), and any differences in how readily sites are invaded.</p>	<p>animals, and water) which prevents effective containment. NB: Controlling human-mediated spread is feasible; however, controlling natural spread is not.</p>	
<p>Identify risks associated with future management actions on infested sites/areas, such as closeness to watercourses and water bodies, presence of significant flora and fauna, site (in)accessibility, susceptibility to fire or flooding, and conflicting land uses.</p>	<p>Site-related risks are generally well understood, based on the current knowledge of the known distribution of Cleavers in the BBI area, and the sites it infests.</p>	<p>Liaise with DPaW to obtain better information on the location and characteristics of high-value conservation and biodiversity sites within the BBI area.</p>
<p>Identify and record other significant plants and animals present in infested areas.</p>	<p>Information is needed on the prevalence of Cleavers in high value native vegetation, and the weed's ability to invade this.</p>	<p>Liaise with DPaW to gain better information on the location and characteristics of sites containing significant native flora and fauna.</p> <p>Attempt to assess each site's susceptibility to Cleavers invasion, such as closeness to known Cleavers seed sources.</p>
<p>Step 2: Develop a weed management strategy</p>		
<p>When dealing with several weeds of significance, determine which are to be the highest priority to manage by assessing the impact of each weed.</p>	<p>BBI has identified five priority declared weeds (Cleavers, Narrow-leaved Cotton bush, Blackberry, Paterson's curse and Bridal creeper).</p>	<p>Conduct evidence-based assessment of the invasiveness and actual impact of Cleavers in the BBI area.</p>

		Undertake an objective assessment of the impact of Cleavers and BBI's other priority weeds, based on their threat level and feasibility of control, in order to determine the priority level of Cleavers relative to the other BBI weeds.⁶
Agree on the objectives for managing each weed.	For established weeds, the objectives will be largely centred on a) asset protection, and b) reducing risk of spread from infested sites. NB: at this stage without full documentation, the actual impacts and control feasibility of Cleavers both appear low.	If assessment (see above) indicates that Cleavers' priority status is high enough to justify further action, decide on future management objectives for Cleavers. For example: defining significant sites or assets to protect from Cleavers invasion; defining containment lines; identifying priority sites at which to limit or prevent seed production.
Set measurable objectives to achieve the agreed priorities, using the resources available.	For established weeds, long-term objectives might include reducing the weed's extent or density by 50%, halving the amount of time needed for control work, or revegetating a proportion of treated areas with native plant species.	Set measurable objectives for Cleavers management after the decision has been made on its priority status (see above). This, in turn, will reflect its impacts and feasibility of control, as well as the availability of resources for Cleavers management.
Keep a long-term view, recognising that weed management may take several years to make a difference.	For well-established weeds under asset-based management, the effort required is long term or, potentially, ongoing.	Anticipate a long term (5-10 years or longer) management program for Cleavers, if its

⁶ See Appendix 1 for further discussion of impact assessment, and determining priorities.

	Observations around Bridgetown indicate that the abundance of Cleavers can be reduced after several years' treatment.	control is demonstrated to be feasible and affordable.
Step 3: Implement the strategy		
Agree on the actions required to achieve the objectives, keeping in mind the resources available.	Decide the most effective control measures.	<p>In collaboration with weed control researchers, seek new control measures relevant to the Cleavers situation in Bridgetown, for example:</p> <ul style="list-style-type: none"> a) Investigate new control methods based on the wide range of herbicides recently approved (by APVMA) for use in environmental weed control⁷. b) Attempt to document the <i>ad hoc</i> herbicide-based control techniques reportedly used recently around Bridgetown, with a view to identifying any that were effective and permissible to use. c) Further investigate the relevance of fire for Cleavers control d) Investigate the role of revegetation as a control measure. <p>In order to reduce human-mediated spread by people and vehicles, a) undertake strategic control of Cleavers at frequently-</p>

⁷ Currently-used registered herbicides should continue to be used until any new herbicide-based methods become available.

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		visited infested sites, and b) increase roadside surveillance. Increase public and stakeholder awareness about Cleavers.
Allocate responsibility for the actions.	Involve active and cooperative stakeholders	BBI to confirm the list of stakeholders in Cleavers management. Allocate tasks to stakeholders once a) relevant tasks and b) appropriate stakeholders have been identified.
Make actions time-lined and measurable.		Develop time frames and performance measures once actions have been agreed.
Start delivering the actions.	These are dependent on the priority status of Cleavers relative to other declared weeds in the BBI area.	
Step 4: Monitor and review		
Periodically (such as annually) survey the prevalence of the weed by mapping or some other form of documentation.	A full <i>Delimitation Survey</i> will provide baseline information on the current (2016/17) distribution of Cleavers in the BBI area. Periodic future surveys will detect and document any changes in weed distribution and infestation level.	Undertake future periodic surveys at the same time of year, eg in late Spring when Cleavers is large and most conspicuous. Visit all known sites.
Assess the impact of management actions on the target weed.	Assess the impact of control on weed distribution, abundance and density	Establish several monitoring sites that are easily accessible and representative of the known distribution of the weed. At these

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		sites make detailed assessments (and take photos) of weed abundance, density, etc.
Investigate and record which actions worked, and which have not.	This will lead to improved future management actions.	Set up a database or other recording system to capture observations and measurements of Cleavers distribution, control, etc.
Revise the plan if objectives are not being met, techniques are not working, and so on. This will improve future outcomes from weed management.	This will lead to improved future management actions.	Adjust the plan in response to the results from regular monitoring, as outlined above.

ACTION PLAN FOR CLEAVERS

Actions recommended for the management of Cleavers in the BBI area

The many actions associated with the four steps in Cleavers management in the BBI area are presented in Table 2 – see pages 12-17 above.

Not all actions should be attempted at once; instead, it is recommended that certain ones should be completed in 2017 to provide the basis for deciding whether to proceed with others. The actions can be grouped into three categories

Group 1 – actions to be undertaken in 2017 that will provide essential background information on Cleavers in the BBI area.

Group 2 – critical actions for 2017 whose outcomes will determine whether to proceed with subsequent actions.

Group 3 – subsequent actions.

Group 1 Actions – essential background information on Cleavers

Table 3: Group 1 Actions for implementation in 2017

- | |
|--|
| <ul style="list-style-type: none"> ❖ Complete the mapping of Cleavers-infested locations in the BBI area, and record the extent and density of Cleavers within infestations. ❖ Include information on weed location and site landscape features when mapping Cleavers distribution. ❖ For each infested site or area, analyse and document the main vectors likely to spread Cleavers seeds into and out of the site/area. ❖ Liaise with DPaW to obtain better information on the location and characteristics of high-value conservation and biodiversity sites within the BBI area. ❖ Liaise with DPaW to gain better information on the location and characteristics of sites containing significant native flora and fauna. ❖ Attempt to assess each site’s susceptibility to Cleavers invasion, such as closeness to known Cleavers seed sources. ❖ Conduct evidence-based assessment of the invasiveness and actual impact of Cleavers in the BBI area. ❖ BBI to confirm the list of stakeholders in Cleavers management. ❖ Establish several monitoring sites that are easily accessible and representative of the known distribution of the weed. At these sites make detailed assessments of weed abundance, density, etc. ❖ Set up a database or other recording system to capture observations and measurements of Cleavers distribution, control, etc. |
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The actions listed above (Table 3) are those that should be undertaken in the coming year (2017). Collectively these actions will provide essential background information required to

- fully describe the distribution of Cleavers in the BBI area,

- identify sites that are of high risk of invasion,
- identify sites with high biodiversity and conservation values that merit protection from Cleavers invasion,
- describe the actual impacts of Cleavers in the BBI area,
- assess the priority status of Cleavers relative to that of BBI's other priority weeds,
- establish a series of monitoring sites to reveal changes in the prevalence of Cleavers.

A further Group 1 action is for the establishment of a suitable recording system to capture all kinds of relevant information on Cleavers.

Other actions shown in Groups 2 and 3, below, will be required if Cleavers is shown to have a sufficiently high priority for BBI to justify pursuing further management actions against it.

Group 2 – critical action for 2017 whose outcome will determine whether to proceed with subsequent actions.

The action listed below in Table 4 is **critical** for deciding whether to pursue the remaining actions outlined in Table 2 (and repeated in Table 5).

Table 4: Group 2 Action for implementation in 2017

- | |
|---|
| <ul style="list-style-type: none"> ❖ Undertake an objective assessment of the impact of Cleavers and BBI's other priority weeds, based on their threat level and feasibility of control, in order to determine the priority level of Cleavers relative to the other BBI weeds. |
|---|

Assessing the impact of Cleavers is considered to be a key action (Appendix 1). Once done, this will provide essential information about the significance of Cleavers and the threat it presents in the BBI area.

The assessment will also allow comparison of the priority status of Cleavers and BBI's other priority weeds, and will enable BBI to decide its weed management priorities (Appendix 1).

All other actions listed below (Group 3) are dependent on the priority status determined for Cleavers. Consequently, they should not be started until the priority status of Cleavers relative to BBI's other priority weeds has been determined and agreed by BBI.

Group 3 – subsequent actions

The actions listed in Table 5, below, should be undertaken **only if assessment shows that Cleavers has sufficiently high priority status** (due to high impact and good feasibility of economical control) to justify further management input. Conversely, these Group 3 actions are **not** needed if Cleavers is found to have low priority status relative to the other priority weeds.

Table 5: subsequent actions – to be undertaken if Cleavers is determined to have a high priority status

- ❖ If assessment indicates that Cleavers' priority status is high enough to justify further action, decide on future management objectives for Cleavers. For example: defining significant sites or assets to protect from Cleavers invasion; defining containment lines; identifying priority sites at which to limit or prevent seed production.
- ❖ Set measurable objectives for Cleavers management after the decision has been made on its priority status. This, in turn, will reflect its impacts and the feasibility of its control, as well as the availability of resources for Cleavers management.
- ❖ Anticipate a long term (5-10 years or longer) management program for Cleavers, if its control is demonstrated to be feasible and affordable.
- ❖ In collaboration with weed control researchers, seek new control measures relevant to the Cleavers situation in Bridgetown, for example:
 - a) Investigate new control methods based on the wide range of herbicides recently approved (by APVMA) for use in environmental weed control.
 - b) Attempt to document the *ad hoc* herbicide-based control techniques reportedly used recently around Bridgetown, with a view to identifying any that were effective and permissible to use.
 - c) Further investigate the relevance of fire for Cleavers control
 - d) Investigate the role of revegetation as a control measure.
- ❖ In order to reduce human-mediated spread by people and vehicles, a) undertake strategic control of Cleavers at frequently-visited infested sites, and b) increase roadside surveillance.
- ❖ Increase public and stakeholder awareness about Cleavers.
- ❖ Allocate tasks to stakeholders once a) relevant tasks and b) appropriate stakeholders have been identified.
- ❖ Develop time frames and performance measures once actions have been agreed.
- ❖ Undertake future periodic surveys at the same time of year, eg in late Spring when Cleavers is large and most conspicuous. Visit all known sites.
- ❖ Adjust the plan in response to the results from regular monitoring.

CONCLUSION

Cleavers had generated a lot of interest and concern in the BBI area following its first detection in 2004.

This weed is noted for its ease and rapidity of spread, its distinctive appearance, its invasion of a variety of habitats within this section of the Blackwood Valley, and its abundance within some of those habitats. These invaded habitats include open forests (“bushland”), roadsides, disturbed sites with other weeds present, crop margins, and young timber plantations.

Many of the sites in which Cleavers occurs have been disturbed as a result of decades of grazing, clearing and other activities associated with the district’s long history of settlement, agriculture, horticulture and plantation forestry. Infested forest areas mostly have an intact canopy, but now lack the dense, species-rich understorey of native herbs and shrubs typical of undisturbed forest and woodland. There are few – if any – reports of Cleavers infesting undisturbed, intact native vegetation in the Bridgetown district.

It is possible that the growth and establishment of Cleavers around Bridgetown have been favoured by the district’s local cool climate, coupled with the absence of competition from understorey plants at many sites.

Close observation by BBI members and others has shown that Cleavers has multiple germinations over the season, and that it does not require frost to stimulate germination. The weed has been noted to be especially prevalent on cool, damp, south-facing slopes. It has been observed to be spreading quite rapidly up slopes from the banks of the Blackwood River to the valley crest. Native, feral and domestic animals are recognised to play an important role in spreading Cleavers seeds.

To date there has been no systematic approach to the management of Cleavers in the Bridgetown district, and there is no management plan for the weed. The present report is structured according to the generic steps and activities recommended for any weed management plan, and recommends many actions for the management of Cleavers in the BBI area - these are summarised in Table 2.

Some of these actions should be undertaken in the coming 2017 growing season, to provide essential background information on the weed and its impacts in the region. These are listed in some detail in Tables 2 and 3.

Information arising from those actions will provide the information required for performing an objective assessment of the priority status of Cleavers – in other words how serious is it and how does it compare with others priority weeds of interest to BBI (Table 4).

The assessment will, in turn, influence whether the remaining actions are required (Table 5).

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REFERENCES

- Anon/Posavec (undated). Bridgetown Greenbushes Biosecurity Group Draft Operational Plan. [Source: <http://www.bridgetowngreenbushesbiosecuri.epage.at/> Accessed 16/11/2016]
- FloraBase (2016). *Galium aparine*. [Source: <https://florabase.dpaw.wa.gov.au/browse/profile/17348> [Accessed 16/11/2016]. *Galium spurium*. [Source: <https://florabase.dpaw.wa.gov.au/browse/profile/25797> Accessed 16/11/2016].
- Howat, S (2016). Important Information for all Blackwood Valley Landowners. 2-page letter from Blackwood Biosecurity to landholders, sent 14/11/2016.
- NHT (2004). ***Introductory weed management manual. Module 1: Developing and implementing a weed management plan.*** CRC for Australian Weed Management and the Department of Environment and Heritage, Canberra. 26 pages. [<http://pandora.nla.gov.au/pan/64168/20080620-0000/www.weeds.crc.org.au/documents/manual.pdf>]
- Richardson, FJ, Richardson RG & Shepherd, RCH (2011). ***Weeds of the south-east: an identification guide for Australia.*** RG and FJ Richardson, Meredith, Victoria. 2nd edition. 546 pages.
- Weeds in Australia (undated). *Galium aparine*. [Source: http://www.environment.gov.au/cgi-bin/biodiversity/invasive/weeds/weeddetails.pl?taxon_id=5065 Accessed 23/01/2017)]

Appendix 1: Determining Weed Priorities

Source: copied *verbatim* from NHT 2004, pages 10-11.

Determining weed priorities

The decision on what weeds are to be the highest priority to manage should be based on an assessment of the significance of the impact of each weed present on the site and the feasibility of their control. The following approach may help you decide:

	Weed threat	
	Low	High
Feasibility of control		
Hard	Lowest priority	2 nd priority
Easy	3 rd priority	1 st priority

Table 1: determining weed management priorities

Whether a weed represents a low or high threat, is dependant upon a number of factors that relate to its invasiveness and impacts, for example:

- its ability to establish amongst existing vegetation
- its competitiveness when established
- likelihood of long distance dispersal (eg by birds, stock, wind or water, on machinery, etc.)
- extent of reduction in desired vegetation caused by the weed
- the change the weed causes to natural; ecosystems
- potential losses to agriculture.

To make an informed decision you will need knowledge about the weeds that are present and the nature of the problems that they represent.