ENVIRONMENT PROTECTION AUTHORITY

REPORT ON CCA TREATED TIMBER IN SOUTH AUSTRALIA

JULY 2008

EPA South Australia

Report on CCA treated timber in South Australia

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BACKGROUND

Copper chrome arsenate treated timber

Timber treated with Copper Chrome Arsenate or CCA (also known as chromated copper arsenate and copper chromated arsenate) has a variety of references that include 'CCA treated timber', 'tanalised timber', 'pressure treated timber' and 'permapine'. CCA is a water-based heavy metal mixture used to preserve timber. The heavy metals used include carcinogens, mutagens and potential teratogens including arsenic, chromium and copper.

CCA is used to protect timber, in both terrestrial and marine environments from natural degradation through the activity of termites, wood-borers, crustaceans, molluscs and decay by soft rot fungi and bacteria. CCA treated timber is hence not subject to normal biodegradation during accepted uses or once discarded, and can persist in the environment.

Following concerns that arsenic, chromium and copper could be released from treated timber under certain conditions, issues relating to the use, re-use, recovery, recycling and disposal of CCA treated timber have drawn both international and national attention over recent years (See Further Reading).

The national body responsible for the registration of the chemical preservative CCA in Australia is the Australian Pesticides and Veterinarian Medicines Authority (APVMA). In 2005, following a three-year review, the APVMA determined to class CCA preservative as a restricted chemical and imposed an authorisation system to regulate receipt and to limit permitted use. The APVMA has permitted ongoing use of CCA to treat timber used for vine posts, a major contributor to the CCA treated timber waste stream in South Australia.

Characteristics of CCA treated timber

Composition

CCA treated timber contains salts of arsenic (As), chromium (Cr) and copper (Cu). These elements cannot be chemically destroyed and can, under certain conditions such as combustion, chemically transform into different states and have the potential to impact upon both human health and the environment when released from the timber (Solo-Gabriele *et al* 2004; Khan *et al* 2006).

Arsenic:

- The toxicity of arsenic carries some dependence upon speciation, oxidation state and whether it is in an organic or inorganic form.
- Trivalent Arsenic species are generally considered more toxic than Pentavalent Arsenic species.
- All species are water soluble and hence very mobile with As (III) more mobile than As(V).
- Organic species are generally less mobile.
- Recognised carcinogen, mutagen and potential teratogen.

Chromium:

- Hexavalent chromium is classified as a Group 1 carcinogen to humans.
- Trivalent chromium is classified as a Group 3 carcinogen.

Copper:

The toxicity of copper is restricted mainly to aquatic environments where it poses risk to aquatic life**.**

Note: For comprehensive toxicological and environmental assessments (refer to <www.apvma.gov.au/index.asp>*).*

CCA treated timber waste classification

There are a range of different classifications of waste, under differing regulatory jurisdictions and structures.

Under the *Environment Protection Act 1993*:

- CCA the chemical preservative, the leachate from CCA treated timber, and products from the combustion of CCA treated timber are classified as Listed Wastes (*Schedule 1 Part B)*
- CCA treated timber waste has not been classified as a Listed Waste.

Classification of CCA treated timber waste under other jurisdictions:

- The EU classifies CCA treated timber waste as hazardous waste and as such has banned it from going to landfill.
- In the USA CCA treated timber waste is exempt from characterisation as a hazardous waste.
- NSW does not formally classify the waste as hazardous. For waste CCA treated timber other than waste which is specified as building and demolition waste, inert waste or municipal waste, NSW provides a general approval of immobilisation of contaminants in the waste. As a result total concentrations of arsenic, chromium and copper are not applied to the waste assessment. The material may be classified according to leachable concentration TCLP (Toxicity Characteristic Leaching Procedure) values alone.
- WA uses the Australian Standard Leaching Procedure (ASLP) test and identifies CCA treated timber waste as a 'Type 1 Inert waste' (Landfill Waste Classification and Waste Definitions 1996). This includes wastes that are largely non-biodegradable, non-flammable and not chemically reactive. Type 1 Inert Wastes are those that contain contaminants in concentrations less than the specified criteria. (ie As: < 0.5 mg/L).
- The National Environmental Protection Council of Australia (NEPC) Controlled Waste National Environment Protection Measure (NEPM) has not identified CCA treated timber waste as a controlled waste; hence it may cross interstate borders without tracking.

Risks

Manufacturer's treatment classification

Manufacturer's classification of CCA treated timber is expressed in hazard classes H1 to H6 (Appendix A). These classes refer to the potential hazard the timber will be subjected to in the environment, and hence the amount of preservative that has been applied to the timber. This classification system is not intended to rate potential environmental impact.

CCA preservative in South Australia

Timber can be treated with different concentrations of CCA preservative (Appendix A). Importantly, it should be noted that the chemistry of the preservative CCA differs from the chemistry and composition of chemicals that may be released from the timber after treatment. The term 'CCA' may be used to refer to any chemical in the formulation or any chemical that may leach out of treated timber. The speciation of arsenic, chromium and copper is important as the potential risk to the environment posed by these elements can vary with speciation. The most typical formulation of preservative used in South Australia (based on H4 formulation can be seen in Table 1).

Dislodged particulates

Heavy metals can dislodge in particulates from the surface of CCA treated timber via physical contact and pose a risk to the environment. Arsenic is released from CCA treated timber with a high degree of variability. Physical abrasion, and other conditions such as age and climate can affect particulates being dislodged from the timber. The presence of water can mobilise chemicals in dislodged particulates.

Machining of CCA treated timber

Any machining of CCA treated timber generates increased surface areas and hence increases the potential for particulate dispersion into the environment. Processes such as pulverization, may diminish the risk of finer grade of particulates as the processes usually causes splitting and separation along the fibrous grains within the timber structure, rather than cut through them. Pulverisation, nonetheless, still increases the state of subdivision and hence increases the potential to enhance leachate generation under wet conditions.

Any process which increases the surface area of CCA treated timber and hence potential for leachate generation should not be undertaken. All effort should be made to maintain the integrity of CCA treated timber.

Disposal and stockpiling of CCA treated timber

Potential for leachate generation

Under certain conditions, CCA treated timber has the potential to generate leachate that contains arsenic, chromium and copper toxins. Leachate from CCA treated timber presents a potential pollutant to soil and/or water and a risk to human health. Leachate management is of considerable concern when timber treated with CCA is stockpiled in large amounts or when disposed of to landfill (APVMA 2005). The EPA provides guidelines in relation to management and storage of CCA treated timber <www.epa.sa.gov.au/pdfs/guide_cca.pdf>.

Leachate generation is dependent upon many variables such as temperature, timber density, humidity, rainfall, the amount of chemical preservative applied to the timber and the level of expertise in applying the technology (APVMA 2005; Solo-Gabriele *et al*, 2004; Vogeler *et al* 2005; Robinson *et al* 2004). Owing to this variability assessment of risk should be undertaken on a site-specific basis.

The TCLP and ASLP are two commonly employed procedures used to identify the leachability of wastes, and hence assign landfill requirements to suitably store waste material. ASLP tests are commonly used in South Australia to determine the leachability of CCA treated timber.

Density

The relatively low density of timber (approximately 500 kg/m^3) results in a high volume per unit mass waste stream. This may impact upon landfill waste body structural stability and transportation costs. This low density may need to be considered when accepting CCA timber for disposal to landfill.

Identification and separation

CCA treated timber can be difficult to identify and sort visually, especially when aged and mixed with other timbers. The presence of treated timber mixed with other waste streams may present elevated risks of environmental harm. For example, CCA mixed with other untreated timber waste may be mulched or burnt. Both of these outcomes are undesirable given the risk they pose to the environment.

CCA treated timber has a green colouration (due to the presence of copper in the preservative) however its colour can fade with age. Another preservative treated timber, ammoniacal copper quaternary (ACQ) used in Australia can also colour the timber green. There are numerous technologies which can be used to assist in the identification of CCA treated timber including chemical stains, arsenic test kits, hand held X-ray and laser.

Sorting CCA treated timber waste from other timber is important in order to support the principles of the waste hierarchy (see Figure 4) including re-use, recycling and appropriate disposal if required.

It is suggested that:

- When clearing vineyards, treated timber should be separated from all other wastes, including wire, plastics and vegetation so that it may be suitably stored, re-used, recycled or disposed.
- When clearing construction or demolition sites treated timber should be separated from other timbers and materials to facilitate recovery and disposal processes for each material. The presence of CCA treated timber in waste delivery may impact on both disposal options and disposal costs for the load.

Note: Sorting of CCA treated timber carries Occupation Health, Safety and Workplace (OHS&W) issues. Refer to relevant procedures prior to handling CCA treated timber.

Storage

Once sorted unwanted CCA treated timber may need to be stored until sufficient quantities accumulate to enable economies of scale that support re-use, recycling, recovery or disposal options. The EPA provides guidance on the storage of CCA treated timber <www.epa.sa.gov.au/pdfs/guide_cca.pdf>**.** Storage of CCA treated timber should also be in compliance with relevant OHS&W procedures.

Safe storage of CCA treated timber should consider:

- elevated fire risk
- potential contamination of soil and surface and/or ground water
- potential impact of leachate from stockpiles requires site-specific risk assessment.

Note: Concentrating large volumes of CCA waste timber into well-managed stockpiles on designed purpose built-sites is more desirable than having a wider distribution of smaller stockpiles under lesser control. An off-site storage facility (such as a regional site) would constitute a waste or recycling depot, and under Schedule 1 of the Environment Protection Act, requires an EPA licence.

Burning of CCA treated timber

The burning of CCA treated timber carries a high risk of causing environmental harm due to toxicity associated with the release of airbourne chromium and arsenic compounds. For example the trivalent chromium, Cr (III) in CCA treated timber readily converts to the highly toxic hexavalent Cr (VI) during combustion. Arsenic compounds in treated timber readily convert to arsenic trioxide and arsenic pentoxide. Arsenic trioxide gas is released at temperatures as low as 200^{o}C (ie pre-ignition temperatures). In addition to presenting a risk to human health through inhalation, the release of toxic gases into the air results in condensation of heavy metals, upon cooling, which may settle on a receiving environment.

Ash formed through combustion of CCA treated timber contains extremely high concentrations of arsenic (III), and chromium (VI), with some arsenic (V). Ash presents a high potential risk to human health through inhalation, can contaminate soil, and can also potentially pollute ground water. Ash contamination can make the land unsuitable for agricultural application and be attractive to stock due to its salty taste, presenting a risk to stock health.

The burning of CCA treated timber is prohibited by the EPA's burning policy. <www.legislation.sa.gov.au/LZ/C/POL/ENVIRONMENT%20PROTECTION%20(BURNING)%20POLICY%201994.aspx>.

Re-use and recycling of CCA treated timber

Recycling and re-use options may not address the end of life disposal of the heavy metal constituents of CCA treated timber. Desirably recycling and re-use can utilise inherent value and can significantly delay disposal. Undesirably, re-use and recycling may also distribute heavy metal constituents of treated timber more widely across the environment. Consequently re-use and recycling options may not represent a secure management of the waste stream. Re-use and recycling options need to be assessed on a site/application-specific basis.

The EPA recognises that CCA treated timber waste has the potential to pose risk to the environment possibly impacting upon air, soil and water quality under certain conditions. Disposal and recovery options exist that can reduce and minimise this risk. The EPA supports appropriate on-site storage, encourages investigation of re-use and recyling options, alternative disposal technologies and landfilling to suitably engineered sites. The EPA prohibits the burning, mulching and uncontrolled burying of CCA treated timber.

CCA TREATED TIMBER IN SOUTH AUSTRALIA

History of CCA treated timber management in South Australia

In response to emerging issues surrounding the management of CCA treated timber in South Australia the EPA commissioned a report examining landfill disposal risks and the potential for recovery and recycling of preservative treated timber (Sinclair Knight Merz 1999). In this report the South Australian wine industry was identified as a major stakeholder given its substantial use of CCA treated timber as vineyard posts. The EPA has supported an industry lead waste management strategy for South Australia. In this regard the South Australian Wine Industry Association, (SAWIA), established a 'Treated Timber Vineyard Post Committee', which comprised representatives from SAWIA, the EPA, Zero Waste SA (ZWSA), Waste Management Association of Australia and the Timber Development Association of SA. The aim of this committee is to develop a sustainable vineyard post management plan, an interim waste management strategy and facilitate the collection of data (qualitative and quantitative) to assist in developing longer-term management plans. Jointly the SAWIA and ZWSA are commissioning a report examining management solutions for both CCA and creosote treated timber waste in South Australia.

Contributors to CCA waste stream in South Australia

CCA treated timber is supplied to the domestic and industrial markets. Industrial users include the building and construction, aquaculture, agriculture and wine industries.

By far the greatest user of this material in South Australia is the wine industry, consuming an excess of 50% of the market for use as vine posts (Sinclair Knight Merz 1999). CCA treated timber vine posts account for approximately 70% of all vine posts used by the wine industry (Wine Industry State of the Environment 2003).

Considering the useful life of a CCA treated post is approximately 30 to 40 years, life disposal volumes are predicted to reach up to 160,000 m^3 each year, in approximately 30 years time as depicted in Figure 1.

Provided the South Australian wine industry is no longer in a state of high growth (SAWIA 2003) and assuming a steady state of vigneron activity this projected figure may represent a probable peak i.e. the curve could be reasonably expected to flatten beyond 2040. However, any major decline in the industry that results in significant vineyard clearing may result in unpredictable peaks in volumes requiring management.

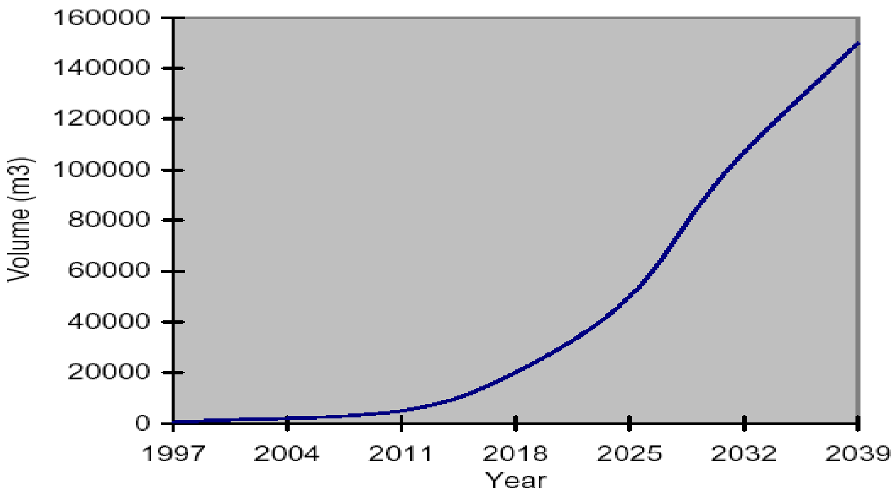


Figure 1 **Extrapolation of predicted volumes of CCA treated timber waste yearly in South Australia (Sinclair Knight Merz 1999 <www.epa.sa.gov.au/pdfs/timber.pdf>)**

Stockpile generation

The current generation of waste CCA treated timber posts arises predominantly from mechanical harvesting or storm damage. For example the Australian Wine Industry Public Environment Report (2003) surveying 33% of the Australian wine industry reported that:

- Mechanical harvesting can significantly increase the number of vine posts that are broken each year.
- Breakages were reported as ranging up to 12 per cent.
- Due to the difficulties in disposing of treated timber vineyard posts, many of the posts are stockpiled.
- The number of treated timber posts stockpiled per hectare reached 12.3 for CCA posts and 1.9 for creosote posts. This accounts for just 2.1% of CCA posts (and 1.6% of creosote posts)
- Many treated timber posts are not stockpiled and are either disposed of by being sent to a registered waste disposal facility, or re-used in some way such as fencing (both vineyard and off site) and in gardens.

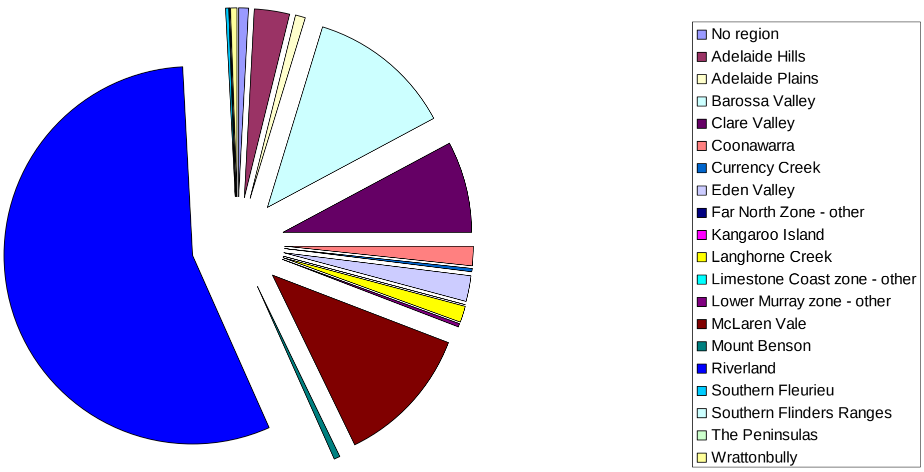
Current estimate of stockpile size and distribution in South Australia

In 2007 the SAWIA undertook a survey to update understanding on the distribution of the waste stream across the state. Tentative unpublished results of the survey suggest an order of magnitude of one million waste posts across the state (see Appendix B for details of calculation). This value should be regarded as a probable overestimate given limited data, declining post breakage rates using mechanical harvesting and a substantial increase in re-use by agriculturalists (unpublished data, SAWIA 2007). Preliminary feedback identifies:

- Approximately 60% of existing posts in stockpiles exceed 1.5 m and hence have a greater re-use potential.
- Approximately 40% of existing posts in stockpiles are less than 1.5 m and may require disposal.

- The regional distribution of stockpiled CCA waste can be seen in Figures 2 (a) and (b) (unpublished data, SAWIA, 2007) and approximated as given below. The locations of wineries within these regions also gives an indication of the location of stockpiles of CCA treated timber across South Australia as stockpiles are often located on vineyard sites within close proximity of wineries (Figure 3):

1. Riverland region: 50%
2. Barossa region: 20%
3. McLaren Vale region: 20%
4. Other (combined): 10%



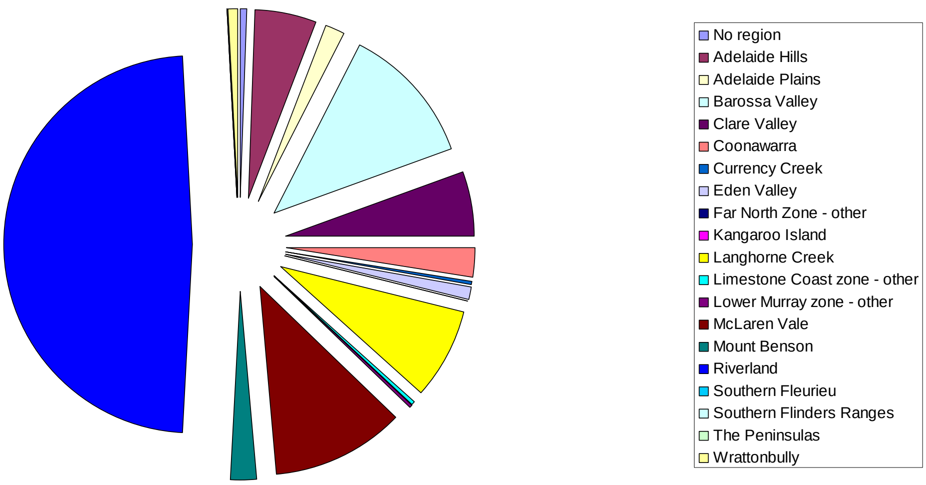


Figure 2 **Distribution of vineyard posts less than 1,500 mm in length by region in SA (top). Distribution of all vineyard posts by region in SA (bottom).**

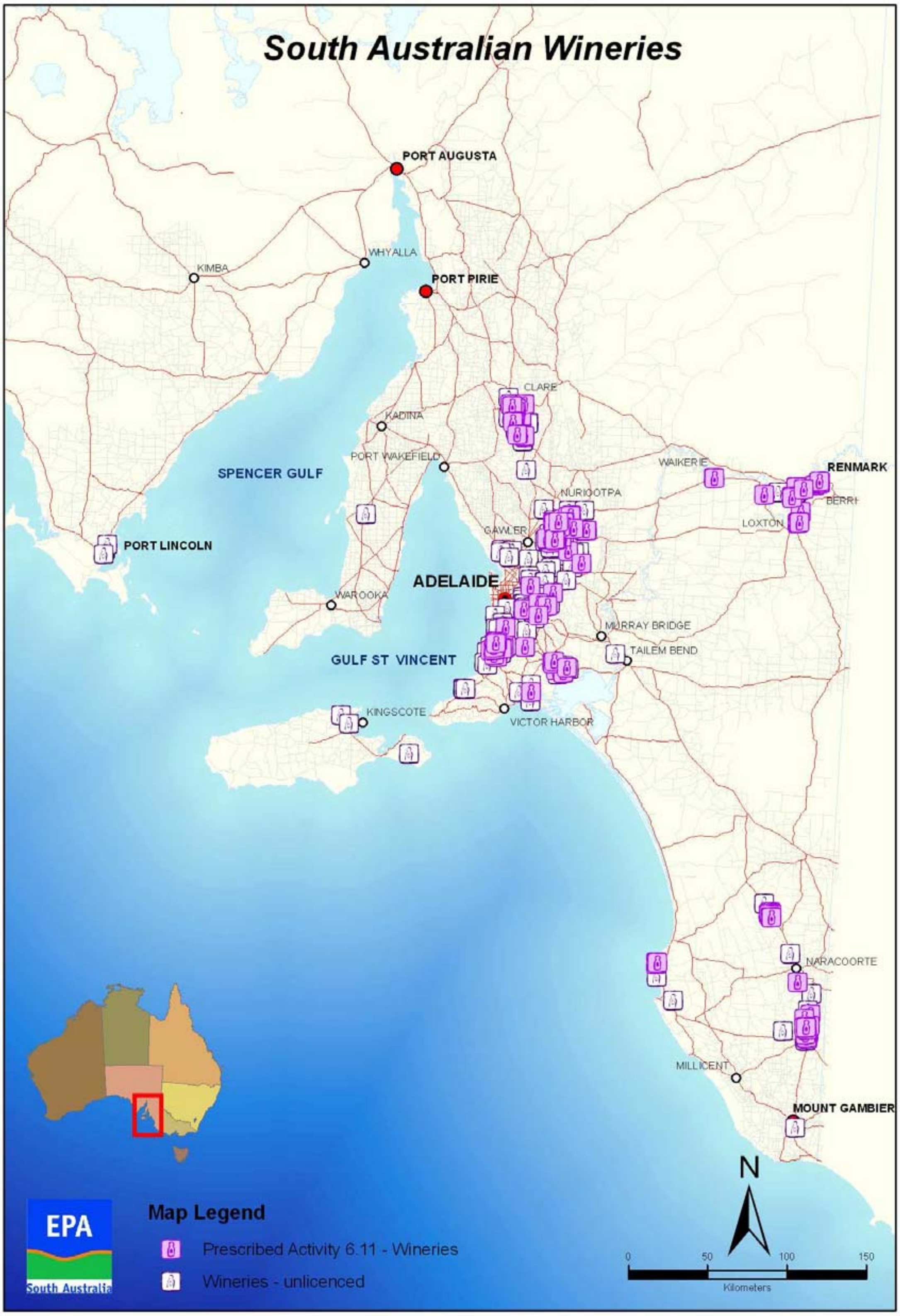


Figure 3 **Distribution of both EPA licensed wineries undertaking prescribed activity 6.11 and unlicensed wineries across South Australia in 2007. Stockpiles of CCA treated timber are usually located on vineyard sites within close proximity of wineries.**

DISCUSSION OF POTENTIAL SOLUTIONS

Avoidance/reduction of the Waste Stream

The EPA does not regulate the use of CCA treated timber, however in support of the waste hierarchy (Figure 4), suggests avoiding and reducing use of CCA treated timber in favour of alternatives such as:

- plastics
- steel
- aluminium
- fibreglass
- brick
- stone
- cement
- composites
- wood species with a natural resistance to decay
- timber treated with other preservatives such as ammonium derivatives of copper that do not contain arsenic or chromium, eg ammoniacal copper quaternary (ACQ).

Even in the event of a substantial shift to alternative materials by commercial and industrial markets, the pre-existing volume of in-use CCA treated timber in South Australia will continue to enter the waste stream for the next 30 to 50 years given the life span of the material.

Extended user responsibility

South Australia has not listed CCA treated timber as a material targeted for product stewardship at this stage. The EPA, however, promotes the ZWSA's charter to develop a 'cradle to grave' management of all resources, under South Australia's Waste Strategy 2005-2010 <www.zerowaste.sa.gov.au/waste_strategy.php>.

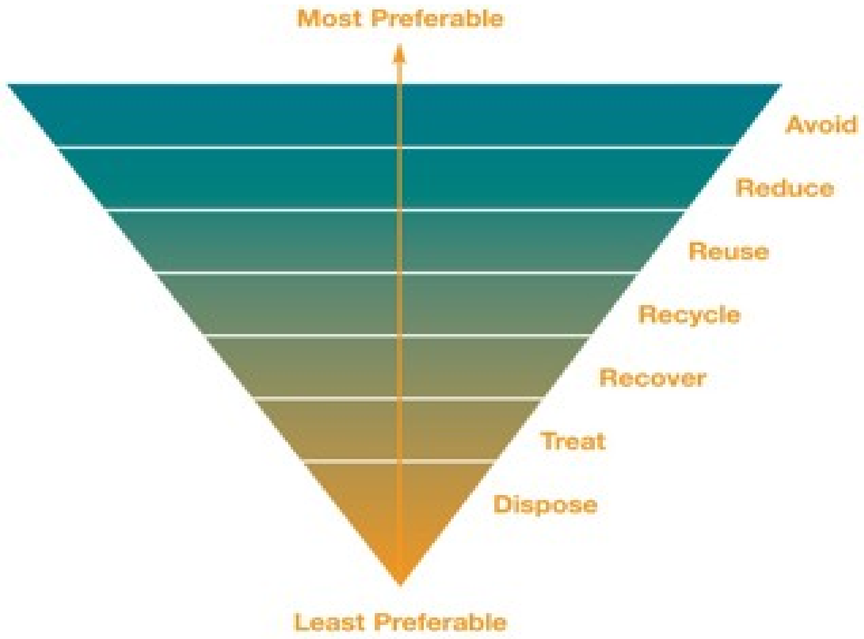


Figure 4 The Waste Hierarchy as outlined in the *Zero Waste SA Act 2004***.**

Re-use, recycling and resource recovery

Re-use and recycling

Where possible CCA treated timber should be re-used to benefit other applications. This is supported by conclusions made by Sinclair Knight Merz in their 1999 review that stated:

'Review of the landfill disposal risks and the potential for recovery and recycling of preservative treated identifies that where possible, unwanted CCA treated timber products may serve to benefit other applications'.

Currently, re-use appears limited although anecdotal evidence suggests some broken vineyard posts are being used for agricultural fencing across South Australia (SAWIA, pers comm). This is reflected by 50% of wine growers stating that 'there is a disposal problem and that vineyards have large stockpile of CCA-treated timber' (Wine Industry State of Environment report 2003). In an attempt to increase re-use of CCA treated posts some vignerons have altered trellis design by purchasing substantially taller posts. As posts often snap at ground level, a taller post, once snapped usually has a length that enables it to have on-going use, hence reducing re-order of new posts.

Re-use options identified by (APVMA 2005) for CCA treated timber include:

- fence posts
- landscape timber
- parking lot bumpers
- guardrail posts
- composting bins
- planter boxes
- shipping crates
- walkway edging

Although not yet available in South Australia, products utilising recycled CCA treated are listed by (APVMA 2005) including:

- flake-board
- oriented strand board
- particleboard
- fire-resistant panels
- highway sound barriers
- wood gypsum composites (that can be used for fire-resistant panels—indoor applications only)
- plastic wood composites, which employ micronised wood (fine particles) as either bulking agents or as components to modify mechanical properties.

Resource recovery

The potential for resource recovery from CCA treated timber is well recognised and has attracted significant research and development attention (see Further Reading). Recovery technologies, however, carry a potential to impact upon the environment if not suitably managed. Proposed resource recovery technologies must be assessed through a merit-based process against the key objectives of South Australia's Waste Strategy 2005-2010 <www.zerowaste.sa.gov.au/waste_strategy.php>.

Possible resources and recovery technologies include:

- metal extraction
- energy recovery
- carbon recovery
- fibre recovery.

Although no recovery technologies are currently available in South Australia, they may become available within the foreseeable future. The development of a well-managed recovery technology could ensure an environmentally secure end-of-life disposal for the contaminants present in CCA treated timber. In the meantime disposal of CCA treated timber into suitably engineered landfill or storage sites maybe the only available option.

Disposal

Disposal of CCA treated timber

The disposal of CCA treated timber requires management that reduces the potential of various disposal pathways to impact upon the environment, particularly due to the arsenic and chromium content of the material (Jambeck 2004; Solo-Gabriele *et al* 2004; Jambeck *et al* 2006; Khan *et al* 2006). Capturing and/or isolating the heavy metals contained in CCA treated timber from the environment are recognised necessary elements of disposal. The EPA will continue to prevent uncontrolled burying, burning, composting and mulching of CCA treated timber.

Disposal of CCA treated timber to suitable landfill sites in South Australia

In the absence of available recycling technologies in South Australia landfill disposal of CCA treated timber is currently the only option. This is an acceptable disposal option provided the facility is suitably engineered for acceptance of the material. The EPA provides a benchmark in engineered landfill design for disposal of municipal solid waste and commercial and industrial general waste through the landfill guidelines released in 2007 <www.epa.sa.gov.au/pdfs/guide_landfill.pdf>.

To develop suitable engineering requirements whilst considering this benchmark for disposing CCA and creosote treated timber to landfill is the focus of a project jointly funded by ZWSA and the SAWIA. This project aims to collate information on the storage, disposal and leachability of CCA and creosote treated timber. It will investigate a monofil disposal option and also provide a risk assessment framework for storage sites, waste transfer stations and landfills applicable across South Australia. Utilising this risk assessment framework and engineering requirements proposed landfill sites will be considered using a site-specific risk assessment approach.

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APPENDIX A CCA TREATED TIMBER CLASSIFICATIONS AND FORMULATIONS

The active components of the preservative CCA are arsenic, copper and chromium. The element copper is used for its anti fungal properties, Arsenic for its toxicity as a pesticide and chromium as a 'fixing agent', binding the elements to the timber cellular structure.

More recent research at CSIRO has shown that arsenic is not needed for the control of termites or marine borers (copper chromate does this). Instead, the main benefit of the arsenic is to inhibit certain copper-tolerant fungi.

The treatment process is done under conditions of vacuum/pressure to assist the hydrating and drawing of the CCA preservative into the timber. Once the timber is removed from the vacuum vessel, the treated timber must be closely managed until the fixation process is complete as during this time heavy metal release can occur readily.

In the presence of the cellulose in timber, the chromium in CCA 'fixes' (or locks) the copper and arsenic compounds into the timber fibre. The chemistry of the CCA formulation changes during this fixation process. The timeframe for the process can vary from days to weeks subject to variables such as temperature. Chemical tests can be done on the treated timber to identify when the fixation process is complete eg the MERCK test (Merck Aquaquant Test Kit No. 14441 or equivalent).

Formulations and blends

There are two preferred mixtures for the formulations, CCA oxide or salt.

Active components of CCA oxide and CCA salt formulations	
Formulation I	Oxides: Copper (II) oxide, chromium trioxide, arsenic acid (arsenic pentoxide)
Formulation II	Salts: Copper sulphate (anhydrous or pentahydrate), sodium or potassium dichromate, arsenic acid or arsenic pentoxide

The Australian Standard 1604.1–2000 provides specifications for preservative treated timber blends and specifies that the composition of CCA formulations shall fall in the limits copper 23–25%, chromium (hexavalent) 38–45% and arsenic (pentavalent) 30–37% in solution.

There are three different blends of CCA preservative: Type A, B and C. The most common is type C which is composed of 34.0% As_2O_5, 47.5% CrO_3 and 18.5% CuO, by weight (Osmose Pty Ltd).

By varying the conditions of exposure of the timber with the preservative, specified retention levels (loadings) can be obtained in the timber that will provide suitable protection for the intended use.

The approved CCA loading depends on the 'hazard' to which the timber will be exposed, expressed in the 'hazard classes' H1 to H6.

Hazard Class	CCA Concentration	Hazards Typical / Applications
H1	Increasing concentration (Retention levels of CCA) ↓	Indoor borers—indoor use
H2		Insect borers and termites—indoor use
H3		Insect borers termites and decay—outdoor, above ground constructions eg pergola
H4		Insect borers termites and severe decay Outdoor below ground eg viticultural industry—posts
H5		Insect borers termites and extreme decay. Outdoor in ground-near saturated conditions
H6		Marine organisms, extreme decay, eg piers, aquaculture industry—posts

Note: The timber used most commonly for domestic purposes is in classes H3 (outdoor above-ground timbers) and H4 (outdoor in ground contact, eg posts).

Table 1 Most typical formulation of CCA preservative in South Australia giving a total of approximately 3.5 kg/m^3 total heavy metal content in preservative.

Element	Oxidation state	Speciation	Typical Concentration
Arsenic	III	Inorganic	Dominant
	V	Inorganic	Older timber can contain traces of Arsenic (V) due to a reductive environment within timber. (Low oxygen & wet).
	Combined arsenic		1.3 kg/m^3 (ref: Osmose Pty Ltd) Approximately 1.7 kg/tonne (ref: APVMA 2005)
Chromium	III	Inorganic	1.46 kg/m^3 (ref: Osmose Pty Ltd) Approximately 3.2 kg/tonne (ref: APVMA 2005)
Copper	II	Inorganic	0.8 kg/m^3 (ref: Osmose Pty Ltd) Approximately 1.7 kg/tonne (ref: APVMA 2005)

APPENDIX B ESTIMATION OF CCA TREATED TIMBER STOCKPILE IN SOUTH AUSTRALIA

Estimation Calculation: 1 Million Posts

Based on:

- 168,800 hectares of vines in Australia (ABS 2007)
- 606 posts per hectare (Fosters Group Limited 2007, pers comm)
- 43% of national vineyards are south Australian (SAWIA 2007)
- 3 to 5% breakage per year (Fosters Group Limited 2007, pers comm)
- 1 to 2% breakage per year (SAWIA 2007)
- 69.9 % of posts are CCA (Australian Wine Industry State of the Environment, 2003)

Annual Stockpile = % breakage X total number of CCA Posts

= % breakage X (total hectares in Australia X % being SA X posts per hectare X % being CCA posts)

= 0.03 X [168,800 X (0.43 X 606 X 0.7)]

or approximately 1 million posts per year