Australian Association of Bush Regenerators

Working with natural processes

Glyphosate and chemical bans

This information has been gleaned from a range of official sources of advice on best practice herbicide use by AABR's *Chemicals in Biodiversity Management Working Group*.

(AABR does not provide advice on the use of chemicals)

The Australian Association of Bush Regenerators (AABR)

AABR promotes the study and practice of ecological restoration, and fosters and encourages effective management of natural areas by qualified people, based on sound ecological principles. Join us today to help promote good work practices in natural areas, strengthen our industry, and network with like minded people.

AABR Members include bush regeneration professionals, volunteers, natural area managers, policy makers, contractors, consultants, nursery people and local, state and Commonwealth government officers – and lots of people who just love the bush and want to see it conserved.

AABR's Chemicals In the Management of Biodiversity (CIMB) Working Group aims to:

- gather information from parties affected by a ban on Glyphosate, such as AABR members and local government
- collate information on the science behind chemical use to manage biodiversity
- provide information on:
  - the impacts of a glyphosate ban, or restrictions, on the control of weeds
  - the health and safety implications of chemical use in managing biodiversity
  - the experiences of other councils and organisations that have already restricted or banned glyphosate and the chemical alternatives being used
  - the biodiversity and conservation impacts of glyphosate and other herbicide restrictions.
  - weed management plans that show herbicides are a necessary, but minor part of conservation efforts or regeneration, with herbicide decreasing to minimal levels over time when implementing Integrated Pest Management systems.

Information sheet design: Little Gecko Media.

RESTORATION DECADE ALLIANCE

Australian restoration organisations supporting the United Nations **DECADE ON ECOSYSTEM RESTORATION** 2021–2030

AABR is a proud member of the Restoration Decade Alliance, a network of non-profit environmental restoration groups in Australia who have joined forces to support the goals of the UN Decade on Ecosystem Restoration.

We support THE ULURU STATEMENT

AABR acknowledges Australian Aboriginal and Torres Strait Islander peoples as the First Nations of this continent and recognises their custodianship and continuing connection to its land, waters and community.

We pay our respects to the Elders past and present and future, for they hold the memories, traditions, culture and hopes of Indigenous peoples across the nation.

Introduction

Over the past decade in Australia, a small number of local councils have implemented bans or restrictions on the use of glyphosate-based herbicides in their operations. Several of these councils eventually overturned or modified their bans after trial periods, citing economic and practical challenges relative to risk level. The Australian Association of Bush Regenerators (AABR), through its *Chemicals in the Management of Biodiversity Working Group*, has been monitoring local government actions in this area.

This fact sheet is to assist decision makers and other interested parties in gaining a high level knowledge of the scientific and emotional debate around glyphosate and other chemical bans. We provide case studies of several local government authorities that implemented partial or total chemical and / or glyphosate use bans.

Glyphosate is a widely used, broad-spectrum herbicide that has become a focal point in debates over chemical use in public land management.

This AABR fact sheet examines the reasons behind glyphosate bans, the role of glyphosate in local government weed control, the scientific and regulatory consensus on its safety, the importance of glyphosate for biodiversity management, alternatives to glyphosate, and lessons learned from council case studies. It also outlines AABR's position and summarises key findings for policymakers and practitioners.

Reasons for glyphosate bans

Local councils that moved to limit or ban glyphosate use have typically cited one or more of the following concerns:

- **Human health** Fears about potential health impacts on workers applying the herbicide or bystanders exposed to spray drift, contact with treated vegetation, or residues in soil. These concerns reflect the hazard potential of glyphosate (i.e. it could cause harm under some conditions), although actual risk depends on the level of exposure and adherence to safety precautions.
- **Environmental** Community worries about chemical residues in the environment and possible effects on soil health, water quality, and local ecosystems. Many residents and environmental groups have been uneasy about extensive herbicide use in public spaces and natural areas, pushing councils to consider "chemical-free" weed control methods.
- **Liability** High-profile court cases in the United States, notably jury verdicts in 2018–2019 linking long-term Roundup® use to cancer, and the World Health Organization's cancer research arm (IARC) classification of glyphosate as "probably carcinogenic to humans" (Group 2A) raised concern that continuing to use glyphosate might expose councils to future legal liability.[1,2]

  The publicity surrounding the U.S. cases created a strong impetus for some councils to "err on the side of caution" and suspend glyphosate use in spite of the cases not being based on scientific merit but jury based decisions and/or settled out of court.

  Class actions in Australia have, to date, been dismissed, and regulatory authorities here maintain glyphosate is safe as directed.[3]

ACRONYM KEY

APVMA Australian Pesticides and Veterinary Medicines Authority

EPA Environmental Protection Agency (United States)

EFSA European Food Safety Authority

FAO Food and Agriculture Organisation of the United Nations

IARC International Agency for Research on Cancer

(WHO); JMPR Joint FAO/WHO Meeting on Pesticide Residues

PMRA Pest Management Regulatory Agency (Health Canada)

WHO World Health Organisation, an agency of the United Nations

Use of glyphosate in local government

Glyphosate-based herbicides, in various formulations, are widely used by local government organisations for cost-effective weed control in parks, gardens, bushland reserves, roadsides, and other public areas.

In Australia, the registration of herbicides is overseen by the Australian Pesticides & Veterinary Medicines Authority (APVMA), which regulates product approvals, labels, and allowable uses, while state legislation regulates training and licensing for commercial pesticide operators to ensure safe use. Glyphosate has become the most heavily utilised herbicide both in Australia and globally, owing to its effectiveness, versatility, and comparatively low hazard when used properly.[4,5] It is a cornerstone of weed management across agriculture, urban landscapes, and environmental restoration. Land managers ranging from council staff and contractors to farmers and volunteer bushcare groups rely on glyphosate as a critical (if sometimes controversial) tool for controlling invasive weeds.

Considered from the viewpoint of land managers, glyphosate's dominance in weed control is underpinned by several practical advantages. It is off-patent and hence inexpensive, widely available, and has a 40+ year track record. Unlike many herbicides that target only certain plant types, glyphosate is non-selective, capable of killing a broad spectrum of grasses and broadleaf plants. This broad efficacy means a single application can replace what would otherwise require multiple different herbicides. In local government operations, glyphosate-based products are valued for their reliability and the reduced need for repeat treatments — factors that translate into lower labor and cost compared with many alternatives.

Regulatory and scientific consensus on safety

IARC Classification (Hazard)

In 2015, the International Agency for Research on Cancer (IARC, a branch of WHO) announced that glyphosate should be classified as "probably carcinogenic to humans" (Group 2A).[2]

This classification was based on what IARC determined to be limited epidemiological evidence of an association with non-Hodgkin lymphoma in exposed people, sufficient evidence of carcinogenicity in laboratory animals, and strong evidence for genotoxicity (DNA damage) in some studies[2].

It is important to note that IARC's evaluation addressed *hazard*, the potential of the material itself to cause cancer under some circumstances, and did not consider specific exposure scenarios or risk levels. That is, while the IARC did place glyphosate in the category of a probable carcinogen, along with items such as shift work and red meat consumption,[6] based on high-dose studies and certain occupational datasets, it did not quantify the likelihood of cancer at the exposures people, including applicators, typically encountered.

Regulatory risk assessments

In contrast to IARC's hazard-focused approach, pesticide regulators around the world have conducted extensive assessments of the *risk* of glyphosate use, which factors in exposure levels. The overwhelming consensus of these agencies is that glyphosate is unlikely to pose a carcinogenic or significant health risk to humans when used according to labelled directions and proper safety measures.

For example, the European Food Safety Authority (EFSA) in 2015 concluded that glyphosate is "unlikely to pose a carcinogenic hazard to humans" if used according to labelled directions and saw no scientific support for classifying it as a carcinogen.[7]

Similarly, the United States EPA, in its 2017–2020 reviews, affirmed that glyphosate is "not likely to be carcinogenic to humans" at expected exposure levels.[8]

Health Canada's Pest Management Regulatory Agency (PMRA) re-evaluated glyphosate in 2017 and likewise found no unacceptable risk, stating that glyphosate is not genotoxic and "unlikely to pose a human cancer risk" under normal use conditions.[9]

Australia's APVMA also reviewed glyphosate in response to the IARC report and decided in 2017 that there were "no grounds to place it under formal reconsideration," reaffirming that approved glyphosate products are safe when used as directed, and stated *based on this nomination assessment, the APVMA concludes that the scientific weight-of evidence indicates that:*

- *exposure to glyphosate does not pose a carcinogenic or genotoxic risk to humans*
- *there is no scientific basis for revising the APVMA's satisfaction that glyphosate or products containing glyphosate:*
    - *would not be an undue hazard to the safety of people exposed to it during its handling or people using anything containing its residues*
    - *would not be likely to have an effect that is harmful to human beings*
    - *would not be likely to have an unintended effect that is harmful to animals, plants or things or to the environment*[5].

The Joint FAO/WHO Meeting on Pesticide Residues (JMPR), which specifically examines dietary exposure, concluded in 2016 that glyphosate is unlikely to pose a carcinogenic risk to humans via diet, given the lack of tumor effects in animal studies at relevant doses and the absence of genotoxicity in standard tests.[10]

Overall evidence of health impacts

The general scientific evidence to date does not appear to confirm a causal link between glyphosate exposure and cancer in human populations at normal exposure levels, although scientific debate continues.

For example, numerous epidemiological studies have been conducted, including large cohort studies of agricultural workers. The largest such study (the U.S. Agricultural Health Study, following over 50,000 applicators) reported no association between glyphosate use and overall cancer incidence or most cancer sub-types, including non-Hodgkin lymphoma.[11] Some case-control studies and meta-analyses have observed a statistical association with non-Hodgkin lymphoma in certain high-exposure groups, but questions remain about potential biases and confounding factors in those datasets.

Regulators have generally weighed this evidence and found it insufficient to overturn the conclusion that glyphosate is unlikely to pose a carcinogenic risk when used with appropriate

precautions. That is, the consensus appears to be that **hazard does exist** (glyphosate can cause harm under some conditions, as IARC highlighted), but **risk to users and the public is low** *if* the product is handled in accordance with safety instructions, for example, using personal protective equipment, avoiding spray drift, and respecting no-spray buffer zones.

It bears mentioning that all chemical herbicides (and indeed many "natural" alternatives) carry some hazard and require such measures; and that glyphosate's profile, after decades of study, places it on the relatively low end of the toxicity spectrum by comparison with other herbicides used in similar situations.

Overall evidence of environmental impacts

Testing of the environmental impacts of agricultural and veterinary chemicals upon the environment is required as part of product registration process.

Glyphosate has a high LD-50 (i.e. threshold Lethal Dose required to kill 50% of a test animal population) and is classified in Australia as a Schedule 5 "Caution" poison, indicating substances with low toxicity that can be safely used with appropriate precautions[12]. Glyphosate products have been found to have potential toxicity to fish and amphibians at the concentrations of operational relevance (largely due to surfactants), which is why some glyphosate products are not registered for use in or near waterways. There are so-called "Frog Friendly" formulations developed that avoid the more toxic surfactants and are registered for use around, and even over waterways, to control aquatic weeds or weeds in riparian areas where the risk of drift into the water is high.

Glyphosate's mode of action (blocking a plant-specific enzyme pathway) is one reason for its low toxicity to most animals, the biochemical pathway it disrupts exists in plants and microorganisms but not in humans or other vertebrates.

Glyphosate also has a favorable environmental fate in soil: it binds tightly to soil particles and is broken down by microbes, so it does not persist as a long-term residual herbicide in most soils.[12]

Studies on glyphosate's primary metabolite, aminomethylphosphonic acid (AMPA) and its degradation products, however, do show instances of persistence in the environment and surface waters in measurable quantities. Some studies suggest that such environmental accumulation could render insects more susceptible to microbial pathogens due to melanin inhibition and other factors, and it appears that there can be at least short term effects on soil microbial communities.

While the degree to which glyphosate and its derivatives may have deleterious impacts upon non-target organisms including insects, soil microorganisms and fungi etc, is as yet inconclusive, such potential continues to be the subject of ongoing study.

Importance of glyphosate in weed management

Toxicity and environmental profile

The generally low human and environmental toxicity profile of glyphosate (described in the previous section) is one of the most important reasons for the preference for glyphosate over other herbicides. It is also not prone to volatilisation (i.e. conversion from a liquid state to a vapor), which avoids the chemical being readily inhaled or transferred to nearby plants. In addition, when used in accordance with guidelines, it has minimal leaching potential, particularly in clay and high-organic soils where it is readily bound up by soil particles. These characteristics mean that, relative to many alternative herbicides, glyphosate is less likely to contaminate water or non-target areas when properly applied.

Efficacy and cost-effectiveness

Another key reason glyphosate is so central to weed control is its broad-spectrum efficacy. It can kill a very wide range of weed species (grasses, broadleaf herbs, shrubs, vines and trees) by translocating systemically throughout the plants including into roots and rhizomes. Many other herbicides are selective (affecting only certain plant types) or only kill the foliage without affecting roots.

Using glyphosate often eliminates the need for multiple different chemicals or repeated re-treatments. This translates into cost savings and operational efficiency. For local councils managing hundreds of parks or roadsides, the ability to do one spray with glyphosate, as opposed to several passes with other methods, is a major practical advantage.

Glyphosate being off-patent also makes it one of the cheapest weed control options on a per-area basis, an important consideration for budget-constrained councils. This cost-effectiveness also, importantly, allows a far larger area of bushland to be treated for the same herbicide budget than if another more expensive or less efficacious herbicide or method were used, such as large infestations of woody weeds or dense vine tangles often cannot be effectively controlled by manual removal alone, especially when resources are limited.

Rapidity of treatment for biodiversity conservation

From a conservation perspective, herbicides have become an indispensable tool in combating environmental weeds that threaten native ecosystems by rapidly interrupting weed life-cycles and fostering their rapid replacement by natives.

The rapid-acting nature of glyphosate is highly important in the case of grasses, and to rapidly prevent seed production in herbaceous weeds that are already in flower. Its rapid action, including through well-tested specialised application methods, is also important to effectively counter highly aggressive woody weeds and particularly climbers whose regrowth can quickly overrun bushland, out-competing native flora and altering habitats.

In many cases, timely application of glyphosate-based herbicide is the only realistic way to contain or eradicate such weeds before they cause irreversible damage, without reverting to herbicides with a higher risk to applicators and the environment. As such, glyphosate allows bush regenerators to rapidly knock down these weed populations, after which the more time-consuming, careful spot spraying or manual follow-up of regrowth can take place to free up natural regeneration of natives. Indeed, such an approach reduces the reliance on herbicide use over the long term, as weed pressure diminishes and native plant cover

returns. In the interim, however, glyphosate treatment can be a critical initial step for protecting high-value conservation areas from being completely smothered by invasive species.

Specialised formulations

It's worth noting that not all glyphosate products are the same, and land managers take care to use appropriate formulations for sensitive situations. For instance, near waterways or wetlands, only certain glyphosate formulations are permitted, those with surfactants that have low toxicity to aquatic life (e.g. products like Roundup Biactive® or Weedmaster Duo®).

Regulators and water authorities often require these "aquatic approved" formulations for weed control in riparian zones, precisely to minimise harm to frogs, fish, and aquatic invertebrates. Standard glyphosate formulations can be more harmful to amphibians, so switching to these specialised products is a way to retain the weed-killing benefits of glyphosate while protecting waterway health.

In other cases highly diluted doses of glyphosate have been found effective (e.g. on Bitou bush if applied in winter or some grasses if applied during favourable growth conditions). These initiatives exemplify how glyphosate's use can be fine-tuned to balance efficacy and environmental safety.

Alternatives to glyphosate and their trade-offs

When political or public pressure has led councils to stop using glyphosate, they have typically turned to a combination of other weed control methods. Each alternative, however, comes with its own set of drawbacks in terms of toxicity, effectiveness, practicality, and cost. Experience has shown that a hasty switch "away from glyphosate at all costs" can inadvertently result in greater harm or lower overall performance if the alternatives are not carefully evaluated. Below is an overview of common alternatives and the considerations associated with them.

Other synthetic herbicides

Some councils that banned glyphosate initially attempted to substitute other synthetic herbicides (such as 2,4-D, glufosinate ammonium, or diquat) or increased the use of chemicals like metsulfuron-methyl for specific weeds. This approach can reduce glyphosate usage, but it often creates a paradox: the replacement herbicides may actually carry higher toxicity or environmental persistence, thus failing to reduce, and even potentially increasing, the risks that motivated the glyphosate ban in the first place.[13]

For example, diquat, (a broad-leaf selective herbicide sometimes proposed as an alternative) has far more acute toxicity to humans and wildlife than glyphosate. Other alternative herbicides like glufosinate ammonium or 2,4-D have higher toxicity profiles or irritancy compared to glyphosate and may pose additional risks (for instance, some formulations of 2,4-D are volatile and can drift onto non-target vegetation more readily).

Additionally, many alternative herbicides have longer soil persistence or other environmental impacts, for instance, residual herbicides can remain active in soils or groundwater, whereas glyphosate is generally not residually active.

Councils found that by banning glyphosate, they sometimes had to use a "cocktail" of different herbicides, or re-treat the site again with a different herbicide, to cover the same spectrum of weeds, increasing complexity and the chances of collateral effects.

"Organic" or "natural" herbicides

Natural-product herbicides, often referred to as "organic" weed killers, include substances like acetic acid (vinegar, in high concentrations), citric acid, pelargonic (nonanoic) acid, clove oil, pine oil, or other plant-derived oils. These have appeal as a more "natural" solution, and some councils have trialled them (e.g., using pine oil or fatty-acid-based sprays on street weeds).

While these products can be moderately effective on very young weeds or small annual species, they have significant limitations:

- **Limited efficacy** Most organic herbicides are contact phytotoxins, they burn off the top growth of plants but do not translocate to kill roots. They generally do not work well on established perennial weeds or plants with extensive root systems; the weed often resprouts from the root after a short time. Multiple repeat applications are needed, which can be labour-intensive. Their effectiveness is also weather-dependent, often requiring warm, sunny conditions for best results. In practice, councils found these products were only useful for spot-treating tiny weeds in hard surfaces or as a supplement to other methods, and that they were not useful as a blanket replacement for glyphosate in bushland.
- **High application rates and cost** Because they only affect the contacted leaves, natural herbicides typically must be applied at much higher concentrations or volumes than glyphosate to achieve results. For instance, horticultural vinegar used as a herbicide might be 15–20% acetic acid (household vinegar is ~5%) and needs to be sprayed generously to thoroughly coat the foliage, whereas glyphosate can often be effective at a lower rate of coverage, where leaves are coated but not dripping. This can mean far more of the product is required to treat a given area. Consequently, labour and supply costs escalate sharply.
- During its chemical-free trial, Frankston City Council found that overall weed control expenditures were projected to increase by hundreds of thousands of dollars annually, roughly a four to five-fold increase, due to the greater frequency and volume of treatments needed when using steam and organic products in place of glyphosate.[14]
- **Safety considerations** The word "organic" can be misleading as it is often used to imply no harm, whereas these products are not without hazards. High-strength acetic or citric acid can cause serious eye and skin burns; workers using them require acid-resistant gloves, face shields, and other protective gear. Some plant oils can be dermal or respiratory irritants, and members of the public have complained about the strong vinegar or clove oil odour when these sprays are used in parks. Moreover, the environmental impacts of repeatedly applying large amounts of acids or salts (such as the sodium in some herbicidal soaps) are not well studied; there is concern that they could alter soil pH, affect soil microorganisms, or harm aquatic life if runoff occurs.

In summary, "natural" does not equate to "harmless", these herbicides carry their own risks and often require precautions just as strict as those for glyphosate.

Thermal methods: steam and hot water

Thermal weed control using steam or hot water involves superheating water and applying it to weeds to scald and rupture plant tissues.

This method has been adopted by some councils especially in highly visible public areas (e.g. playgrounds, downtown sidewalks) where they want to avoid any chemical use. Steam can kill or significantly set back very small weeds and seedlings if applied correctly.

However, it suffers from major drawbacks:

- **Low efficiency** Steam is only effective where it directly contacts the plant, and it provides no systemic action. Perennial weeds with substantial roots often survive and regrow, meaning repeat treatments are needed for lasting control.

  More critically, steam weeding is extremely slow compared to herbicide spraying. Operators must hold the steam wand over each weed patch for several seconds to cook it, so treating large areas is laborious.

  Trials have found that using steam can be on the order of 10–15 times or more slower (or more costly) than using glyphosate for the same area.[15,13] In Hobart's trial, for example, council staff estimated that switching entirely to steam would cost over 15 times more than the status quo with glyphosate because crews could not cover the ground nearly as efficiently .[15] Similarly, the Town of Bassendean (WA) reported that steam/manual methods could be up to 10 times the cost of chemical treatment for their playgrounds and street verges, yet still wouldn't control certain tough weeds like couch grass or woody suckers effectively.[13]
- **High fuel and water use** Steam units are typically truck or trailer-mounted machines with diesel fired boilers and large water tanks. They consume significant fuel to generate steam, and large volumes of water compared to chemical spraying.

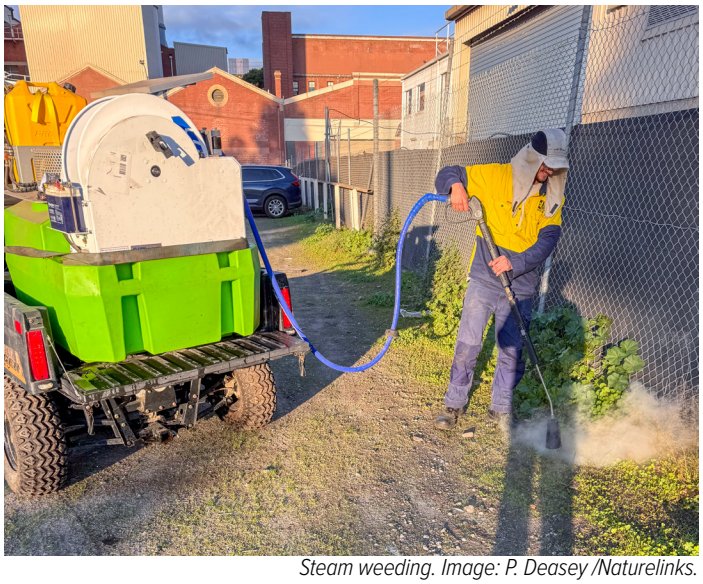
  From an environmental standpoint, the fuel usage translates into higher greenhouse gas emissions. Paradoxically, one environmental benefit of chemical herbicides in agriculture has been facilitation of no-till farming, which reduces fuel usage; by going fully "non-chemical" with methods like widespread steam, councils can end up burning more fossil fuel for the same weed control outcome.
- **Operational constraints** The equipment needed for steam weeding is expensive and heavy. Not all terrain is accessible, steep or rough bushland sites may not be reachable with a truck-mounted steam unit or may pose safety risks in transporting boiling water.

  Additionally, steam weeding is not suitable in fire-prone conditions; while steam itself is not flame, the process can dry out vegetation and has, on occasion, led to smoldering or small fires if used carelessly during high fire danger periods.
- **Safety** Steam avoids chemical exposure, but it introduces heat-related hazards. Operators work with very hot hoses and wands; there is risk of burns if an accident occurs. Extra care is needed to keep the public (and pets) at a distance during treatment to prevent scald injuries. In wet weather, surfaces can become slippery after steam treatment due to scalded plant matter, posing a temporary slip hazard to pedestrians.

In summary, steam has a role for small-scale weed control in sensitive locations and is generally well-received by the public in those contexts (no chemicals, visible "green" effort). However, as multiple councils discovered, it is not a feasible like-for-like replacement for glyphosate on a broad scale.

Hobart City's trial concluded that while steam could replace glyphosate in select high-sensitivity spots, the council could not afford to use steam for all roadside weeds without an enormous budget increase.[15]

Frankston City Council likewise found that after a few months of trying to maintain all parks and streets with steam and manual methods, the weeds were growing faster than they could control and the costs were ballooning, prompting them to abandon the "no glyphosate" policy after about 7–8 months.[14]



Steam weeding. Image: P. Deasey /Naturelinks.

Flame weeding

Another alternative occasionally proposed is flame weeding, using a propane torch to apply direct flame to weeds, essentially burning off the top growth. This method is used in some organic farming systems (e.g. to kill weeds between crop rows or along fence lines).

While flame can kill small annual weeds and even has niche ecological benefits (it can stimulate germination of certain native plant seeds adapted to fire cues), it is highly restricted in its application for obvious fire hazard reasons. In urban or peri-urban environments, using flame weeders is generally impractical except in very controlled situations.

Some councils and bushland operators find it a useful method of scorching patches of newly germinated weeds in damp conditions. During times of high fire danger or in areas with dry vegetation or mulch, flame weeding is unsafe. Even under moderate conditions, there is a non-trivial risk of igniting unintended fires, so councils have to exercise extreme caution and typically avoid this method except perhaps for very localised needs. Additionally, like steam, flame is a contact treatment, it may knock back weeds but often won't kill deep roots, in which cases repeated treatments are often needed.

Flame weeding typically involves the carrying of a 7kg bottle of gas along with the wand and hose, which occasionally results in manual handling injuries, as opposed to using a knapsack sprayer. Most councils have not pursued flame weeding as a significant strategy for these reasons, aside from limited trials.

Mechanical removal and other methods

Mechanical and manual techniques (hand-pulling, whipper-snipping, brush cutting, mowing, and mulching) are staples of integrated weed management and are always encouraged where effective, practicable, affordable or provide other advantages over herbicide.

Councils aiming to reduce herbicide use have increased these efforts, e.g. by scheduling more frequent mowing of road verges or deploying teams to hand-weed certain invasive plants. These methods work well for some situations, especially when weed infestations are at an early stage or confined to small areas. However, they can become impractical or prohibitively costly for extensive infestations or for weeds that resprout from any root fragment (making hand-pulling ineffective or highly time-consuming).

Manual removal or hand weeding is physically demanding. Bushland regenerators find that many musculoskeletal injuries are caused or exacerbated by being on hands and knees or pulling out weeds between desirable plants.

Careful spot spraying with a knapsack, using minimal chemical, at low pressure, with minimal chance of drift or off target damage has been found to often be the most cost effective, productive and labour saving technique. Many invasive woody weeds will also simply reshoot unless the root is removed or chemically treated. Mechanical control can also be counterproductive in some cases by causing soil disturbance (which invites more weed germination) or being too selective (e.g. whipper-snipping might remove tall weeds but leave behind low seedlings that then take their place).

In practice, what councils have learned is that **no single alternative method can replace glyphosate's broad utility**. Instead, a combination of methods, each with added cost and often added risk, would be needed, and even then the overall efficacy might decline. This reinforces the view that glyphosate, used judiciously, remains one of the most efficient and relatively low-risk options available for landscape-scale weed control.

Reducing herbicide use: integrated approaches

Importantly, whether or not a formal "ban" is in place, virtually all land management authorities agree that minimising chemical use is a worthwhile goal.

The experiences with glyphosate bans have underscored that outright elimination is often impractical with current technology, but there is still ample room to reduce *unnecessary* herbicide use through better practices. Integrated Weed Management (IWM) is the guiding principle here: using a combination of control techniques (manual, mechanical, cultural, biological, and chemical) to manage weeds in a way that reduces reliance on any one method.

Key strategies for councils include:

- **Targeted application vs. blanket spraying** Herbicides should be used in a targeted manner, focusing on problem areas and specific weed outbreaks rather than routine blanket spraying of large areas.

  Many councils have audited their spraying programs and identified ways to cut down the volume of glyphosate applied simply by being more precise, for example, spot-spraying only the weeds of concern, or creating detailed weed maps so that crews only treat known infestation spots. This precision avoids the old habit of "spray everything just in case" and can significantly reduce total herbicide usage without sacrificing control outcomes.

- **Training and identification skills** Following on from the point above, using operators who have good plant identification skills can maximise the gradual replacement of weeds with native grasses and groundcovers or desirable plants, which in many cases will outcompete weeds, and reduce herbicide use over time.

- **Timing and prevention** By timing weed control efforts to prevent seeding (thereby reducing the next generation of weeds), councils can break the cycle of infestation more efficiently. The use of pre-emergent herbicides in some cases (chemicals that stop weed seeds from germinating) has also helped reduce the need for frequent spraying of established weeds later. The introduction of seasonal maintenance schedules that prioritise early intervention can greatly diminish the amount of herbicide needed over time.

- **Native vegetation restoration** Selectively favouring the retention and regeneration of native species, or reintroduction of natives after weed removal, can naturally suppress weeds and reduce herbicide needs in the long term.

  Techniques like nurturing competitive native grasses, dense replanting of native groundcovers, mulching bare soil and controlling weedy groundcovers while promoting weed suppressing trees and shrubs each can create a living barrier against new weed incursions.

  The more that native plant communities can recover, the more likely they are to resist weed invasion and the less intervention (chemical or otherwise) will be required. AABR emphasises this successional approach: i.e. use herbicide to knock back the worst weeds initially, but concurrently or subsequently promote native regeneration so that nature starts to do the weed suppression for you.

- **Herbicide rotation to prevent resistance** Although not directly related to the glyphosate ban issue, a side benefit of diversifying weed control methods is reducing the selective pressure for herbicide-resistant weeds.

  Over a dozen weed species in Australian agriculture have evolved resistance to glyphosate due to over-reliance on it. In natural areas, glyphosate resistance is not yet widespread, but it's a possibility. By integrating non-chemical methods and occasionally using different herbicides with other modes of action for specific tasks, land managers can mitigate the risk of weeds developing resistance, thus preserving glyphosate's effectiveness.

In summary, the lesson is that even when glyphosate is retained in the toolkit, it should be used safely and sparingly, as one component of a broader IWM strategy. This not only addresses public concern about chemicals but also makes ecological sense. Nearly all councils, including those that reintroduced glyphosate after bans, have stepped up efforts in manual removal, mulching, selective planting, and trials of new techniques (like electrical weed control or foam herbicides). Glyphosate is then reserved for situations where those methods fall short, for example, treating noxious weeds that would cause more harm if left uncontrolled. This balanced approach aims to **minimise chemical use without compromising weed control outcomes.**

Local government case studies

Experiences from various Australian councils[16] that attempted to eliminate or sharply reduce glyphosate provide valuable insights.

Byron Shire Council (NSW)

Byron Shire is known for its strong environmental ethos. In 2013, Byron sought to phase out all synthetic pesticides in many public areas, relying on mowing, hand-weeding, and steam.

Over the ensuing years, they significantly cut back spraying in parks, playgrounds, and roadways. However, by around 2017–2018, the council observed a decline in the effectiveness of weed management, invasive weeds were proliferating in certain bushland and roadside areas, threatening native vegetation.

In 2019, after developing an Integrated Pest Management policy, Byron Shire reversed the blanket ban and re-allowed targeted glyphosate use in specific situations (for example, in non-urban roadside weed control and in bushland reserves where invasive species were overwhelming native plants). The decision explicitly noted that environmental outcomes were being compromised during the ban and that careful glyphosate use was necessary to protect biodiversity.

Byron's experience demonstrates that while reducing chemical use is feasible and laudable, completely eliminating glyphosate was unsustainable with the available alternatives, given the shire's extensive weed challenges.

Frankston City Council (VIC)

Frankston decided in 2019 to cease glyphosate use and began 2020 with a suite of alternative measures (steam weeding, pelargonic acid-based organic herbicides, increased manual weeding, etc.).

This effort proved short-lived. Within about 7–8 months, the council faced a surge in weeds and escalating costs. An internal report projected an additional **$600,000 per year** would be required to continue the glyphosate ban and achieve the same level of weed control.[14] Residents were also complaining about untidy parks and rapid weed regrowth. In February 2021, Frankston Council officially rescinded the ban. Glyphosate use was reintroduced on a targeted, case-by-case basis, with a focus on high-priority infestations, while the council continued non-chemical methods in playgrounds and other sensitive sites.

Frankston's mayor at the time noted that the trials with alternatives did yield some minor benefits (e.g. insights on better steam techniques for certain weeds), but overall, the ban's cost and reduced efficacy were unacceptable.

After reintroduction, the council still aimed to use significantly less glyphosate than historically, the goal became **"use as little as necessary, but use it when we must."**

Kingston City Council (VIC)

Kingston (a suburban Melbourne council) voted in late 2019 to stop using glyphosate. Over 2020, Kingston tried to manage all weeds through manual removal, steam, and organic herbicides.

By early 2021, the council started partially rolling back the ban. Reports indicated that maintaining service levels without glyphosate was costing on the order of an extra $1 million per year, an unsustainable burden on the budget (this figure was an estimate cited by council officers, aligning with the magnitude of Frankston's experience).

In September 2021, Kingston formally ended the blanket ban and adopted an integrated approach: glyphosate would be permitted again in certain low-public-traffic locations (like roadside reserves and bushland fringes), while high-profile public areas (like playgrounds and town centers) would continue to be maintained with alternative methods as much as possible.

The council acknowledged that the alternatives alone "just haven't been as effective" and that they had to balance safety concerns with practical reality.

Kingston's case echoed Frankston's, completely eliminating glyphosate proved untenable given existing technologies, so a middle-ground policy was implemented.

City of Hobart (TAS) — Trial

Hobart City Council never fully banned glyphosate, but in 2019 it conducted a controlled trial comparing steam versus glyphosate for roadside weed control.

The trial's results were striking and have been frequently cited in the national discussion. Glyphosate spray treatment, done once, kept the roadside weeds down for the season. The steam-treated sections, however, required multiple passes and still saw quicker regrowth. When the council extrapolated costs, they found that doing all their routine roadside weed control with **steam would blow out the annual cost to around $1.7 million, compared to about $114,000 using glyphosate**, roughly a 15-fold difference in cost.[15]

Hobart's Parks Committee concluded that while it would continue and even expand use of steam units in highly sensitive locations (and in response to public requests), it would also continue using glyphosate for broadscale work because the cost-benefit was overwhelmingly in glyphosate's favor for general operations.

The Hobart trial has served as a reality check, illustrating the resource implications of replacing glyphosate with thermal methods.

Town of Bassendean (WA)

Bassendean Council initially suspended glyphosate use on footpaths and playgrounds in 2016 as a precaution after the IARC announcement. They awaited the APVMA's review; during that time they tried steam and manual methods on those areas.

By 2021, after several years of experience, the council's staff recommended lifting the suspension. The reasons were familiar: the alternatives were costly and not fully effective, especially on tough weeds like couch grass.

Bassendean's data showed they were spending only about $7.5k per year on herbicide in playgrounds, whereas the steam/manual approach was costing around $45k for the same scope of work.[13] In March 2022, the council voted to reinstate glyphosate use, noting that continuing to avoid it for a "theoretical" risk was not justified against the very tangible costs and the risk of weed infestations overtaking some areas.[13]

Bassendean adopted a policy of using an "aquatic-safe" glyphosate formulation (Roundup Biactive) for routine urban spraying and continued using steam in a limited way for select high-pedestrian areas. Essentially, they moved to a hybrid approach to balance public reassurance with effective weed control.

Across these case studies, a common theme emerges: **most councils that experimented with eliminating glyphosate eventually returned to it in some capacity**.

The initial bans were driven by genuine concerns and the precautionary principle, but on-the-ground outcomes, skyrocketing costs, labour strain, and insufficient weed control, forced a reappraisal. The reversals were often accompanied by public communications explaining that the decision was based on evidence and the need to maintain community spaces properly. In no case did a council simply go back to "indiscriminate" glyphosate use; rather, they folded glyphosate back in as one tool among many, usually with tighter controls and lower usage than before.

This reflects what might be called the "middle path" that is now being adopted: **use glyphosate where it makes sense to do so safely, avoid it where possible, and keep evaluating new alternatives as they develop**.

AABR's position

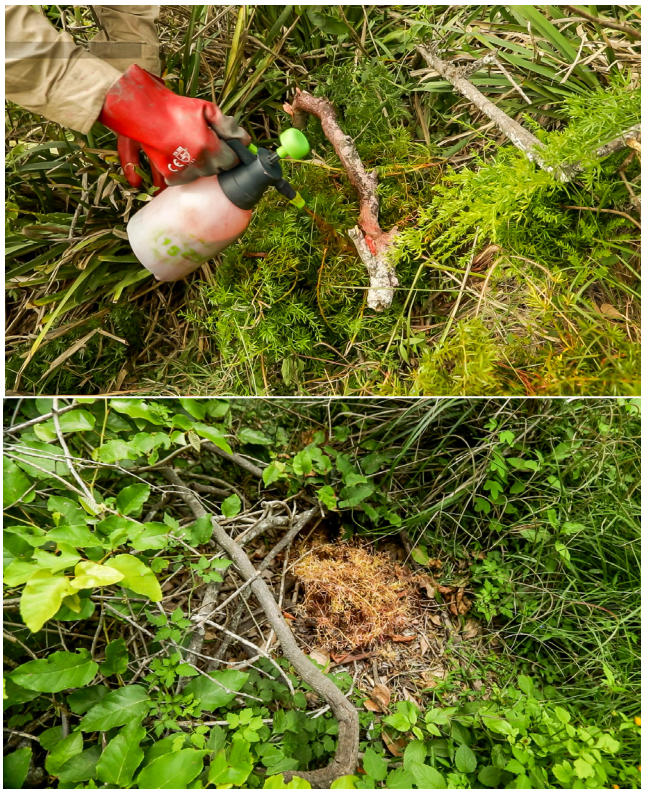
The Australian Association of Bush Regenerators (AABR), whose members include professional and volunteer bushland managers, has closely followed the glyphosate debate. AABR's stance is grounded in both the scientific evidence and decades of practical experience in ecological restoration.

AABR supports ongoing research and agrees with the APVMA view that glyphosate **can be used safely as directed** and is **unlikely to pose a carcinogenic risk to humans** under normal use conditions.[17]

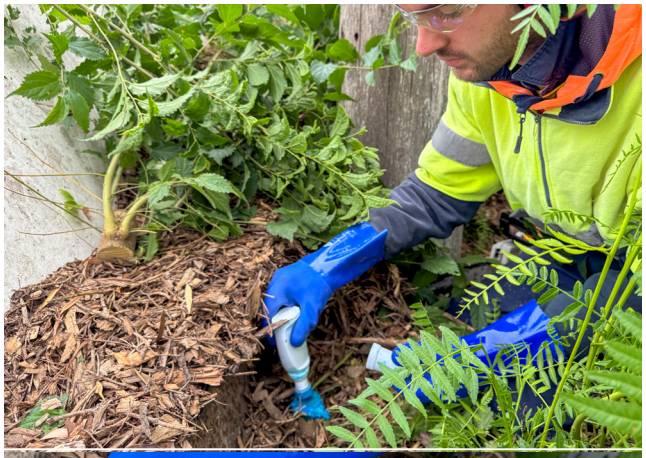
In summary, AABR views glyphosate as a **relatively safe, effective, and essential tool** for weed management in conservation areas, **when used correctly and judiciously**. The organisation stresses that most bush regenerators are environmentally conscious practitioners who use herbicides in a highly targeted way, following best practices to minimise any off-target damage or personal exposure. Without a significant increase in funding for restoration and biodiversity management funding, the above case studies have shown that chemical bans, and specifically glyphosate bans will have a detrimental effect on operator safety and poor outcomes for the environment.

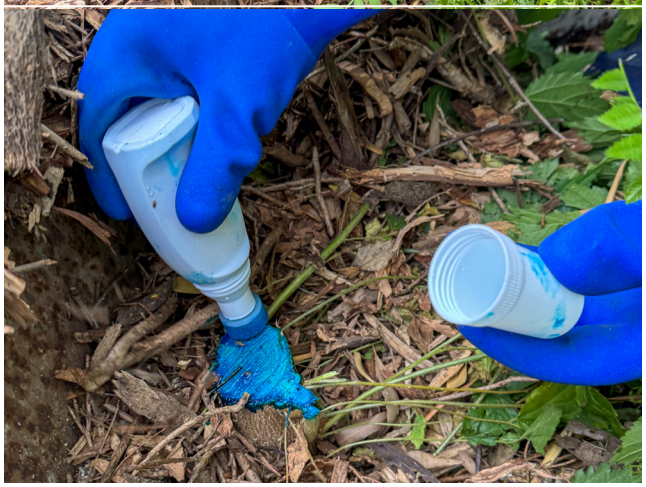
AABR supports ongoing research into the safety of all chemicals, and integrated weed management techniques.

In a 2019 position statement, AABR noted that their weed control approaches involve "targeted and judicious use of herbicides, combined with non-herbicide methods where appropriate," with the goal of eventually reducing and phasing out herbicide use as sites become ecologically stable. They also remind practitioners to "exercise caution in the use of all herbicides, including glyphosate, and to ensure minimisation of exposure through proper PPE and procedures".[18] This encapsulates the balanced view: **use glyphosate when necessary for biodiversity protection, but do so carefully and as part of an integrated strategy aimed at long-term weed suppression via ecological restoration.**



Strategic use of glyphosate in bush regeneration to minimise off-target damage and personal exposure. ABOVE precision spraying of ground asparagus in littoral rainforest, and previously treated area. Credit: V. Bear. BELOW Cut stump treatment of woody weeds. Credit: P. Deasey/Naturelinks.





Summary of findings

1 Regulatory consensus

All major pesticide regulators (APVMA, EPA, EFSA, Health Canada, etc.) have concluded that glyphosate **can be used safely as directed** and is **unlikely to pose a carcinogenic risk to humans** under normal use conditions.[5,8,7,9]

The 2015 IARC classification was a hazard-based warning ("possible carcinogen") that did not account for real-world exposure levels, it generated public concern, but subsequent extensive reviews by expert bodies reaffirmed that glyphosate's actual risk, when used properly, is very low.

2 Relative toxicity

Glyphosate is among the **least acutely toxic** synthetic herbicides available. Its lethal dose (LD_{50}) in rodents is over 5,000 mg/kg, and it is categorised as a low-toxicity (Schedule 5 "Caution") substance.[12]

By contrast, many alternative herbicides (e.g. paraquat, diquat, glufosinate, 2,4-D) are far more toxic or irritant. Replacing glyphosate with these chemicals could **increase health hazards** for workers and the public. Moreover, some older herbicides persist longer in soil or have higher volatility, hence higher propensity to drift, potentially causing greater environmental harm than glyphosate, which binds to soil and biodegrades relatively quickly.

3 Efficacy trade-offs

No single alternative method matches glyphosate's broadspectrum efficacy and systemic action.

Outright bans on glyphosate often forced councils to deploy multiple other herbicides or methods in combination, sometimes resulting in even higher overall chemical use (for example, needing two different selective herbicides to do the job of glyphosate, effectively doubling applications) and often involving products with greater safety risks[13]. In other cases, councils turned to labour-intensive mechanical or thermal techniques that struggled to contain aggressive weeds, especially perennials. This demonstrated that glyphosate's unique effectiveness is hard to replace without significant downsides.

4 Cost implications

Outright bans have **dramatically increased operational costs** for weed control.

For example, Hobart's analysis showed that using steam instead of glyphosate for city-wide weed management would cost roughly **15 times more** annually,[15] and Frankston's brief glyphosate ban was projected to cost an extra **$600k per year** to maintain acceptable weed control.[14] Such cost escalations are often unsustainable for local governments and ultimately for ratepayers. The experiences consistently showed that going "glyphosate-free" with current alternatives requires either massively higher spending or an unavoidable decline in service quality (or both).

5 Weed control outcomes

Multiple councils found that without glyphosate, **weed control effectiveness declined**.

Invasive weeds grew back faster than they could be removed in many instances, leading to overgrown parks, trails, and roadside verges. In environmentally sensitive areas, the inability to adequately control weeds risked significant damage to native ecosystems (ironically undermining the environmental goals of the bans). Councils like Byron Bay and Bassendean observed that weed infestations were beginning to overrun certain areas when herbicide was not used, prompting concerns about long-term biodiversity loss and public safety (e.g. trip hazards, fire fuel load).[13]

6 Integrated approach preferred

The prevailing lesson is that an **integrated weed management** approach is preferable to an outright ban. IWM means using nonchemical methods wherever they can effectively substitute, but still having glyphosate (or other herbicides) available for strategic targeted use where they are the most efficient tool.

All councils, even those that reversed bans, have adopted stronger IWM practices, increasing manual removal, mulching, and careful spotspraying, to minimise herbicide use without compromising control. This balanced approach can substantially reduce the *quantity* of glyphosate used (and thus potential exposures) while avoiding the pitfall of losing control of invasive weeds.

7 Community communication

Successful weed management policies require clear communication with the public.

Councils that reintroduced glyphosate did so alongside efforts to educate residents about the scientific consensus on glyphosate's safety (e.g. citing APVMA and other authorities that it can be used safely per label) and the reasons why certain chemical use was being retained for now.[14] They also implemented measures like signage and advance notice of spraying to increase transparency. This points to the importance of public engagement, explaining that a measured, evidence-based use of glyphosate is actually in the community's best interest (both financially and environmentally) until truly benign and effective alternatives are developed.

8 Ongoing vigilance and innovation

The status quo is not the endpoint, councils and land managers continue to monitor scientific developments and trial new weed control technologies.

The goal shared by all stakeholders is to eventually reduce dependence on chemical herbicides **without sacrificing environmental outcomes**. Until then, the pragmatic approach is to use glyphosate as one tool in a broader integrated strategy, guided by best practices and continually refined as new knowledge emerges.

Banning glyphosate outright at this stage appears premature given the available alternatives and can lead to unintended negative consequences. Instead, a focus on training, proper use, and incremental improvements (e.g. smarter application techniques, safer product formulations, and ongoing research into alternatives) will yield the best results for human health and the environment.

Conclusion

Glyphosate has proven to be a critically important tool for weed management in both agriculture and biodiversity conservation. The push by some local governments to eliminate its use stemmed from genuine concerns, but real-world trials have shown that there is currently no replacement that matches glyphosate's combination of efficacy, safety, and cost-effectiveness.

An outright ban on glyphosate can, paradoxically, lead to worse environmental and health outcomes, if it results in the use of more dangerous chemicals or the failure to control invasive weeds that then wreak ecological havoc.

The fact-checked evidence indicates that glyphosate can be used responsibly to protect our natural and urban environments.

The prudent course, championed by AABR and many practitioners, is to **continue using glyphosate as one component of an integrated approach**: always striving to minimise overall herbicide use, but retaining glyphosate for those scenarios where it is truly the best tool for the job. In doing so, land managers can fulfill their duty of care to both the environment and the community, ensuring weeds are managed in the most safe and effective way available.

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